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NOTE.

The earlier publications of the Alabama Agricultural Experiment Station, forming Volume I, are as follows:

Bulletins Nos. 1–10....................1883–1885.
Bulletins Nos. 1–9.....................1885–1887. "Second Series."
Bulletins Nos. 1–8 for 1887.
Bulletins Nos. 1–5 for 1888.

These early bulletins issued before the passage of the "Hatch Act," are rare and mostly out of print; this is partly due to the burning of the college building in 1887 which destroyed many of the files. The present volume commences the series issued under the Hatch fund.

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In the following citations the number preceding the colon refers to the number of the bulletin; the number or numbers following it to the page:

BULLETIN No. 1.

NEW SERIES.

REPORT OF

AGRICULTURAL EXPERIMENT STATION.

AGRICULTURAL AND MECHANICAL COLLEGE, AUBURN, ALA.,

JULY 1888.

REPORT OF AGRICULTURAL
EXPERIMENT STATION,
Agricultural and Mechanical College,
AUBURN, ALA., JULY, 1888.

BOARD OF VISITORS:
COMMITTEE OF TRUSTEES ON EXPERIMENT STATION:
Hon. J. G. Gilchrist, Hon. R. F. Ligon, Hon. J. B. Mitchell.

BOARD OF DIRECTION:

W. L. Broun	President.
J. S. Newman	Director and Agriculturist.
N. T, Lupton	Vice-Director and Chemist.
P, H. Mell	Botanist.*
————	Biologist.†

Assistants:

Isaac Ross	First Assistant Agriculturist in charge of Live Stock and Dairy.
E. R. Lloyd, M. Sc.	Second Assistant Agriculturist.
J. T. Anderson, Ph. D.	First Assistant Chemist.
L. W. Wilkinson, M. Sc.	Second Assistant Chemist.
T. D. Samford, B. Sc.	Assistant Botanist.

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* Prof. Mell has also charge of Meteorological observations.

† To be filled.

REPORT OF J. S. NEWMAN, DIRECTOR.

OUTLINE OF WORK.

The experiment station of the A. & M. College was established under State law in the summer of 1883.

An exhausted farm of 226 acres was purchased to be used for the purpose. Much of it was turned out on the commons; the buildings and fences on the remainder were in a very dilapidated condition. A large portion of the land had been abandoned for cultivation on account of its poverty and gullied condition.

Under these circumstances, with only one official connected with the Station, the Director, who was also prof. of Agriculure, progress in development was slow, especially since the funds appropriated to the Station were small in amount Notwithstanding these difficulties, considerable progress has been made in some departments of the work,—especially is this true of the Horticultural department.

Field experiments have been conducted each year, and bulletins furnished the Department of Agriculture for publication, as required by law.

The equipment, so far as machinery and improved impliments are concerned, has been, until now, inferior to that of an ordinary well conducted, private farm.

Much time and labor have been expended in clearing up pine thickets, filling gullies, building fences, and arranging for a supply of water under pressure.

The only experiment, so far, conducted with cattle, has been that of intense inbreeding with thoroughbred Jerseys—This has been continued for four years, under careful supervision, with apparently favorable results.

Besides experiments already completed, a large number are now in progress in field, orchard, vineyard, and garden.

The cotton plant has been made a subject of special inquiry, both as to its development above ground, and its root growth.

Similar inquiries have been made with regard to the corn plant

In both, varieties have been compared, inquiries made as to the fertilizers best adapted to their growth upon the soil of this Station, and with the additional facilities which will now be supplied through the Congressional appropriation, inquiries will be multiplied and carried to much greater detail.

The experiment work upon the Station is divided into two general classes:

First, The demonstration of facts already known to the advanced agriculturist, but not generally disseminated.

Second, Original investigation having for its object the discovery of truth. So far as the study of plants is concerned, investigations will be made first upon the most useful and generally cultivated plants in the Southern States.

Feeding experiments will be principally confined to inquiries looking to determining the nutritive value of peculiarly southern crops, and their digestibility. Besides the experiments reported on the following pages, inquiries are in progress with reference to cotton, corn, sweet potatoes, tobacco, forage plants, ground-peas, sorghum, wheat, and in the orchard, pears, apples, plums, peaches, figs, quinces and cherries.

All of these have been planted in considerable variety for the purpose of ascertaining which varieties are best adapted to this soil and climate, as well as to record the characteristics, both as to vegetation and reproduction of varieties.

The diseases affecting the different species of fruits and vines, as well as their enemies amongst birds and insects will be subjects of special investigation.

Fifty-eight varieties of grapes are being fruited and propagated, sixty varieties of strawberries, and twenty-nine of raspberries.

The soil of the Station is principally either sandy or pebble drift, mostly with clay sub-soil generally beyond the reach of the plow. There is, however, sufficient area of clay subsoil within reach of the plow to vary the investigation so far as soil is concerned.

The soils of the Station, therefore, represent a large area of the State of Alabama; a portion of which lies above the prairie region extending nearly across the State, but a still larger area lying between the prairie belt and the gulf.

In order to investigate the properties, physical and chemical, and the needs of typical soils throughout the State, ten such soils have been collected from the virgin forests, keeping the soil and subsoil separate and replacing them in their natural relative position in bins prepared for the purpose and placed under identical circumstances. Each soil and subsoil is being subjected to chemical and mechanical analysis in the laboratory, and plant analysis in the field.

Each soil and sub-soil is divided into eight parcels and placed in as many bins.

The cotton plant is growing in each bin. To these has been applied different elements and combinations of elements of plant food for the purpose of inquiring which of these elements are needed by each particular soil. This will be repeated from year to year until a sufficient number of tests have been made to eliminate the variable factor of climatic influences resulting from difference in seasons.

Additional barns, silos, offices and working rooms are being supplied, and a complete outfit of improved machinery and farm implements has been purchased.

It is proposed to test by the Dynamometer the draft of different tools and machines, and manufacturers will be invited, at a stated period each year, to send to the Station specimens of their implements, plows especially, to be carefully and accurately tested, and the results reported in the Station Bulletins.

A new and complete laboratory building is now thoroughly equipped for work in the chemical department.

A complete meteorological outfit has been purchased, and microscopes ordered for thorough work in investigation of the secrets of animal and vegetable life especially the fungi injurious to useful vegetation, as well as the habits of insects, friendly or, injurious to vegetation.

A Creamery will be equipped during the present year, with the best modern appliances by means of which the most approved methods of handling milk and butter will be demonstrated, and, in connection with that department, feeding experiments with special reference to milk and butter production will be conducted.

The Experiment Station being in immediate connection with the college grounds, the members of the agricultural classes have exceptional opportunities for acquiring familiarity with its work and of becoming acquainted with methods of scientific investigation.

The Station was re-organized under the act, known as the "Hatch Bill," to take effect the fiirst of April. It came too late for the inauguration of new experiments in the field or garden.

The following results are from experiments commenced under the old organization and completed since April 1st:

EXPERIMENTS WITH TABLE CORN.—

Object—To compare earliness of varieties.

Planted March 7th, except Hickory King, White Pearl and Perry's Hybrid, which were planted March 22nd.

RESULTS.

NAME OF VARIETY.	Seedman.	First Tassel.	Time Edible.
1. Early Minnesota	Ferry	May 9	May 30
2. Old Colony	"	" 31	June 18
3. Cory	"	" 8	May 28
4. Black Mexican	"	" 18	June 1
5. Crosby's Ex. Early Sweet	"	" 12	" 2
6. Early Southern	"	" 15	" 5
7. Leets' Early	"	" 14	" 1
8. Excelsior Sweet	"	" 21	" 18
9. Perry's Hybrid	"	" 14	" 4
10. Boynton's Early	"	" 12	" 2
11. Landreth's Sugar	Landreth	" 25	" 18
12. Hudson's Bay (field)	"	" 12	" 1
13. Old Cabin Home	"	June 5	" 22
14. 2d 1st Early Landreth's Market	"	May 11.	May 30
15. Golden Beauty	U. S. Dep.	" 29	June 21
16. Clark's Flour Corn	" " "	June 15	July 2
17. Stabler's Early	" " "	May 16	June 9
18. Egyptian	" " "	" 28	" 15
19. Cory	" " "	" 10	May 29
20. White Giant Normandy	" " "	June 1	June 18
21. Improved Evergreen	" " "	May 28	" 15
22. Livingston's Evergreen Sugar	Livingston	" 23	" 18
23. Adam's Early	Exp't St'n	" 11	" 5
24. Evergreen Sweet	" "	" 25	" 20
25. New Hickory King	" "	June 2	" 22
26. Champion Early White Pearl	" "	" 4	" 28
27. Perry's Hybrid	" "	May 27	" 22

EXPERIMENT WITH ENGLISH PEAS.

Object—To compare earliness and continuance in bearing of different varieties.—Planted February 9th and 10th.

RESULTS.

NAME OF VARIETY.	Seedman.	First Blossom.	Time Edible.	Finished Blossoming.	First Ripe.	Last Edible.
1. Ferry's Earliest of all	Ferry	April 2	April 18	May 2	May 5	May 9
2. Minimum	"	" 5	" 21	April 30	" 7	" 9
3. First and Best	"	" 2	" 18	May 10	" 5	" 12
4. Champion of England	"	" 15	May 4	June 7	" 19	June 11
5. Yorkshire Hero	"	" 16	" 4	May 18	" 21	May 22
6. Bliss' American Wonder	"	" 3	April 18	" 1	" 7	" 9
7. Dreer's Eureka Extra Early	Dreer	" 2	" 18	" 2	" 5	" 9
8. Kentish Invicta	"	" 2	" 18	" 2	" 5	" 9
9. Rural New Yorker	"	" 2	" 18	" 3	" 5	" 9
10. Dwarf Blue Imperial	"	" 15	May 8	" 25	" 22	" 29
11. Bliss' Abundance	"	" 15	" 5	" 22	" 19	" 24
12. Champion of England	"	" 15	" 7	" 28	" 21	June 7
13. American Wonder	"	" 3	April 18	" 2	" 7	May 9
14. McLean's Little Gem	"	" 4	" 19	" 3	" 7	" 9
15. Extra Early Premium Gem	"	" 3	" 24	" 10	" 7	" 16
16. Philadelphia Ex. Early	"	" 2	" 19	" 10	" 7	" 18
17. Telephone	"	" 19	May 14	June 2	" 26	June 6
18. Carter's Telephone	Thorburn	" 10	" 3	May 14	" 14	May 15
19. Abundance	"	" 10	" 4	" 11	" 17	" 19
20. Champion of England	"	" 9	" 1	" 31	" 16	June 1
21. Carter's Strategem	"	" 15	" 4	" 14	" 18	May 23
22. Premium Gem	"	" 2	April 19	" 2	" 5	" 9
23. Alaska	"	" 2	" 19	" 7	" 5	" 9
24. Bishop's Long Pod	"	" 15	May 5	" 14	" 16	" 2

25. First and Best	"	Mar. 30	April 18	" 4	" 5	" 10
26. Saxton's Earliest of all	"	" 31	" 19	" 5	" 5	" 10
27. White Marrowfat	"	April 24	May 11	" 29	" 25	June 2
28. Extra Early Alpha	"	" 3	April 19	" 11	" 9	May 21
29. Small's Early French	"	" 2	" 18	" 11	" 9	" 21
30. Prince of Wales	"	" 11	May 4	" 19	" 19	" 24
31. Saxton's Minimum	"	" 3	April 20	" 1	" 5	" 9
32. Pride of the Market	"	" 15	May 3	" 19	" 19	" 21
33. Day's Early Sunrise	"	" 4	" 1	" 14	" 14	" 21
34. Rural New Yorker	"	Mar. 31	April 18	" 3	" 5	" 9
35. Thorburn's Extra Early Market	"	" 31	" 18	" 5	" 5	" 9
36. Culyerwell's Telegraph	"	April 15	May 2	" 19	" 16	" 23
37. Everbearing	"	" 18	" 4	" 14	" 22	" 23
38. American Wonder	"	" 2	April 18	" 3	" 5	" 9

EXPERIMENT WITH IRISH POTATOES.

Object--To compare the yield per acre in bushels of different varieties under identical circumstances.

RESULTS.

No. Plat	Name of Variety.	From Whom	Choice.	Medium.	Culls.	Scabby.	Total.	Remarks.
1.	Beauty of Hebron	Thorburn	15 75	45 50	18 37	14 87	94 49	Earliest—Few Rotted
2.	Chas. Downing	"	50 75	107 62	35 00	7 00	200 37	
3.	Clarke's No. 1	"	29 75	25 37	28 87	19 25	103 24	
4.	Dictator	"	73 50	87 50	23 62	28 00	212 62	
5.	Early Albino	"	28 00	12 22	14 87	6 12	61 21	2nd Earliest—Few Rotted
6.	Early Sunrise	"	28 00	53 35	38 50	7 00	126 85	
7.	Early Rose	Auburn M'kt	56 00	33 25	42 00	16 62	147 87	Few Rotted
8.	Empire State	Thorb.	133 00	15 75	54 25	14 00	217 00	Few Rotted
9.	Garfield	Thorburn	79 62	95 37	42 00	9 62	226 61	
10.	Great Eastern	"	53 37	143 50	25 37	13 12	235 36	
11.	May Flower	"	0 00	57 75	31 50	2 62	91 87	
12.	Morning Star	"	46 37	106 75	22 75	16 62	192 49	
13.	New Giant	"	129 50	77 00	25 37	0 87	232 74	3d Earliest
14.	Pearl of Savoy	"	20 12	33 25	33 25	14 87	101 49	
15.	Rose's Beauty of Beauties	"	55 12	96 25	35 87	24 50	211 74	
16.	Rose's Wild Rose	"	56 87	71 75	22 75	3 50	154 87	Few Rotted
17.	Sunlit Star	"	23 62	42 00	15 75	21 87	103 24	
18.	The Thorburn	"	3 50	39 37	22 75	3 50	69 12	
19	Thorburn's Late Rose	"	39 37	94 50	25 37	1 75	160 99	
20.	White Elephant	"	37 62	127 75	35 00	7 00	207 37	
21.	White Star	"	49 87	122 50	31 50	16 62	220 49	

NOTES ON RASPBERRIES.

VARIETIES.	Growth of Plants.	Size of Fruit.	Form of Fruit.	Color of Fruit.	Quality of Fruit.	Productiveness.	Use F & M	Date of Ripening.	Type.
Brandywine	Vigorous..	Medium	Roundish	Redish....	Good	Not Prolific.	F & M	May 8	Red Cap.
Caroline	N't Vig's.	Small...	"	Black	Good	Prolific	M	" 4	Black Cap
Crimson Beauty	" "	Medium	"	Deep Red.	Poor	Not Prolific.	....	" 23	Red Cap..
Cuthbert	Vigorous..	Large..	Oblong...	Red	Very Good.	Prolific	F & M	" 12	" "
Doolittle	"	Medium	Round...	Rlack	" "	Prolific	M	" 4	Black Cap
Davidson's Thornless	N't Vig's.	Small...	"	Black	Poor.	Not Prolific.		" 14	" "
Early Prolific	Vigorons..	Medium	"	Purple...	Very Good..	Prolific	F	" 7	Red Cap..
Florence	"	"	"	Yellow...	" "	Prolific	F & M	" 8	"
Gregg	"	"	"	Black	Good	Not Prolific.	M	" 17	Black Cap
Golden Queen	"	Large..	Oblong...	Yellow...	Best	Prolific	F & M	" 15	Red Cap..
Hopkins	N't Vig's.	Medium	Ronudish	Black	"	"	F & M	" 12	Black Cap
Highland Hardy	" "	"	Round...	Red	"	Not Prolific.	F	" 21	Red Cap..
Hansell	" "	Large..	Roundish	Red	Good	" "	M	" 11	" "
Mammoth Cluster	" "	Medium	Round...	Black	Very Good..	" "	F	" 21	Black Cap
Marlboro	" "	Large..	"	Red	Poor	" "	....	" 29	Red Cap..
New Rochell	Vigorous...	Medium	"	Crimson..	Good	" "	M	" 8	" "
Ohio	"	Small...	"	Black	Good	Prolific	F	" 11	Black Cap
Rancocas	N't Vig's...	Small...	"	Red	Poor	Not Prolific.	....	" 18	Red Cap..
Reliance	" "	Medium	"	Red	Good	" "	F	" 11	" "
Sauhegan	Vigorous...	Small...	"	Black	Very Good..	Prolific	F & M	" 5	Black Cap
Shafer's Colossal	"	Large...	"	Crimson..	Good	"	M	" 23	Black Cap
Superb	N't Vig.s.	"	"	Red	Poor	"		" 15	Red Cap..
Tyler	Vigorous...	Medium	"	Black	Very Good..	"	F & M	" 5	Black Cap
Thompson's Early Prolific	not ripes'...	....	....	....	....	....	....	....	....
" " Pride	not vigor'us	....	....	....	....	....	....	....	....
Welch	N't Vig's..	Medium	Round..	Red	Good	Not Prolific.	F	" 8	Red Cap..

NOTES ON STRAWBERRIES.

VARIETIES.	Growth of Plauts.	Size of Fruit.	Form of Fruit.	Color of Fruit.	Quality of Fruit.	Productiveness.	Texture of Fruit.	First Ripe Berries.
Atlantic	Not Vig's.	Medium	Conical.	Deep Red.	Good	Prolific	Firm	April 25
Agriculturist	Vigorous	"	"	Red	Best	"	"	" 23
Bidwell	"	"	Oblong	"	Good	"	"	" 24
Boyden's No. 30	Not Vig's.	"	Round	"	"	Not Prolific.	Soft	" 24
Big Bob	Vigorous	No test						" 27
Champion	"	No sample.						May 31
Chas. Downing	Not Vig's.	Small	Round	Deep Red.	Best	Not Prolific.	Soft	April 10
Captain Jack	" "	"	"	" "	Good	" "	Soft	" 18
Cornelia	" "	"	Oblong	Light Red	"	" "	Firm	May 21
Continental	Vigorous	"	"	Red	"	" "	"	April 6
Crescent	"	Medium	Conical	"	"	Prolific	"	" 21
Crystal City	Not Vig's.	Small	Round	"	"	Not Prolific.	"	" 18
Cumberland Triumph	Vigorous	Medium	Round	Light Red	"	" "	Soft	" 27
Dan Boone	Not Vig's.	"	Oblong	Deep Red.	"	" "	Soft	" 26
Early Canada	Vigorous	Large	Round	"	"	Prolific.	Soft	" 24
Finch's Seedling	Not Vig's.	Small	"	Light Red	"	"	Firm	" 19
Glendale	" "	"	Conical	Red	"	Not Prolific.	"	" 26
Golden Defiance	" "	"	"	Deep Red.	"	" "	Soft	" 21
Harris' Mammoth	Vigerous.	"	Oblong	Deep Red	"	" "	"	" 28
Henderson	Not Vig's.	Medium	Round	Light Red.	Best	" "	Firm	" 24
Indiana	Vigorous	"	"	" "	Good	" "	Soft	" 30
James Vick	"	Small	Oblong	Red	"	" "	Firm	" 25
Jersey Queen	Not Vig's.	no sample.						May 8

Jewell	Vigorous	“ “	....	....	....	....	......	“ 11
Jucunda	Not Vig's	Small	Round	Deep Red	Very Good	Not Prolific	Soft	“ 2
Jumbo	Vigorous	Large	“	Light Red	Good	Prolific	Firm	April 28
Kentucky	Not Vig's.	Medium	“	Deep Red	Very Good	Not Prolific	Soft	“ 24
Lacon	Vigorous	Small	“	“	Good	“ “	Firm	“ 27
Legal Tender	Not Vig's.	Medium	“	“	Very Good	“ “	Soft	“ 20
Longfellow	Not Vig's	“	Conical	“	Very Good	“ “	“	“ 25
May King	Vigorous	Small	Oblong	Light R.	Good	“ “	Firm	“ 18
Manchester	“	Large	Round	“ “	Very Good	Prolific	“	“ 26
Miners	Not Vig's.	Medium	“	Deep Red.	Good	“	Soft	“ 26
Monarch of the West	Vigorous	“	“	Light Red	Good	Not Prolific	Firm	“ 21
Mt. Vernon	Not Vig's.	Small	“	Deep Red	Very Good	Prolific	Soft	“ 25
Mrs. Garfield	Vigorous	Large	“	Red	Good	“	Firm	“ 28
Nig's Superb	Vigorous	Medium	Oblong	Red	Very Good	Not Prolific	Soft	“ 23
Old Iron Clad	Not Vig's.	no sample	....	....	....	....	......	“ 23
Parry	Vigorous	Medium	Oblong	Light Red	Good	Not Prolific	Soft	“ 23
Piper's Seedling	“	“	Oblong	Red	Good	Prolific	Soft	“ 25
President Lincoln	“	no test	....	....	....	Not Prolific	......	May 1
Primo	“	medium	Conical	Light Red	Very Good	Not Prolific	Firm	April 25
Prince of Berries	“	Small	Round	“	Good	Not Prolific	Soft	“ 33
Sharpless	“	Large	Oblong	“	Very Good	Not Prolific	Soft	“ 23
Triumph de Gand	“	Medium	Round	Deep Red	Good	Not Prolific	Soft	“ 27
Vineland Seedling	“	“	Oblong	Light Red	Good	Prolific	Soft	“ 25
Warren	Not Vig's	no test	....	....	....	Not Prolific	......	“ 21
Wilson	Vigorous	Medium	Round	Red	Very Good	Prolific	Firm	“ 23
Windsor Chief	“	“	“	Deep Red.	Good	Not Prolific	Soft	“ 30
Wonderful	“	no test	....	....	....	Not Prolific	......	“ 28

MULCHED AND UNMULCHED STRAWBERRIES.

To compare the production of mulched with that of unmulched plants. In the early spring of 1887 two hundred plants of the Sharpless variety of strawberries were planted in fertile, pebbly drift.

One hundred of the plants were mulched with oat straw and one hundred left unmulched.

During the spring of '87 the flower stalks were pulled from 50 of the mulched and fifty of the unmulched plants for the purpose of ascertaining the effect of this treatment upon the production the next year.

During the fall of 1887 eleven of the unmulched plants died while only one of the mulched perished.

These were carefully replaced with plants of the same age from an adjacent bed in order that the final test of productiveness might be made upon equal number of plants in each case.

Last spring the following notes were made: viz. The unmulched plants commenced ripening their fruit April 18th, and the mulched April 24th.

The mulching therefore had the effect of retarding the ripening of the berries six days.

The patch was divided into four plats as follows:

1st. Fifty plants, unmulched which were allowed to ripen their fruit in 1887, the first season after planting.

2d. Fifty plants, mulched which bore fruit the first season.

3d. Fifty plants, unmulched from which the fruit stalks were removed the first season.

4. Fifty plants, mulched from which the fruit stalks were removed.

Plat No.	Results.	No. of quarts.	Largest yield at one picking.	
1.	50 plants unmulched allowed to fruit in 1887..............	8⅜	3	Qts
2.	50 " mulched " " " " "	16¼	4	"
3.	50 " unmulched not" " " " "	10⅜	2¾	"
4.	50 " mulched not " " " " "	14¼	4	"

Mulching increased the yield several quarts from fifty plants, nearly doubling the yield.

Removing the fruit stalks the first season did not pay.

Twenty-five selected berries from these plats weighed upon the scales in the chemical lobaratory, one pound; and 22 of them filled a quart measure.

The unmulched being earlier than the mulched plats, sustained grearter loss from late frosts. The extent of this could not be ascertained.

REPORT OF N. T. LUPTON, CHEMIST.

During the year ending July 1st, a large amount of work has been done in the Laboratory by the chemist in charge and his assistants, Messrs. L. W. Wilkinson and B. S. Burton. Since the 1st of April, Dr. J. T. Anderson has been employed as First Assistant Chemist of the Agricultural Station, and has been engaged on the analysis of representative soils of the state.

The work of the year has been mainly in connection with the State Department of Agriculture, of which the Professor of Chemistry in the Agricultural and Mechanical College is made by law, "the official chemist." He is required "on the application of the Commissioner to analyze and certify the analysis of all fertilizers, samples of which are furnished him," also, of such other materials as the Commissioner may direct.

The Director of the Agricultural Experiment station is also authorized to have such analyses made as may be necessary to carry on the experimental work under his supervision.

The variety and extent of this work can be seen from the following tabular statement of the number and character of the quantitive analyses made during the past four years. It is scarcely necessary to state that in the analysis of fertilizers, only those constituents have been determined which are required under the law, viz: Water soluble, citrate soluble and acid soluble phosphoric acid, nitrogen and potash.

NUMBER AND CHARACTER OF QUANTATIVE ANALYSIS MADE IN THE STATE LABORATORY DURING THE PAST FOUR YEARS, UNDER THE GENERAL SUPERVISION OF THE COMMISSIONER OF AGRICULTURE AND THE DIRECTOR OF EXPERIMENT STATION.

	Number of Analyses.			
	1884-85.	1885-86.	1886-87.	1887-88.
Acid phosphates with nitrogen and potash	13	24	79	65
Acid phosphates with potash				3
Acid phosphates	6	18	41	52
Natural guanos	3	3	11	8
Phosphatic rocks and deposits	103	27		3
Marls and calcareous rocks	12	19	5	9
Mucks	3	4	1	2
Cotton seed meal				3
Cotton seed hull ash				1
Cave earths				3
Composts		5	3	
Kainit and potash salts	2	4	6	6
Feed stuffs		2	5	3
Nitrogenous material				5
Wheat			10	
Cane juice and begasse		6	7	
Coal		1	2	4
Iron ores	4	4	1	2
Clays				10
Waters		2		3
Soils		12	4	4
	146	131	175	186

In addition to the above, a considerable number of minealogical specimens, such as pyrites, limestones, marles, etc., were determined qualitatively, and some other work done not properly belonging to the Department of Agriculture or Ex. Station.

The details of the analysis of fertilizers are as follows:

RESULTS OF ANALYSES OF FERTILIZERS REPORTED BY DR. N. T. LUPTON, STATE CHEMIST, FROM SAMPLES FURNISHED BY MANUFACTURERS AND OTHERS, FOR SEASON OF 1887-88—SEPTEMBER TO JULY.

Station No.	Name of Fertilizer or Chemical.	By whom reported.		Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	COMMERCIAL VALUE	
		Name.	Address.						$	Cts
826	Acid phosphate	Ga. Chem. W'ks	Augusta, Ga.		15 41	1 45	0 47		25	29
842	Palmetto Acid Phosphate	J. Steiner & Son	Greenville, Ala		13 15	1 61	0 60		22	14
851	Ga. State Standard Acid Phosphate	Ham'd, H. & Co	Savannah, Ga		11 04	1 52	2 62		18	84
856	Furman's Acid Phosphate	Adair, Bros.& Co	Atlanta, Ga.		10 75	3 56	0 76		21	52
857	Adair's Acid Phosphate	“ “	“ “		10 94	3 66	0 76		21	90
864	Acid Phosphate No. 1	Ala. Fertil. Co.	Montg'ry, Ala.		13 44	0 57	1 15		21	00
865	Acid Phosphate No. 2	“ “	“ “		13 05	1 09	1 12		21	21
866	High Grade Phosphate	Troy Fertl. Co.	Troy, Ala.		15 64	1 20	0 44		25	26
875	Ashepoo Acid Phosphate	Ashepoo, Ph. Co	Charlest'n, S.C		14 20	0 97	0 38		22	75
876	Eutaw Acid Phosphate	“ “	“ “		14 78	1 12	0 32		23	85
879	Acid Phosphate	Marks & Gayle.	Montg'ry, Ala.		11 80	1 93	0 38		20	59
881	Royal Phosphate	Troy Fertl. Co.	Troy, Ala.		12 67	3 23	1 66		23	85
889	Magnet Acid Phosphate	Davis, Mar.& Co	Mobile, Ala.		10 75	4 96	1 66		23	56
893	Stonewall Acid Phosphate	Com. Guano Co	Savannah, Ga.		13 82	1 31	0 99		22	69
894	Chatham Acid Phosphate	“ “ “	“ “		13 34	1 44	0 96		22	17
895	Dissolved Bone	“ “ “	“ “		12 19	1 63	1 02		20	73
896	Pomana Acid Phosphate	“ “ “	“ “		12 09	2 78	1 16		22	30
897	Patapsco Acid Phosphate	W. F. Beard.	Troy, Ala.		14 88	0 07	1 08		22	42
900	Soluble Bone	Columb's Fer Co	Columbus, Ga.		12 86	2 52	0 54		23	07
902	Etiwan Dissolved Bone	Etiwan Ph. Co.	Charlest'n, S.C		11 42	2 70	2 06		21	18
908	Stern's Dissolved Bone	Malone & Col'ns	Geneva, Ala.		13 72	1 42	0 22		22	71

910	Stern's Acid Phosphate	Malone & Colins	Geneva, Ala.		12 92	1 23	0 25		21	22
917	X X Acid Phosphate No. 1	Vandiver & Co.	Montg'y, Ala.		13 05	1 88	1 77		22	39
918	X X Acid Phosphate No. 2	" "	" "		12 67	2 52	1 47		22	72
919	Phosphate	Troy Fertl. Co	Troy, Ala.		12 86	1 06	0 28		20	88
920	Sunny South Acid Phosphate	Pike Co. Gu. Co.	" "		13 52	2 49	0 20		24	01
922	Wando Acid Phosphate	N. W. E. Long.	Hurtsboro, Ala		12 28	3 03	3 23		22	96
924	Lister's Plain Dissolved Bone	D. L. Roberts.	Savannah, Ga.		13 90	1 07	0 19		22	45
938	"Ammoniate Phosphate"	A. C, Williams	Talladega, Ala		4 03	6 72	5 76		16	12
939	Grand Imperial Acid Phosphate	Pike Co. Gu. Co	Troy, Ala.		4 03	9 50	4 13		20	30
947	Southern Acid Phosphate	So. Ac. Ph. Co	Atlanta, Ga.		10 17	5 03	5 53		22	80
948	Sunny South Acid Phosphate	R. S. Williams.	Wet'mpka, Ala		2 20	9 13	4 69		16	99
950	Acid Phosphate	O. W. C., & Co	Oxford, Ala.		12 47	4 17	2 56		24	96
951	Wando Acid Phosphate	L. W. Lawler.	Montg'ry, Ala.		9 02	5 54	3 10		21	84
952	Grand Imperial Acid Phosphate	Pike Co. Gu. Co	Troy, Ala.		4 03	10 01	4 96		21	06
959	Acid Phosphate	Ham'd H. & Co.	Savannah, Ga.		11 90	3 45	0 29		23	02
958	"Fertilizer" (Phosphate)	D. K. Thomas.	Clayton Ala.		4 99	3 04	0 22		12	04
961	"Fertilizer" (Phosphate)	Folmer & Sons.	Troy, Ala.		10 75	2 86	2 14		20	41
962	Scott's High Grade Phosphate	Freeman & D.	Alexand'a Ala		10 36	3 92	3 00		21	42
965	High Grade Eng. Acid Phosphate	Folmer & Sons.	Troy, Ala.		11 82	2 65	2 04		21	70
966	Sunny South Acid Phosphate	H.C M., S.C.D., Z.F.	Opelika, "		3 45	6 72	4 69		15	25
969	Phosphate	A. F. Pruett.	Guerryt'n "		4 60	12 94	3 96		26	31
970	Bradley's Patent Acid Phosphate	J. M. Hurt.	Auburn, "		12 67	3 23	1 76		23	85
972	Acid Phosphate	O. H. Henderson	Bingham, "		10 56	3 56	2 84		21	18
977	Eutaw Acid Phosphate	A. Mc Intyre.	Waverly, "		9 02	2 98	2 11		18	44
978	"Fertilizer"	Mc Queen Smith	Pratville, "		9 98	5 83	2 43		23	71
990	English Acid Phosphate	J. S. Newman.	Ag. Stat'n "		12 17	2 58	0 26		22	12½
*991	Eng Acid. phosp. reverted	" "	" " "		0.00	9 55	2 35		..	..
994	Acid Phosphate	N. Levy.	Coatopa, "		.....	6 12	8 28		9	18

*Same as 990 with adddition of one-fourth its weight of lime.

Phosphates With Potash

858	Farish Furman Formula	Adair Bros & Co	Atlanta, Ga.		9 79	0 54	1 47	4 13	19	62
884	Farish Furman Formula	" "	" "		9 40	2 13	1 23	4 13	21	42

Phosphates With Nitrogen and Potash.

Station No.	Name of Fertilizer or Chemical.	BY WHOM REPORTED.		Nitrogen.	Water Soluble.	Citrate Soluble.	Aceid Soluble.	Potash	COMMERCIAL VALUE	
		Name.	Address.							
828	Port Royal Cotton Fertilizer..................	....	Columbia, Ala	1 68	8 92	0 97	1 72	2 99	24	37
830	Ammoniated Guano........................	Rasin Fert. Co.	Baltimore, Md	2 24	6 43	4 57	2 44	1 69	26	92
838	Ga. State Grange...........................	Baldwin Fert Co	Savannah, Ga	2 17	9 02	2 37	1 85	2 08	27	31
843	B. D. Sea Fowl Guano.....................	J. Steiner & Sons	Greenville, Ala	2 52	9 69	3 00	1 80	1 23	27	28
844	"Bradley's Patent Phosphate".............	" "	" "	2 17	8 83	2 32	2 48	1 89	27	08
850	Farmer's AmmoniatedDis. Bone............	Hm'd, Hull & Co	Savanah, Ga..	1 86	8 05	2 25	1 12	1 52	24	22
852	Ga. State Standard and Supr-phosphate....	" "	" "	1 79	8 83	0 42	2 36	2 59	23	44
853	H. H. & Co's Pure Am. Bone H. G. Veg. Ft.	" "	" "	6 02	6 81	1 15	1 06	6 60	42	01
859	Adair's Am. Dis. Bone....................	Adair Bros & Co	Atlanta, Ga...	2 45	9 60	1 09	0 44	0 40	25	98
	....									
860	Furman's Amd. Soluble Bone,.............	" "	" "	1 08	9 60	0 61	1 79	2 41	21	93
861	Buffalo Bone Guano.......................	" "	" "	1 86	7 10	1 73	2 30	3 57	24	06
862	Planter's Soluble Guano..................	" "	Atlanta, Ga.	1 82	5 95	3 12	5 37	2 65	23	34
863	Homestead Guano,.........................	" "		2 24	10 27	0 61	0 25	0 55	25	60
867	Perfect Guano.............................	Troy Fertl'r Co	Troy, Ala.....	2 38	9 79	1 03	0 31	1 47	26	98
868	Furman's High Grade Guano.............	Adair Bros &Co	Atlanta, Ga...	2 52	9 60	2 24	1 02	3 07	30	65
877	Ashepoo Fertilizer........................	Ashepoo phosCo	Charleston, SC	2 38	9 79	1 12	1 95	2 67	28	31
878	Eutaw Fertilizer...........................	" "	" "	2 31	9 40	1 16	1 53	2 40	27	24
885	Buffalo Bone Guano.......................	Adair Bros & Co	Atlanta, Ga...	1 86	7 68	2 35	0 72	3 57	25	86
886	Eddystone Soluble Guano.................	F. G. McElhany	Auburn, Ala..	1 89	6 04	3 74	3 85	2 00	24	04
887	Formula No. 1............................	N. H. Holmes..	Montgomery..	4 36	6 04	2 44	1 31	0 80	30	52
888	Formula No. 2............................	" "	Montgomery..	2 94	8 44	2 54	0 15	0 77	28	70
892	Home Mixture.............................	Columbus F'r co	Columbus Ga.,	2 45	9 60	1 02	0 51	2 88	28	28
898	Magnet Soluble Guano,....................	Davis, Mar'll co.	Mobile, Ala..	3 15	7 39	0 80	0 25	1 79	26	35
904	Bone Vegetable Grower....................	Currie Fertz'r co	Louisville, Ky.	1 55	7 10	3 17	1 05	3 25	24	65

906	No. 1 Stern's Amd. Raw Bone Superphosp'te	Malone & Col'ns	Geneva, Ala.	1 89	0 78	5 62	3 77	1 16	18	13
907	Crown Guano	Treadw'll, A.&co	Atlanta, Ga.	2 73	6 72	3 84	3 45	1 25	27	73
909	No. 2. Stern's Amd. Raw Bone Superphosp'te	Malone & Col'ns	Geneva, Ala.	1 86	7 06	2 43	1 03	1 27	22	75
912	Georgia State Grange Fertilizer	“ “ “	“ “	2 10	7 68	2 47	1 37	3 10	26	54
913	Soluble Pacific Guano	“ “ “	“ “	1 65	7 68	2 40	1 82	2 72	24	27
914	Golden Grain Guano	Adair Bros & co	Atlanta, Ga.	1 68	6 91	2 48	1 31	1 37	22	00
915	“Fertilizer”	Clayton F'r Co	Clayton, Ala.	2 15	8 44	1 60	1 28	0 90	24	34
916	“	C W Hooper &co	Selma, Ala.	2 88	6 52	3 24	0 99	1 38	26	90
925	Lister's Amd. Dis. Bone	D L Roberts	Savannah, Ga.	2 22	11 75	1 95	1 66	2 02	31	25
926	Lister's Harvest Queen	“ “	“ “	1 47	9 60	3 03	1 96	2 23	26	90
927	Lister's Celebrated Ground Bone	“ “	“ “	2 94	0 41	7 08	3 07		21	69
928	Lister's Standard Phosphate	“ “	“ “	2 52	9 60	3 28	1 71	1 45	30	61
929	“High Grade”	Coweta Frtl'r co	Newnan, Ga.	2 17	8 31	1 65	0 65	2 57	25	77
930	Aurora Fertilizer	“ “	“ “	2 24	10 17	1 22	0 70	1 71	27	52
937	Amd. Phosphate	“ “	“ “	2 13	9 03	1 86	0 80	2 48	27	11
940	Guano Co Guano	N H Holmes	Montgomery	2 10	5 76	2 59	3 74	2 33	23	04
941	L. & R. Guano	“ “	“	1 40	7 29	1 61	3 58	1 89	20	70
942	Pike County Guano	A. H. Rainer	Troy, Ala.	1 82	3 72	5 71	2 81	3 16	25	89
943	Eddystone Guano	A H Rainer	“ “	1 68	4 60	6 95	2 46	1 65	25	52
944	Southern Amd. Dis. Bone	So. acid phos co.	Atlanta, Ga.	1 82	8 53	2 32	2 78	1 35	24	71
945	Samana Guano	“ “	“ “	2 31	9 40	1 67	1 79	1 62	27	22
946	Old Dominion Guano	“ “	“ “	2 59	8 83	0 45	1 85	1 70	25	72
949	Ga. State Grange Guano	O W Cooper & co	Oxford, Ala.	1 82	8 06	4 13	2 65	1 90	27	37
955	Soluble Pacific Guano	Frank S Roberts	Mobile, Ala.	1 86	6 14	4 20	2 33	1 04	23	72
960	Old Reliable	Ham'd, Hull &co	Savannah, Ga.	1 89	9 40	1 39	2 84	0 92	24	47
963	L. & C. Dissolved Bone	Freeman& Du'g's	Alexandria, Ala	1 54	9 79	1 92	1 53	1 58	25	75
964	Scott's Animal Amd. Guano	“ “	“ “	0 98	8 16	4 45	1 31	2 51	25	24
967	Eddyston Soluble Guano	Murphy, D & F	Opelika, Ala.	2 10	6 14	4 16	2 56	1 88	24	82
968	Soluble Pacific Guano	Frank S Roberts	Mobile, Ala.	1 82	6 56	3 94	2 36	1 08	23	92
971	Hinton Fertilizer	W G Hinton &S	Pickensv'le Ala	0 35			0 57	1 78	3	14
974	B. D. Seafowl Guano	J Steiner & sons	Greenville, Ala	1 96	8 06	2 09	2 33	2 31	25	65
979	Rock City Superphosphate	O W Cooper	Oxford, Ala.	2 24	8 25	1 51	1 88	2 95	26	38
981	Gossypium Phospho	J B Collins	Fayette, C. H.	2 03	7 69	2 09	2 31	1 33	23	91
988	Complete Fertilizer	W. G. Whitman	Young'boro Ala.	1 75	6 13	3 63	0 99	1 99	23	45
989	Farmer's Standard Phosphate	“ “	“ “	1 40	8 52	1 85	0 84	2 83	24	04
992	Gossypium Phospho	J. S. Newman	A. Station, Ala	2 31	5 95	3 54	1 53	1 85	25	08

Natural Guanos, Cotton Seed Meals, Marls, Etc.

Station No.	Name of Fertilizer or Chemical.	By whom reported. Name.	By whom reported. Address.	Nitrogen.	Water Soluble.	Citrate Soluble	Acid Soluble.	Potash.
993	Cotton Seed Meal..	J. S. Newman.	Ag. Station, Ala					
855	Swan Island Guano	Frank S Roberts	Mobile, Ala. ...	6 82½			1 15	1 93
880	" " "	" "	" "	0 42		12 65	6 49	0 92
899	" " "	" "	" "	0 42	0 32	16 67	5 66	0 41
901	" " "	" "	" "	0 58	0 51	14 02	6 78	0 57
954	" " "	" "	" "	0 38	0 25	16 14	7 32	0 30
976	" " "	" "	" "	0 28	0 30	14 90	6 88	0 37
911	Virginia Grain Fertilizer................................	Jno. O. Martin..	Eufaula, Ala....	0 49	0 97	6 94		0 30
923	Currie Bone Meal..	Currie Fel'r Co.	Louisville, Ky..	0 08	0 38	0 58	0 38	0 07
982	Swan Island Guano......................................	Frank S Roberts	Mobile, Ala....	4 27	1 01	16 08	5 18	
984	" " "	" "	" "	0 41	0 22	8 02	15 72	0 22
	Cotton Seed Hull Ash....................................	J S Newman...	Ag. Station.....	0 28	0 20	7 86	17 28	0 41

995 Moisture 13.12 ; Organic matter 2.00 ; Insoluble matter (Silica) 6.88 ; Iron and Al. Oxides 14.00 ; Phosp. acid 9.60 ; Lime 2,80 ; Magnesia 6.59 ; Carbonic acid 9.56 ; Sulphuric Acid 1.71 ; Potash 25.93 ; Soda 3.86 ; Chlorine 3.00. Total 100.03.

Natural Guanos, Cotton Seed Meals, Marles, Etc.

Station No.	Name of Fertilizer or Chemical.	By whom reported.		Insoluble Matter.	Phosphoric Acid.	Calcium Carbonate.	Magnesium Carbonate	Nitrogen.	Potash.
		Name.	Address.						
829	Marl	R. M. Parker	Coatopa ,Ala		1 05	61 95			
831	Limestone	A. A. Coleman	Greensb 'o, Ala	3 35	-	73 98	22 05		
833	Shell Marl	T. A. Craven	Midway, Ala	41 98	1 34	50 70			
841	Marl	S. R. Weaver	Fort G'ines, Ga	7 52	trace	85 65			
931	No. 1 Cave Earth	R. Nicholson	Collinsvlle, Ala		1 27				
932	No. 2. Cave Earth	“	“ “		0 38			0 14	
933	No. 3 Cave Earth	“	“ “		0 44				
854	Cotton Seed meal	So. Cotton Oil co	Montg'ery, Ala		2 24			6 79	1 78
891	Natural Phosphates (a)	F M Pennington	Troy, Ala		24 05				
891	Natural Phosphates (b)				22 14				
891	Marl				0 06				
891	Shell.				0 51				
891	Shell				0 51				
905	Kainit	Malone & Colins	Geneva, Ala						13 89
975	Cotton Seed Meal	Southern Oil co.	Selma, Ala		1 34			7 00	1 37

The methods of analysis used are those adopted by the Association of Official Agricultural Chemists at their last meeting in Washington and published in pamphlet form.

In soil analysis, the methods published by the Department of Agriculture at Washington have been strictly followed, and great care has been taken to secure accurate results. While soil analysis has, of late years, fallen somewhat into disrepute, on account of hasty conclusions drawn from imperfect data, and a want of thorough study of all the conditions of plant growth, it has an important value in the scientific investigation of the productive capacity of soils and the means best adapted to restore fertility and to prevent exhaustion.

In accordance with the plan of experimentation agreed upon for the Station, representative soils with sub-soils from different portions of the State have been collected which will be analyzed ith great care, and their productive value with and without fertilizers, determined by carefully conducted and accurate experiments at the Station. Important conclusions, it is believed, will be drawn from these results, not only of general scientific value, but of practical utility to the agriculturists of Alabama and other states.

The results of soil analysis thus far completed are as follows:

RESULTS OF ANALYSES OF AIR-DRIED SOILS AND SUB-SOILS.—SOIL RECEIVED FROM AGRICULTURAL EXPERIMENT STATION.

	VIRGIN SOIL.		Cul'd or worn s'il	
	SOIL.	SU	SOIL.	SUBSO'L
Soil marked	1 (a)	1 (b)	2 (a)	2 (b)
Station number	1001	1002	1003	1004
Moisture	3 686	1 535	0 981	0 512
Insoluble Silica	82 131	88 718	89 713	91 602
Hydrated Silica	2 253	2 173	1 909	2 161
Soluble Silica	0 194	0 115	0 307	0 067
Sesquioxide of Iron, F, O 3	1 434	1 505	0 813	1 028
Alumina, Al 2, O 3	3 028	3 140	1 867	2 590
Phosphoric Acid, P 2, O 5	0 059	0 093	0 056	0 060
Lime, Ca.O	0 091	0 031	0 086	0 034
Magnesia, Mgo	0 058	0 023	0 072	0 012
Potash, K 2, O	0 062	0 090	0 034	0 092
Soda, Na. 2, O	0 184	0 718	0 440	0 281
Sulphuric Acid, S O 3	0 101	0 041	0 056	0 021
Chlorine, Cl	0 009	0 011	0 015	0 014
Carbonic Acid, C O 2	0 180	0 058	0 106	0 095
Volatile and Organic Matter	5 838	2 064	3 208	1 112
Total	99 308	100 315	99 663	99 681
Nitrogen	0 379	0 274	0 293	0 253
The Air-dried soil contains				
Coarse Gravel	31 20	22 11	26 18	18 13
Fine Material	68 80	77 89	73 82	81 87

REPORT OF P. H. MELL, BOTANIST.

So short a time has elapsed since the organization of the Experiment Station, but little can be said of the Botanical work. An outline of some of the plans proposed, however, may not be amiss here.

The investigations in this department were intended by the laws establishing the station to cover the entire state. In other words it is contemplated to write in popular language a botany of Alabama that will be equally intelligible to the farmer and valuable to the scientific student. This will not be the work of a few months, nor will it be accomplished by one person. But it must be the work of years and through the combined efforts of the earnest farmers of Alabama and the officers of the Experiment Station.

As we look over the field before us it seems best at present to divide the work as follows:

1. The Classification and determination of the relative economic values of all wild plants useful for forage and other like agricultural purposes.
2. The classification of all noxious weeds and a discussion of the best and cheapest methods of eradicating them.
3. The medical plants of the State.
4. Trees and shrubs that are suitable for lumber and building interests.

It will also be a matter of importance to examine these wild plants while under a state of cultivation and thus prove their adaptation to the wants of the farmer.

Valuable assistance in the prosecution of this work may be rendered by the farmers of the State if they will send specimens of plants to the Station carefully collected in the following manner:

1. In the case of an herb or grass the entire plant must be sent including roots, stem, leaves, flowers and, if possible, the fruit also. Select fifteen or twenty vigorous, well grown specimens and place them between sheets of thick unsized paper, taking care to spread the leaves and adjust the flowers so that the smallest proportions of parts are not folded and bent out of shape. Place a pressure of 30 or 40 lbs on the paper and place aside to dry When the plant is too long for the size of the paper, bend the stems until reduced to proper proportions.

2. Take careful notes of the plant surroundings. The characacter of soil, whether found on up land or low land, moist or dry land, foreest or open field, time of flowering and seeding, etc., height of plants. State whether the plants are in large or small nnmbers. Are stock known to eat them, etc.

3. In case of large trees and shrubs it will be best to take sections of the trunk and collect the leaves, flowers and fruits. The sections must be cut ten inches long and the bark left on unbruised. These specimens should then be numbered and carefully packed in strong boxes and shipped by freight to the station at Auburn. Notes must be taken concerning the tree, where it is found, kind of soil, common name, if known, and if it has been used for any special purpose. Place a number on the note corresponding to that on the section. Send the notes by mail to Auburn. The leaves must be pressed between paper as already described.

4. In sending specimens through the mail or by express do not roll the papers but pack them spread out as they come from the press. Lay the sheets containing the plants one on top of the other, place at the top and bottom of the package stout paste board. Wrap all with strong paper and address to Experiment Station, Auburn, Ala., (Department of Botany.) In every shipment send notes, name and post office.

The grasses are best collected between the first of May and the first of October. Many plants mature their seeds by the first of June, and they must be collected early in the spring just as soon as the flowers are formed well.

AVERAGE PRECIPITATION, IN INCHES, FOR THE STATE OF ALABAMA.

	Jan.	Feb.	Mar	Apr	M'y	June	July	Aug	Sep	Oct.	Nov	Dec	Year	Peri'd of ob'vati'n
Auburn	4 91	4 56	5 88	4 08	3 28	5 23	4 94	4 49	3 15	2 38	4 45	6 26	53 61	11 years.
Birmingham	7 07	2 59	1151	7 76	3 06	4 28	3 07	3 84	3 40	1 72		3 40		5 “
Calera*				4 45	2 91	6 09	2 76	2 58	1 87	0 49				6 “
Carlowville	5 83	6 85	9 09	7 68	3 58	5 01	4 53	4 34	4 50	2 29	5 63	5 63	64 96	16 “
Coatopa	5 40	4 90	6 60	3 00	4 05	5 80	3 70	1 35	2 25	2 80	7 00	5 80	52 65	2 “
Carrolton	5 55	3 98	2 25	5 35	4 99	3 21	3 44	3 55	2 65	2 30	2 76	5 42	45 46	4 “
Decatur	7 28	5 08	6 37	5 00	3 41	3 45	3 58	2 42	2 13	2 45	4 53	3 31	49 01	9 “
Demopolis				6 20	1 81	7 60	4 44	5 36	1 76	2 66				2 “
Edwardsville	7 33	5 48	4 76	1 90	6 78	5 19	4 34	3 74	2 68	1 70	2 25	4 52	49 67	2 “
Elyton	3 94	4 40	8 28	1 12	1 87	4 08	3 87	4 44	3 43	3 75	3 25	4 00	46 35	2 “
Eufaula	5 94	4 64	3 15	2 46	2 13	3 27	6 97	4 34	3 25	1 88	5 08	1 12	44 23	4 “
Evergreen*				3 55	1 88	5 72	7 37	3 38	4 94	1 77				4 “
Fish River*	3 49	2 00	4 28		1 00	3 05	5 69	7 52	5 23	0 89	2 33	3 32		5 “
Florence	5 94	4 02	3 14	1 91	5 33	3 54	5 40	2 43	4 31	2 17	3 41	4 66	46 26	4 “
Fort Deposit*				9 96	4 68	3 87	3 31	2 32	2 18	1 50				4 “
Gadsden	5 77	3 77	3 47	1 80	5 84	5 22	3 76	3 52	2 48	2 40	3 51	6 44	47 98	4 “
Greensboro	5 41	5 21	4 87	4 49	3 34	3 94	3 06	5 22	7 74	2 08	4 83	4 50	50 69	20 “
Greenville*				7 83	4 64	8 89	4 66	3 30	2 33	1 51				6 “
Gum Springs	5 17	4 85	5 87	6 62	3 76	4 40	4 46	4 57	2 79	2 95	4 59	4 93	54 36	28 “
Havana	8 66	6 54	3 76	8 52	2 90	0 66	3 16	3 25	4 59	6 35	3 45	5 08	56 92	2 “
Huntsville	5 47	4 55	5 64	5 72	3 98	5 16	4 84	5 12	2 65	2 93	3 28	4 71	54 05	16 “
Livingston	3 22	4 25	1 54	5 06	7 87	3 71	3 62	3 15	1 81	5 73	2 06	6 06	48 08	4 “
Marion	2 50	5 00	5 50	8 92	3 48	2 56	4 81	4 24	2 74	3 37	2 00	2 60	47 72	6 “
Mobile	5 57	4 46	7 72	5 64	4 26	5 72	5 93	6 75	5 15	3 26	4 43	4 72	63 62	22 “
Monroeville	3 68	6 69	4 65	5 52	7 04	4 95	6 89	7 30	2 74	1 56	5 72	4 15	60 89	5 y 5 m.
Montgomery	5 40	5 57	6 22	5 77	3 83	5 00	4 06	3 44	2 68	2 56	3 91	5 77	54 21	21 y'rs.
Mt. Vernon Barracks	6 51	5 88	6 41	4 93	3 99	6 23	6 41	6 19	3 66	3 50	5 27	5 33	64 31	30 “
Mt. Willing	8 59	6 28	1 47	4 87	5 26	2 50		2 92	2 28	1 42	3 30	6 86		4 “
Moulton	3 66	4 10	5 57	6 41	3 48	3 84	3 25	2 10	3 29	2 55	2 70	2 93	43 88	10 “
Newton	7 03	4 98	3 57	4 45	4 39	2 45	3 82	8 08	2 61	1 60	3 49	5 26	51 53	4 “
Opelika*				6 48	9 08	5 20	6 97	3 93	2 52	3 30	3 14	4 44		8 “
Pine Apple*				6 13	2 67	3 46	3 86	2 44	1 24	1 33				6 “
Prattville	9 17	3 69	1 87	2 44	7 25	6 50	3 99	3 06	0 00	2 44	3 15	6 73	50 25	2 “

Selma	4 31	6 43	8 74	6 55	2 16	4 18	4 16	3 78	2 20	2 50	4 97	5 93	55 91	13 “
Scottsboro*				5 73	3 63	4 60	5 59	3 57	2 41	2 91				6 “
Talladega*				1 37	0 21	0 40	0 45	0 91	0 18	0 30				2 “
Trinity	7 28	5 98	3 99	5 38	4 60	7 02	4 37	1 99	0 95	1 68	2 06	5 73	50 88	4 “
Troy	4 77	5 68	11 14	6 36	3 57	4 95	6 35	4 80	3 55	1 80	4 19	4 68	61 85	5 “
Tuscaloosa	3 27	1 73	6 99	9 71	2 70	3 32	2 71	2 06	2 05	2 61	3 24	1 36	41 95	6 “
Tuscumbia	6 02	4 84	2 74	2 31	5 45	5 78	5 07	2 52	3 77	2 46	3 25	5 16	49 37	4 “
Uniontown*				7 73	1 97	3 93	4 80	4 50	1 16	1 38				2 “
Union Springs	3 81	4 02	5 64	4 96	3 74	6 13	4 08	3 39	2 08	1 91	3 33	3 93	46 73	19 “

*These stations comprise the cotton-belt stations and only report during the crop season.

METEOROLOGICAL OBSERVATIONS.

METEOROLOGICAL REPORT FOR THE STATE OF ALABAMA BY P. H. MELL.

AVERAGE TEMPERATURE OF EACH MONTH FOR THE STATE. COMPILED FROM ALABAMA WEATHER SERVICE REPORTS, FOR FOUR YEARS (84–88).

January	43 8 deg's.	July	81 deg's.
February	48 6 "	August	78 2 "
March	54 3 "	September	75 1 "
April	64 5 "	October	64 2 "
May	71 9 "	November	52 3 "
June	77 6 "	December	45 2 "

AVERAGE TEMPERATURE FOR THE STATE.

Spring	69 7 deg's.	Summer	78 9 "
Autumn	63 9 "	Winter	47 5 "

Average for the State	65 deg's.

AVERAGE PRECIPITATION FOR SEASONS FOR FOUR YEARS 1884–88).

Spring	4 26 inches.	Summer	3 90 inches.
Autumn	7 77 "	Winter	5 11 "

Average precipitation for North Alabama	49 56 inches
Average precipitation for Middle Alabama	50 46 "
Average precipitation for South Alabama	54 22 "
Average precipitation for State	50 88 "
Yearly average clear days	116
" " fair days	119
" " cloudy days	126

AVERAGE BAROMETER FOR THE STATE FOR EACH YEAR. COMPILED FROM REPORTS FROM ALABAMA WEATHER SERVICE.

1884, from March 1st, 1184, to March 1st, 1885	30 089
1885, from March 1st, 1885, to March 1st, 1886	30 081
1886, beginning January 1st	30 087
1887	30 144
1888, —January 1st, to June 1st	30 130

Maximum Barometer, 30,800. Observed on 3d of January, 1887, at Livingston.

Minimum Barometer, 28.955. January 3d, 1886, at Auburn.

First killing frost in fall in North Alabama occurs between the eighteenth of October and sixteenth of November.

In Middle Alabama it occurs between the twenty-fourth of October and twenty-sixth of November. In South Alabama it occurs between November seventh and twenty-fifth.

During a period of seventeen years (1871 to 1888), the highest recorded summer temperature was 109 degrees, which occurred at Livingston on the sixth of June, 1885.

The lowest recorded temperature during the same period was seven degrees below zero at Gadsden, on the eleventh of January, 1886, making an absolute range within the seventeen years of 116 degrees. These were exceptional periods, however, because, comparing one year's average temperature with averages of other years, we find there is only a range of 2.8 degrees, thus indicating that the climate of the State is mild and uniform; no very great extremes.

SOIL TEMPERATURES.

MEAN TEMPERATURE OF SOIL, AT DIFFERENT DEPTHS, FOR UP-LAND, ON EXPERIMENT STATION, 1888.

The data in the following tables represent the averages of observations taken three times per day at 7:30 a. m, 2:30 p. m. and 6:30 p. m.

SET I.

	Months.	
Depth.	May.	June.
1 inch	74 deg's.	81 deg's.
3 "	74 "	80 5 "
6 "	73 "	80 "
9 "	72 5 "	79 "
12 "	71 5 "	78 5 "
24 "	71 5 "	76 5 "
36 "	68 "	74 "
48 "	66 5 "	72 "
60 "	65 5 "	70 5 "

MEAN TEMPERATURE OF SOIL AT DIFFERENT DEPTHS ON UPLAND ON THE EXPERIMENT STATION, 1888.

SET II.

	Months.	
Depth.	May.	June.
1 inch	73 deg's.	79 5 deg's.
3 "	73 "	80 "
6 "	72 5 "	79 5 "
9 "	72 "	79 "
12 "	71 "	78 "
24 "	69 "	75 5 "
36 "	67 "	73 "
48 "	66 "	71 5 "
60 "	65 "	70 "
72 "	64 "	67 5 "
84 "	63 5 "	67 5 "
96 "	62 5 "	66 5 "

MEAN TEMPERATURE OF SOIL AT DIFFERENT DEPTHS ON LOWLANDS. EXPERIMENT STATION, 1888.

SET. III.

Depth.	Months.	
	May.	June.
1 inch	73 5 deg's	80 deg's
3 "	73 5 "	80 "
6 "	74 "	80 "
9 "	71 5 "	78 "
12 "	71 5 "	77 5 "
24 "	68 5 "	75 5 "
36‘ ‘	67 5 "	73 5 "
48‘ ‘	67 5 "	72 5 "
60‘ ‘	65 5 "	70 "

Bul. 3 was
inserted between
pages 16 & 17 of
Bul 5

BULLETIN NO. 2. NEW SERIES.

REPORT

OF

Agricultural Experiment Station.

Agricultural and Mechanical College,

AUBURN, ALA.

OCTOBER, 1888.

REPORT

OF

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA., OCTOBER, 1888.

BOARD OF VISITORS.

COMMITTEE OF TRUSTEES ON EXPERIMENT STATION:

HON. J. G. GILCHRIST, HON. R. F. LIGON, HON. J. B. MITCHELL.

BOARD OF DIRECTION.

W. L. BROUN	President
J. S. NEWMAN	Director and Agriculturist
N. T. LUPTON	Vice-Director and Chemist
†P. H. MELL	Botanist
‡————	Biologist

ASSISTANTS.

ISAAC ROSS	First Assistant Agriculturist in Charge of Live Stock and Dairy
E. R. LLOYD, M. SC.	Second Assistant Agriculturist
J. T. ANDERSON, PH. D.	First Assistant Chemist
L. W. WILKINSON, M. SC.	Second Assistant Chemist
P. L. HUTCHINSON	Third Assistant Chemist
T. D. SAMFORD, B. SC.	Assistant Botanist

†Prof. Mell has also charge of Meteorological Observations.
‡To be filled.

Report of the Director.

The equipment of the Agricultural department of the station having been very much improved during the present year, its future work will be more in accordance with a proper conception of experimental investigation than has hitherto been practicable. Experiments with stock have not been attempted on account of the absence of the necessary conditions of success. Barns, machinery, a silo, dairy and ice house, with stalls constructed expressly for feeding experiments, and the necessary help having been provided, experiments looking to the encouragement and improvement of the stock and dairy industry of the State, will be undertaken during the approaching winter.

Having no adequate storage room in the past, and being dependent upon a custom gin, all past reports of cotton experiments had to be made in seed cotton, which, though very unsatisfactory, was the best that could be done without room for storing the product of each experiment separately, and the means of ginning each separately. In future, results will be given in *lint*, instead of *seed* cotton.

Another difficulty with which this department has contended has been the frequent change of assistants. So great has been the demand for trained experts in experiment work, that so fast as young men have become especially efficient, they have been offered better positions at other stations. Three of our graduates have been thus taken from us within the last fifteen months. This is detrimental to the work of the station, since much of the details of planting and gathering experiments, as well as the periodical observations upon them, must, of necessity, be entrusted to assistants. The result has been that much valuable time has been expended in training men for the benefit of other stations.

EXPERIMENTS WITH WHEAT.

The question as to the proper depth to plant small grain, has received much attention in the columns of the Agricultural press of the country.

In order to test this accurately, plats of equal area were planted at depths ranging from half inch to six inches, 25th November, 1887. The soil was evenly prepared, and rows merely marked with a line one foot apart. Two grains of carefully selected wheat were then dropped every six inches in the row, and carefully pressed in with a large dibble, which had previously been accurately marked in half-inch divisions. The number of grains which vegetated were carefully counted upon each plat, and the percentage of the whole number planted calculated with results as shown in the tabulated statement. In order to ascertain the extent to which the stand was supplemented by tillering, on the plats on which only a small per cent. of the seed vegetated, the number of heads to each stool was counted. The wheat from each plat was rubbed out by hand and weighed, with results shown in the table. The wheat rusted on both blades and stalk, upon all of the plats; all plats were cultivated.

RESULTS.

VARIETY.	Depth Planted.	Per Cent. Germinated.	Number of Heads to Stool.	Weight of Wheat.
Purple straw	½ inch	77	11.5	1¼ lbs.
Purple straw	1 "	77	9.7	1¼ "
Purple straw	1½ "	69	11.8	1 "
Purple straw	2 "	70	12.1	1 "
Purple straw	2½ "	65	14.5	¾ "
Purple straw	3 "	34	16.2	½ "
Purple straw	3½ "	62	12.1	1 "
Purple straw	4 "	31	19.2	1 "
Purple straw	4½ "	26	19.9	1 "
Purple straw	5 "	37	13.6	¾ "
Purple straw	5½ "	20	19.5	½ "
Purple straw	6 "	18	24.4	¾ "

Equal areas were also planted at the same date in the following varieties, all of which grew under identical circumstances:

RESULTS.

VARIETY.	Seed From.	Rusted.	Weight Per Plat.
La Huerta Mexico	Dept. Agricult're.	Badly on blades.	1¼ Pounds.
Wolf Mexico	"	"	1 "
Juaniro Mexico	"	"	1 "
Jropuerto Mexico	"	"	1 "
Ahuchettan Mexico	"	"	1 "
Cologa Mexico	"	"	¾ "
Fulcaster	"	None	½ "
Colorado Multiple head	R. E. Collier.	Rusted.	½ "
Name unknown	Dept. Agricult're.	None.	½ "
Purple Straw	Moore, Auburn.	Rusted.	1½ "

Two plats of highly fertilized soil were planted in wheat in drills, twelve inches apart. One of these was carefully cultivated while the other was not, for the purpose of observing the effect of such cultivation. The soil, as was that of the other experiments, deep sand, with no clay within a foot of the surface. At no stage of the growth of the plants could any difference in appearance be discovered. The seed of the Purple Straw wheat grown in the neighborhood was used.

That cultivated produced 39 4-5 bushels per acre; that not cultivated produced 36¾ bushels per acre. The difference was not enough to pay the cost of cultivation.

Mr. Francis, of Calhoun county, Alabama, presented two bushels of wheat, of a new variety, claimed to have originated in Calhoun county, to the Commissioner of Agriculture, with the request that one bushel be experimented with at the experiment station at Auburn, and one at the Canebrake station.

The bushel presented to this station was sown upon one acre of thin, sandy soil, fertilized with twelve bushels of green cotton seed, and two hundred pounds of cotton seed meal and acid phosphate mixed in equal quantities—100 pounds of each per acre. When the wheat headed, it was found to be badly mixed with the Purple Straw variety. Much waste occurred in separating the latter, after which a yield of 12½ bushels was measured from the acre.

The wheat stood in shocks in the field until the first of September, and thus sustained another serious loss. Much of it was ripe on the 10th of May. It was harvested May 14th. There was no rust upon the stalk, but some upon the last leaf. Five grains to the mesh were not uncommon in this wheat, and occasionally seven were found. It is a smooth-headed, velvet chaff variety, presenting a very peculiar appearance when ripe. It has a plump red berry. Its milling properties have not yet been tested. I neglected to state that this wheat was jointed 20th March, when the mercury registered 29 ° farh., and many of the stalks were bursted by being frozen. Earliness and productiveness are two desirable qualities possessed by this variety. As it came to me without name, I have christened it "Early Velvet Chaff." It is ten days earlier than the Purple Straw.

VARIETIES OF CABBAGE.

The following varieties of cabbage were planted under identical circumstances for the purpose of comparing their earliness, productiveness, and heading qualities. They were planted too late to attain respectable weights. They were injured by both drouth and heat, which diminished the size of the heads. Best results are obtained with cabbage in this climate by very early planting. Some of the varieties here reported were transplanted early in February for domestic use, and produced heads weighing from five to ten pounds each. The cabbage endures a reasonably low degree of temperature with less injury than excessive heat.

It will be observed that the percentage of plants that headed under the unfavorable circumstances under which they were grown, gives evidence of well bred seed. The date of heading was noted when a number of plants of a variety had formed hard, marketable heads. The weights were obtained after stripping all loose leaves, leaving only those suitable for cooking. Only the firm, merchantable heads were counted in determining the percentage headed.

RESULTS.

NAME OF VARIETY.	Seedsmen.	Time of Heading.	Average Weight in lbs.	Per cent. that Headed.
All Seasons	Ferry.	June 26.	0.94	62½
All Seasons.........................	Thorburn.	June 22.	1.00	75
Bloomsdale Brunswick...........	Landreth.	June 23.	2.22	89
Bloomsdale Bullock Heart.......	"	June 23.	2.07	77
Bloomsdale Early Market........	"	June 21.	1.95	79
Buncombe.................. ..	U. S. Dept.	Too Late.	... .	....
Canon Ball.........	Dreer.	June 21.	1.52	96
Dreer's Large Early York	"	June 22.	1 35	54
Early Cone	Landreth.	June 13.	2.06	100
Early Drumhead	Dreer.	June 20.	1.02	100
Early Dwarf Flat Dutch.........	Landreth.	June 23.	2.07	83
Early Dwarf Savoy......... . ..	Thorburn.	June 29.	0.90	83
Early Flat Dutch................	Landreth.	June 29.	0.41	46
Early French Ox Heart....	Dreer.	June 26.	0.62	50
Early Improved Flat Brunswick.	Dreer.	June 22.	1.89	75
Early Jersey Wakefield..... ..	Dreer.	June 13.	1.55	79
Early Jersey Wakefield....... .	Ferry.	June 22.	1.35	71
Early Mammoth Bulgaria.......	Thorburn.	June 25.	1.78	87
Early Paris Market.....	Dreer.	June 25.	1.05	46
Early Sugar Loaf................	Landreth.	June 22.	0.50	77
Early Ulm Savoy...	Thorburn.	June 23.	1.00	70
Early Winningstadt......... .	Dreer.	June 23.	1.55	87
Ferry's Early York	Ferry.	June 22.	1.43	54
Ferry's Green Glazed...	Ferry.	Failure.	....	0
Henderson' Early Sunrise.	Dreer.	June 20.	1.70	92
Improved Early Summer.... ...	Thorburn.	June 13.	1.39	71
Landreth's Earliest...	Landreth.	June 9.	1.77	83
Landreth's Early Summer.......	"	June 22.	1.56	66
Landreth's Large York.........	"	June 22.	1.57	83
Large Early Jersey Wakefield...	Dreer.	June 21.	1.24	87
Large Jersey Wakefield.........	Landreth.	June 18.	2.15	96
Large Late Flat Dutch...	Dreer.	June 21.	1.66	92
Late Drumhead Savoy	Thorburn.	June 26.	1.50	75
Late Flat Dutch................	Ferry.	June 26.	1.06	67
New York Early Summer........	Landreth.	June 18.	1.85	100
Reedland Early Drumhead......	"	June 22.	1.73	92
Select very early Jersey Wakefield...	"	June 21.	1.45	87½
Winningstadt....	"	June 25.	1.58	75

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TOMATOES.

A list of seeds of choice varieties of Tomatoes were purchased from J. M. Thorburn, New York, D. Landreth & Sons, Philadelphia. D. M. Ferry & Co., Detroit, Michigan, presented the station with an assortment of seed for experimental testing, and A. W. Livingston & Sons, of Columbus, Ohio, presented a number of their choice varieties which they originated. A number of our best varieties of Tomatoes have been originated by the Livingstons.

In addition to the varieties tabulated, the yellow pear shaped and Landreth's Peach Tomatoe were cultivated. The former is a small, very prolific variety of best quality—excellent for table use, and especially adapted to preserving and pickling. The Peach is a small variety, resembling a peach in form and color, desirable only as a curiosity. Like Vick's Criterion and the small seedling Tomato, it has a decided core to which the seed are attached, and a thin flexible pulp, between which and the seed is a decided cavity. The seed of all these varieties were planted in the green house February 20th, and transplanted April 7th. In productiveness, size, appearance and quality, these varieties of Tomatoes presented a picture, when in full bearing, that was exceedingly attractive. The utmost care and accuracy were observed in the classification of the varieties; the waste was ascertained by weighing a number of specimens of each variety, then cutting from the stem end just so much as would be removed and discarded in an economical preparation of the tomatoes for the table. The specimens were then weighed, and the difference divided between the number of specimens employed. This gave the average waste per specimen; several weighings were made, and the average taken. The size of the specimens is indicated by the diameter, which was the measurement of a section through the largest part at right angle to the axis.

VARIETIES OF TOMATOES.

NAME OF VARIETY.	Seedsmen.	Time of Ripening	Average Weight in Ounces.	Form.	Color.	Cavity around the Seed.	Core.	Average Waste in Ounces.	Flavor.	Corrugations.	Diameter in Inches.	Remarks.
Acme	Livingston.	June 22.	6	Round smooth.	Pinkish red.	None.	None.	0.⅔	Best	None.	3⅜	
Beauty	Landreth.	July 7.	6⅓	Roundish.	Red.	None.	None.	0.	Poor.	None.	2⅞	
Bermuda ex. Early.	Landreth.	July 9.	5⅓	Flat.	Bright red.	Very large.	None.	0.⅓	Very good.	Very deep.	3⅛	Irregular in form and soft.
Bronze Foliage.....	Livingston.	July 5.	10⅔	Irregular.	Red.	None.	None.	0.⅓	Good.	Very marked.	3¾	
Cincinnati Purple..	Ferry.	July 16.	10⅔	Irregular.	Red.	None.	None.	0.⅔	Very good.	Slight.	3½	Large and firm, but irreg.
Conqueror..........	Thorburn.	June 22.	5	Flat.	Red.	None.	None.	0.⅙	Very good.	Distinct.	3¼	
Essex Hybrid......	Thorburn.	June 26.	6⅓	Round Flatish.	Deep red.	None.	None.	0.⅔	Very good.	None.	3⅜	
Early Conqueror....	Ferry.	June 21.	5⅔	Flat.	Bright red.	None.	Decided	0.⅔	Good.	Distinct.	3¼	Quite irregular.
Early Jersey.......	Landreth.	July 10.	7⅓	Flatish round.	Red.	None.	None.	0.⅔	Good.	Slight.	3⅛	
Early Advance.....	Thorburn.	July 9.	2⅔	Round	Red.	None.	Slight.	0.⅙	Very good.	None.	2⅝	Small, but very choice.
Essex Early Hybrid.	Ferry.	June 29.	6	Round.	Dark red.	None.	None.	0.	Best.	None.	3	
Feger Island.	Landreth	....	11	Very irregular.	Pinkish red.	Medium.	Large.	0.⅔	Good.	Deep and distinct.	4	Streaks—irregular in form.
Fulton Market....	....	July 10.	8⅔	Very irregular.	Red.	None.	None.	0.⅔	Best.	Distinct.	3¼	
Golden Queen......	Livingston.	July 2.	6⅔	Roundish Flat.	Golden yellow.	Very slight.	None.	0.⅓	Best.	None.	3⅜	
Golden Queen......	Ferry.	July 7.	7⅓	Round.	Yellow.	None.	None.	0.	Best.	None.	3⅛	Tinged with red.
Golden Queen......	Thorburn.	June 16.	6	Round.	Yellow.	None.	None.	0.⅙	Best.	None.	3⅛	
Golden Trophy....	Landreth.	July 9.	6	Flat & irregular.	Yellow.	None.	Decided	0.⅓	Very good.	Medium.	3⅛	
Imprv'd Large Yel.	Thorburn.	July 9.	2⅔	Flat.	Dark yellow.	Slight.	Slight	0.⅙	Poor.	Very distinct.	2¼	
Improved Green	Thorburn.	July 5.	8	Flat.	Red.	None.	None.	0.⅔	Very good.	Distinct.	3⅝	Light hard streaks.
Livingston's Fav'rte	Landreth.	June 23	6⅓	Round smooth.	Red.	None.	None.	0.⅔	Good.	None.	3¼	
" "	Livingston.	June 25.	7	Flatish round.	Bright red.	None.	None.	0.⅔	Very good.	Slight.	3⅜	
" Perfection..	Livingston.	June 28.	5⅔	Roundish.	Dark red.	None.	None.	0.	Best.	None.	3¼	A perfect Tomato.
Mikado	Thorburn.	June 22.	10⅓	Irregular.	Pinkish red.	None.	None.	0.	Very good.	Distinct.	4⅜	
New Beauty.......	Livingston.	July 2.	7	Roundish.	Red.	None.	None.	1.⅓	Best.	None.	3½	
New Jersey	Thorburn.	June 23.	8⅔	Round flatish.	Deep red.	None.	None.	0.⅙	Very good.	None.	3⅝	
Paragon...........	Livingston.	July 28.	7½	Round flatish.	Deep red.	None.	None.	0.⅔	Good.	Very slight.	3¼	Hard streaks in seed cavity.
Potato Leaf	Livingston.	June 30.	6	Round.	Dark red.	None.	None.	0.⅓	Best.	None.	3	A perfect Tomato.
Prize Belle........	Thorburn.	July 2.	7	Flat.	Red.	Very slight.	None.	0.⅓	Poor.	Very marked.	3½	
Trophy	Livingston.	June 21.	6⅔	Roundish flat.	Red.	None.	None.	0 ⅓	Best.	Slight.	3½	
Trophy	Thorburn.	July 17.	8⅔	Round flattened.	Red	Very small.	None.	1.⅓	Very good.	Slight.	3½	Not fully ripe.
White Apple.......	Ferry.	July 11.	1⅓	Round.	Light yellow.	None.	None.	0.	Best	None.	1¾	Small but very prolific.

NOTES ON VARIETIES OF CANTALOUPES.

NAME OF VARIETY.	Seedsmen	Average Weight in Pounds.	Netting.	Form.	Thickness of Rind	Thickn'ss of Flesh	Cavity.	Color of Flesh.	Flavor or Quality.	Remarks. Planted March 24, 1888.
Acme Citron	Landreth.	2.5	Very Good	Oblong	⅜	1 2-8	Very Small.	Yellowish green	Very good	A beautiful melon; sweet and good.
Baltimore	Dept Ala.	1.8-9	Perfect	Round	2-8	⅞	Small	Light green	Very good	A superior melon.
Baltimore	Ferry	1.3-5	Good	Oblong	2-8	⅞	Very Small.	Light green	Very good	...
Bay View	Dept Ala.	4½	Poor	Very Obl'ng	4-8	8-8	Very Large.	Pale green	Good	Sun-scalded.
Pineapple	Auburn St	2.2-12	Very Good	Oblong	2-3	8-8	Very Small.	Pale green	Good	A perfect melon.
Casaba	Dept Ala.	2.	Very Poor.	Oblong	2-3	8-8	Very Large.	Sickly yellow	None.	Too tender and always sun-scalded.
Casaba	Dreer	4¾	Poor	Very Obl'ng	⅜	⅞	Medium	Sickly green	Insipid	Sun-scalded.
California yellow flesh Citron	Landreth.	1⅔	...	...	...	...	...	...	...	Failure.
Extra Early Citron Melon	Landreth.	2-5-18	Good	Oblong.	2-8	1 4-8	Very Small.	Green	Very good	A very fine melon.
Green Citron Nutmeg	Dept Ala.	3½	Good	Round	4-8	6-8	Large	Light green	Very good	...
Golden Jersey	Dreer	1¼	Very Good	Roundish	2-8	⅞	Large	Green	Good	...
Hackensack	Ferry	3.18	Very Poor.	Round	⅜	⅞	Very Large.	Pale green	Good	...
Hackensack	Dreer	3.25	Good	Round	⅜	8-8	Medium	Pale green	Good	...
Improved Cantaloupe	Dept Ala.	3.68	Good	Round	4-3	8-8	Small	Sickly green	Very poor	Failure.
Improved Orange Christina	Thorburn	2 41	None.	Round	⅜	8-8	Small	Yellow	Good	...
Improved Citron Nutmeg	...	2½	Good	Round	4-3	6-8	Large	...	Very good.	Had only one melon to test.
Jenny Lind	Ferry	...	...	...	...	...	...	Light green	...	Failure
Montreal Market	Ferry	3¾	Good	Round	2-8	8-8	Medium	Pale green	Poor	An inferior melon.
Montreal	...	4½	Good	Roundish	4-8	1 4-8	Very Small.	Pale green	Poor	...
Netted Pineapple	Dreer	2.22	Good	Oblong.	4-8	6-8	Very Large.	Pale green	Good	...
Prolific Nutmeg	Dept Ala.	2.93	None	Round	⅜	6-8	Very Large.	Sickly yellow	Poor	An inferior melon; had only one to test.
Prescott	Dreer	4	Poor	Oblong	⅜	⅞	Very Large.	Sickly green	Poor	Badly sun-scalded.
Reedland's Giant Citron	Landreth.	4	Poor	Oblong	2-8	8-8	Medium	Yellowish green	Poor	...
Surprise	Ferry	2¾	None	Round	2-8	⅞	Very Large.	Sickly yellow	Good	Like a musk melon.
Woods' Nectar	Thorburn	2	Was not te	sted. Had	on	ly o	ne melon	...	...	...

VARIETIES OF WATERMELONS.

The following varieties of melons were planted as nearly as practicable, under identical circumstances, four hills of each variety. The following notes will convey some information as to the productiveness, character and quality of the varieties:

NOTES ON WATERMELONS.

Name of Variety.	Seedsmen	Total Weight.	Average Weight.	Color of Rind.	Form.	Corugations	Thickness of Rind in Inches.	Color of Flesh.	Color of Seed.	Cavity.	Quality.	Remarks.
Black Spanish	Ferry	102¼	20.3-20	Deep green	Round	Very distinct	6-8	Pale red	Black	None.	Poor.	Deep green, hard streaks.
Cuban Queen	Dreer	221¾	24.7-36	Light green stripe.	Round	Very distinct	8-8	Sickly red	Black	None.	Good	....
Early Mountain Spro't	Thorburn	117	14.6-8	Green	Round	Distinct	⅞	Pink	Black	None.	V'y insip.	Very inferior
Extra Early	Landreth.	103	12.⅞	Mottled	Oblong	Very slight	⅞	Red	White, bl'ck edges	None.	Good	Flesh stringy.
Ferry's Peerless	Ferry	91	13.	Green	Round	Slight	⅞	Deep red	Small and white	None.	Very good	Grain fine and tender.
Florida Favorite	Thorburn	131	21.5-6	Green stripe	Oblong	Slight	⅞	Deep red	White	None	Best	Grain fine, tender; choice melon
Goodwin's Imperial	Thorburn	108	13.1	Light green	Round	Very distinct	8-8	Pale red.	Black	None	Good	Superior
Improved Rattlesnake	Thorburn	248	17.5-7	Striped green	Very Obl'g.	Wide, irr'glar	1¼	Red	White, black tips.	None	Very good	Flesh tender—good.
Icing	Thorburn	79¼	19 ¾	....	....	....	...	....	....	....	....	....
Ice Cream	Thorburn	144¾	16.¾	Green	Round	Distinct	1½	Red	Black	None	Very good	....
Johnson's Christina	Ala. Dept	105	15.	....	....	....	...	....	....	......	....	....
Jordan's Gray M'n'ch.	Thorburn	136¾	22.1-12	Light grey	Oblong	None	⅝	Deep red.	White	None	Best	....
Kolb Gem	Ferry	251	19.4-13	Striped	Round	None	6-8	Red	Black	None	Very good	Meat tough, and stringy.
Landreth l'ng lig't ri'd	Landreth	105¼	17.¼	Light grey	Oblong	Slight	1⅛	Red	White	None.	Good	....
Landreth's Boss	Landreth.	66¾	13.4-20	Dark green	Oblong	Distinct	⅞	Red	Black	None.	Good	....
Mammoth Iron Clad.	Thorburn	186¼	23.¾	Strip'd or Rattles'k	Oblong	Very slight	8-8	Red	Yellowish brown	None.	Poor	Very much like rattlesnake.
Mountain Sweet	Dreer	179¼	16.1-44	Dark Green	Oblong	Slight	6-8	Pale red.	Black	None.	Good	....
New Round Excelsior	Thorburn	102	20.3-5	Like Kolb Gem.	Round	Distinct	8-8	Pale red.	Black	None.	Good	Same as Kolb Gem.
Orange	Dreer	28¼	9.1-12	Dark green	Sli'tly obl'g.	Slight	4-8	Red	Brown	None.	Very good	....
Pride of Georgia	Dreer	171¾	15.3-10	Deep green	Round	Distinct	4-8	Deep red.	White, bl'k border	Solid.	Very good	Very good melon; sweet, tender
Phinney's Early	Ferry	79¾	13.4-10	Mottled	Oblong	None.	6-8	Pale red.	White, bl'k border	None.	Poor	Mottled grey with slight lines
Peerless	Dept Ala.	48	24.	Dark green	Very oblong	None	8-8	Red	White	None	Very good	A very good melon.
Scaly Bark	Dept Ala.	146	24.3-10	Mottled green	Oblong	Wide, distinct	6-8	Red	Light brown	None.	Poor	Flesh stringy and course.
White Seed'd Ice-cr'm	Thorburn	145¼	29.¼	Mottled	Round	Distinct	1¼	Red	White	Small	Good	....

Report of N. T. Lupton, Chemist.

During the quarter ending October 1st, fifteen specimens of fertilizers, containing Nitrogen and Potash, besides Phosphoric Acid, usually denominated "*Complete Fertilizers*," have been analyzed in the Chemical Laboratory ; also, one containing Potash, five Acid Phosphates, and four specimens of Natural Phosphates from Geneva, Alabama. In addition to these, nine specimens of Irish Potatoes raised on the Experimental Farm, ten soils and sub-soils from various parts of the State, and several other substances have been analyzed, the details of which are as follows:

PHOSPHATES WITH NITROGEN AND POTASH.

Station No.	Name of Fertilizer.	By Whom Sent.	Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
1005	Scott's Animal Am. Guano	G. W. Riley & Son, Echo, Ala	1.02	10.29	4 04	2.37	1.59	$27 06½
1006	"Fertilizer"	H. B. Wilson, Grove Oak, Ala	0.53	0.53	0.12	0.23	0.45	3 48½
1007	McLawrin's Am Lime Phosphate	Jasper Smith, Guntersville, Ala	0.59	0.00	0.08	0.17	0.22	2 64
1008	No. 1. Fertilizer	A. B. Windham, Georgiana, Ala	2.45	6.81	2.13	2.17	1.50	24 46
1009	No. 2. Fertilizer	A B. Windham, Georgiana, Ala	0.98	9.19	4.50	1.84	0.44	24 79
1010	Swan Island Guano	J. O. Mathewson & Co., Augusta, Ga	0.42	0.35	15.17	8.48	0.90	....
1012	McLawrin's Am. Lime Phosphate	W. N. Winfrey & Co.. Woodland Mills, Ala	0.42	....	....	0.55	0.28	......
1013	Koton Guano	Rome Oil Mills, Rome, Ga	1.75	8.35	3.03	2.04	1.16	25 05
1017	McLawrin's Am. Lime Phosphate	Porter & Foster, Town Creek, Ala	0.52	....	0.17	0.40	0.24	2 52
1033	Am. Super-phosphate	Etiwan Phos. Co., Charleston, S. C	1.40	6.50	3.68	4.20	1.50	22 23
1037	Plow Brand Rawbone Super-phosphate.	" " " " " "	2.24	4.78	4.26	3.99	2.37	24 66
1038	Etiwan Am. Dis. Bone	" " " " " "	1.26	6.60	3.98	3.37	1.94	22 72
1039	Am. Dis. Bone	" " " " " "	1.26	6.62	2.43	3.21	1.83	20 31
1040	Reliance Am. Super-phosphate	" " " " " "	1.33	6.14	3.89	3.15	2.41	22 63
1041	Etiwan Guano	" " " " " "	1.82	4.64	6.05	3.36	1.71	24 83

ACID PHOSPHATES.

Station No.	Names of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
1011	Acid Phosphate	Marvyn Alliance, Marvyn, Ala	13.32	1.90	1.08	....	$22 83
1015	Swan Island Guano	J. O. Mathewson & Co., Augusta Ga	0.37	18.38	6.17	....	... ..
1034	X X Acid Phosphate	Etiwan Phos. Co., Charleston, S. C	10.54	3.06	2.24	....	20 40
1035	Soluble Bone	" " " " " "	10.31	3.30	2.33	...	20 41
1036	Etiwan Acid Phosphate	" " " " " "	8.96	4.92	2.19	1.31	22 13
1042	Etiwan Dis. Bone	" " " " " "	9.79	5.00	2.07	....	22 18

Special attention is called to Nos. 1,006, 1,007 and 1012. The first mentioned was labled "Fertilizer," the other two, "McLaurin's Ammoniated Lime Phosphate," and are practically worthless to the planter as fertilizers. They are not, properly speaking, "phosphates," nor are they "ammoniated." The chief constituent is carbonate of lime.

MISCELLANEOUS SUBSTANCES.

Station No. 1014. Mineral water from James Petite, Kennedy Ala.

This sample of water was examined qualitatively and found to contain 12.13 grains of solid matter in one U. S. gallon. This consists of oxide of iron and salts of lime and magnesia, in the form of chlorides, sulphates, and a little carbonate. The water may be classed as chalybeate, and will doubtless act as a mild tonic.

Station No. 1016. Red clay, supposed to be suitable for use in painting.

Insoluble matter (silica and white clay.)	83.70	per cent.
Oxide of iron	7.04	" "

The remainder consists of water of combination, a little lime and magnesia. It has too much clay for a good pigment.

Station Nos. 1018, 1019, 1020, 1021. Natural phosphates from J. C. McDougald, Geneva, Ala. In these phosphates, phosphoric acid alone was determined with the following results:

No. 1018	Phosphoric acid	19.17	per cent.
No. 1019	" "	20.46	" "
No. 1020	" "	0.74	" "
No. 1021	" "	0.48	" "

Two of the above were fragments of fossil bones, the others were fossil shells and rotten limestone.

Station No. 1022. Iron ore, limonite from Messrs. McCall and Paine, Calera, Ala.

Moisture	1 40	per cent.
Water of combination	10.40	" "
Silica	7 50	" "
*Oxide of iron	74.50	" "
Oxide of aluminium	1.92	" "
†Phosphoric acid	2.96	" "
Sulphur		a trace.

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*Equivalent to metallic iron ..... 52.15 per cent.

† " " phosphorus ..... 1.29 " "

Analyses of nine varieties of Irish potatoes raised at the Experiment Station gave the following results:

Station Nos. 1043–1051:

No.	Varieties.	Moisture	Ash	Fats	Fibre	Albuminoids	Carbo-hydrates
1	Early Rose	74.63	0.76	1.17	0.98	2.68	19.78
2	New Giant	83.59	0 91	1.36	0.98	2.84	10.33
3	Sunlit Star	81.39	1.15	0.92	0.87	1.96	13.71
4	White Star	75.18	0.89	1.94	0.78	2.62	18.59
5	Pearl of Savoy	78.46	0.96	0.88	0.77	3.06	15.87
6	Morning Star	80.17	1.10	0.83	0.56	3.06	14.28
7	Thorburn	75.11	0.84	0.57	0.70	2.62	20.14
8	Great Eastern	80.56	0.86	0.98	0.80	2.03	14.77
9	Garfield	81.08	0.34	1.04	0.82	1.97	14.75

By reference to the last Bulletin, the yield per acre in bushels of the above varieties, under identical circumstances, can be seen. The order, beginning with the highest, is as follows: Great Eastern, New Giant, Garfield, White Star, Morning Star, Thorburn, Early Rose, Sunlit Star, and Pearl of Savoy.

RESULTS OF ANALYSES OF AIR-DRIED SOILS AND SUB-SOILS.

Locality.................	Near Mobile.		Sumter Co.		Marengo Co.		Dadeville.		Dadeville.	
Variety	Sandy Gray Loam						Pine Land.		Hickory Land.	
Soil Marked..............	Soil 3 (a)	Sub-soil 3(b)	Soil 4 (a)	Sub-soil 4(b)	Soil 5(a)	Sub-soil 5(b)	Soil 6(a)	Sub-soil 6(b)	Soil 7(a)	Sub-soil 7(b)
Station Number..........	1023	1024	1025	1026	1027	1028	1029	1030	1031	1039
Moisture	1.297	1.127	2.367	1.494	7.468	8.803	3.530	1.753	3.676	2.699
Insoluble Silica	87.644	81.926	80.628	84.958	39.437	36.585	72.576	84.654	62.896	61.929
Hydrated Silica........	2.964	5.958	4.561	4.338	19.784	22.374	4.570	3.019	8.272	10.283
Soluble Silica............	0.062	0.080	0.126	0.084	0.062	0.311	0.236	0.116	0.115	0.323
Sesquioxide of iron F 2 O 3	1.075	2.031	1.912	2.175	5.448	6.857	1.792	1.744	7.168	7.789
Alumina Al 2 O 3.........	2.568	5.877	4.128	4.183	12.158	15.981	4.007	3.978	8.393	10.753
Phosphoric Acid P 2 O 5..	0.037	0.027	0.196	0 134	0.267	0.152	0 050	0.050	0.052	0.085
Lime Ca O.......... ...	0.066	0.073	0.386	0.158	3.742	1 256	0.186	0.116	0.517	0.056
Magnesia Mg O..	0.005	0.018	0.014	0.017	0.212	0.671	0.009	0.115	0.362	0.514
Potash K 2 O............	0.130	0.158	0.183	0.171	0.866	0.621	0.232	0.233	0.348	0.389
Soda Na 2 O.......... ...	0.254	0.273	0.393	0.376	0.909	0.876	0.447	0.443	0.769	0.503
Sulphuric Acid So 3......	0.038	0.029	0 089	0.033	0.120	0.069	0.053	0.051	0.096	0.122
Chlorine..................	0.009	0.012	0.021	0.011	0.015	0.020	0.006	0.124	0.006	0.017
Carbonic Acid C O 2......	0.136	0.044	0.137	0.134	1.938	0.213	0.249	0.075	0.214	0.140
Volatile and organic mat..	3.792	2.330	4.942	1.856	7.345	5.466	12.053	3.759	7.248	4.149
Total........	100.077	99.963	100.083	100.122	99.771	100.253	100.002	100.220	100.132	99.751
Nitrogen..................	0.295	0.294	0 195	0.087	0.282	0.087	0.245	0.087	0.260	0.195
Air-dried soil contains....										
Coarse gravel.........	2.229	1.373	4.539	3.903	....	....	11.412	11.906	20.849	13.407
Fine material.....	97.771	98.627	95.461	96.097	100.00	100.00	88.588	88.094	79.151	86.593

By the time of the issuance of our next report, the analyses of soils collected from various parts of the state will have been completed, and a discussion of the results will then be given.

Department of Botany.

WOODS OF ALABAMA.

P. H. MELL.

A number of persons looking out on an extended forest are not impressed alike with its usefulness and value. The majority look upon it as a great waste of land that might be yielding cotton and grain; some few consider the view as a beautiful landscape, pleasing to the eye; while a still smaller number have made in their minds an estimate of the number of cubic feet of lumber the trees will yield, and the amount of money the lumber will produce when placed on the market. The forests of Alabama therefore furnish us a subject worthy of serious consideration, particularly when they are being so rapidly destroyed.

There are few countries richer in natural resources than Alabama. According to statistics this State has about 15,000,000 acres of cleared land, or about fifteen acres to each man, woman and child. In forests there are about 17,000,000 acres, or something over one-half the area of the State in woodlands. Of all the States in the union Alabama stands third in the acreage of forests. This is a handsome showing, it is true; but the question arises, How long a time will elapse before these woods will be destroyed? The annual clearing is very great, and it may be reasonably asked also, What is the necessity of clearing any more land for agricultural purposes when we have acres of land already denuded of forests sufficient to cultivate all the plants necessary for food and raiment that the people of the State require? The inroads made upon the forests by the saw mills and railroads are great enough without this additional destruction that seems so unnecessary.

There are numerous benefits belonging to a well timbered country, among which may be mentioned: The purification of the atmosphere that has been vitiated by breathing animals. The trees counteract the baneful effects of a hot summer's sun, and ward off the winter's cold blast. A well timbered country is also supposed to be a preventive of drought. It has been found that each leaf that expands in the air emits quantities of watery vaper, and that a well grown, well developed tree will evaporate from its leafy surface tons of water per month. Of the large variety of woody plants in Alabama, about one third are suitable for lumber and building purposes, and a large number furnish the finest varieties of variegated and ornamental woods, well adapted for inlaid work.

The list that is given in this article includes only those woods that have been collected in the neighborhood of the college during the past six or eight months, as well as also some fine specimens donated to the institution by Dr. Charles Mohr, of Mobile, and Mr. James Clayton, of Opelika. This list will be largely added to during the coming year, and a larger area of the State will be represented.

As far as possible we will discuss in these bulletins the useful qualities of the woods mentioned in the lists. It is also our intention to experiment with those woods that are now unknown in the arts to determine whether or no demands may not be created for them also.

For the convenience of reference the woods have been arranged alphabetically and not according to Botanical order.

	COMMON NAMES.	SCIENTIFIC NAMES.
1.	Ailanthus—Tree of Heaven.	Ailanthus grandulosus, Desf.
2.	Ash, white.	Fraxinus Americana, L.
3.	Ash, red.	Fraxinus pubescens, Lam.
4.	Ash, green.	Fraxinus viridis, Mx.
5.	Ash, swamp or water.	Fraxinus platycarpa, Mx.
6.	Alder.	Alnus Serrulata, Ait.
7.	Bass wood.	Tilia Americana, L.
8.	Buckeye.	Aesculus pavia, L.
9.	Button Bush.	Cephalanthus occidentalis, L.
10.	Buckthorn.	Bumelia lanuginosa, Pers.
11.	Bay, red.	Persea Carolinensis, Nees.
12.	Black walnut.	Juglans nigra, L.
13.	Butter nut.	Juglans cinerea, Mich.
14.	Beech.	Fagus ferruginea, Ait.
15.	Birch, black—River Birch.	Betula nigra, L.
16.	Birch, cherry.	Betula lenta, L.
17.	China tree—Pride of India. False Sycamore--Holy tree. Bead tree.	Melia Azederach, L.
18.	Cherry, wild.	Prunus serotina, Ehrt
19.	Crab-apple.	Pyrus coronaria, L.
20.	Crossvine.	Bignomia Capreolata, L.
21.	Catalpa.	Catalpa bignonioides, Walt.
22.	Chestnut.	Castanea vesca, L.
23.	Chinquapin.	Castanea pumila, Mx.
24.	Cedar, red—Virginia Cedar.	Juniperus Virginiana, L.
25.	Cedar, white—Juniper.	Cupressus thyoides, L.
26.	Cypress.	Taxodium distichum, Rich.
27.	Dogwood.	Cornus Florida, L.
28.	Dogwood, swamp.	Cornus stricta, Lam.
29.	Devil wood.	Olea Americana, L.
30.	Elder, box-Ash-leaved Maple.	Negundo aceroides, Mch.
31.	Elm, red—or Slippery Elm.	Ulmus fulna, Mx.
32.	Elm, American—White Elm.	Ulmus Americana. L.
33.	Elm, water—Whahoo.	Ulmus alata, Mx.
34.	Grape, frost.	Vitis cordifolia, Mx.
35.	Grape, Muscadine, Bullace.	Vitis vulpina, L.
36.	Gum, tupelo.	Nyssa uniflora, Walt.
37.	Gum, black—Sour gum.	Nyssa multiflora, Wang.
38.	Haw, apple—red haw.	Crataegus aestivalis, F. & Gr.
39.	Haw, summer.	Crataegus flava, Ait.
40.	Haw, swamp—white rode.	Vibernum nudum, L.
41.	Haw, black.	Vibernum prunifolium, L.
42.	Huckleberry, blue.	Vaccinium crassifolium, Andr.
43.	Honeysuckle.	Azalea viscosa, L.
44.	Holly.	Ilex opaca, Ait.
45.	Hickory, bitter pecan.	Carya aquatica, Nutt.
46.	Hickory, shellbark--shagbark.	Carya alba, Nutt.
47.	Hickory, common—white heart.	Carya tomentosa, Nutt.
48.	Hickory, pignut—broom.	Carya glabra, var. porcina, Nutt.
49.	Hickory, bitternut—swamp.	Carya amara, Nutt.
50.	Hickory, pecan nut.	Carya olivaeformis, Nutt.
51.	Ivey bush—calico bush.	Kalmia latifolia, L.
52.	Laurel, sheep.	Kalmia angustifolia, L.
53.	Iron wood.	Carpinus Americana, Mx.
54.	Locust.	Robinia pseudacacia, L.
55.	Locust, honey.	Gleditchia triacanthus, L.
56.	Magnolia.	Magnolia grandiflora, L.
57.	Magnolia, umbrella tree.	Magnolia umbrella, Lam
58.	Magnolia, swamp—Bay.	Magnolia glauca, L.
59.	Magnolia, great-leaved.	Magnolia macrophylla, Mx.

	COMMON NAMES.	SCIENTIFIC NAMES.
60.	Magnolia, Cucumber tree.	Magnolia acuminata, L.
61.	Maple, red-scarlet-swamp.	Acer rubrum, L.
62.	Maple, silver—white.	Acer dasycarpum, Ehr.
63.	Maple, sugar—hard.	Acer saccharium, Wang.
64.	Mulberry.	Morus rubra, L.
65.	Old Man's Beard—fringe tree.	Chionanthus Virginica, L.
66.	Osage orange—bow wood.	Maclura aurantiaca, Nutt.
67.	Oak, willow.	Quercus phellos, L.
68.	Oak, Chinquapin-dwarf Chestnut Oak.	Quercus prinoides, Wild.
69.	Oak, turkey—barren.	Quercus catesbaei, Mx.
70,	Oak, black—yellow bark.	Quercus tinctoria, Bart.
71.	Oak, live.	Quercus virens, L.
72.	Oak, water.	Quercus aquatica, Cates.
73.	Oak, black jack.	Quercus nigra, L.
74.	Oak, scarlet.	Quercus coccinea, Wang.
75.	Oak, red.	Quercus rubra, L.
76.	Oak, Spanish.	Quercus falcata, Mx.
77.	Oak, post.	Quercus alba, L.
78.	Oak, swamp chestnut.	Quercus prinus, L.
79.	Oak, chestnut.	Quercus castanea, Wild.
80.	Papaw.	Asimina triloba, Dun.
81.	Persimmon.	Diospyros Virginiana, L.
82.	Poplar, water.	Populus angulata, Ait.
83.	Poplar, cotton wood.	Populus monilifera, Ait.
84.	Pine, scrub.	Pinus inops, Ait.
85.	Pine, red.	Pinus rubra, Mx.-P. resinosa, Ait.
86.	Pine, old field—loblolly.	Pinus taedo, L.
87.	Pine, mountain.	Pinus pungens, Mx.
88.	Pine, short-leaved.	Pinus mitis, Mx.
89.	Pine, long-leaved—yellow.	Pinus australis, Mx.
90.	Pine, swamp—pond.	Pinus serotina, Mx.
91.	Red Bud—Judas tree.	Cercis Canadensis, L.
92.	Sumach.	Rhus capallina, L.
93.	Sumach, poison oak or ivy.	Rhus toxicodendron, L.
94.	Sumach, poison dogwood.	Rhus venenata, D. C.
95.	Sumach.	Rhus cotinoides, Nutt.
96.	Seven bark.	Hydrangia quercifolia, Bart.
97.	Sweet gum.	Liquidambar styraciflua, L.
98.	Sour wood, sorrel tree.	Oxydendrum arboreum, D. C.
99.	Snow drop tree.	Halesia diptera, L.
100.	Silver bell tree, o'possum tree.	Halesia tetraptera, L.
101.	Sassafras.	Sassafras officinale, Nees.
102.	Spice-bush, Fever-bush.	Benzoin odoriferum, Nees.
103.	Sycamore.	Platanus occidentalis, L.
104.	Trumpet flower, creeper.	Tecoma radicans, Juss.
105.	Willow.	Salix nigra, M.
106.	Witch hazel.	Hamamelis Virginica, L.
107.	Yellow Jessamine.	Gelsemium Sempervirens,

Magnolia. There are several species of this genus found in Alabama. Some make beautiful ornamental trees when properly trained, but the woods are generally very soft and not well adapted for cabinet work. The wood of the *acuminata* is sometimes used for pump logs and for the manufacture of wooden bowls. The flowers of the *glauca* are very fragrant and in the neighborhood of large cities, they are readily sold at the flower stands because of this fragrance and the showiness of the flowers. When carefully trained in a space where plenty of room is given in which to expand, this tree grows into a graceful form and becomes very attractive to the eye. A tincture made of the bark or cones while green, before the volatile matter escapes, possesses medicinal properties and is sometimes used with success in chronic rheumatism and especially in fever and ague.

Tilia Americana. (Bass Wood.) The inner bark of this tree is sometimes used for cordage and also by nurserymen for surrounding buds during the propagating season. The bark contains a large per cent. of mucilage. The wood is white, soft and light and is very well adapted for certain kinds of inside work. It makes good material for carvers in wood and is also largely used in the manufacture of musical instruments. The tree grows to the height of sixty or eighty feet and is very handsome.

Ailanthus grandulosus, Desf—(Tree of Heaven.) Grows to a height of fifty or sixty feet and furnishes a beautiful yellow wood, that takes a very good polish and is much prized by cabinet makers. Within recent years it has been found that a certain species of silk worm eats with relish the leaves of this tree and some attention is being given to it by silk manufacturers.

Melia Azederach, L. (China tree.) The wood makes excellent furniture and if it is true as claimed that insects seldom attack it, chests made of the wood will serve admirably for packing away clothing. " A decoction of leaves or bark is cathartic and emetic. Taken in large doses it produces narcotic effects. Robins are rendered partially insensible when eating the fruit, but recover within a few hours." The fresh bark, leaves and fruit are vermifuges.

Acer rubrum, L. (Red maple.) Supplies a beautiful wood for cabinets, known as "curled birdseye." When this tree is properly cultivated it produces a pleasing effect upon lawns and in parks on account of its rounded and graceful top. It will thrive in moderately dry soils.

Acer dasycarpum, Ehr. (Silver Maple.) This is a rapid growing tree and will succeed well in a variety of soils. The wood is white, fine grained, will take a moderate polish and is suited for that character of work that does not require hard woods. The tree grows to a height of eighty feet.

Acer saccharium, Wang. (Sugar Maple.) This tree belongs to the variety *nigrum* or black sugar maple and is found sparingly in middle and north Alabama. It grows to a large tree, reaching a height of sixty or eighty feet, with a trunk three or four feet in diameter. The wood is fine grained, very hard, will take a high polish and is valuable for inside work in houses.

Negundo aceroides, Mch. (Box Elder.) The wood is moderately fine grained. The tree is small, attaining a height of twenty or thirty feet. Not used much in the arts.

Locusts. There are two or three species of this tree growing in the State, each producing trees of considerable growth. They are found from the sea board to the mountains. The wood grades from white to greenish yellow and is very hard and fine grained. It is also very durable for posts. There is a borer, however, that is very fond of the wood, and the trees are rapidly destroyed in some sections by this insect. The honey locust (Gleditschia triacanthus, L.,) seems to be free from the attacks of insects, with the exception possibly of the fruit. The wood, however, is coarse grained.

Cercis Canadensis, L., (Red Bud.) The wood is hard and compact, and yields, when polished, beautiful slabs with black, green and yellow spots on a gray ground. It is, therefore, well adapted for inlaid work.

Prunus serotina, Ehrt. (Wild Cherry.) The wood of this tree is a light red that deepens with age. It is close grained and is well known among cabinet makers and furniture manufacturers. The tree grows to a height of sixty feet, with a trunk about three feet in diameter. The medicinal properties of the bark and roots are well known, its chief value being in reducing irritation and diminishing nervousness. When largely taken, however, the action of the heart is retarded.

Cornus Florida, L., (Dogwood.) This is a small tree quite common in oak woods. The flowers are very showy, and coming out so early before the forests are well clothed with leaves, make this tree quite attractive. If it was not so common it would be more prized for ornamental purposes. It is a slow growth and the wood is hard and tough. On account of the small size of the tree the wood is only used for tool handles. The bark is used as a tonic and astringent for intermittent fevers.

Nyssa uniflora and multiflora, (Tupelo Gum and Black Gum.) The first mentioned has soft wood frequently used for corks, while the wood of the latter is close grained and difficult to split because the fibre crosses at various angles through the stem, and for this reason it is frequently used for hubs of wheels. The growth is rapid, attaining a height of thirty to sixty feet.

Ilex opaca, Ait. (Holly.) About forty species of this genus are known. Six or eight belong to the South. The only tree of any considerable size is the *opaca*, that grows to the height of thirty or forty feet. It is an evergreen and is well suited for lawn and hedge purposes. It attains its largest size in a rich, sandy soil, but it will thrive in almost any kind of good soil, provided it is not overcharged with moisture. The holly may be propagated by seeds, grafting, cutting or budding. No plant requires less care than the holly when it is once established ; hence it makes one of the best hedges for the farm and park. When transplanted for a hedge, and it is desirable that the growth should be rapid, the ground ought to be trenched to the depth of three or four feet and the earth replaced must be raised at least a foot above the surrounding surface, to allow for settling. Along this ridge the plants should be placed one foot or eighteen inches apart. The wood of the holly is of almost an ivory whiteness, except near the center of old trunks, where it is of a brownish hue. It is hard and compact, with fine grain and susceptible of a high polish. It should be well dried and seasoned before use, as it is very retentive of its sap. It readily takes a durable color of almost any shade, and is therefore, adapted for cabinet purposes. When stained black, its color and lustre are little inferior to that of ebony. It may be applied to a great many p rposes, and, next to the box and pear tree, the holly is the best wood for engraving, as it is compact and stands the tools well.

(*Continued in next Bulletin.*)

MEAN TEMPERATURE OF SOIL AT DIFFERENT DEPTHS,

FOR JULY, AUGUST AND SEPTEMBER, 1888.

Set 1. (On Top of Hill.)				Set 2. (On Top of Hill.)				Set 3. (On Top of Hill.)			
DEPTH.	J'ly	Aug	Sep	DEPTH.	J'ly	Aug	Sep	DEPTH.	J'ly	Aug	Sep
1 inch	85.5	85	76	1 inch	85	83	74.5	1 inch	84.5	83	74.5
3 "	85.5	84	76	3 "	84.5	83	75	3 "	84	82 5	75
6 "	84.5	83.5	75.5	6 "	85	82	75.5	6 "	83	81.5	75
9 "	83.5	82	75	9 "	84	82.5	74.5	9 "	81.5	81	74.5
12 "	82.5	82	74.5	12 "	82.5	81.5	74	12 "	81	80	74
24 "	83	81.5	76	24 "	80	80.5	75	24 "	77.5	77.5	74.5
36 "	79	80	75.5	36 "	77.5	79.5	75	36 "	75.5	76.5	74
48 "	76.5	80	75.5	48 "	76	78.5	75.5	48 "	75	76	74.5
60 "	75	78	75.5	60 "	74.5	77	75	60 "	73	74.5	73.5
				72 "	73	76	74.5				
				84 "	72	75	74.5				
				96 "	71	73.5	73.5				

METEOROLOGICAL REPORT.

P. H. MELL.

Mean Temperatures at some Towns in Alabama.

Stations.	Jan.	Feb.	M'rch	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l	Max.	Min.	No. Years
Auburn	42.4	49.2	53.3	63.4	70.8	76.8	78.4	78.4	74.9	64.3	54.7	44.4	62.5	99	5	11
Carlowville	47.3	52.6	57.3	65.7	72.7	79.7	82.4	47.1	49.0	65.0	56.4	48.9	60.3	.103	8	16
Coatopa	47.3	52.3	56.4	62.8	70.2	77.2	80.6	82.0	73.4	66.2	52.4	43.8	61.7	98	11	2
Greensboro	46.2	50.6	56.3	62.1	70.6	77.2	79.5	78.5	72.5	62.2	52.7	47.5	62.9	98	8	8
Green Springs	44.6	49.5	55.8	62.8	70.8	76.8	80.4	79.0	73.8	62 7	52.2	47.9	62.9	103	4	30
Huntsville	41.7	44.6	50.0	59 2	70.2	78.7	80.9	78.0	71.0	58.8	50.0	42.9	60.5	....	..	5
Mobile	53.5	56.0	62.8	68.5	75.8	81.0	82.4	81 8	77.1	68.0	59.1	53.5	65.9	....	..	20
Monroeville	47.9	56.4	62.8	65.6	73.5	78.3	80.0	80.2	76.1	69.5	56.4	52.7	66.6	....	..	4
Moulton	40.4	48.4	52.4	62.2	68.8	75.0	77.9	77.4	70 7	59.2	48.4	42.9	60.0	92	11	9
Mt. Vernon	52.5	54.1	59.9	66.9	74.3	78.6	80.2	79.8	76.2	66.0	56.8	51.3	66.2	104	9	21
Opelika	45.8	50.7	56.9	62.8	68.9	77.7	80.2	78.4	74.8	62.3	52.1	46.9	63.1	105	11	3
Selma	49.3	52.0	55.8	64.0	73.5	79.0	82.0	81.0	74.4	66.6	55.7	49.3	65.7	98	14	5
Troy	46.9	51.3	58.3	65.2	74.4	80.5	82.2	80.4	76.6	65.5	57.1	78.5	68.0	....	..	5

BULLETIN NO. 3. NEW SERIES.

REPORT

OF

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA.

JANUARY, 1889.

SUBJECTS.

REPORT OF EXPERIMENTS WITH CORN, SWEET POTATOES, GROUND PEAS, TURNIPS AND GRAPES.

ANALYSES OF FERTILIZERS, SOILS, ETC.

WOODS OF ALABAMA—CONTINUED.

METEOROLOGY.

THE BAPTIST PRINTING CO., MONTGOMERY, ALA.

REPORT

—OF—

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA., JANUARY, 1889.

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*Prof. Mell also has charge of Meteorological Observations. †To be filled.

Report of Agriculturist.

EXPERIMENT WITH CORN.

The object of this experiment was to inquire if corn could be grown profitably upon land which chemical analysis classes as practically sterile. The soil in question is a sandy drift with no clay within three feet of the surface. When the station took charge of it, it had been "worn out" and had grown up in stunted pines and broom sedge. Chemical analysis showed the following percentage composition:

	Soil, Per Cent.	Sub-soil, Per Cent.
Sand and insoluble matter....	96.00	95.95
Soluble silica	0.02	0.04
Sulphuric oxide........	0.01	——
Phosphoric oxide.............	0.017	0.011
Ferric oxide Aluminic oxide	0.55	1.36
Lime	0.051	0.14
Magnesia	0.01	——
Potash	0.15	0.11
Clorine........................	0.01	0.01
Moisture Organic matter	2.49	2.10

By order of the Board of Trustees, ten acres of this land were carefully prepared and fertilized, an account of all expenses kept and products carefully weighed.

The land was thoroughly broken with turn plows on the 6th, 7th and 8th of March, and the corn planted on the 15th and 16th—rows five feet, stalks three feet in the row. Compost of cotton seed, stable manure and English super phosphate was applied between the hills of corn in the drill at the rate of 1,000 pounds per acre. After the corn was planted heavy rains, followed by drying winds, baked the soil to such an extent as to render it necessary to re-break the land after the corn came up. This seriously checked its growth by breaking its feeding roots.

A drouth and heated term, which occurred while the plants were in flower, caused an estimated injury of twenty per cent. Corn planted upon land adjoining, which was broken and planted after that on the ten acres was up, produced, with half the manure, twenty per cent more per acre. Ordinarily, early planted corn gives best results, but the last season proved an exception in this locality.

One acre adjoining the ten, and of same quality of soil, was planted without manure and cultivated in the manner usually practiced in this section of the State:

TEN ACRES CORN FERTILIZED—RESULTS.

Fodder per acre..	387.3 lbs.	
Shucks per acre	169.06 "	
Corn per acre....	13.68 b'shl's.	
Total value of crop per acre...	$15 01—	$15 01
Cost seed corn per acre..................................	0 20	
Cost of fertilizer per acre..............................	5 00	
Cost of labor per acre.....................................	4 25—	$ 9 45
Profit....		$ 5 56

ONE ACRE CORN—WITHOUT MANURE.

Fodder per acre	202.1 lbs.	
Shucks per acre	74.9 "	
Corn per acre	6.5 b'shl's.	
Total value of crop per acre	$ 7 26—	$ 7 26
Cost of seed corn per acre	0 20	
Cost of labor per acre	4 57	
Total cost per acre	$ 4 77—	$ 4 77
Profit		$ 2 49

GROUND PEAS.

The accompanying experiment with fertilizers applied to ground peas was undertaken with the hope of discovering a remedy for the tendency of this crop to produce faulty pods (pops) upon sandy soils.

The yield was so far beyond our expectation that extra pains were taken to secure accurate and absolute results. A given number of hills were selected from each plat of apparently average vigor, the vines carefully lifted and all peas collected and counted with the results shown in the first column of the table. In order to ascertain as nearly as possible the whole product, after the vines were lifted the ground was carefully raked to collect the peas which remained.

To ascertain the effect of the different manures in reducing the percentage of "pops," a measured peck of peas was taken from the produce of each plot and the sound peas and "pops" in each accurately counted. It will be observed that an application of air-slaked lime gave the largest per cent of good peas, while the complete manure gave the smallest. A combination of the so-called complete manure with the lime might possibly combine the large yield with good quality.

EXPERIMENTS WITH GROUND PEAS.

Planted March 6th and gathered November 1st, 2d and 3d, 1888. Object: To compare effects of different fertilizers.

Plat No.	FERTILIZERS PER ACRE.	Average No. of Peas Per Hill.	Yield Per Acre in Bushels of Sound Peas and Pops.	Percent of Sound Peas.	Yield of Sound Peas Per Acre in Bushels.
1	400 pounds lime (air-slaked)	205	134.67	95.6	128.74
2	200 pounds English super phosphate	246	154.58	91.6	141.59
3	200 pounds cotton seed meal	294	136.81	90.9	124.36
4	200 pounds English super phosphate and 100 pounds kainit.	252	220.59	84.2	185.73
5	200 pounds English super phosphate and 200 pounds cotton seed meal	357	202.91	90.4	183.43
6	600 pounds of compost	306	240.85	84.2	202.79
7	No manure	291	196.65	84.2	175.58
8	200 pounds cotton seed meal and 100 pounds kainit	428	343.00	66.6	228.43
9	200 lbs. C. S. meal, 100 lbs. kainit, 200 lbs. E. S. phosphate	342	323.07	61.5	198.68

EXPERIMENT WITH SWEET POTATOES.

Planted May 7th, and gathered November 21st, 1888.
Object: To compare effects of different fertilizers.

Plat No.		Yield Per Acre in Bushels.	Yield Merchantable Per Acre in Bushels.	Per Cent. Merchantable.
1	200 lbs. C. S. Meal	*69.20	57.71	83.4
2	100 " Kainit	130.45	115.70	88.7
3	50 " C. S. Hull Ashes	132.22	118.33	89.5
4	200 " English Acid Phos	145.72	132.45	90.9
5	50 " Sulphate of Ammonia	168.15	153.85	91.5
6	200 " Gossypium	180.56	165.21	91.5
7	No manure	128.18	109.59	85.5
8	400 lbs. Compost	156.06	142.48	91.3
9	70 " Nitrate of Soda	154.00	143.52	93·2
10	200 " C. S. Meal & 50 lbs. C. S. H Ashes	156.54	142.76	91.2
11	200 " E. S. Phosphate & 50 lbs. C. S. H. Ashes	150.65	140.55	93.3
12	200 " E. S. " " 200 " C. S. Meal	*86.22	75.87	88.0
13	200 " E. S. " " 200 " " " " & 50 lbs. C. S. H. Ashes	137.29	120.95	88.1
14	No Manure	91.15	78.57	86.2

*Plats 1 and 12 were injured by shade and roots of wild vegetation, along a fence row.

FERTILIZERS FOR TURNIPS.

The following questions were propounded to the turnip plant. Beds one acre in length and ten feet wide, were prepared and planted August 22nd in plats as shown in the tabulated statement. The questions asked, are:

(a) What element or elements of plant food does the turnip plant need to be supplied on the soil in question?

(b) From what source does it prefer to derive its nitrogen?

(c) From what source its potash?

(d) What are the comparative effects of acidulated phosphate and the raw phosphate?

(e) How do cow-lot and horse-lot manures compare in producing capacity with commercial compounds?

(f) What is the best distance at which to leave the plants in the drill?

The Norfolk variety of turnips was planted on all of the plats August 22nd. In order to detect the effect of the different manures in securing and maintaining a stand, all were planted exactly alike in the same seed and missing places filled by transplanting once, and finally, the number of turnips on each plat carefully counted. To compare the effects of the different manures in producing tops and roots, the whole plants were weighed when gathered, December 18th, then the roots weighed after removing the tops. In answer to the first question, kainit gave a larger yield than any other single substance. See plat 5. It will be observed also, that the application of the same number of pounds of kainit and cotton seed hull ashes resulted in favor of the former, though the cotton seed hull ash contains an average of about twice the per centage of potash.

While cotton seed meal compared with sulphate of ammonia with reference to the percentage of ammonia in each gives better result than the latter when each is used alone, the sulphate of ammonia gives better results where it was used either in combination with potash only, or with potash and phosphoric acid.

The former result in favor of the cotton seed meal may have been due to the fact that the latter contains both potash and phosphoric acid, while the sulphate ammonia contains neither of these. See plats 2 and 3, and 8 to 13 inclusive, and 19 to 22 for comparison of sources of nitrogen.

High grade English super phosphate was compared with raw phosphate presented to the Station by the Meridian Phosphate Company, Meridian, Miss. In the former nearly all of the phosphoric acid was soluble; in the latter it was all insoluble, but the quantity greater than in the former. It will be observed that the raw phospate was applied in twice the quantity per acre, but it will be remembered that its cost per ton is but little more than half that of the super-phosphate. Considering the results on all of the plats to which the two forms of phosphoric acid were applied alone, and in various combinations, the plant seems to have been indifferent as to the source from which it derived this important mineral element and seemed to have the means of procuring it from the raw as well as from the acidulated.

The effects of 2½ tons of cow and horse-lot manure do not compare favorably with one twentieth that weight of commercial goods. See plats 27 and 28 and compare with 2 and 4. Finally, the turnip finds itself somewhat crowded at six inches in the drill, but lonesome at two feet. The best results both as to the aggregate weight and average size were obtained from those left to grow one foot apart in the drill.

The season during the last fall was exceptionally favorable for growing turnips. The accompanying tabulated statement gives the results in compact form.

EXPERIMENTS WITH FERTILIZERS WITH TURNIPS.

NORFOLK VARIETY. PLANTED AUGUST 22D.

Plat No.	NAME.	Yield per Acre with Tops, in lbs.	Yield per Acre without Tops, in lbs.	No. of Turnips per Acre.	No. of Bushels per Acre.	Average Weight of Turnips in lbs.	Increase from use of Fertilizers in bus.	Per Cent Increase.
1	440 lbs. English Super-phosphate.........	22330	13200	16500	220	.80	66	43
2	220 " Sulphate Ammonia................	30360	17380	18480	289⅓	.93	135⅓	88
3	440 " Cotton Seed Meal......	32670	20790	30800	346½	.64	192½	125
4	220 " Cotton Seed Hull Ash.....	25960	16720	21120	278½	.79	125⅔	82
5	440 " Kainit	39600	25080	31020	418	.80	264	106
6	880 " Raw Phosphate	23320	15180	19360	253	.77	99	64
7	No Manure.....	29261	14960	20240	249	.73	......	... ..
8	220 lbs. C. S. H. Ash, 220 lbs. Sulph. Am.	39380	30360	33000	506	.92	352	129
9	220 " C. S. H. Ash, 220 " Sulph. Am., 440 English Super-phosphate.......	50600	31900	29480	541⅔	1.04	387⅔	251
10	220 lbs. C. S. H. Ash, 220 lbs. Sulphate Ammonia, 880 lbs. Raw Phosphate..	22400	17600	20900	273⅔	.84	139⅔	90
11	220 lbs C S. H. Ash, 440 lbs. C. S. M..	34320	21340	25740	355⅔	.82	201⅔	130
12	220 " C. S. H., Ash, 440 " C. S. M., 440 lbs. English Super-phosphate..	36910	20350	29260	339⅙	.69	185⅙	120
13	220 lbs. C. S. H. Ash, 440 lbs. C. S. M., 440 lbs. Raw Phosphate	37400	19800	20680	330	.95	176	114
14	No Manure........	13640	6600	13200	110	.50	. ....	.. ...
15	220 lbs. C. S. H. Ash, 440 lbs. English Super-phosphate..........	20460	11880	16720	194⅓	.71	40⅓	26
16	220 lbs. C. S. H. Ash, 880 lbs Raw Phos..	23320	12540	18260	209	.68	55	36
17	220 " Kainit, 440 lbs. Eng. Sup-phos....	37400	19800	23100	330	.85	176	114
18	220 " Kainit, 880 " Raw Phosphate....	43780	18480	20020	308	.90	154	100
19	220 " Sulphate Ammonia, 440 lbs. Eng Super-Phosphate	28820	14960	23100	249⅔	.64	140⅔	91
20	220 lbs. Sul. Am., 880 lbs Raw Phos......	30140	16940	23100	282⅓	.73	128⅓	83
21	440 lbs. C. S. M., 440 lbs. Eng. Sup-phos.	25080	12100	17160	201⅔	.70	47⅔	30
22	440 lbs. C. S. M., 880 lbs. Raw Phosphate	33220	15400	20900	256⅔	.73	102⅔	60
23	No Manure.....	11880	6160	10160	102⅔	.60	......	......
24	440 lbs. C. S. H. Ash, 440 lbs. Sulp. Am., 440 lbs. Eng. Super-phosphate, Turnips 6 inches in drill	36300	19140	18040	319	1.06	165	107
25	440 lbs. C. S. H. Ash, 440 lbs. Sulph. Am., 440 lbs. Eng. Super-phos, Turnips 1 foot in drill.....	42460	22880	18700	381⅓	1.21	227	147
26	440 lbs. C. S. H. Ash, 440 lbs. Sulph. Am., 440 lbs. Eng. Super-phos., Turnips 2 feet in drill.....................	23760	12760	11440	212⅔	1.10	58⅔	38
27	4400 lbs Rotted Cow Lot Manure..........	19140	10120	16500	168⅔	.61	14⅔	08
28	4400 " " Horse Lot Manure........	23540	12540	19140	209	.65	55	35

COMPARISON OF VARIETIES OF TURNIPS.

Twenty-five varieties of turnips were planted August 23d upon thin, sandy land, well manured broadcast with compost, cotton seed meal and cotton seed hull ash. The difference in the stands on the plats, due to the difference in vigor of the varieties in their early growth, was quite marked, though in nearly every case a good stand and in many a perfect stand was secured. Some of the seed of the varieties were purchased from D. Landreth & Sons, Philadelphia, and some presented to the station by the United States Department of Agriculture. Earliest Bloomsdale Red Top is the earliest of the twenty-five varieties; Milan Strap-leaf, second; Early Flat Dutch Strap-leaf, third; Purple Top Strap-leaf, fourth; and Large Early Red Top Globe, fifth. White Globe and White Globe Strap-leaf seem to be identical.

Each of these varieties has been put in hills in the open ground, as sweet potatoes are hilled, to test their keeping qualities. The tabulated statement presents results of observations in compact form.

EXPERIMENTS WITH VARIETIES OF TURNIPS.

No. Acre.	NAME.	Seedsman.	Number of Turnips Per Acre.	Yield Per Acre with Tops, in Pounds.	Yield Per Acre Without Tops, in Pounds.	Number of Bushels Per Acre.	Average Weight of Turnips in Pounds.	Diamet'r of Variet's on Nov. 1 in Inches.	Color Above Ground	Color Below Ground.	Form.
1	Amber Globe Strap Leaf	Landreth.	25 856	39 396½	24 932	415½	.97	3⅞	Greenish Yellow	Golden Yellow.	Globe.
2	Aberdeen, or Scotch Yellow	“	15 428	25 346	14 737	245½	.96	3¼	“	“	“
3	Bloomsdale Swede Improved Purple	“	39 121	44 080	30 105	501⅔	.76	2¾	Purple.	Yellow.	“
4	Champion Swede	“	33 611	44 080	23 693	394 5-6	70	2¼	Light Purple.	White.	“
5	Cow Horn	“	37 468	56 890¾	36 917	615⅙	.98	3⅝	White.	“	Long, Round, Point'd
6	Early White Egg	“	42 978	51 293	35 815	596 5-6	.83	3⅞	“	“	Pointed Globe.
7	Early Snow Ball	“	24 795	38 156¼	24 795	463⅙	1.00	5	Greenish Yellow.	“	Globe.
8	Early Flat Dutch Strap Leaf	“	31 607	43 391¼	26 274½	437 5-6	.83	5½	White.	“	Flat.
9	Earliest Bloomsdale Red Top	“	43 529	37 908¼	32 233½	437⅙	.73	5¼	Bright Purple.	“	“
10	Golden Rose	U. S. Dept. Agri.	22 591	19 973¾	8 540½	142⅓	.37	3¼	Greenish Yellow.	Golden Yellow.	Globe.
11	Improved Yellow Purple Top Ruta Baga	Landreth.	33 060	51 794	29 203	486⅔	.88	2½	Purple.	Yellow.	“
12	Long French	“	26 448	46 284	30 105	501⅔	1.13	1¾	Greenish Purple.	White.	Roots Sprangled.
13	Landreth's Snow White Globe	“	19 285	26 370¼	13 324	222	.69	3½	White.	“	Globe.
14	Large Early Red Top Globe	“	17 081	28 101	20 214	336 5-6	1.18	4⅞	Bright Purple.	“	“
15	Milan Strap Leaf	U. S. Dept. Agri.	29 754	39 396½	25 791	129⅔	.86	4	Purple.	“	Roundish Flat.
16	Norfolk	Landreth.	14 326	26 605¾	11 295½	188⅙	.78	2⅝	White.	“	Pointed Globe.
17	Purple Top Strap Leaf	U. S. Dept. Agri.	33 611	34 299¾	23 968½	394⅔	.71	4⅜	Purple.	“	Flat.
18	Purple Top Munich	“	21 489	21 626¾	9 678	161⅙	.45	3¼	Dingy Purple.	Golden Yellow.	Globe.
19	Prussian	Landreth.	22 591	47 386	28 652	477½	1.22	2	....	....	Roots Sprangled.
20	Pomeranian White Globe Strap Leaf	“	21 489	29 478	15 288	254⅔	.71	3½	White.	White.	Flattened Globe.
21	Sweet German	“	30 105	46 835	27 825½	463⅓	.92	2½	....	....	Roots Sprangled.
22	White Globe Strap Leaf	U. S. Dept. Agri.	31 407	40 350¾	18 734	312⅙	.59	4¼	Tinged with Purple.	White.	Globe.
23	White Fleshed Purple Top White Swede Ruta Baga	Landreth.	33 611	39 121	22 040	367⅓	.69	2½	Purple.	“	....
24	White Stone	“	24 244	43 529	19 836	330	.81	3½	White.	“	Pointed Globe.
25	White Globe	“	29 203	43 529	21 349	372⅓	.73	3 4-7	“	“	Globe.

9

VARIETIES OF GRAPES.

In order to convey reliable information with regard to the general adaptation of varieties to this soil and climate, a large number of the varieties of grapes generally grown by nurserymen are being tested on the grounds of this station. Thirty-nine of these fruited last season, on vines just three years old. The accompanying tabulated statement of results of observations made upon the vines and fruit may serve as a partial guide to those desiring to purchase. To render these observations very valuable and reliable, they must be continued through a series of years under the effects of different seasons. In order to test the practicability of protecting the berries from the attack of "black rot," insects and birds by means of paper bags pinned over the bunches, in early spring, about 7,000 bags were used on varieties under test and in the commercial vineyard. The common two-pound bags used by retail merchants were employed on the varieties to test the effects of bagging upon the berries—on the standard commercial sort, to determine the question of profit from their use. The effects upon the varieties is given in the tabulated statement as far as practicable in so compact form. The effects of confinement in the bags are not alike in all the varieties. The Delaware takes a soft rot in the bags or dries like raisins. The Perkins is preserved perfectly in bags, but is not good when thoroughly ripe, and hence it is not profitable to bag them.

The Hartford was planted on the lower edge of the vineyard with a N. Western exposure—that most favorable to the development of black rot. All of these not protected by the bags rotted before they ripened, while the berries upon the protected bunches were perfectly preserved and good August 18th, or 33 days after ripening. The Concord and Ives are well preserved in bags, the Ives *perfectly*. The skin of the Concord is so thin that the berries burst in the bags when very ripe and thus cause fermentation, which attracts insects.

The Ives improves in flavor for a month after it turns black and shipped well as late as August 19th, forty days after the crop is usually marketed.

These standard varieties sold at five cents net when first ripe without the bags early in July. Those protected and preserved in the bags brought ten cents per pound net a month later when the local crop not so protected had been consumed or destroyed. It costs one dollar to protect 500 pounds or 1,000 bunches of grapes. The bags should be put on as soon as the berries set. The bag is simply slipped over the bunch, folded around the stem and pinned. Before taking the bags out of the bundles in which they are packed, a small opening should be made in the bottom of each by means of a sharp knife or chisel in order that any moisture which may accumulate in the bags in wet seasons may escape. It is believed that it will not only prove desirable for the amateur grower to use the bags to prolong the season and insure exemption from attacks of rot, birds and insects, but those growing grapes on a commercial scale may find it to their interest to thus protect a portion of the crop.

NOTE.—The bulletins of this station will be sent free to any farmer who desires them. Address all requests to Experiment Station, Auburn, Ala.

EXPERIMENTS WITH GRAPES. OBJECT: TO TEST VARIETIES.

	Name.	Color.	Time of Ripening.	Effect of Bagging.	Condition Out of Bags.	Size and Shape of Bunch.	Quality.	Growth of Vine.
1	Agawam	Red	July 16th	Good	Rotted badly	Medium, compact	Good	Vigorous
2	Beauty	Red	July 21st	Excellent	Good	Medium, compact	Best	Very vigorous
3	Berckmans	Red	July 23rd	Excellent	Good	Small, compact	Best	Vigorous.
4	Brighton		Did not ripen	Mildewed				Not vigorous
5	Catawba	Red	July 25th	Very good	Good	Medium, compact	Best	Vigorous
6	Champion	Black	August 4th	Excellent	Good	Large, compact	Good	Vigorous
7	Concord	Black	July 25th	Excellent	Good	Very large, compact, shouldered	Very good	Very vigorous
8	Delaware	Red	July 18th	Rot'd slightly	Good	Small, compact	Best	Small but vigorous.
9	†Diana							
10	*Duchess							Not vigorous
11	Elk Eagle	Black	July 17th	Very good	Rotted	Very large and shouldered, open	Very good	Very vigorous
12	Elvira							Not vigorous
13	Goethe	Light Red	July 28th	Rotted	Rotted	Medium	Best	Vigorous.
14	Greins' Golden	Golden yellow	August 8th	Good	Rotted	Small, compact	Very good	Vigorous
15	Hartford	Black	July 6th	Excellent	Rotted badly	Medium, compact	Good	Vigorous
16	Iona							Not vigorous
17	Ives	Black	July 10th	Excellent	Very good	Large, very compact, shouldered	Good	Very vigorous
18	Irving	White	July 28th	Very good	Rotted	Large, compact, shouldered	Very good	Vigorous
19	Jefferson	Red	August 5th	Very good	Good	Large, open	Best	Very vigorous
20	Lady Washington	White	August 6th	Very good	Rotted slightly	Large, compact	Good	Not vigorous
21	Lindley	Red	July 18th	Rotted	Rotted	Small, open	Best	Not vigorous
22	Martha	White	August 5th	Good	Good	Large, compact	Good	Vigorous
23	Mason's Renting	White	July 25th	Very good	Good	Medium, compact	Good	Vigorous
24	Maxatawney	Pale yellow	July 20th	Good	Rotted	Small, open	Good	Moderate
25	Meno	Pale yellow	July 25th	Good	Rotted	Small, open	Good	Moderate
26	Merrimac	Black	July 25th	Good	Rotted	Small, compact	Very good	Quite vigorous
27	Moore's Early	Black	July 12th	Very good	Good	Small	Good	Moderately vigorous
28	Norton's Virginia	Black	July 28th	Very good	Good	Large, compact	Very good	Very vigorous
29	Pearl	Pale yellow	July 18th	None bagged	Rotted	Medium	Very good	Vigorous
30	Perkins	Pale Red	July 8th	Not good	Excellent	Medium, very compact	Good	Very vigorous
31	Pocklington	Golden		Very good	Good	Medium, compact		Not very vigorous
32	Peter Wylie	White	July 15th	Very good	Rotted	Small, compact	Best	Not vigorous.
33	Rogers No. 11		July 21st	None bagged	Rotted			Quite vigorous
34	Telegraph	Black	July 15th	Rotted	Rotted badly	Large, compact	Good	Vigorous
35	Triumph	White	July 20th	Good	Good	Medium	Good	Not very vigorous
36	Vergennes	Red	July 20th	Very good	A few rotted	Medium, compact	Best	Very vigorous
37	Wilder	Black	July 25th	Very good	Some rotted	Medium, compact	Good	Vigorous
38	Worden	Black	August 2nd	Good	Good	Large, compact	Good	Vigorous
39	Wyoming Red	Red	July 12th	Very good	Good	Small, compact	Very good	Vigorous

†Vines died. *Vines mildewed and berries rotted.

Report of N. T. Lupton, Chemist.

During the quarter ending December 31, 1888, the work in the Chemical Laboratory has been chiefly the analysis of commercial fertilizers received from the State Commissioner of Agriculture. This includes thirty-seven samples of fertilizers containing phosphoric acid, nitrogen and potash, twenty-one acid phosphates, and twelve miscellaneous samples, consisting of muriate of potash, cotton seed meal, tankage, Swan Island, Mona Island, and Carib natural guanos, also several phosphatic marls. In addition to these, six soils and sub-soils, and two specimens of coal have been analyzed, and a variety of minerals examined and their character determined.

The details of these analyses are as follows:

PHOSPHATES WITH NITROGEN AND POTASH.

Stat'n No.	Name of Fertilizer.	By Whom Sent.	Nitr	Phosphoric Acid.			Potash.	Commrc'l Value.
				Water Soluble.	Citrate Soluble.	Acid Soluble		
1062	Furman's Am. Soluble Bone....	Adair Bros. & Co., Atlanta, Ga.....	1.47	8.23	2.06	1.69	1.96	$23 08
1063	Buffalo Bone Guano............	Adair Bros. & Co., Atlanta, Ga........	2.17	7.75	2.32	1.62	2.56	26 12
1065	Furman High Grade Guano....	Adair Bros. & Co., Atlanta, Ga.......	2.17	8.14	2.85	1.18	2.70	27 64
1066	Farish-Furman Formula.........	Adair Bros. & Co., Atlanta, Ga... ...	....	9.75	3.23	2.10	4.13	23 60
1067	Bone Compound.............	Baldwin Fertilizer Co., Savannah, Ga...	1.64	9 02	2.06	0.44	1.20	24 21
1068	Georgia State Grange Fertilizer	Baldwin Fertilizer Co., Savannah, Ga..	1.92	8.64	1.28	3.13	2.45	24 81
1070	Bone and Potash.	Baldwin Fertilizer Co., Savannah, Ga..	....	10.36	2.77	2.94	3.86	23 55
1071	Am. Dissolved Bone.......	Baldwin Fertilizer Co., Savannah, Ga...	1.92	9.02	1.55	2.19	2.00	25 33
1078	Fertilizer...	J. S. Phillips, Somerville, Ala..........	2.38	8.71	4.33	1.36	1.12	29 96
1079	Acid Phosphate with Potash...	Georgia Chemical Works, Augusta, Ga..	...	12.26	2.32	1.24	1.61	23 48
1080	Mastodon	Georgia Chemical Works, Augusta, Ga..	2.24	8.33	2.71	2.86	1.85	27 13
1083	Fertilizer....................	W. J. Hudson, Mobile, Ala.....	2.24	5.95	5.79	3.71	1.18	27 52
1084	Soluble Pacific Guano.........	Frank S. Roberts, Mobile, Ala........	2.24	5.35	7 19	2.09	1.43	28 97
1086	Fertilizer....................	R. A. Mitchell, Opelika, Ala..........	....	....	1.47	0.23	0.27	......
1089	Eutaw Fertilizer	Ashepoo Phos. Co., Charleston, S. C...	2.34	7.08	2.65	3.59	2.04	25 56
1090	Ashepoo Fertilizer.............	Ashepoo Phos. Co., Charleston, S. C..	2.17	7.56	1.60	3.78	1.20	23 40
1092	B. D. Sea Fowl Guano.........	Bradly Fertilizer Co., Boston, Mass.	2.03	9.92	1.73	1.54	1.13	26 51
1093	Bradly's Pat.Super-phos. of Lime	Bradly Fertilizer Co., Boston, Mass. ..	2.66	10.52	0.93	0.81	1.95	29 52
1097	Georgia State Grange Fertilizer	Baldwin Fertilizer Co., Savannah, Ga..	1.67	10.06	1.84	0.94	1.98	26 26
1098	Bone and Potash........... ..	Baldwin Fertilizer Co., Savannah, Ga..	....	11 0[illegible]	2.71	1.32	3.11	23 70
1099	Baltimore Am. Dissolved Bone.	Mrs. Geo. Welp, Hanceville, Ala... ..	1.33	9.46	3.47	1.52	0.25	24 82
1100	Home Mixture................	Columbus Fertilizer Co., Columbus, Ga	2.45	10.37	0.73	1.20	2.52	28 72
1106	Crown Guano........	Jno. D. Weld, Savannah, Ga........ .	1.89	7.68	1.95	2.46	1.51	21 95
1107	Bowker's Cotton Fertilizer.. ...	Jno. D. Weld, Savannah, Ga...........	2.13	8.34	1.48	2.66	1.45	24 48

PHOSPHATES WITH NITROGEN AND POTASH.

Station No.	Name of Fertilizer.	By Whom Sent.	Nitrogen.	Phosp'ric Acid.			Potash.	Commercial Value.
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1108	Nassau Guano	John D. Weld, Savannah, Ga	1.82	7.37	2.98	2.31	1.64	24.25
1109	Carib Am. Guano	W. J. Hudson, Mobile, Ala.	1.26	0.65	9.58	7.89	3.19	23.44
1111	Fertilizer	East Alabama Fertilizing Co., Clayton, Ala.	1.96	9.00	1.11	1.98	2.50	25.30
1112	Complete Cotton Fertilizer	Commercial Guano Co., Savannah, Ga.	1.75	8.77	1.51	2.73	2.47	24.71
1113	Chatham Guano	Commercial Guano Co., Savannah, Ga.	1.61	8.41	1.71	2.76	2.20	23.65
1114	Pomona Guano	Commercial Guano Co., Savannah, Ga.	1.64	8.31	2.34	2.77	2.48	24.84
1119	Rasin Fertilizer	Rasin Fertilizing Co., Baltimore, Md.	2.06	7.39	2.57	2.52	2.12	25.05
1123	Holmes' Formula	N. H. Holmes, Montgomery, Ala.	2.20	8.04	1.82	1.74	0.59	24.96
1124	Ivey's Formula	N. H. Holmes, Montgomery, Ala	3.04	6.50	0.46	1.85	0.92	23 21
1125	Soluble Pacific Guano	Prof. W. L. Hutchinson, A. & M. College, Miss.	2.24	4.22	3.97	5.99	1.28	22.29
1115	Farmers' Alliance	Troy Fert. Co., Troy, Ala.	2.02	7.94	2.18	1.53	1.11	24.16
1116	Troy Perfect Guano	" " " " "	2.45	7.56	1.19	1.60	1.73	24.40
1117	Pike County Fertilizer	" " " " "	1.75	7.48	1.46	1.08	2.56	23.79

ACID PHOSPHATES.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosp'ric Acid.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
1052	Diamond Soluble Bone, No. 1.	W F Vandiver & Co., Mont'gy, Ala	10.36	4.42	3.18	$22.17
1053	Diamond Soluble Bone, No. 2.	" " " " "	10.08	4.23	3.16	21.46
1054	XX Acid Phosphate, No. 1	" " " " "	10.36	3.77	2.99	21.19
1055	" " " " 2	" " " " "	10.36	4.08	2.60	21.66
1056	Cotton Boll Eng. Acid Phosphate, No. 1	" " " " "	10.84	3.16	3.08	21.00
1057	Cotton Boll Eng. Acid Phosphate, No. 2	" " " " "	10.08	4.39	3.19	21.70
1064	Furman Acid Phosphate	Adair, Bros. & Co., Atlanta, Ga.	11.11	2.77	2.38	20.82
1069	Georgia State Grange Acid Phosphate	Baldwin Fert. Co., Savannah, Ga	10.36	2.77	0.69	19.69
1075	XX Acid Phosphate	W F Vandiver & Co., Mont'gy, Ala	10.54	4 09	2.65	21.94
1076	High Grade Eng. Acid Phos.	" " " " "	10.84	4.50	2.41	23.01
1081	Acid Phosphate	Ga. Chem. Works, Augusta, Ga.	12.36	4.58	1.35	25.41
1082	Troy Acid Phosphate	Troy Fert. Co., Troy, Ala.	12.17	2.97	2.31	22.71
1087	Eutaw Acid Phosphate	Ashepoo Phos. Co. Chls'ton, S. C.	10.25	2.39	2.50	18.96
1088	Ashepoo Acid Phosphate	" " " " "	10.92	2.54	2.36	20.19
1091	Brady's Patent Acid Phosphate	Brady Fert. Co., Boston, Mass.	13.61	1.42	0.50	22.54
1096	Georgia State Grange Acid Phosphate	Baldwin Fert. Co., Savannah, Ga.	12.46	2.42	1.49	22.32
1101	Soluble Bone	Columbus Fert. Co., Columbus, Ga	11.28	2.75	1.84	21.04
1104	Nassau Dissolved Bone	John D. Weld, Savannah, Ga.	12.19	1.28	2.65	20.20
1105	Bowker's Dissolved Bone	" " " "	7.39	3.77	3.52	16.74
1121	Magnet Acid Phosphate	Davis, Marshall & Co. Mobile, Ala	11.98	1.57	2.17	20.32
1122	Dissolved Bone	N. H. Holmes, Montgomery, Ala	12.48	1.03	2.79	20.26

MISCELLANEOUS FERTILIZERS.

Station No.	Name of Fertilizer.	By Whom Sent.	Nitrogen.	Phosp'ric Acid.			Potash.
				Water Soluble	Citrate Soluble	Acid Soluble	
1073	Muriate of Potash.... ..	East Ala. Fert. Co., Clayton, Ala.	....	....	.....	.....	46.25
1074	" " "	" " " " " "	...	....	.....	.....	47.48
1077	Cotton Seed Meal.......	" " " " " "	7.00	....	.....	3.52	1.99
1085	Tankage	Troy " " Troy, "	7.14	....	.....	9.52	0 10
1094	Swan Island Guano.....	Frank S. Roberts, Mobile, Ala.....	...	0.69	9.62	11.73	......
1095	Mona Island Guano......	Campbell & Co., 59 Wall St., N. Y.	....	0.23	12.51	11.41	......
1103	Swan Island Guano......	Frank S. Roberts, Mobile, Ala....	....	0.79	16.57	7.48	......
1110	Carib Natural Guano....	W. J. Hudson, Moblle, Ala.......	....	0.84	15.76	6.68	......
1118	Swan Island Guano... ..	Frank S. Roberts, Mobile, Ala...	....	0.62	13.59	6.66	......
1120	"Phosphate Rock"......	Troy Fertilizer Co., Troy, Ala....	....	....	.....	0.38	... ..

MISCELLANEOUS SUBSTANCES.

STATION NO. 1061—COAL FROM H, G. MCCALL, CALERA, ALA.

Moisture....................................	0.40
Volatile Matter...............................	32.40
Fixed Carbon................................	51.90
Ash...	15.30
Total.......................................	100.00
Sulphur.....................................	6.64

STATION NO. 1102—COAL FROM PROF. O. F. CASEY, AUBURN, ALA.

Moisture....................................	3.60
Volatile Matter...............................	33 00
Fixed Carbon................................	54.61
Ash...	8.79
Total.......................................	100.00
Sulphur.....................................	1.21

STATION NOS. 1126, 27 AND 28—"MARLS" FROM R. M. PARKER, COATOPA, ALA.

	No. 1.	No. 2.	No. 3.
Phosphoric Acid...............	0.77	0.51	4.13
Carbonate of Lime	75.90	0.37	81.80

AIR-DRIED SOILS AND SUB-SOILS.

Locality.....	Butler Coun y.		Talladega Co.		Pike County.	
Soil Marked........................	8 (a) Soil.	8 (b) Sub-soil	9 (a) Soil.	9 (b) Sub-soil	10 (a) Soil	10 (b) Sub-soil
Station No....	1129	1130	1131	1132	1133	1134
Moisture	2.559	2.469	3.676	3.670	0.817	1.267
Insoluble Silica..	78.379	68.586	66.126	68.159	92.931	85.507
Soluble Silica.....................	0.105	0.198	0.153	0.175	0.067	0.102
Hydrated Silica....	4.759	11.084	8.627	7.280	2.118	5.417
Sesquoxide of Iron.	1.864	3.584	3.942	4.128	0.812	1.601
Alumina	4.562	9.684	8.007	8.020	1.609	4.472
Phosphoric Acid...	0.029	0.020	0.150	0.174	0.032	0.035
Lime	0.275	0.176	0.289	0.255	0.039	0.050
Magnesia.	0.293	0.409	0.633	0.654	0.062	0.081
Potash	0.182	0.194	0 903	0.992	0.149	0.174
Soda	0.550	0.410	0.391	0.287	0.350	0.293
Sulphuric Acid.....................	0 103	0.068	0.233	0.177	0.127	0.153
Chlorine	0.006	0.008	0.056	0.039	0.009	0.008
Carbonic Acid....	0.133	0.046	0.114	0.154	0.066	0.088
Volatile and Organic Matter...........	5.462	3.219	5.969	6.089	1.553	1.603
Total	99.361	100.155	99.369	100.253	100.741	100.851
Nitrogen.......	0.260	0.239	0.260	0.280	0.109	0.087
Air-Dried Contains } Coarse Gravel............	8.50	6.91	9.81	12.49	1.50	1.92
Air-Dried Contains } Fine Material.............	91.50	93.09	90.19	87.51	98.50	98 08

Department of Botany.

WOODS OF ALABAMA—(*Continued.*)

P. H. MELL.

Fraxinus (Ash.)—The trees of this genus grow rapidly and attain a height of forty feet or more. The quality of the wood is very much the same in all species—the white ash, however, is considered to be the best. The wood possesses great toughness and durability. Experience has shown that in the case of white ash the second growth is superior in toughness to the first growth of timber. The wood is well adapted for all purposes requiring light colored, tough and hard material as in the manufacture of carriages, oars, cabinet work and blocks for pulleys. The roots are finely veined and sometimes have knotty convolutions, which resemble certain compound figures and are susceptible of high polish. In the trunk there is little difference between the sap and heart woods and therefore a large proportion of the stem is suitable for cabinet work and most farm utensils. It has been estimated that the cohesive power of the wood is about 160 pounds to the square inch when the load is applied transversely. The tensile strain per square inch is 5,495 pounds. The crushing strain per square inch is 2.4 tons. In selecting the timber care should be taken to obtain the wood that is gray white, because when the color changes to a dark shade, it is an indication that the wood is decaying. The best season for felling the tree is in winter, and it should be cut into boards soon after felling, because if left in the log state, cracks will open on the surface and severe loss be sustained. If the trees are cut in any other season than winter the timber will perish quite rapidly. The flexibility of the wood renders it unfit for the framing timbers in buildings.

The leaves of the white ash fall so early it should not be placed by itself on the lawn if transplanted, but should be clustered with other trees, so that its ragged condition, when denuded of its leaves, will not be perceptible. It requires a moist, cool,deep soil, and stands transplanting well on account of numerous small fibrous roots. The green ash is a very handsome tree and will be quite showy on lawns; it is, however, smaller than the others. This tree is found on river banks in moist soils. The red ash resembles the white, but differs from it in the down over the young branches and lower surfaces of leaves. It has a broad spreading head and is quite graceful in a landscape. The bark of the ash is used for tanning calf skins and for dyeing black, green, and blue.

For medicinal purposes the ash is highly prized. The white ash furnishes an excellent tonic and astringent. The extract of the bark is valuable for salt-rheum and other cutaneous diseases. When used as an infusion, it is good in some cases of constipation and dropsical affections. When the leaves are rubbed on the sting made by mosquitoes, the inflammation is reduced at once. "A decoction of the leaves is said to be an antidote to the poison of lamb-kill, or sheep laurel (*Kalinia Augustifolia*) when taken by lambs." (*Trees of Mass.*)

Aesculus pavia, L. (Buckeye.) The tree is ornamental, but the wood is of poor quality. The bruised branches and bark are used to stupefy fish so that they may be easily caught.

Cephalanthus occidentalis, L. (Button Bush.) A handsome shrub growing to a height of six to twelve feet. It is generally found in damp places. The bark is used as a remedy for intermittent and remittent fever, and the inner bark of the root forms a bitters that is thought to be good for coughs.

Bumelia lanuginosa, Pers. (Buckthorn.) Grows from fifteen to thirty feet in height. The wood has been used but little, if any, in the arts, although it is very hard. The berries make a good vegetable paint and a first-rate dye. They are also strongly purgative or cathartic, but the action is so strong and severe the remedy is but little used now. The tree has been tried with some success as a hedge and for this purpose may be propagated by means of seed, cuttings or layers. It requires a rich, moist soil and will stand transplanting and training very well. The juice of the berries, evaporated to dryness with alum or lime and gum arabic, make the color sap green.

Juglans nigra, L. (Black Walnut.) A graceful tree with a straight trunk and broad branching head. It grows quite rapidly, and is a valuable tree to transplant and cultivate for lawn, or for the fruit or timber. The wood is dark purple, becoming almost black with age. The fineness of the grain, toughness and durability make it valuable for many purposes. Even the roots of the trees are now cut up for veneering, and beautiful variegated slabs are thus obtained. The nuts furnish an oil that is used in mixing paints and is not congealed by cold, and the sap is said to yield sugar that will crystalize on evaporation. The bark when properly treated gives strength to the stomach and is recommended in fevers. The hull of the nut is used to make an excellent dye. The walnut and butternut furnish in the young stage of the fruit an excellent material for pickles.

Walnut trees are rapidly disappearing from the State because of the great numbers cut annually for lumber; and unless some steps are taken to protect them they will soon be unknown in the forests of Alabama. It would be a wise plan if the people of the State would plant even a small number of the trees each year, to take the place in some degree of those now being cut. The cultivation of walnuts will well repay the outlay.

Fagus ferruginea, Ait. (Beech.) This is a large and graceful tree and the wood is very hard, fine grained and will take a very fine polish. The color of the wood is red, with a delicate silky gloss, and it cleaves very easily. It makes an excellent tree for the lawn, but for one drawback: the leaves remainuntil nipped by the frost and fall very slowly, producing constant litter on the grass throughout the winter.

Betula nigra, and *Cuta*, L. (Black (and cherry birch.) The cherry birch g ows 70 feet high, with a diameter of two to three feet. This is a beautiful tree and flourishes best in mountain districts. The wood is a delicate rose color, takes a good polish, and deepens with age, but never becomes dark. It is even grained and works with ease. The variegated cast given to the wood by the annual rings adapts it for panels in cabinet work. The bark as a dye gives a beautiful drab color to wool.

Catalpa bignonioides. (Catalpa.) This is a handsome tree that grows to a height of 60 feet or more and two to four feet in diameter. The growth is rapid, but the grain of the wood is close and will take a fine polish. The color of the wood is grey white, and it is quite durable. It is commonly believed that the seeds are poisonous, but the United States Dispensary states that they have been used with good results in cases of asthma. It is best, however, to begin with small doses of the decoction made from the seeds.

Castanea vesca, L. (Chestnut.) The wood of this tree is coarse grained, but retains considerable elasticity and is very durable. There is but little sap wood. It is used for fences, and wherever wood of durability is required. The grain, however, is so coarse and so porous it is not well suited for cabinet work where high polish is desired. The color of the wood is light yellow or brown. When the bark is treated with iron, an exceedingly black ink is obtained from the tannin, which abounds in the bark. The tree thrives best in granite or sandy soils and submits readily to transplanting. The nuts may be improved in size and flavor by cultivation, but there are certain varieties to be found in the wild state that produce unusually large nuts, and it is best to select these for transplanting, if the yield of nuts is the chief object. The trees of this State seem to be subject to a blight or some destructive disease that is rapidly destroying them. This is particularly true when other trees are cut from around them. This subject is worthy of careful investigation, and it will be a problem for the experiment station to solve in the future. There is a very good market for the nuts and many of them are sent each year to Europe. One great drawback, however, in keeping the nuts consists in the fact that they wither and become mouldy. They may be kept successfully by placing them in boxes of clean, moderately dry sand and the boxes buried in the ground, where they will be neither too wet nor too dry, and of sufficient depth to be out of the range of sudden atmospheric changes. Before burying, all wormy and imperfect nuts must be carefully picked out. In using the wood for fence posts, it is best to select old trees, because experience has shown that young wood will soon decay—within six or eight years unless coated with tar or other preservatives. The wood makes an inferior fuel. The bark of the chinquapin, a species of the same genus, is used in medicine as an astringent and tonic in intermittent fevers.

The following woods are added to the list given in the last bulletin:

	COMMON NAMES.	SCIENTIFIC NAMES.
108.	Ash, blue.	Fraxinus quadrangulata, Michx.
109.	Alder, black.	Ilex verticillata, Gray.
110.	Alder, white.	Clethra alnifolia, L.
111.	Arrow wood.	Vibernum acerifolium, L.
112.	Arrow wood.	Vibernum dentatum, L.
113.	Blueberry, swamp.	Vaccinium corymbosum, L.
114.	Blueberry, Farkleberry.	Vaccinium arboreum, Mar.
115.	Buckeye, yellow.	Aesculus flava, Ait.
116.	Chokeberry.	Pyrus arbutifolia, L.
117.	Haw.	Cratægus arborescens, Ell.
118.	Hawthorn.	Cratægus spathulata, Mx.
119.	Huckleberry, dwarf.	Graylussacia dumosa, T. and Gray.
120.	Hazlenut.	Corylus Americana, Walt.
121.	Mock Orange.	Prunus Caroliniana, Ait.
122.	Mulberry, French.	Callicarpa Americana, L.
123.	Oak, overcup.	Quercus lyrata, Walt.
124.	Oak, white.	Quercus alba, L.
	Oak, post. (Typographical error in last bulletin.)	Quercus obtusiloba, Mx.
125.	Prickly Ash, Southern.	XanthoxylumCarolinianum, Lam.
126.	Strawberry Bush.	Euonynius Americanus, L.
127.	Titi.	Cliftonia ligustrina, Banks.

(*Continued in next Bulletin.*)

Meteorological Report.

P. H. MELL.

T. D. SAMFORD, Assistant.

Climatic influences upon vegetation are of the greatest importance. The success or failure of crops is due largely to the state of the weather. It is a well known fact that, not only the warmth of the atmosphere, but also the heat in the soil is necessary to germination of seeds as well as for the development of the plant.

Recognizing the importance of these principles, meteorological observations have been made at this station for the purpose of more accurately determining the effects of the weather upon crops and to ascertain the exact temperature of the soil at different depths, as well as the conditions affecting climatic changes.

To accomplish this work the station is furnished with a complete set of atmospheric meteorological instruments, and also with thirty soil thermometers, divided into three sets, ranging in depth from one to ninety-six inches.

Two of these sets of soil thermometers are placed on the top of a hill which is exposed to the constant sweep of the winds and the full strength of the sun's rays. The third set is situated in bottom land on the banks of a running stream. This set is more or less shaded by a rank growth of vegetation. Over each instrument is placed a box perforated with holes to allow a free circulation of air and at the same time to exclude the heat rays of the sun. The character of the soil is sandy and is well drained.

In studying the data of these instruments the following conclusions may be drawn: During the summer months the upper layers of the soil are ten to fifteen degrees warmer than the atmosphere, but become cooler with depth, and in July a depth of five feet below the surface shows a temperature ten degrees cooler than the upper layer. In the fall and winter the reverse of this is true, that while the upper layers of the soil are still somewhat warmer than the atmosphere, yet the lower layers increase in warmth, proportionally so with depth. For instance, the month of July shows a temperature, at the depth of ninety-six inches below the surface, eleven degrees cooler than the air; while December shows a temperature at the same depth nearly fifteen degrees warmer than that of the air.

It is also observed that while the range of temperature of the atmosphere fluctuates considerably, that of the soil is more constant; and further, that the daily range steadily decreases for twenty-four inches, below which depth it is practically nothing—seldom being higher than a half of a degree, and from the figures in the table below it will be seen that the daily range of temperature is several degrees less in the bottom than it is on the hill; showing the effects of location of land, moisture in soil, and the effects of evaporation caused by the sweep of the winds—the bottom being greatly protected from this agent.

Again, it will be seen that there is but little difference in the temperature of the bottom land and upland, during the fall months. During the hot summer the bottom is a little cooler, during winter it is a little warmer than the upland, and whenever the temperature is about forty degrees and below, then the bottom land is several degrees warmer than the upland.

DATA FROM SOIL THERMOMETERS

AT DIFFERENT DEPTHS COMPARED WITH TEMPERATURE OF ATMOSPHERE.

ATMOSPHERE.	OCTOBER.			NOVEMBER.			DECEMBER.		
Monthly mean	62.5			54.7			46.1		
Monthly maximum	81.			78.			66.		
Date	6			6			25		
Monthly minimum	43.			29.			20.		
Date	21			28			20		
Range for month	38.			49.			46.		
Greatest daily range	19.			22.			25.		
Date	30			24			21		
Least daily range	3.			1.			3.		
Date	10			8			26,31		
Mean daily range	17.4			19.1			16.1		
SURFACE.									
Monthly mean	50.			43.2			38.4		
Monthly maximum	62.			66.			52.		
Date	23			8			10		
Monthly minimum	41.			30.			19.		
Date	2			26			20		
Range for month	21.			36.			33.		
ONE INCH.	SET I	SET II.	SET III.	SET I.	SET II.	SET III.	SET I.	SET II.	SET III.
Monthly mean	65.5	65.5	65.	57.5	56.5	57.	48.2	48.3	47.5
Monthly maximum	78.5	81.	76.	77.5	76.	73.	60.	60.	55.5
Date	6	5	5,6	3,6,7	1	3	16	25	25
Monthly minimum	49.	47.	52.	34.5	34.	38.	30.5	31.	32.5
Date	29	29	14	28	28	28,29	21	20	21
Range for month	29.5	34.	24.	43.	42.	35.	29.5	29.	23.5
Greatest daily range	21.	22.	16.5	19.	19.	12.5	21.5	22.	14.
Date	1,4,21	4,21	1	1	12	1	3	3	3
Least daily range	1.5	1.	1.	1.	2.	.5	2.	2.	2.
Date	25	25	11,25	8	9,14,21	21	26	10	10,26
Mean Daily range	13.37	12.85	9.8	11.21	11.5	7.55	11.43	11 53	8.5
THREE INCH.									
Monthly mean	66.5	65.5	65.	57.5	57.	56.5	48.1	48.3	48.
Monthly maximum	80.	80.5	75.	75.5	76.	71.5	59.	58.5	55.5
Date	5,6	5	6	3,7	7	3	16	25	25
Monthly minimum	51.	49.	53.5	37.5	35.5	40.5	33.	33.	35.
Date	13,14,29	14,29	14	28,29	28,29	28,29	21	21	21,22
Range for month	29.	31.5	21.5	38.	40.5	31.	26.	25.5	20.5
Greatest daily range	19.	22.5	13.5	15.5	17.	10.	15.5	19.5	11.
Date	1	4	5	1	1	7	2	7	2,3
Least daily range	.5	1.5	1.5	0.	.5	.5	2.	2.	2.
Date	25	25	25	......	8	13,20	10,16	10	10
Mean daily range	11.53	12.33	7.84	7.8	10.11	6.03	8.62	10.56	6.80
SIX INCH.									
Monthly mean	66.	66.	65.	57.5	57.	58.	47.9	48.1	48.5
Monthly maximum	77.	78.5	73.	72.5	73.5	70.	57.5	56.	55.
Date	6	5,6	6	3,6,7	7	3	6	9	10
Monthly minimum	53.5	51.	57.	40.5	38.5	44.5	35.5	35.	38.5
Date	13,14	14	14	28	28,29	29	20,21	21	21,22
Range for month	23.5	27.5	16.	32.	35.	25.5	22.0	21.	16.5
Greatest daily range	12.5	17.5	8.	10.5	13.	5.	11.5	14.	6.5
Date	1,5	1,4,5	5	1,12	12	6,7	6	3	30
Least daily range	1.5	2.	1.	0.	1.	.5	.1	1.5	1.
Date	25	25	10,11	8	8,17,21	14,19,21	27	10	10
Mean daily range	7.61	10.46	4.03	6.	7.58	3.33	6.16	7.90	3.47
NINE INCH.									
Monthly mean	65.5	65.	65.	57.	55.5	56.5	47.4	47.4	48.4
Monthly maximum	74.5	76.	71.5	70.5	71.5	68.5	54.5	55.	54.
Date	6	6	6	3	7	3	10	10	10
Monthly minimum	56.	53.	59.	43	40.	46.	38.	38.5	40.
Date	13,14	14	14	29	29	29,30	20	22	22
Range for month	18.5	23.	12.5	27.5	31.5	22.5	16.5	18.5	14.
Greatest daily range	8.5	12.5	5.5	6.5	9.5	3.5	6.5	9.5	4.5
Date	5	4	5	1	7	1,7	25	3	9
Least daily range	.5	1.	1.	0.	0	0	0.5	1.	.5
Date	10	10	8	8	21	9,19	27	27	10
Mean daily range	4.77	7.43	2.95	3.4	5.36	2.06	3.12	5.17	2.06
TWELVE INCH.									
Monthly mean	65.	64.5	65.	57.	57.	58.	47.7	47.3	48.5
Monthly maximum	73.5	73.5	70.	69.	68.5	67.5	54.	54.	54.
Date	6	6	6	3	3	9	10	10	9,10
Monthly minimum	58.	55.5	61.	45.	43.5	48.	39.	39.5	41.5
Date	13,14	14	14,15	29	29	29,30	21,22	21,22	22,23

DATA FROM SOIL THERMOMETERS.

(CONTINUED.)

ATMOSPHERE.	OCTOBER.			NOVEMBER.			DECEMBER.		
TWELVE INCH.	SET I.	SET II.	SET III.	SET I.	SET II.	SET III.	SET I.	SET II.	SET III.
Range for month........ . .	15.5	18.	9.	24.	25.	19.5	15.	14.5	12.5
Greatest daily range.......	6.5	13.5	3.5	4.5	4.5	2.5	4.	3.	4.
Date........................	19	14	3	1	1,24	14	25	3,4,9	9
Least daily range....	0	.5	0	0	0	0	0.5	0.	0
Date........................	10	20,24	21,22	19	19	8	10,27	27	15,21
Mean daily range.....	2.95	3.51	1.46	2.2	2.28	.81	1.90	1.63	.97
TWENTY-FOUR INCH.									
Monthly mean..............	67.5	66.5	65.5	60.5	59.	61.5	51.1	50.4	52.6
Monthly maximum.... .	71.5	70.5	70.5	68.	67.5	67.	55.	54.	55.
Date......	6,7	7	3	8,9	8,9	9	10,11	10,11	10
Monthly minimum	64.5	63.5	64.5	52.	51.	54.	45.	45.	49.
Date	8	8	17	29,30	29,30	30	25	2.5	22
Range for month......... ..	7.	7.	6.	16.	16.5	13.	10.	9.	6.
Greatest daily range........	3.5	2.	4.	2.	1.5	1.	1.5	2.5	1.
Date........................	11	11	10	10	10	14,24	31	25	9
Least daily range...........	0	0	0	0	0	0	0	0	0.
Date	8	8	8	8	8	8	8	8	8
Mean daily range...........	.5	.56	.72	.4	.4	.28	.51	.5	.18
THIRTY-SIX INCH.									
Monthly mean..............	69.5	68.	68.5	62.5	62.	63.	53.1	53.	54.6
Monthly maximum.........	71.5	71.	71.5	67.	67.	67.	55.5	55.5	57.5
Date...........	1	1	1	5,7,8,9	8,9	10	12	10,11	2
Monthly minimum.........	65.5	65.5	66.	55.	55.	57.	49.5	49.5	51.5
Date.................... ..	31	31	31	30	30	30	25	25	25
Range for month....	6	5.5	5.5	12.	12.	10.	6.	6.	6.
Greatest daily range........	.5	2.5	1.	5.	1.	1.	.5	.5	.5
Date....	8	......	11	8	14	14,16	8	8	8
Least daily range...........	0	0	0	0	0	0	0	0	0
Date......................	8	8	8	8	8	8	8	8	8
Mean daily range..	.32	.29	.16	.11	.18	.18	.13	.08	.18
FORTY-EIGHT INCH.									
Monthly mean..............	69.5	69.5	69.5	64.	64.	64.5	54 3	55.2	56.5
Monthly maximum.... ...	72.5	72.5	72.5	67.5	67.5	67.5	58.	58.	59.5
Date......................	12	1	1	7,8,9	2,9	8	1,2	1	1
Monthly minimum.........	67.	67.	67.5	58.5	58.5	60.	52.5	52.5	53.5
Date...........	31	31	29 31	30	30	30	25,26	25	29
Range for month...........	5.5	5.5	5.	9.	9.	7.5	5.5	5.5	6.
Greatest daily range........	1.	1.	.5	.5	1.	.5	.5	.5	.5
Date....	11	11	......	8	2	8	8	8	8
Least daily range...........	0	0	0	0	0	0	0	0	0
Date..	8	8	8	8	8	8	8	8	8
Mean daily range..........	14.	.25	.05	.11	.16	.10	.06	.08	.08
SIXTY INCH.									
Monthly mean.............	70.	70.	70.	66.	65.	65.5	56.8	57.5	58.4
Monthly maximum.........	73.	73.	72.5	67.5	68.	68.	60.	60.5	61.5
Date......................	1	1	1	8	1,2	1	1.2	1,2	1,2
Monthly minimum.........	67.5	68.	68.	60.	61.	62.	54.	55.	56.
Date......................	29,30,31	27,31	29,31	30	30	30	8	8	31
Range for month..........	5.5	5.	4.5	7.5	7.	6.	6.	5.5	5.5
Greatest daily range.......	.5	.5	5	.5	1.	.5	.5	.5	.5
Date......................	8	8	8,16,21	8	14	8	8	8	10
Least daily range...........	0	0	0	0	0	0	0	0	0
Date......................	8	8	8	8	8	8	8	8	8
Mean daily range..........	.06	.19	.05	.1	.13	.06	.04	.06	.016
SEVENTY-TWO INCH.									
Monthly mean..............	......	70.5	......	......	66.	......	......	58.7	......
Monthly maximum.........	......	73.	......	......	68.5	......	......	62.	......
Date	......	1,2	......	......	1,2	......	......	1,2	......
Monthly minimum.........	......	68.5	......	......	62.	......	......	56.	......
Date......................	......	26,31	......	......	30	......	......	31	......
Range for month..........	......	4.5	......	......	6.5	......	......	6.	......
Greatest daily range........	......	.5	......	......	.5	......	......	.5	......
Date.....	......	......	......	......	......	......	......	3,28	......
Least daily range...........	......	0	......	......	0	......	......	0	......
Date......................	......	8	......	......	8	......	......	8	......
Mean daily range..........	......	.06	......	......	.07	......	......	.03	......
EIGHTY-FOUR INCH.									
Monthly mean..............	......	71.	......	......	66.	......	......	60.1	......
Monthly maximum.........	......	73.	......	......	68.5	......	......	63.5	......
Date......................	......	1	......	......	1,2,3	......	......	1	......
Monthly minimum.........	......	69.	......	......	63.5	......	......	57.5	......
Date...	......	28,31	......	......	30	......	......	31	......
Range for month..........	......	4.	......	......	5.	......	......	6.	......
Greatest daily range........	......	.5	......	......	.5	......	......	.5	......
Date......................	......	......	......	......	10,18	......	......	8	......
Least daily range...........	......	0	......	......	0	......	......	0	......
Date......................	......	8	......	......	8	......	......	8	......
Mean daily range..........	......	.07	......	......	.03	......	......	.06	......

DATA FROM SOIL THERMOMETERS.

(CONTINUED.)

ATMOSPHERE.	OCTOBER.			NOVEMBER.			DECEMBER.		
NINETY-SIX INCH.	SET. I.	SET II.	SET III.	SET I.	SET II.	SET III.	SET I.	SET II.	SET III.
Monthly mean	....	71.	......	......	67.5	....	......	62.	......
Monthly maximum	....	73.	......	......	69.	....	......	65.	......
Date	....	1	......	......	1–5	....	......	1	......
Monthly minimum	....	69.5	......	......	65.	....	......	59.5	......
Date	....	28,31	......	......	30	....	......	31	......
Range for month	....	3.5	......	......	4.	....	......	5.5	......
Greatest daily range	....	.5	......	......	.5	....	......	.5	......
Date	....	......	......	......	10	....	......	2	......
Least daily range	....	0	......	......	0	....	......	0.	......
Date	....	8	......	......	8	....	......	8	......
Mean daily range	....	.06	......	......	.017	....	......	.017	......

DATA FROM OTHER INSTRUMENTS.

ATMOSPHERIC PRESSURE (In Inches.)	Oct.	Nov.	Dec.
Monthly mean	30.060	30.060	30.133
Maximum	30.340	30.360	30.150
Date	18	12	23
Minimum	29.740	29.770	29.710
Date	11	9	10
Monthly range	.600	.590	.440
PRECIPITATION.			
Total in inches	4.39	4.96	2.94
Greatest daily	1.08	2.15	......
Date	25	8	......
Number of rainy days	9	6	6.
Number of cloudy days	11	11	9.
Number of fair days	15	12	13
Number of clear days	5	7	9
WIND.			
Prevailing direction from	N.W	E.	S.E.
Total monthly movement (in miles)	3.632	4.361	......
Average daily movement	118.1	150.4	......
Greatest daily movement	210.	271.	......
Date	29	14	......

APPENDIX.

In response to a number of inquiries for the act establishing the experiment stations in connection with the Agricultural and Mechanical colleges of the different States and Territories, we give below:

THE HATCH ACT.

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 second, eighteen hundred and sixty-two, and of the acts supplementary thereto.

Be it enacted in 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 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 second, eighteen hundred and sixty-two, 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 such 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 case 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 and 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 specially 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 equal 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 colleges 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 exceeding 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 or 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 second aforesaid, an agricultural department or experimental station, in connection with any university, college or institution not distinctly 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 of such State 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 instalments 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 npon the assent of the Governor thereof duly certified by 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 the 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.

Approved, March 2, 1887.

Bul. 3 was inserted
between pages
16 & 17 of Bul. 5

BULLETIN NO. 4. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

Auburn, Ala. - - - February, 1889.

Contents:

THE BROWN PRINTING CO., PUBLIC PRINTERS AND BOOK BINDERS.

BULLETIN NO. 4,

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - FEBRUARY, 1889.

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P. L. HUTCHISON	Third Assistant Chemist
T. D. SAMFORD, B. SC	Assistant Botanist

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† Prof. Mell has also charge of Meteorological Observations.

‡ To be filled,

BY J. S. NEWMAN, AGRICULTURIST.

In response to numerous inquiries from those who have been induced by the work of this Station to begin fruit culture, and for the purpose of instructing local experimenters who receive plants from this Station for experiment purposes, the following practical instructions are given. A complete treatise is not attempted, but simply practical suggestions to the beginner, that he may avoid mistakes in the outset that may lead to disappointment and discouragement. Homes in the country can not be made attractive to the young without fruits and flowers. Nothing will attach the young to their homes more than a cultivated taste for these. Nothing will contribute more to health, refinement and happiness.

STRAWBERRIES.

It is not a little remarkable that so few homes are supplied with this delicious fruit. Being the first to ripen in the spring, so convenient, so delicious and so easily grown, there is no excuse for failure to have an abundant supply for family consumption and some to sell if desirable. It is not only surprising that so few grow strawberries, but equally so that so few know anything about their propagation, fertilization, cultivation and handling.

Many homes even that have pretentious orchards of apples, peaches and pears from which they gather crops, probably one year in five, neglect entirely the strawberry, grape and raspberry, which yield without fail, if properly cared for, annual crops of the most delicious fruit.

PROPAGATION.

The strawberry is propagated by "sets" which form upon what are called "runners," which are woody stems starting from the base of the crown and reaching out in different directions, having at intervals two to three plants upon each runner. These plants take root from their base where they come in contact with the surface of the soil. These runners usually start into activity in the latter part of the fruiting season, and, in some varieties, cover the ground between the rows with new plants.

If the maximum fruitage is desired, the runners should be removed as fast as they form, since they tend to diminish the vigor of the parent plant and prevent the development of fruit-buds for the new crop. The buds which produce the fruit stalk are formed during the growth of the previous season, and hence anything which hinders the healthful growth of the plants this year will reduce the yield of the first crop of the next season. The plants which form upon the runners are used to start new beds.

They may be transplanted upon well prepared soil at any time from October to April, if the soil is moist and the temperature not below forty degrees Far., giving the preference to January or February. The yield of fruit the first season will depend more upon whether the plants formed in the early part of the previous season, and were surrounded by favorable conditions, than upon the time of transplanting. Plants which set in May will form more fruit buds than those which start in August.

We said plants were propagated by sets. This is the only method by which we can propagate them true to variety. They may be propagated by seed, but without assurance of perpetuating the variety from which the seed are taken. This method is employed only to originate new varieties.

TRANSPLANTING.

The sets should be taken up with a garden trowel or pointed garden hoe, with as little mutilation of the roots as practicable.

Portions of the runners left attached to the plants should be cut, not pulled, from them before planting.

If the roots are long and straggling, or have partly died in being transported, cut them back to within three inches of the crown.

If in garden culture in which the hoe will be used to the exclusion of the plow, check the rows two feet each way, open the soil at the checks sufficiently to allow the roots to be spread in as nearly a natural position as possible, insert the roots, draw pulverized soil upon them and press firmly. On soils naturally well drained plant on level surface without bedding. If on soil in which the drainage is not good, plant on flat beds.

If the plants are to be cultivated with the plow, plant in checks three feet by two. This will admit the plow one way and leave ample room between the crowns the other way to facilitate hoeing.

SELECTION AND PREPARATION OF THE SOIL.

Strawberries are so readily and injuriously affected by drouth, especially during the bearing season, that in locating a bed selection should be made of a soil which is naturally or artificially well drained, and yet one which will readily absorb and hold moisture. A rich loam with abundant supply of vegetable matter will prove most satisfactory. Deep and thorough preparation and liberal fertilization of the soil are necessary to secure maximum results. The roots will penetrate as deeply as the soil is prepared, and thus be rendered less liable to injury from drouth.

Only a small area is needed to supply a family with these delicious berries, and any one can afford to spend the time and money necessary to insure the maximum production upon so small an area. Indeed, the husband will find ample compensation for any reasonable expenditure of time and money, in observing the pride and pleasure with which the wife presents her neighbors with boxes of choice berries, and the satisfaction which she derives from the conscious independence arising from the daily contributions from the strawberry bed to her own table.

MANURING.

We often read instructions as to strawberry culture, written by Northern men, in which they recommend covering the ground with stable manure two or three inches deep, and Southern readers have been led astray by such advice. We will guarantee failure upon beds so treated in our climate. Such treatment will insure vigorous growth of plants in early spring, but the fruitage will be small and the plants will wither and die under the effects of hot sun and drouth.

Our best results have been obtained from applications of ashes and raw bone accompanied with mulch of straw between and around the plants, from Gossypium Phospho applied before planting and during the growth of the plants, from light dressings of cotton seed meal in early spring, and from heavy mulching around the plants with green cotton seed applied in December. Most satisfactory results have been attained from all these methods of treatment. Acid phosphate will answer in the place of the raw bone, though not so permanent in its effects. The largest berries I have ever grown were produced by an application of Gossypium Phospho broadcast; before planting, at the rate of 1,600 pounds per acre, followed the next winter by mulch of green cotton seed applied at the rate of 100 bushels per acre. The most abundant crop, however, resulted from an application of wood ashes and super-phosphate.

CULTIVATION.

Strawberries should be cultivated as thoroughly as cotton, and in the same manner. The cultivation should be entirely on the surface, to avoid as far as practicable any injury to the roots. They require cultivation during the entire growing season to secure satisfactory results. Many persons remand their strawberry beds to the tender mercy of the grass and weeds as soon as the crop has been gathered. This ensures failure. To secure best results, both as to appearance of the bed and the yield of fruit, no sets should be allowed to take root, but the single crown system pursued. The largest and finest berries are obtained by this system, but a larger qantity of berries may be grown per acre by what is known as the "matted row" system. By this method new plants are allowed to remain between the plants in the drill until there is a continuous row of plants, and these of different ages.

Under the single crown system the beds need renewing every three years, because only the original plants are allowed to grow, and all become too old for profitable fruitage at the same time, while under the matted row plan the old plants are renewed by the sets which take root in the row from year to year, and thus the bed to some extent renews itself. The single crown system will prove most satisfactory in the size and quality of the fruit, and is more easily kept clear of weeds and grass. It is a good plan to set a new bed every winter and destroy one that has borne two full crops. The plants for the new bed are allowed to grow upon the one to be destroyed after the crop of fruit has been gathered.

MULCHING.

In cold climates the crowns are covered with straw in the fall and left thus protected during the winter. This is neither necessary nor desirable in our climate. We need the mulch in spring and summer to protect the plants from injurious effects of drouth, and to protect the berries from the soil. Mulch, however, delays fruitage by preventing the heat of the sun from warming into activity the roots of the plants in early spring. The mulch prolongs the bearing season. It is, therefore, a good plan to mulch half the bed and leave half unmulched. In no case, however, must the crowns be covered with the mulch in our warm climate. Wheat or oat straw that has been tramped by cattle serves an admirable purpose. Green cotton seed applied around the plants in November protect the roots from freezes, keep the berries clean in spring, retain moisture about the roots, and as they gradually decay, supply food to the plants.

VARIETIES.

It is always best for the amateur to plant standard varieties that have stood the test and proved reliable. The Sharpless is to-day the most popular berry on account of its large size and good flavor. The Wilson is the most hardy, and hence should occupy a part of every garden bed. It is a little too acid until thoroughly ripe, and hence taxes the the patience of the grower when craving fruit in early spring.

The old Agriculturist resembles the Wilson very closely, is not so acid nor quite so prolific. Cumberland Triumph, Crescent, Kentucky, Parry, Triumph de Gand, and others, are popular, but the three first mentioned will give entire satisfaction. If fine flavor is to take precedence of all other qualities, the Henderson will be selected. It is the best in flavor of fifty-three varieties tested.

GATHERING THE BERRIES.

Though the utmost care may be used to prevent it, more or less grit will adhere to some of the berries, and hence the manner of picking assumes some degree of importance. The berries should not be handled at all, but the stem of the ripe berry grasped between the thumb and forefinger and, after giving it a twist to expose the lower side of the berry, pinched off if the berry is sufficiently ripe. The surface of berries often appear quite ripe when they are still white underneath.

PISTILLATE VARIETIES.

These have imperfect flowers and consequently will not bear unless planted near staminate varieties. The Crescent, one of the most prolific varieties, is of this character. It is claimed by some growers of strawberries that the size and quality of the berries grown upon pistillate varieties are influenced by the staminate variety employed to fertilize them.

GRAPE CULTURE.

There are varieties of grapes which are profitably grown upon nearly every character of soil in the cotton States.

Of fifty-four varieties planted at this Station four years since, forty-four have done reasonably well and a majority of them have proved most satisfactory. No farm in Alabama should be without a vineyard sufficient at least to supply the table of its owner, while there are large areas upon which grape growing may be made very profitable as a market crop.

To grow grapes successfully the soil must be thoroughly drained, either naturally or artificially.

The idea, imported from Europe, that the land must be trenched three or four feet deep to produce grapes successfully has long since been exploded. The preparation of the soil, however, should be as deep and thorough as practicable by the use of plow and harrow. If not already fertile, it should be liberally fertilized with manures of a permanent characacter, such as bone and animal manures. If these are not available, cotton seed or cotton seed meal, acid phosphate, and potash in some form, such as kainit or cotton seed hull ash or wood ashes may be employed. These should be applied broad cast and thoroughly incorporated with the soil before planting.

Deep furrows should be opened in the line of the proposed row of grapes. In these a thoroughly rotted compost should be applied at the rate of not less than one thousand pounds per acre. After applying the compost, mingle it with the soil and subsoil by using in the furrow long plows run as deeply as possible.

PLANTING.

Grapes are usually planted eight feet apart each way. Cut back the vines of the young plants to three buds, dip the roots in water and set as deep as they stood in the nursery row. Spread the roots in their natural position and press the fine soil firmly upon them. If well rooted plants are properly set, every vine should grow.

At the time of planting drive in a stake four feet long by every vine and write the name of each variety and the number of plants of each upon a stout label to be placed by the first plant of the variety. In addition to this, record the names of the varieties, their location and the number of each in the vineyard in a book kept for this purpose. If this is neglected, much of the pleasure to be derived from the vineyard will be lost. A mulch of some partly decayed vegetation placed around the plants will prove very beneficial. During the growing season the grape vines should be cultivated with the same care that would be bestowed upon a crop of cotton, avoiding at all times such cultivation as will break the roots of the plants.

A row of field peas, of a bunch variety, may be planted between the rows of vines and carefully cultivated to prevent the growth of grass and weeds.

Enough peas will be made to pay for the cultivation of the grapes and the vines left upon the soil will improve its fertility. The following method of training the vine has been used on this station with most gratifying results :

When the buds start into growth in the spring the most vigorous is selected to remain and the others rubbed off Tie the single cane to a stake and when it reaches a length of three feet pinch the bud to arrest longitudinal and promote lateral growth, i. e.., increase in size rather than length of cane. Soon after the bud has been pinched branches will put forth at the axils of the leaves. When these are a foot long pinch back to two leaves. All sprouts that put forth from the body of the cane must be rubbed off as they appear.

When the new canes commence to grow the next spring now the second year of the vine, select the two most vigorous and rub off the others. By this time the wire trellis should be ready and the canes as soon as long enough, tied to the first wire. The first wire should be two feet and the second four feet from the ground.

The canes must not be tied so tightly as to risk injury from binding. To avoid this, pass the middle of the pieces of twine, already cut in foot lengths, around the cane below the leaf, cross the ends and tie to the wire.

When these canes attain three feet in length pinch back to increase their size as explained for the first year. Only the two canes should be allowed to grow and the laterals upon these pinched back to one foot or less. If bunches of grapes appear upon these canes they must be removed, except perhaps, upon a few extra strong vines on which one or two bunches may be allowed to ripen. Occasionally three canes can be left upon extra vigorous vines, two of which may be trained along the lower, and one tied to the top wire. Any adventitious buds which put forth from the main stem should be rubbed off as soon as they appear, so as to direct the entire growth into the canes selected as above.

The soil should be repeatedly stirred between and around the vines for the double purpose of aeration and to prevent the growth of weeds and grass.

The next pruning which prepares for the third year's growth of vine and fruit production, we have to start with either two or three vigorous canes which, if they have been properly fertilized and cultivated, will be from one-half to three-fourths of an inch in diameter with short laterals at the joints. Vigorous growers, like the concord, perkins, etc., may be pruned upon the spur or the renewal system. If on the former plan, cut alternate spurs or laterals close to the main cane and on the remainder leave one or two eyes. The principal canes should be cut back to two or three feet according to the vigor of the vine and its habit of growth.

The best eyes are on the laterals, since these were formed from the principal buds on the leading canes, leaving only the stipular buds undeveloped on the latter. If all the spurs are cut off close to the canes only the stipular or small secondary buds are left and these may not produce vigorous canes.

If the renewal system is adopted, one-half of the vine is pruned on the spur system, and the other cut back to good buds for wood production for the next year. On those canes which grow from the side cut severely back, no fruit should be allowed to grow, all being produced upon that half pruned on the spur plan.

The next year the canes which bore the fruit are cut back for wood production, and the new canes of the previous year's growth pruned for fruit. The spring pruning is very important in the economy of the vine. It consists in removing all feeble and surplus canes soon after growth commences, and, a little later, pinching back the fruiting canes two leaves beyond the last bunch of grapes. On vigorous young canes three bunches may be expected. The number of bunches likely to be produced may, therefore, be calculated in advance by multiplying the number of plump buds left by three. As soon as the new canes are well established, so that they can be handled without risk of breaking at the base, they should be tied to the wires separately to give proper exposure, to air the bunches of grapes and to facilitate gathering when ripe.

PROTECTING WITH PAPER OR CLOTH SACKS.

As soon as the grapes have set in the spring small sacks of either cloth or paper may be slipped over the bunch and the mouth folded and pinned. If paper is used, a small puncture should be made in the bottom of the sack to allow any water, which may enter, to escape. An active man or boy can put on 1,500 to 2,000 of these in a day, the number depending much upon the manner in which the vines are tied upon the trellis. These bags protect the grapes from attacks of mildew and rot, and from birds and insects when ripe. They remain fresh upon the vines four to six weeks after the exposed bunches have been consumed or destroyed.

Any arrangement by which the season for such delicious fruit may be prolonged a month beyond its ordinary limits is well worth adopting.

Some facts showing the effects of bagging the bunches were given in Bulletin No. 3, of this station.

The bunch grapes may be pruned at any time after growth has entirely ceased and before the buds begin to swell towards spring. It is well to prune part of the vineyard very early in the fall and leave half till February.

The canes pruned early will put forth early in spring and, if not killed by frost, will ripen fruit earlier than those pruned later. The later pruning insures against injury by frost and prolongs the fruiting season.

The muscadine or rotundifolia type will not bear pruning during the winter, and hence the prevalent opinion that they will not admit of it at all. They may be pruned with perfect impunity immediately after the leaves are shed in the fall.

Cuttings made at this season grow almost as readily as those made from the bunch grapes during winter.

A number of cuttings of the scuppernong planted in October, 1887, made vigorous growth last year. The scuppernong vines should not be planted nearer than fifty feet each way, if intended to be grown upon arbors. If grown on trellis and pruned annually the rows need not be more than ten feet apart, and the vines thirty or forty feet in the row. The top bud of cuttings should be covered with an inch of soil to secure the most satisfactory results.

RASPBERRY CULTURE.

The impression prevails with many that the raspberry cannot be successfully grown in the cotton states.

There is some difficulty in growing the black cap type on account of liability of the canes to be sun scalded where they bend over, and their failure, in field culture, to propagate. They propagate by layering at the tips of the new canes in the late fall. If our seasons are dry they often fail to take root. The plants, however, bear abundantly, and may be grown for propagation in partially shaded positions such as the north or west sides of fences.

Twenty-five varieties have been grown for three years in the horticultural grounds of this station, upon high sandy soil, with results showing that the red varieties, and some of the hybrids, propagate as readily as briars, bear as abundantly and endure our long summers equally as well. This is especially true of the Turner and Cuthbert, two exceedingly hardy and productive varieties, producing berries of exquisite beauty and delicious flavor. Golden Queen, a hybrid variety of superior quality, has given entire satisfaction. Schaffer's Colossal, a cap variety, propagates readily by cuttings, produces abundant crops of very large berries of an unattractive purple tinge, and is especially desirable on account of its lateness in ripening, commencing just as the earlier varieties finish bearing and thus prolonging the season. The red varieties propagate by root cuttings and hence should be planted not nearer than four feet each way.

The soil should be made rich for best results with raspberries and kept so by annual top dressings of well rotted compost or a mixture of cotton seed meal, phosphate and kainit, applied in early spring and forked in.

The old canes which have borne fruit must be removed, in winter, from all types. The canes grow one year, bear fruit the next, and die.

The red varieties should have the new canes cut back to two feet in June or July to cause them to branch and become stocky and self-supporting. The cap varieties must not be cut back until winter if plants are desired to be formed at the tips of the vines.

Bul. 3 was inserted between pages 16 & 17 of Bul. 5

BULLETIN NO. 5. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

Auburn. Ala., - - - April, 1889.

Contents :

COTTON—Experiments with Fertilizers.
" " Varieties.
" on different Soils.
PIGS—Feeding for Pork.
CATTLE—Description of Barn and Dairy—Feeding for Butter.
ANALYSES—Of Fertilizers, Soils and Feed Stuffs.
METEOROLOGY—Temperature of Soil at different depths; Atmospheric Conditions; Rainfall, etc.

BROWN PRINTING CO., Montgomery, Ala.

BULLETIN NO. 5,

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - APRIL, 1889.

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†Prof. Mell has also charge of Meteorological Observations.
‡To be filled.

COTTON—EXPERIMENTS WITH FERTILIZERS—COMPARISON OF VARIETIES—ON DIFFERENT SOILS.

J. S. NEWMAN, AGRICULTURIST.

The object of the several sets of experiments with cotton, which follow, was to inquire how much reserve force remained from previous applications of commercial manures to sandy soil which has no retentive clay within three feet of the surface.

Cotton was planted in 1888, *without manure*, upon plats to which different elements and combinations of elements of plant-food had been applied in 1886 and 1887. Comparison of results of 1888 with those of 1886 and 1887 can be made only in the seed cotton, since facilities for ginning the plots separately were not secured until 1888. It will be observed that the principal loss in seed cotton occurred where the different sources of nitrogen were applied.

No difference in the per cent. of lint worthy of comment occurs, except where kainit had been applied and where no manure was used in 1887.

EXPERIMENTS WITH COTTON. OBJECT: To compare effects of different Fertilizers.

		Results in 1888.			1886	1887
No. of Plat.	FERTILIZERS APPLIED IN 1886 AND 1887.	Yield of seed cotton per acre in pounds.	Yield of lint cotton per acre in pounds.	% Lint.	Yield of seed cotton in 1886 in pounds.	Yield of seed cotton in 1887 in pounds.
				%		
1	420 ℔ E. S. Phosphate	301.87	98 31	32.57	240.62	422.30
2	420 ℔ Kainit	319.37	120.21	37.64	373.97	363.20
3	210 ℔ Nitrate of Soda	345.62	110.39	31.94	288.75	420 00
4	140 ℔ Sulphate of Ammonia	385.00	118.15	30.95	424.37	522.13
5	105 ℔ Muriate of Potash	520 62	157.48	30.25	352 10	450 10
6	420 ℔ Cotton Seed Meal	376.25	118.10	31 39	411.25	667.30
7	210 ℔ Blood	297.50	100.61	33.82	315.00	448.70
8	420 ℔ E. S. Phosphate and 420 ℔ C. S. Meal	371.87	115.83	31.15	402.50	603.1
9	420 ℔ E. S. Phosphate, 420 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	424 37	131.21	30 92	402.50	599.60
10	420 ℔ E. S. Phosphate and 105 ℔ Muriate of Potash	315.00	99.38	31 55	297.50	380.10
11	No manure	328.12	63.32	19.30	227.50	163.12

INQUIRY AS TO PROPER RATIO BETWEEN PHOS. ACID AND NITROGEN.

In this experiment the quantities of phos. acid and potash are constant, while the nitrogen varies so as to give the following ratios between the nitrogen and phosphoric acid, from the two sources, dried blood and cotton seed meal:

The ratios are—

1 lb. nitrogen to 1 lb. phos. acid.
1 " " to 2 " "
1 " " to 4 " "
1 " " to 6 " "
1 " " to 8 " "

The smaller quantity of nitrogen applied seemed to furnish as much as the plant with its environments could take up, and the plant seemed indifferent as to the sources from which it derived it. There seemed to be a certain degree of cumulative force in 1887, which was lost by failure to renew by additional applications in 1888. The quantity of nitrogen applied seems not to have affected the relations between the weight of seed and that of the lint.

See tabulated statement on next page.

RATIO BETWEEN NITROGEN AND PHOS. ACID.

No. of Plat.	FERTILIZERS APPLIED IN 1886 AND 1887.	Results in 1888			1886	1887
		Yield of seed cotton per acre in pounds.	Yield of lint cotton per acre in pounds.	% of Lint.	Yield of seed cotton per acre in pounds.	Yield of seed cotton per acre in pounds.
1	420 ℔ E. S. Phosphate, and 105 ℔ Muriate of Potash	472.50	104 32	22.08	402 50	531.90
2	420 ℔ E. S. Phosphate, 350 ℔ Blood, and 105 ℔ Muriate of Potash	520.62	129.01	24.7[illegible]	376.25	706.90
3	420 ℔ E. S. Phosphate, 280 ℔ Blood, and 105 ℔ Muriate of Potash	425.00	133.57	31.43	411.25	592 13
4	420 ℔ E. S. Phosphate, 210 ℔ Blood, and 105 ℔ Muriate of Potash	389.37	124.67	32.02	345.62	557.13
5	420 ℔ E. S. Phosphate, 140 ℔ Blood, and 105 ℔ Muriate of Potash	393.12	126.31	32.13	354.37	529.60
6	420 ℔ E. S. Phosphate, 70 ℔ Blood, and 105 ℔ Muriate of Potash	393.75	127.89	32.48	332.50	463.12
7	420 ℔ E. S. Phosphate, 840 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	433.12	141.06	32.57	459 37	680 50
8	420 ℔ E. S. Phosphate, 560 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	281.37	88.58	31.15	367.50	573.20
9	420 ℔ E. S. Phosphate, 420 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	450 62	141.72	31.45	329.52	599.60
10	420 ℔ E. S. Phosphate, 280 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	288.75	84.17	29.15	321.47	517.80
11	420 ℔ E. S. Phosphate, 140 ℔ C. S. Meal, and 105 ℔ Muriate of Potash	385.00	76.53	19.88	297.50	612.80

THREE FORMS OF PHOSPHORIC ACID.

In 1886 each of the forms of phosphoric acid was applied to two adjacent plats without nitrogen.

In 1887 the same quantities of the phosphoric acid in the three forms, viz: Acid soluble (insoluble), citrate soluble (reduced), and water soluble (soluble), were applied each to one plat, and nitrogen, in cotton seed meal, applied to each of the other plats.

In 1888 all of the plats were planted without manure.

These results indicate very little leaching of the phosphoric acid and a cumulative effect of the floats.

The results in 1888, without additional application, uniformly exceed those of 1886, when the phosphates were first applied, and in No. 1, to which only floats have been applied, yielded more as the effect of the reserve force than in either previous year.

PHOSPHORIC ACID SET.

	Fertilizers Applied in 1887.	Results in 1888.			1886	1887
		Yield of seed cotton in lbs.	Yield of lint cotton in lbs.	% of Lint.	Yield of seed cotton in lbs.	Yield of seed cotton in lbs.
1	420 lbs. Floats	476.87	151.88	31.85	271 25	395.50
2	420 lbs. Floats and 420 lbs. C. S. Meal	472 50	153.09	32.40	336.87	710 50
3	420 lbs. Reduced Phosphate	494.37	120.28	24.33	446.25	568.12
4	420 lbs. Reduced Phosphate and 420 lbs. C. S. Meal	363.12	*55.63	*15.32	354.62	376.40
5	420 lbs. E. S. Phosphate	328.12	118.72	36.00	328.75	363.20
6	420 lbs. E. S. Phosphate and 420 lbs. C. S. Meal	380.62	102.69	26.98	266.87	435.15
7	420 lbs. Floats and 420 lbs. air-slaked Lime	389.37	108.12	27.77	266.87	374.10
8	420 lbs. Floats and 420 lbs. C. S. Meal	341.25	87.49	25 64	280.00	465.50
9	No manure	310 62	66.66	21.46	231 87	282 30

*Evident error.

WILL LIME INCREASE THE EFFICIENCY OF THE PHOSPHATES?

Several years since the opinion was expressed by several agricultural experimenters of national reputation, that the addition of air-slaked lime would increase the activity of acid phosphates. This opinion seemed to be in conflict with the fact that the phosphates have not been uniformly profitable upon calcarious soils. To make practical inquiry into the matter, air-slaked lime was mixed in the drill with both Floats (powdered raw phosphate) and acid phosphate. This was commenced in 1886, repeated in 1887, and cotton planted on the plats without addition of manure in 1888. Note results of plat 7 in the last tabulated statement, where the lime was used with floats, and compare with plat 1 in the same table. Below are results of its use with acid phosphates. It seems not to have produced the effect claimed for it.

AIR-SLAKED LIME AND PHOSPHATE.

	Fertilizers Applied in 1886 and 1887.	Results in 1883.			1886	1887
		Yield of seed cotton in lbs.	Yield of lint cotton in lbs.	% of lint.	Yield of seed cotton in lbs.	Yield of seed cotton in lbs.
1	420 lbs. E. S. Phosphate and 420 lbs. air-slaked Lime	328.12	58.96	17.97	266.25	266.14
2	240 lbs. E. S. Phosphate	354.37	77.50	21.87	240.62	258.20

FLOATS WITH DIFFERENT SOURCES OF NITROGEN.

	Fertilizers Applied in 1887.	Results in 1888.			1886	1887
		Yield in seed cotton per acre in lbs.	Yield in lint cotton in lbs.	% of Lint.	Yield in seed cotton in lbs.	Yield in seed cotton in lbs.
1	420 lbs. Floats and 210 lbs. Nitrate of Soda	166.25	49 16	29.57	202.50	413.70
2	420 lbs. Floats and 140 lbs. Sulph. of Ammonia	170.62	50.21	29 43	262.50	367.80
3	420 lbs. Floats and 210 lbs. Blood	205.62	63.33	30.80	262.50	361.40
4	420 lbs. Floats and 420 lbs. C. S. Meal	188 12	55.64	29.58	236.26	405.15

FLOATS AND ACID PHOSPHATE COMPARED IN COMBINATION WITH NITROGEN AND POTASH.

		Results in 1888.			1886	1887
	Fertilizers Applied in 1886 and 1887.	Yield of seed cotton per acre in lbs.	Yield of lint cotton per acre in lbs.	% of Lint.	Yield of seed cotton in lbs.	Yield of seed cotton in lbs.
38	420 lbs. Gossypium	227.50	76 46	33.61	371.87	306.40
39	420 lbs. Floats and 420 lbs. Kainit	253.75	78.73	31.03	240 62	280.00
40	420 lbs. Floats and 420 lbs. C. S. Meal	350.00	111.47	31.85	350.00	387.30
41	420 lbs. Floats, 420 lbs. C. S. Meal and 420 lbs. Kainit	297.50	95.02	31.94	428.75	519.10
42	420 lbs. E. S. Phosphate and 420 lbs C. S. Meal	358.75	74 36	20 73	433.12	461.90
43	840 lbs. Compost	122.50	40.42	33.00	236.25	445.10
44	No manure	175.00	54.60	31.20	93 75	161.14

CAN IMPROVED METHODS AND THE USE OF FERTILIZERS INCREASE THE PROFITS OF COTTON CULTURE UPON VERY POOR SANDY LANDS?

By order of the Board of Trustees this inquiry was made upon ten acres in a body, taken without regard to topography of the land or quality of the soil. These were thoroughly prepared, well fertilized and carefully cultivated. The fertilizers applied were 1,000 lbs. of compost of cotton seed, stable manure and phosplate and two hundred lbs. of cotton seed meal and acid phosphate, equal parts ot each, per acre, at a cost of seven dollars per acre. These were applied in the drill. One acre of the same average quality as the ten, and adjoining the latter, was planted without manure, for comparison. The cotton on the ten acres grew off beautifully, but in consequence of heavy leaching rains upon the coarse deep sand it began to blight in June and was dead upon nine acres early in August. About one acre lying near a branch continued to fruit until September.

In consequence of the blight, not only did production cease in August, but many bolls already formed failed to mature. The unmanured acre being later was not so early nor so seriously affected.

Both were cultivated entirely with heel scrape. Owing to the frequency of rains, the cotton was plowed once oftener than usual.

An examination of the statements which follow will reveal the fact that the difference in value over cost of production per acre on manured and unmanured land is $5.96, which is attributable to the use of the manure, which cost seven dollars per acre, just three times the usual cost,—and yet we find here the increase resulting from the use of the manure pays 85 per cent. profit upon its cost.

TEN ACRE COTTON EXPERIMENT.

[STATEMENT OF EXPENSE AND PROFIT.]

Cost of breaking land	$ 8 75
“ opening and bedding land	13 12
“ planting cotton	2 50
“ first plowing	5 00
“ second plowing	5 00
“ third plowing	5 00
“ fourth plowing	2 50
“ chopping cotton	8 00
“ second hoeing	6 00
“ fertilizer	70 00
“ scattering fertilizer	7 00
“ picking cotton	29 01
Total expense	$161 88
Total yield of seed cotton	7,253 lbs.
Value of entire crop	$241 76

Summary:

Value of entire crop	$241 76
Total cost of production	161 88
Profit	$ 79 88

Profit on cost, 49 per cent.

ONE ACRE COTTON EXPERIMENT.

[STATEMENT OF EXPENSE AND PROFIT.]

Cost of bedding land	$1 25
“ opening and covering seed	0 69
“ planting seed	0 20
“ first plowing	0 62½
“ second plowing	0 62½
“ third plowing	0 62½
“ fourth plowing	0 62½
“ fifth plowing	0 18½
“ chpping cotton	0 80
“ second hoeing	0 60
“ picking cotton	1 12
Total expense	$7.345
Yield of seed cotton	281 lbs.
Value of crop	$9.366

Summary:

Value of crop	$9.366
Total cost of production	7.345
Profit	$2.021

Profit on cost, 27 per cent.

VARIETIES OF COTTON.

Eleven distinct varieties of cotton were planted for the purpose of comparing their productiveness, quality of lint, &c. As full stands were not secured upon some of the plats, the yield is given per plat and per hill. It was planted in hills 3 by 4 feet. One hundred bolls were picked and weighed at four different times from each variety, the average of which is given in the table. The product of each variety was weighed in the seed, carefully ginned and the lint weighed.

A sample of the lint of each variety was reserved and carefully wrapped and sent to Mr. C. E. Porter of Opelika, who is an expert classifier of cotton. The names of the varieties were not given Mr. Porter, but the samples merely numbered. Mr. Porter's report, in connection with the following tabulated statement of results, will convey very clearly the comparative merits of the varieties.

VARIETIES OF COTTON.

No. of Plat.	NAMES OF VARIETIES.	Average weight of 100 bolls in lbs.	No. of hills to plat.	Yield of seed cotton per plat in lbs.	% of Lint.	Average yield per hill in lbs.
1	Truit	1.83	32	32.00	30.46	1.00
2	Cherry's Cluster	1.50	109	89.25	31.09	0.81
3	Hawkins' Improved	1.41	110	87.00	30.74	0.79
4	Welborn's Pet	1.41	84	75.00	29.66	0.89
5	Jones' Improved	1.58	102	80.50	31.05	0.78
6	King's Improved Prolific	1.41	112	92.00	31.52	0.82
7	Okra Cotton	1.33	122	79.50	30.81	0.65
8	Peerless	1.41	78	72.00	39.58	0.92
9	Rameses	1.41	99	86.50	28.61	0.87
10	Barnett	1.83	110	92.00	30.71	0.83
11	Zellner	1.50	101	75.50	30.46	0.74

Opelika, Ala., March 23d, 1889.

Col. J. S. Newman, Auburn, Ala.:

Dear Sir—Yours of 22d, also samples, received. I send you classification by the New York standard types.

No. 1 (Rameses) classes Strict Middling. Staple one-half to five-eighths inch, fibre very weak and irregular.

No. 2 (Truit) classes Middling. Staple thirteen-sixteenths inch, strong but some little waste.

No. 3 (Barnett) classes Strict Low Middling. Staple seven-eighths inch, strong and regular. Excellent spinning cotton.

No. 4 (Jones' Improved) classes Strict Low Middling. Staple one-half to three-fourths inch, irregular but good spinning cotton.

No. 5 (Zellner) classes Strict Middling. Staple three-fourths inch, strong but a little irregular, with some waste.

No. 6 (Okra) classes Strict Low Middling. Staple one-half to thirteen-sixteenths inch, very irregular, weak and a good deal of waste.

No. 7 (King's Improved Prolific) classes Strict Low Middling. Staple seven-eighths inch and strong; fibre is very fine, but has some small cracked leaf and some waste.

No. 8 (Cherry's Cluster) classes Middling. Staple three-fourths inch, very regular and strong, not much waste, good spinning cotton.

No. 9 (Hawkins' Improved) classes Middling. Staple thirteen-sixteenths inch, rather weak but fibre is regular; sample has a flimsy appearance.

No. 10 (Peerless) classes Strict Middling. Staple thirteen-sixteenths to seven-eighths inch, fibre is fine and regular but not very strong.

No. 11 (Welborn's Pet) classes Strict Middling. Staple three-fourths inch, not strong, rather irregular and some waste.

All of these samples are very well ginned, and well matured, good white cotton.

Yours truly,

C. E. PORTER.

STUDY OF THE SOILS OF THE STATE.

For the purpose of studying the needs of the various typical soils of the State, a dozen sacks of the soil and subsoil from localities representing large areas of the State were collected and subjected to chemical and plant analysis.

Samples of both soil and subsoil were furnished the chemist, the analyses of which will be found in the report of Dr. N. T. Lupton, chemist, in this Bulletin. Bins were prepared 18 inches broad and wide and 12 inches deep, eight for each soil. In these the subsoil was first deposited and the box then filled with soil, thus restoring somewhat the natural conditions.

Different elements and combinations of elements of plant food were applied to seven of these bins, the eighth receiving nothing, as shown in the tabulated statements appended.

A cotton plant was grown in each bin and careful observations made of their development and production. All of the soils were not in place until the second week in June, when the seed were planted.

Owing to the lateness of the planting a few bins on which the seed failed could not be reported upon, as the second plantings were too late to fruit.

The results show very marked differences in the effects of the manures, and valuable *suggestions* are made by them, but *conclusions* should not be drawn from a single experiment.

Attention is invited to the results in the set in which the Thomas Scoria is used. This is a cheap source of phosphoric acid, which is a by-product from the manufacture of iron. Attention is also invited to the similar effects produced by the fertilizers upon the sandy soils of the State.

No. of Bin.	SOIL FROM PIKE COUNTY, ALA.	Date of first blossom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% open.	Total weight from each bin in ozs.	Average weight per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 30.	Nov. 20	2	0	100	0.085	0.0425
2	¼ oz. Cotton Seed Hull Ash (No stand)	......	......	...	...	.....	....	....
3	1 oz. Acid Phosphate	Aug. 14.	Oct. 17.	8	0	100	0.818	0.101
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash	Aug. 28.	Nov. 10.	6	1	85.7	0.712	0.118
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 18.	Oct. 31.	12	2	85.7	1.45	0.120
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phos	Aug. 20.	Nov. 12.	15	1	93.7	1.95	0.130
7	1 oz. Acid Phos. and ¼ oz. C. S. H. Ash	Aug. 16.	Oct. 29.	7	0	100	1.04	0.148
8	No manure (No stand)	......	......	..	..	...	.....	....

No. of Bin.	Soil from Talladega County, Ala.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average weight per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 9.	Oct. 6.	20	0	100	2.294	0.114
2	¼ oz. Cotton Seed Hull Ash.	Aug. 13.	Oct. 14.	9	0	100	0.927	0.103
3	1 oz. Acid Phosphate	Aug. 12.	Oct. 2.	20	0	100	2.46	0.123
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash	Aug. 15.	Oct. 18.	14	0	100	2.13	0.152
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 10.	Oct. 23.	15	0	100	2.10	0.140
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate	Aug. 17.	Oct. 30.	16	0	100	2.291	0.143
7	1 oz. Acid Phos. and ¼ oz. C. S. H. Ash	Aug. 14.	Oct. 9.	16	0	100	1.70	0.106
8	No manure	Aug. 19.	Oct. 26.	12	0	100	1.77	0.147

No. of Bin.	SOIL FROM NEAR LIVINGSTON, SUMTER CO., ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant,	% Open.	Total weight from each bin in ozs.	Av'rage w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 6.	Sept. 28.	12	0	100	2.04	0.170
2	¼ oz. Cotton Seed Hull Ash	Aug. 9.	Oct. 8.	7	0	100	0.809	0.1155
3	1 oz. Acid Phosphate	Aug. 9.	Oct. 8.	9	0	100	1.37	0.1522
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash	Aug. 15.	Oct. 14.	13	0	100	2.19	0.168
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phos	Aug. 9.	Oct. 8.	14	0	100	2.06	0.147
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate	Aug. 1.	Sept. 26.	32	1	96.9	4.13	0.129
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash	Aug. 5.	Sept. 27.	22	0	100	4.16	0.189
8	No manure	Aug. 7.	Oct. 3.	33	0	100	4.20	0.127

No. of Bin.	SANDY SOIL FROM NEAR CITRONELLE, MOBILE CO., ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia........................(Failed to get a stand)							
2	¼ oz. Cotton Seed Hull Ash.	Aug. 22.	Nov. 3.	3	0	100	0.283	0.0943
3	1 oz. Acid Phosphate	Aug. 15.	Oct. 18.	7	0	100	0.748	0.1068
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash	Aug. 14.	Oct. 19.	5	0	100	0.720	0.144
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 5.	Sept. 29.	20	0	100	2.98	0.149
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate	Aug. 16.	Oct. 30	7	0	100	0.739	0.1055
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash.	Aug. 8.	Oct. 1.	8	0	100	1.28	0.160
8	No manure..................................(Failed to get a stand)							

No. of Bin.	"Worn Soil" from near Auburn, Ala.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia..	Aug. 14.	Oct. 14.	12	0	100	1.33	0.1108
2	¼ oz. Cotton Seed Hull Ash.	Aug. 6.	Oct. 10.	6	0	100	0.561	0.0935
3	1 oz. Acid Phosphate...............	Aug. 20.	Oct. 31.	6	0	100	1.02	0.170
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash..............................	Aug. 16.	Oct. 29.	18	0	100	2.55	0.141
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate.........	Aug. 17.	Oct. 16.	5	0	100	0 721	0.144
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate...........................	Aug. 18.	Oct. 16.	4	0	106	0.673	0.168
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash............................	Aug. 7.	Sept. 29.	21	0	100	3.18	0.151
8	No manure......	Aug. 14.	Oct. 8.	8	1	88.8	0.920	0.115

No. of Bin.	VIRGIN SOIL FROM NEAR AUBURN, ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 18.	Oct. 18.	6	0	100	0.568	0.0946
2	¼ oz. Cotton Seed Hull Ash..	Aug. 8.	Oct. 7.	4	1	80	0.383	0 0957
3	1 oz. Acid Phosphate	Aug. 10.	Sept. 27.	10	0	100	0.965	0 0965
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash	Aug. 17.	Oct. 7.	9	0	100	0.989	0.109
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 9.	Sept. 28.	11	0	100	0.660	0.060
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate.	Aug. 9.	Sept. 25.	11	0	100	1.01	0.0909
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash.	Aug. 7.	Oct. 7.	3	0	100	0.854	0.184
8	No manure	Aug. 15	Oct. 9.	4	0	100	0.440	0.110

No. of Bin.	RED SOIL FROM NEAR DADEVILLE, TALLAPOOSA CO., ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 15.	Oct. 18.	5	0	100	0.663	0.132
2	¼ oz. Cotton Seed Hull Ash	Aug. 10.	Oct. 6	9	0	100	0.909	0.101
3	1 oz. Acid Phosphate	Aug. 5.	Oct. 6	15	0	100	1.93	0.128
4	¼ oz. Ammo. Sulph. and ¼ oz. C. S. H. Ash	Aug. 9.	Oct. 3.	13	0	100	2.21	0.170
5	¼ oz. Ammo. Sulph., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 3.	Sept. 27.	18	0	100	2.61	0.145
6	¼ oz. Ammo. Sulph. and 1 oz. Acid Phosphate.	Aug. 8.	Sept. 27.	21	0	100	3.29	0.156
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash.	Aug. 3.	Sept. 27.	22	1	95.6	2.78	0.126
8	No manure	Aug. 15.	Oct. 14.	10	0	100	1.06	0.106

No. of Bin.	SANDY SOIL FROM NEAR DADEVILLE, TALLAPOOSA CO., ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	% Open.	Total weight from each bin in ozs.	Average w'ght per boll in ozs.
1	¼ oz. Sulphate of Ammonia........................(Failed to get a stand.)	....	....	....	....	.....	......	......
2	¼ oz. Cotton Seed Hull Ash.	Aug. 14.	Nov. 10.	5	2	74.1	0.885	0.177
3	1 oz. Acid Phosphate	Aug. 11.	Oct. 15.	6	0	100	0.619	0.124
4	¼ oz. Ammo. Sulph. and ¼ oz. C. S. H. Ash..	Aug. 9.	Oct. 7.	25	0	100	3.05	0.122
5	¼ oz. Ammo. Sulph., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 11.	Oct. 18.	18	1	94.7	2.05	0.114
6	¼ oz. Ammo. Sulph. and 1 oz. Acid Phosphate..	Aug. 12.	Oct. 10.	12	1	92.3	1.28	0.107
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash.	Aug. 4.	Oct. 6.	21	0	100	3.07	0.141
8	No manure..	Aug. 18.	Nov. 3.	3	1	75	0.298	0 099

No. of Bin.	Soil from near Uniontown, Perry Co., Ala.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	Per cent. open.	Total weight from each bin in ozs.	Average weight per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 9.	Oct. 8.	9	0	100	1.05	0.116
2	¼ oz. Cotton Seed Hull Ash	Aug. 12.	Oct. 10.	4	0	100	0.395	0.0987
3	1 oz. Acid Phosphate	Aug. 10.	Oct. 8.	8	0	100	0 634	0.0792
4	¼ oz. Ammo. Sulph. and ¼ oz. C. S. H. Ash	Aug. 8.	Oct. 3.	11	0	100	1.27	0.115
5	¼ oz. Ammo. Sulph., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 7.	Oct. 6	10	0	100	1 01	0.101
6	¼ oz. Ammo. Sulph. and 1 oz. Acid Phosphate	Aug. 11.	Oct. 1.	11	0	100	0.875	0.0795
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash	Aug. 7.	Sept. 29.	28	0	100	4.12	0.147
8	No manure	Aug. 6.	Sept. 30.	18	0	100	2.11	0.117

No. of Bin.	SIX MIXED SOILS FROM BUTLER COUNTY, ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	Per cent. open.	Total weight from each bin in ozs.	Average weight per boll in ozs.
1	¼ oz. Sulphate of Ammonia	Aug. 17.	Oct. 24.	9	0	100	0.793	0.0891
2	¼ oz. Cotton Seed Hull Ash	Aug. 19.	Oct. 21.	9	4	69.2	1.72	0.191
3	1 oz. Acid Phosphate	Aug. 7.	Oct. 18	35	3	92.1	4.68	0.133
4	¼ oz. Sulph. Ammo. and ¼ oz. C. S. H. Ash (No stand)	......	......	...	...	......	......	......
5	¼ oz. Sulph. Ammo., ¼ oz. C. S. H. Ash, and 1 oz. Acid Phosphate	Aug. 13	Oct. 10.	23	0	100	2.73	0 118
6	¼ oz. Sulph. Ammo. and 1 oz. Acid Phosphate	Aug. 11.	Oct. 15.	29	5	85.2	3.71	0.127
7	1 oz. Acid Phosphate and ¼ oz. C. S. H. Ash	Aug. 7.	Oct. 10.	26	0	100	3.38	0.130
8	No manure	Aug. 19.	Oct. 29.	15	0	100	2 30	0.153

NOTE.—For description and analysis of these soils, see report of Chemist in this Bulletin.

No. of Bin.	WORN SOIL FROM AUBURN, ALA.	Date of first bloom.	Date first boll opened.	No. of open bolls to plant.	No. of unopen bolls to plant.	Per cent. open.	Total weight from each bin in ozs.	Average weight per boll in ozs.
1	1 oz. Thomas Scoria.	Aug. 16.	Oct. 15.	9	0	100	0.591	0.0656
2	1 lb. Marl.	Sept. 5.	Oct. 2.	2	0	100	0.203	0.1015
3	1 lb. Marl and ¼ oz. Ammonium Sulphate.	Sept. 7.	Oct. 5.	3	0	100	0.333	0.111
4	1 oz. Thomas Scoria and ¼ oz. Sulph. Ammo.	Aug. 24.	Nov. 4.	3	0	100	0.422	0.1406
5	1 oz. Thomas Scoria and ¼ oz. Cotton Seed Meal..	Sept. 3.	Nov. 26	7	0	100	0.909	0 1296
6	No manure.	Sept. 3.	....	0	7	000	.....	.....

FEEDING PIGS FOR PORK PRODUCTION.

Six Essex pigs, 12 to 14 months old, that had grown fat upon field peas, ground peas and sweet potatoes, gleaned from the fields, were put into separate pens on the 17th December, 1888, and each given as much corn as he would eat, as a preparatory period to detect individual peculiarities and to learn accurately the producing power of whole corn fed wet. The pigs were already fat enough when put up, and by the second period, in which each was fed differently as shown in the accompanying tabulated statement, were excessively fat.

This being true, their capacity for laying on additional fat was reduced.

The gradually diminishing ratio of increase from the first to the last period indicates that the profits of feeding diminish with increased fatness. This is especially shown in No. 1, which was fed continuously upon corn. It would not be just to make any charge for the ground peas, field peas, sweet potatoes or buttermilk, since these as ordinarily consumed by hogs on the farm are waste products, which would be largely lost if not consumed by swine. This is especially true of the ground peas, sweet potatoes and field peas which are gleaned from the fields by swine and converted into pork.

The condition of the pigs when fed upon these products renders a repetition of the experiment upon pigs not so far advanced in fatness. A box with a trap door at each end, and a sliding door to each pen, rendered weighing very convenient without unnecessary excitement to the pig. An attempt was made in the second period to feed cotton seed meal, but the pig refused to eat it.

The pigs were butchered 21st January. Gross and net weight of each is given in the tabulated statement. To ascertain the loss sustained in curing, the hams from each pig were weighed before salting, when taken up for hanging, and 28th March, after being smoked for 34 days, with results shown in accompanying table.

EXPERIMENTS WITH SWINE,

TO COMPARE EFFECTS OF DIFFERENT FEED STUFFS.

Hog No.	Food Eaten. First Period—15 days.	Weight of Hogs at beginning of period.	Weight of Hogs at end of period.	Gain of Pork.	Pounds of food to one of Pork.	Gross weight of Hogs at end of experiment.	Net weight at end of experiment.	Net per cent.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1	119.2 lbs. Corn..............	183	221	38	3.13	250	200	80.0
2	119.2 "	188	222.5	34.5	3.45	238	186.75	78.4
3	134.8 "	161 5	196	34.5	3 90	210	167	79.5
4	119.2 "	173	202	29	4.11	217	167.25	77.0
5	134.8 "	207	247	40	3 37	284	232.50	81.8
6	119.2 "	174	200	26	4.58	218	176	80.7
	SECOND PERIOD—15 days.							
1	116 lbs. corn.................	221	246	25	4.64	......	......	....
2	79 " peas.................	222.5	236	13.5	5.85	......	......	....
3	246 " potatoes.............	196	211	15	16.44	......	......	....
4	92 " ground peas..........	202	212	10	9.20	......	......	....
5	42 " gr. peas, 81 lbs. corn.	247	276	29	3.24	......	......	....
6	129 lbs. potatoes, 264 butt'rmilk	200	212	12	32.75	......	......	....

EXPERIMENTS WITH SWINE—TO COMPARE EFFECTS OF DIFFERENT FEED STUFFS—Continued.

Hog No.	FOOD EATEN. THIRD PERIOD—(6 Days.)	Weight of Hogs at beginning of period.	Weight of Hogs at end of period.	Gain of Pork.	Pounds of Food to one of Pork.	WEIGHT OF HAMS.							
						Green.		When hung for smoking.		After smoking, 28th March.		Loss in Curing.	
		lbs.	lbs.	lbs.	lbs.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1	48 lbs. corn..	246	250	4	12	17	8	16	4	15	4	2	4
2	36 " peas.....	236	238	2	18	15	6	15	0	13	10	1	12
3	120 " potatoes..	211	210	1 loss.	......	13	8	13	0	12	0	1	8
4	36 " ground peas......	212	217	5	42.4	14	2	13	6	12	6	1	12
5	24 " ground peas and 36 lbs. corn	276	284	8	34.5	21	0	20	2	18	5	2	11
6	60 " potatoes and 120 lbs. buttermilk..........	212	218	6	35.33	14	6	13	12	13	0	1	6

TURNIPS.

KEEPING QUALITIES OF VARIETIES.

Twenty-five varieties of turnips, grown last fall, were gathered and banked in the open ground December, 1888, covered with pine straw, corn stalks and earth, as sweet potatoes are banked.

All were opened 28th March, 1889, and the following notes made after a careful examination:

VARIETIES.	CONDITION.
Amber Globe Strap-leaf	Partly rotted and pithy.
Aberdeen, or Scotch Yellow	" " "
Cow Horn	Sound but pithy.
Early White Egg	Sound, brittle and sweet.
Early Snowball	Rotted.
Early Flat Dutch Strap-leaf	Sound but very pithy.
Earliest Bloomsdale Red-top	Sound but slightly pithy.
Golden Rose	Sound but very pithy.
Landreth's Snow White Globe	Pithy and commencing to rot.
Large Early Red-top Globe	Badly rotted.
Milan Strap-leaf	Pithy but sound.
Norfolk	Rotted.
Purple-top Strap-leaf	Very pithy but sound.
Purple-top Munich	Sound but very pithy.
Pomerarian White Globe Strap-leaf	Rotted.
White Globe Strap-leaf	Pithy and beginning to rot.
White Globe	Rotted.
White Stone	Rotted.
RUTA BAGAS.	
Bloomsdale Swede Imp'd Purple	Pithy and beginning to rot.
Champion Swede	Sound but pithy.
Improved Yellow Purple-top	Sound and brittle—perfect.
Long French	" " "
Prussian	" " "
Sweet German	" " "
White flesh'd Purple-top White Swede	" " "

The yield of these varieties was reported in Bulletin No. 3, New Series.

DESCRIPTION OF BARNS AND DAIRY—FEEDING EXPERIMENTS.

By Isaac Ross, First Assistant Agriculturist, in Charge of Dairy and Live Stock.

This being the first report since the establishment of this department, I deem it not amiss to give to the public a short description of the plan of the Barn, Dairy, Ice House, &c.

The barn for the cattle is built of yellow pine, 40 by 60 feet, 9 feet from floor to joist; through the middle and running the long way is an alley, or passage, 8 feet wide and floored. On the right, as you enter the barn from the front, is an office 10 by 12 feet, furnished with desk, table, chairs, clock, stove, etc., on the left, a room of the same size, containing three feed-bins with tight covers, and scales for weighing milk. This room is also used for the milkers to prepare themselves for milking.

On either side of the alley there are nine stalls 4 ft. wide; in rear of, and running the entire length of the stalls, is a waste trough to catch both liquid and solid manure, and by the use of an absorbent all is saved.

At the end of the alley is a large comfortable box-stall for calving cows.

The floor is of cement from outer walls to feed trough, and sliding glass windows are on both sides. There are two large doors in the back end of the barn through which the cattle enter, and double doors in front with ventilator overhead, thus securing plenty of fresh air during summer, and warm stable during the winter. The building is neatly painted.

The dairy is built of same material as barn, except in the rear where cutting into the side of a hill rendered a brick wall necessary. It is 16 by 20 feet, 10 feet from floor to ceiling, with partition across the long way, thus dividing the building into two rooms. The front room is used for churning, working butter, moulding and shipping; the other and smaller room is used for the creamer and vat, and in one end of this apartment is the cold storage room for butter.

The walls of the dairy have a six-inch dead air space, lined on inside with two thicknesses of plank, with building-paper between; floor cemented, and a terra cotta drain-pipe running fifty feet off. The double doors and windows are covered with wire gauze.

Adjoining the dairy is the brick ice house, with the capacity of a car load of ice. The walls are 20 inches thick with dead air space.

The dairy is supplied with all the latest improved dairy apparatus for butter making. On the outside and near the west wall is a number one well of pure clear water, with pump, water tank and pipes connecting the same with creamer on inside. Like the barn, this building is neatly painted. Total cost of cattle barn, dairy and ice house is $800.

At a convenient distance from the cattle barn are located the feed grinding and cutting rooms, 50 by 60 feet. In one end is the Silo of 35 tons capacity. The entire machinery is run by steam power.

Next in order comes the cattle, 27 head—13 A. J. C. C. Jersey cows of the best butter blood grace the barn. Two Jersey bulls, one Holstein bull calf, with Jersey calves and yearlings, constitute the remainder. The first bull, Ida's Stoke Pogis 2d, is sired by Ida's Stoke Pogis, out of Duchess of Bloomfield 2d, a daughter of the great Tormentor. He is closely related to every cow with an *official* test of 30 pounds of butter in 7 days—a combination through the best butter channels of St. Lambert and Coomasse. The second bull is Signal Ransom, sired by Dunraven (a son of Tenella), out of Edwina 2d, a daughter of Edwina. As his name indicates, he is an inbred Signal, and, judging from his calves, he is the equal of his breeding.

The practical work of the dairy began on December 1st, 1888, beginning with 10 cows, 3 coming fresh since; two of the herd are heifers with first calves, two now being dried off, two more to calve in May. Young calves born since December 1st fed principally upon whole milk. The change incident to moving the cattle from one farm to another placed the herd at a very great disadvantage for the first 30 days. Jersey cows are extremely sensitive to any sudden change, as all great dairy cows should be, and are possessed of a nervous temperament. The output of the dairy has been within a small fraction of a pound of butter per day for each cow; apparently a small yield, but one half the herd has been doing the greater part of it; no forcing, but good feed and proper care of the animals. All are and have been in most excellent condition, and their almost silken coats in midwinter must be largely due to the 3 lbs. of cotton seed meal each is getting per day. In addition to this, we are now feeding daily one-third each of ground oats, corn meal and bran, or 10 lbs. per day (by weight)—15 to 20 lbs. of ensilage and 4 to 6 lbs. of hay, divided into two feeds. Three cows now undergoing an experiment are fed differently.

Our experience in creaming milk as between the Cooley Creamer and DeLaval Separator is limited, the Separator having been in use only for a short while. After the few trials that have been made, I can see but little difference in the results, I am aware that in all the great dairy centers where large quantities of milk are gathered, and from many of the different breeds of dairy cattle, the superiority of machine creaming is unquestioned, or that the place for the machine is at the butter factory. For the small farmer or dairyman, those more particularly who are so fortunate as to have on their farms cold springs of running water the year round, and where the cow and the creamer being very near each other, the milk set to the best advantage—which is warm,—thus situated and under these conditions, I do not think as yet that the question has been decided in favor of the Separator. Here at the Station we shall strive to give each system or method during the year a fair and impartial test—side by side, and after *repeated* trials (one or two being of no value), we will be much better prepared to give an opinion than at present. We do not know which is the superior, or the most profitable.

Experiments with Prof. Short's method of determining the butter fats in milk are in progress, and will be reported in the next Bulletin.

The following summary of the work of the dairy may be of interest to dairymen:

MONTH.	Pounds Milk.	Pounds Butter.	lbs. Milk to make lb. of Butter.	Cost of Feed per day.	Butter sold per pound.	$	cts.
1888.							
December.	4,113½	275	14.94	19c.	35c. net.	96	25
1889.							
January..............	5,201	302¾	17.17	"	"	105	96
February	4,831½	301¾	16.01	"	"	105	61

Ten cows in dairy from December 1st to February 20th, and since then thirteen; two of which are heifers with their first calves; two cows being dried off, and two due to calve in May; and the whole herd have been bred and are believed to be safe in calf. All skim-milk not fed to the calves sold at 15 cents per gallon; buttermilk not fed to the hogs sold at 10 cents per gallon at the dairy.

EXPERIMENTS IN CATTLE FEEDING, AS ORDERED BY THE DIRECTOR.

COWS—Food consumed in Fourteen Days. Yield of Milk and Butter.

First Period.	No. Days.	lbs. Bran.	lbs. Ground Oats.	lbs. Corn Meal.	lbs. Ensilage.	lbs. Collards.	lbs. Rye.	lbs. Milk.	Butter.	
									lbs.	oz.
No. 1. Hattie Signal 2d	14	46⅔	46⅔	46⅔	238	......	.....	263	14	13
2. Kate Hazen	14	46⅔	46⅔	46⅔	.....	448	......	240	15	5
3. Lady Toorner	14	46⅔	46⅔	46⅔	..	......	308	142	10	4

COWS—Food consumed in Fourteen Days. Yield of Butter and Milk.

Second Period.	No. Days.	lbs. Bran.	lbs. Ground Oats.	lbs. Corn Meal.	lbs. Cotton Seed Meal.	lbs. Ensilage.	lbs. Johnson Grass.	lbs. Clover.	lbs. Milk.	lbs. Butter.	
										lbs.	oz.
No. 1. Hattie Signal 2d	14	46⅔	46⅔	46⅔	42	364	......	.....	288	16	6
2. Kate Hazen	14	46⅔	46⅔	46⅔	42	....	... ..	154	252	16	11
3. Lady Toorner	14	46⅔	46⅔	46⅔	42	......	84	.....	143	8	4

For analysis of feed stuffs see report of Chemist in this Bulletin.

FEEDING EXPERIMENT.

A preparation period of seven days preceded each feeding experiment, during which no note was made of yield, this period being intended to bring the animal under the influence of the new food and insure exemption from the effects of the previous food.

During the first seven days all of the cows were fed upon the same food and subjected to the same environments in every respect, for the purpose of detecting individual peculiarities.

The food being tested was increased or diminished in quantity given, as the appetite of the cows seem to require.

In the first period each cow ate 140 lbs. of bran, ground oats and corn meal mixed, or 10 lbs. per day. In addition to this, No. 1 was fed 238 lbs. ensilage, No. 2, 448 collards, and No. 3. 308 lbs. rye.

In second period the grain ration was continued as above, and added to this 42 lbs. cotton seed meal to each cow; for No. 1 the ensilage was continued, but increased to 364 lbs., and for Nos. 2 and 3 clover hay and Johnson grass was substituted in place of collards and rye. See table.

Cows Nos. 1 and 2 four years old; No. 3 two year old heifer with first calf.

REPORT OF THE CHEMIST.

The work in the Chemical Laboratory during the present quarter has embraced a variety of commercial fertilizers, feed stuffs, dairy products, and miscellaneous substances, with results as given below.

The methods of analysis adopted at the fifth annual convention of the Association of Official Agricultural Chemists, held at the United States Department of Agriculture August 9th and 10th, 1888, have been strictly followed.

The rates of valuation for commercial fertilizers in Alabama, as fixed for the present season, are as follows:

Water Soluble Phosphoric Acid,	7½	cents	per pound.
Citrate " " "		"	"
Nitrogen, - - - -	19½	"	"
Potash, - - - -	5	"	"

Relative commercial values are intended as indicators to farmers and planters of the comparative agricultural and practical values of different fertilizers, and they will be found to be a safe guide in making purchases.

PHOSPHATES WITH NITROGEN AND POTASH.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
1135.	Guanaco Guano	N. H. Holmes, Montgomery, Ala	8.08	0.79	2.49	1.96	1.75	$22.60
1136.	Etiwan Guano	Etiwan Phos. Co., Charleston, S. C	4.94	4.07	5.38	1.96	1.77	22.92
1138.	Plow Brand Rawbone Superphosphate	Walton, Whann & Co., Wilmington, Del.	4.80	4.62	4.40	2.10	2.39	24.71
1139.	Reliance Am. Superphosphate	“ “ “ “	5.39	4.00	4.95	1 82	1.88	23.25
1140.	Etiwan Am. Superphosphate	Etiwan Phos. Co., Charleston, S. C	5.52	4 50	4.90	1.54	1.91	22 94
1141.	Clark's Soluble Guano	Southern Phos. Co., Atlanta, Ga	8 58	0.82	0 65	2.31	2.89	25 99
1142.	Southern Am. Dis. Bone	“ “ “	8.87	0.18	0.95	2.69	2.48	26.56
1143.	Old Dominion Guano	“ “ “	8.44	1.26	0.74	2.24	2.48	25.72
1145.	Potent Pacific Guano	“ “ “	8.42	1.00	0.72	2.41	2.79	26.32
1146.	Samana Guano	“ “ “	8.73	1.03	0.70	2.31	2 45	26.09
1153.	Plow Brand	W. F. Vandiver & Co., Montgomery, Ala.	4.70	5.10	4.40	2.17	2.15	25.31
1154.	Am. Dis. Bone	“ “	6.33	5.89	4.21	1.54	2.04	26.37

1155.	Reliance	" "	4.76	4.44	3.76	3.08	1.67	27.48
1157.	Lister's Harvest Queen	Lister's Ag. & Ch. Works, Baltimore, Md.	8.21	2.39	1.74	1.68	1.79	24.24
1158.	Lister's Standard Phosphate	" "	8.25	3.81	1.36	2.17	1.58	28.14
1159.	Lister's A. D. Bone	" "	8.08	3.40	1.46	1.96	1.65	26.51
1160.	Lister's Celebrated Ground Bone	" "	0.64	9.44	3.93	2.73	0.53	26.29
1161.	Perfect Guano	Troy Fertilizer Co., Troy, Ala.	7.02	1.32	3.50	2.31	1.50	23.01
1164.	Crown Guano	Treadwell, Abbott & Co., Atlanta, Ga.	4.60	5.00	4.97	2.31	2.17	25.57
1170.	Ground Am. Bone	N. H. Holmes, Montgomery, Ala.	.....	2.53	7.37	4.20	0.34	20.51
1172.	"Fertilizer"	J. J. Woodall, Hartselle, Ala.	2.49	1.21	0.14	1.61	6.09	17.91
1173.	Harvest Queen	John T. Davis, Jr., Columbia, Ala.	9.63	1.59	0.83	1.82	2.11	21.03
1174.	Am. Dis. Bone	" "	8.98	4.17	0.88	1.91	2.46	29.62
1175.	Am. Guano	Rasin Fertilizer Co., Baltimore, Md.	8.04	2.61	3.05	2.13	2.30	26.57
1176.	Soluble Pacific Guano	Frank S. Roberts, Mobile, Ala	6.14	3.10	2.83	2.03	1.98	23.75
1179.	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala.	3.82	3.34	3.36	2.66	2.29	23.40
1181.	Am. Dis. Bone	Treadwell, Abbott & Co., Atlanta, Ga.	5.28	3.93	1.27	1.82	1.46	22.36
1184.	Georgia State Stan. Am. Superphosphate	Hammond, Hull & Co., Port Royal, S. C.	7.14	1.43	2.95	1.75	2.40	22.55
1186.	Am. Dis. Bone	" "	9.38	1.36	1.91	1.61	1.46	23.84
1187.	Hammond, Hull & Co's Animal Bone	" "	8.08	4.88	1.61	5.39	5.32	45.78

PHOSPHATES WITH NITROGEN AND POTASH—Continued.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
1209.	Fertilizer (light color)	Frank P. Kelly, Troy, Ala	2.16	2.52	1.04	0.35	0.43	$ 8.80
1210..	“ (dark color)	“ “	1.01	2.99	0.66	0.28	0.27	7.44
1211..	Pike County Guano	Ed. F. McKinnon, Inverness, Ala	3.80	5.73	1.95	2.48	1.58	25.54
1212..	Eddystone Guano	“ “	5.43	5.15	1.57	2.62	1.90	28.00
1213.	Fertilizer	Frank P. Kelly, Troy, Ala	3.10	3.01	1.98	0.77	0.96	13.11
1214..	Coweta High Grade	Coweta Fertilizer Co., Newnan, Ga	10.31	0.98	0.67	2.59	1.65	28.68
1215..	Aurora Am. Phosphate	“ “	8.98	1.05	1.83	2.24	2.06	25.83
1224..	Fertilizer	Ed. F. McKinnon, Inverness, Ala	3.26	4.95	4.07	2.80	1.50	24.73
1225..	Georgia State Grange Fertilizer	O. W. Cooper & Co., Oxford, Ala	9.17	1.77	2.71	1.92	2.16	26.07
1226..	Eutaw Fertilizer	Ashepoo Phosphate Co., Charleston, S. C.	4.68	2.76	3.72	2.20	1.61	24.61
1227..	Fertilizer	G. W. Braswell, Perote, Ala	1.97	4.28	1.43	1.40	0.74	15.57
1229..	Baugh’s Rawbone Phosphate	O. W. Cooper & Co., Oxford, Ala	7.73	3.28	3.83	2.38	0.51	25.30

ACID PHOSPHATES.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	PHOSPHORIC ACID. Citrate Soluble.	PHOSPHORIC ACID. Acid Soluble.	Commercial value.
1137..	XX Acid Phosphate..........................	Etiwan Phos. Co., Charleston, S. C..........	11.69	2.30	3.23	$21.73
1144..	Southern Acid Phosphate.....................	Southern Phosphate Co., Atlanta, Ga.........	14.55	0.74	1.35	22.93
1162..	Acid Phosphate...............................	Troy Fertilizer Co., Troy, Ala.....	11.04	3.17	4.72	21.31
1166..	"Fertilizer".................................	J. W. Hamvil, Troy, Ala......................	7.36	3.37	3.43	16.23
1167..	"Phosphate".................	M. T. Traywick, Opelika, Ala................	10.26	2.72	3.58	19.47
1168..	"Phosphate".................................	" "	10.46	2.19	3.47	19.02
1180..	Phosphate Gossippia..........................	Troy Fertilizer Co., Troy, Ala...............	9.17	2.28	5.02	17.19
1185..	Georgia State Stan. Acid Phos...............	Hammond, Hull & Co., Port Royal, S. C.....	12.36	0.06	2.09	19.44
1193 ..	Phosphate No. 1.............................	C. D. Worman, Montgomery, Ala............	10.36	2.96	0.33	20.08
1194..	" No. 2 (wet).......................	" "	9.48	2.34	0.12	17.73
1195..	English Acid Phosphate..............	Harmony Alliance, Skelton, Ala.............	11.94	2.23	0.23	21.25
1196..	" "	A. G. Miller, Skelton, Ala..................	12.26	1.71	0.25	20.95

ACID PHOSPHATES—Continued.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	PHOSPHORIC ACID. Citrate Soluble.	PHOSPHORIC ACID. Acid Soluble.	Commercial value.
1207..	Phosphate..............................	S. B. Shivers, Selma, Ala...................	......	1.00	4.32	.....
1208..	Phosphatic Nodules in Rotten Limestone.....	J. F. Wiatt, Coatopa, Ala....................	......	.....	12.63	.....
1218..	Phosphate................................	L. D. Cox, Tuskegee, Ala.....................	11.05	2.91	2.72	$20.94
1219..	Phosphatic rock..........................	S. B. Shivers & Co., Selma, Ala..............	.....	......	6.13	......
1221..	Phosphatic rock (brown)................. ...	Columbus Fertilizer Co., Columbus, Ga......	....	.....	18.41	......
1222..	" " (blue).......................	" " .	......	......	24.16	......
1228..	Acid Phosphate..	O. W. Cooper & Co., Oxford, Ala............	3.99	5.99	3.90	14.97
1230..	Keystone Concentrated Phosphate...........	W. F. Vandiver & Co., Montgomery, Ala.....	.....	24.72	21.79	37.08
1231..	Acid Phosphate............................	S. A. Lowery, Evergreen, Ala.................	12.72	1.44	0 62	21.24
1232..	Raw Phosphate............................	W. H. Newman, Uniontown, Ala.............	......	......	4 08	.....

MISCELLANEOUS FERTILIZERS.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial value.
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1147	Ammonium Sulphate	J. S. Newman, Auburn, Ala.	20.44					
1148	Sodium Nitrate	" "	13.51					
1149	Muriate of Potash	" "					48.77	
1150	Kainit No. 1	" "					12.38	
1151	" No. 2	" "					11.36	
1152	China Berries	" "	1.61			0.43	1.19	
1156	Swan Island Guano	Davis, Marshall & Co., Mobile, Ala		0.37	14.75	7.61		
1163	Phosphatic Rock	Troy Fertilizer Co., Troy, Ala				27.78		
1165	Cotton Seed Meal	N. H. Holmes, Montgomery, Ala	7.00			3.44	1.88	
1169	Kainit	Davis, Marshall & Co., Mobile, Ala					11.75	
1171	Phosphatic Marl	Tinsley Fertilizer Co., Selma, Ala				9 96		
1182	Kainit	Hammond, Hull & Co., Port Royal, S. C.					12.68	

MISCELLANEOUS FERTILIZERS—Continued.

No. Station.	NAME OF FERTILIZER.	BY WHOM SENT.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial value.
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1188	Swan Island Guano	Frank S. Roberts, Mobile, Ala.	....	0.94	14.49	6.20	....	....
1190	Cotton Seed Hull Ash	Zimmerman Bros., Mobile, Ala.	....	....	....	10.04	23.73	....
1205	Bat Manure	Hon. R. F. Kolb, Montgomery, Ala.	8.82	....	....	5.20	2.12	....
1206	Natural Phosphate	" "	0.35	....	....	13.01	2.12	....
1220	Marl	G. W. Creagh, Suggsville, Ala.	....	....	....	0.11	....	9.52 Carb. Lime
1223	Shell Marl	W. F. Vandiver & Co., Montgomery, Ala.	....	....	....	0.23	....	27.65 " "
1233	Kainit	W. H. Newman, Uniontown, Ala.	....	....	....	....	11.00	....
1234	Cotton Seed Meal	" "	7.14	....	....	3.23	1.69	....
1235	Cotton Seed Hull Ash	" "	....	....	....	10.96	28.17	....

MISCELLANEOUS FERTILIZERS—Continued.

Station No. 1189—Land Plaster, W. F. Vandiver & Co., Montgomery, Ala.

Moisture and Water of Combination....	21.15	per cent.
Calcium Oxide (Lime).................	32 82	"
Sulphuric Acid (S. Oz.)................	45.95	"
Total..............................	99.92	

Station Nos. 1198–1204—Phosphatic Nodules, J. M. Carter, Olustee, Pike County, Ala.

	No. 1.	2.	3.	4.	5.	6.	7.
Phosphoric Acid............	6.57	0.34	18.88	1.67	0.18	0.08	13.38

Numbers 1, 2 and 7 consist of Shells and Phosphatic Nodules, which are quite valuable if found in large quantities.

ANALYSES OF FEED STUFFS FROM THE EXPERIMENT STATION.

	Ground pea.	Field pea.	C. S. Meal.	Oats.	Bran.	Corn Chops.	Sweet Potatoes.	Johnson Grass.	Ensilage.	Green Rye.	Collards.
Water	7.015	13.965	8.477	10.555	12.808	14.148	61.250	11 564	60.932	71.518	85.764
Ash	1.824	2.937	6.475	3.122	5.492	1.202	0.997	8.398	2.430	1 286	1.550
Ether Extract (Fats and Oils)	42 587	1.290	8.218	4.668	4.174	3 788	0.521	1.279	1.818	1.257	0.749
Crude Protein (Albuminoids)	26.698	21.025	47.719	14.406	17.275	10 362	3.444	6.037	3.215	4.606	5.744
Crude Fibre	2.490	5.351	7.278	10.453	8.024	1.676	1.009	34.411	13 766	7.083	1.812
Nitrogen Extract (Starch, etc.)	19.386	55.432	21.833	56.796	52.227	68.824	32.779	38.311	17.839	14 250	4.381
Total	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Nitrogen.. Total	4.272	3.361	7.634	2.305	2.764	1 658	0.551	0.966	0.553	0.737	0.919
Nitrogen.. Albuminoid	4.048	2.209	7.362	2.026	2.673	1.658	0.551	0.966	0.553	0.736	0.460

The above-mentioned feed stuffs when received for analysis were in the usual condition of such materials as they are fed to stock during the winter. It may be well to state a few particulars in regard to each, as follows:

1. The ground peas, of the Virginia variety, were carefully freed from hulls before analysis.
2. The shelled field pea was of the usual Clay variety.
3. The cotton seed meal was analyzed as it came from the mill. An attempt was made to separate and determine the actual amount of hull contained in the meal, but the results were not satisfactory. The quality of the sample used was very good.
4. The specimen of oats was a northern variety, with small white grain.
5. The bran was of good quality.
6. The sweet potatoes were what is generally known as the "Red Burmuda" variety, grown for stock feeding.
7. The corn came from the northwest, and was coarsely ground.
8. The ensilage was made of Indian corn, cut and placed in the silo just after it had passed the roasting-ear condition.
9. The Johnson grass came from Mr. M. C. Scott near Montgomery, and was well cured.
10. The rye was sown in drills in September and used for green soiling during the winter.
11. The collards were transplanted in October and fed during February and March.

RESULTS OF ANALYSES OF AIR-DRIED SOILS AND SUBSOILS FROM VARIOUS LOCALITIES IN ALABAMA.

Locality…	Experiment Station, Auburn.		Experiment Station, Auburn.		Butler Co.		Talladega Co.		Pike County.	
Variety…	Virgin soil. Sandy Drift.		Worn soil. Sandy Drift.		Gray pine land.		Gray loam.		Ridge Land. ash gray color.	
Soil marked…	Soil. 1 (a)	Subsoil 1 (b)	Soil. 2 (a)	Subsoil 2 (b)	Soil. 8 (a)	Subsoil 8 (b)	Soil. 9 (a)	Subsoil 9 (b)	Soil. 10 (a)	Subsoil 10 (b)
Station number…	1001.	1002.	1003.	1004.	1129.	1130.	1131.	1132.	1133.	1134.
Moisture…	3.686	1.535	0.981	0.512	2.559	2.469	3.676	3.670	0.817	1.267
Insoluble silica…	82.131	88.718	89.713	91.602	78.379	68.586	66.126	68.159	92.931	85.507
Hydrated silica…	2 253	2.173	1.909	2.161	4.759	11.084	8.627	7.280	2.118	5.417
Soluble silica…	0.194	0.115	0 307	0.067	0.105	0.198	0.153	0.175	0.067	0.102
Sesquioxide of iron (F.$_2$ O.$_3$)…	1 432	0 505	0.813	1.028	1.864	3.584	3.942	4.128	0.812	1.601
Alumina (Al.$_2$ O.$_3$)…	3.028	3.140	1.867	2.590	4.562	9.684	8.007	8.020	1.609	4 472
Phosphoric acid (P.$_2$ O.$_5$)…	0.059	0.093	0 056	0.060	0.029	0 020	0.150	0.174	0 032	0.035
Lime (Ca. O.)…	0.091	0.031	0.086	0.034	0.275	0.176	0 289	0.255	0.039	0.050
Magnesia (Mg. O.)…	0.058	0.023	0 072	0.012	0 293	0 409	0.633	0.654	0.062	0.081
Potash (K.$_2$ O.)…	0.062	0.090	0.034	0.092	0.182	0.194	0.903	0.992	0 149	0.174

Soda (Na_2O.)	0.184	0.718	0.440	0.281	0.550	0.410	0.391	0.287	0.350	0.293
Sulphuric acid ($S. O._3$)	0.101	0.041	0.056	0.021	0.103	0.068	0.233	0.177	0.127	0.153
Chlorine	0.009	0.011	0.015	0.014	0.006	0.008	0.056	0.039	0.009	0.008
Carbonic acid ($C. O._2$)	0.180	0.058	0.106	0 095	0.133	0.046	0.114	0.154	0.066	0.088
Volatile and organic matter	5.838	2.064	3.208	1.112	5.462	3.219	5.969	6.089	1.553	1.603
Total	99.308	100.315	99.663	99.681	99.361	100.155	99.369	100.253	100.741	100.851
Nitrogen	0.370	0.274	0 293	0.253	0.260	0.239	0.260	0.280	0.109	0.087
The air-dried soil contains—										
Coarse gravel	31.20	22.11	26.18	18.13	8 50	6.91	9.81	12.49	1.50	1.92
Fine material	68.80	77.89	73.82	81.87	91.58	93.09	90.19	87.51	98.50	98.08

RESULTS OF ANALYSES OF AIR-DRIED SOILS AND SUBSOILS FROM VARIOUS LOCALITIES IN ALABAMA.

Locality...	Citronelle.		Sumter Co.		Perry Co.		Tallapoosa County.			
Variety	Sandy Gray Land.		Light Prairie Soil.		Cultivated Slough Bottom.		Pine Land. Gray-Sandy.		Hickory land Red.	
Soil marked	Soil. 3 (a)	Subsoil 3 (b)	Soil. 4 (a)	Subsoil 4 (b)	Soil. 5 (a)	Subsoil 5 (b)	Soil. 6 (a)	Subsoil 6 (b)	Soil. 7 (a)	Subsoil 7 (b)
Station Number	1023	1024.	1025.	1026.	1027.	1028.	1029.	1030.	1031.	1032.
Moisture	1.297	1.127	2.367	1.494	7.468	8.803	3.530	1.753	3.676	2.699
Insoluble silica	87.644	81.926	80.628	84.958	39.437	36.585	72.576	84.654	62.896	61.929
Hydrated silica	2.964	5.958	4.561	4.338	19.784	22.374	4.570	3.019	8.272	10.283
Soluble silica	0.062	0.080	0.126	0.084	0.062	0.311	0.236	0.116	0.115	0.323
Sesquioxide of iron ($F._2\ O._3$)	1.075	2.031	1.912	2.175	5.448	6.857	1.792	1.744	7.168	7.789
Alumina ($Al._2\ O._3$)	2.568	5.877	4.128	4.183	12.158	15.981	4.007	3.978	8.393	10.753
Phosphoric acid ($P._2\ O._5$)	0.037	0.027	0.196	0.134	0.207	0.152	0.050	0.050	0.052	0.085
Lime (Ca. O.)	0.066	0.073	0.386	0.158	3.742	1.256	0.186	0.116	0.517	0.056
Magnesia (Mg. O.)	0.005	0.018	0.014	0.017	0.212	0.671	0.009	0.115	0.362	0.514
Potash ($K._2$ O.)	0.130	0.158	0.183	0.171	0.866	0.621	0.232	0.233	0.348	0.389

Soda (Na_2O)	0.254	0.273	0.393	0.376	0.909	0.876	0.447	0.443	0.760	0.503
Sulphuric acid ($So._3$)	0.038	0.029	0.089	0.033	0.120	0.069	0.053	0.051	0.096	0.122
Chlorine	0.009	0.012	0.021	0.011	0.015	0.020	0.006	0.124	0.006	0.017
Carbonic acid ($C. O._2$)	0.136	0.044	0.137	0.134	0.938	0.213	0.249	0.075	0.214	0.140
Volatile and organic matter	3.792	2.330	4 942	1.856	7.345	5.466	12.053	3.759	7.248	4.149
Total	100.077	99.963	100.080	100.122	99.771	100.253	100.002	100.220	100.132	99.751
Nitrogen	0.295	0.294	0.195	0.087	0.282	0.087	0.245	0.087	0.260	0.195
Air-dried soil contains—Coarse gravel	2.229	1.373	4.539	3.903	......	......	11.412	11.906	20.849	13.407
Fine material	97.771	98.627	95.461	96.097	100.000	100.000	88.588	88.094	79.151	86.593

The above results of soil analyses, published in the Bulletins of last year, are here brought together and republished for more convenient reference. The methods of analysis, as detailed in Bulletin No. 10 issued from the U. S. Department of Agriculture in 1886, have been strictly followed.

The following particulars in regard to these soils are of interest:

1. The soils from the Experiment Station, about three-fourths of a mile south of Auburn, represent virgin and worn soils. The forest is of long-leaf pine, interspersed with an occasional oak, hickory, black gum, etc.

2. The soil from Butler county, sent by Mr. D. G. Dunklin, is a gray sandy soil from the lands of Mr. Geo. Lazenby, sixteen miles northeast of Greenville, representing, as stated in his letter, gray pine lands of the county. The growth on the red lands consists of post oak, red oak, hickory, dogwood, etc.; on the sandy lands pine, oak and hickory.

3. The soil from Talladega county, sent by Mr. E. T. McEldery, was taken from the farm of Mr. Hugh McEldery, nine miles east of Talladega. Depth of soil reported to be from 12 to 14 inches; growth, water oak, white oak, hickory, ash, elm, alder, walnut, sweet gum, poplar, sycamore and mulberry—trees tall and from one and a half to three feet in diameter. This soil is commonly known as "gray land." It represents the valley lands of the county.

4. Hon. T. J. Carlisle writes that the soil sent by him from Pike county was gotten from the land of Mr. T. D. Connell, about ten miles southeast of Troy. It represents ridge land, is a fine soil, of ash color; growth, oak and hickory, with occasional chestnut and short-leaf pine. The timber is tall.

5. The soil from Citronelle, near Mobile, was sent by Prof. J. P. Stelle, and represents the gray sandy pine lands from that portion of the State.

6. The soil from Sumter county, sent by Prof. J. W. A. Wright, was taken from land cultivated by Judge DeLoach, about one mile north of Livingston. It is known as "light brown" soil, aud was taken from an undisturbed forest of hickory, black-jack, oak, etc., the trees being from eight to fifteen inches in diameter.

7. Perry county soil, sent by Mr. H. G. Smith, was taken from a cultivated slough bottom on the Canebrake Experiment Station.

8. The soils from Tallapoosa county, sent by Hon. J. P. Oliver, represent the red and the gray lands of that section. The red soil, says Mr. Oliver, is about four inches deep, with growth of oak and hickory principally, interspersed with dogwood, black gum, oak from two and a half to four feet, and hickory from one to two and a half feet in diameter. The sample of red soil came from Col. Oliver's land about one-half mile northwest of Dadeville. The gray soil was taken from the farm of Mr. W. A. Wynn, three miles northwest of Dadeville, and represents a thickness of from two to two and a half inches of soil with accompanying subsoil. The original growth is pine, with undergrowth of oak and hickory. The largest pines measure from three and a half to four feet in diameter.

The following are results of analyses of Jersey milk produced by the herd now on the Station. The ration consisted of three and one-third pounds each of corn meal, ground oats, and bran, three pounds of cotton seed meal, twenty pounds of ensilage and four pounds of crab grass hay, in two feeds per day.

No.	DATE.	Water.	Fat.	Casein.	Sugar.	Ash.
1	Febuary 19.	86.321	4.151	3 345	5.468	0.775
2	“	85.142	5.119	3 900	5.088	0.751
3	“	85 940	4.229	3 432	5 639	0 760
4	“ 21.	83 316	6.205	4.501	5.044	0 834
5	“	84.547	5.500	3 925	5 210	0.818
6	“	82.812	6.422	4.322	5 592	0.852
7	“ 25.	84.948	5.026	3 652	5 592	0.782
8	“	83.823	5 712	4.254	5.412	0.799
9	“	85.384	4 578	3.465	5.762	0 811
10	“ 26.	84.498	5.071	3.006	6 721	0.704
11	“	83.734	5.093	3.714	6.764	0 695
12	“	84 076	6.250	3.643	5.262	0 769
13	March 4.	83.551	5 693	3.621	6.306	0.829

MEAN TEMPERATURE OF SOILS AT DIFFERENT DEPTHS,

For January, February and March, 1889.

P. H. Mell. T. D. Samford, Assistant.

Set I—(On top of hill.)

	Jan.	Feb.	Mar.		Jan.	Feb.	Mar.
1 inch.........	47.1	47.1	5.75	24 inches........	49.5	48.2	54.4
3 "	47.0	46.9	5.72	36 "	50.9	48.9	53.2
6 "	46.6	46.3	56.	48 "	52.3	50.2	53.1
9 "	46.4	45 9	55.	60 "	53.1	50.9	53.6
12 "	46.6	45.9	54.4				

Set II—(On top of hill.)

	Jan.	Feb.	Mar.		Jan.	Feb.	Mar.
1 inch.........	47.4	47.0	56.7	36 inches.........	50.8	48.9	53.1
3 "	47.3	46.8	56.4	48 "	52.5	50.3	53.2
6 "	47.3	46.7	55.8	60 "	53.6	51.6	53.3
9 "	46.8	46.0	54.7	72 "	54.7	52.4	53.3
12 "	46.7	45.8	53.5	84 "	55.9	53.4	54.
24 "	49.2	47.7	53.4	96 "	57.5	55.0	54.8

Set III—(In bottom.)

	Jan.	Feb.	Mar.		Jan.	Feb.	Mar.
1 inch...........	47.5	46.2	55.2	24 inches.........	50.8	49.4	54.4
3 "	47.6	46.1	54.7	36 "	52.0	50.2	53.9
6 "	48.2	46.7	54.6	48 "	53.4	51.6	54.3
9 "	47.9	46.3	53.8	60 "	54.6	52.6	54.2
12 "	48.2	46.7	53 8				

DATA FROM OTHER INSTRUMENTS.

Altitude 826—Lat. N. 32.40—Long. W. 85.30.

ATMOSPH'IC PRES. (in inches.)	Jan.	Feb.	Mar.	PRECIPITATION.	Jan.	Feb.	Mar.
Monthly mean..	29.960	30.180	29 930	Total in inches..	9.48	5.72	2.81
Highest	30.400	30 56	30 250	Greatest daily...	......	......	1.31
date......	22	20	30	date......	......	......	2
Lowest	29.64	29.710	29.48	No. of rainy days	11	11	5
date......	8	17	18	No, cloudy days.	15	11	5
Monthly range..	.760	.850	0.770	No. of fair days.	11	14	18
TEMPERT. (°Farh.)				No. of clear days.	5	3	8
Monthly mean..	46.9	46.3	54 7	WIND.			
Mean of maxm..	55.1	54.4	64.8	Prev'g dir't'n f'm	W.	N.W.	N.W.
Mean of minim..	38.7	38.3	44.7	Total monthly			
Highest dur'g m.	67.	75.	76.	mov'm't (in miles	5,876	5,590	6,261
date.	16	17	17	Average daily			
Lowest during m.	23.	16.5	30	mov'm't(in miles	189.5	199.6	202
date.	29	7	10	Greatest daily			
Monthly range..	44.	58.5	46.	mov'm't (in miles	400.0	502.0	398
Mean daily range	16.4	16.1	20.7	date	5, 9	18	20

Note.—In the meteorological report concerning soil thermometers in Bulletin No. 3 of this Station, typographical errors occur as to the dates of the "*greatest daily range*" and of the "*least daily range*" of all the thermometers below twelve inches. Where the figure "8" occurs a * should be inserted to signify that the range was the same on several different dates.

BULLETIN NO. 6. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

Auburn. Ala., - - - July, 1889.

Contents:

GRASSES AND THEIR CULTIVATION.

THE BROWN PRINTING CO., PUBLIC PRINTERS AND BOOK BINDERS.

BULLETIN NO. 6,

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - JULY, 1889.

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†Prof. Mell has also charge of Meteorological Observations.

PREFACE.

This bulletin is a revised form of the pamphlet on "Wild Grasses," issued from the Department of National History and Geology in 1886. The work has been carefully re-written and additions made of grasses that have been analyzed since the first edition was published.

The cultivation of forage plants is of such great importance to southern farmers and stock raisers, a knowledge of their growth and adaptation to certain kinds of soils and conditions is greatly desired. The present bulletin is therefore given to the public as an introduction to a series on forage plants growing wild in Alabama, that will be issued by the Station from time to time, with the hope that the information furnished will aid in stimulating the planters to renewed efforts to increase the acreage of pastures and the production of hay..

A glance at the list of grasses printed in this bulletin will show that a large proportion of the species growing wild in the United States east of the Mississippi river are to be found within the borders of Alabama. Not half of these have been tested to determine their values for stock-food. Some are known to be worthless, and so considered by most farmers. Many of those that are described in this work are so valuable that if properly cultivated they will supply all the hay needed for the stock of the State, and furnish ample pasturage through spring, summer and autumn.

During the past few years some agriculturists have found from observation and experiment that grass, when well cultivated, adds a large item to the value of the farm; and the question is frequently asked: how can this important stock food be best cultivated and adapted to the uses for which it was intended by nature, and what varieties are best suited for hay?

It is well known that Alabama, like many other Southern

States, requires more wheat, corn and hay than she produces. It is a fact also that large sums of money go out of the State each year to purchase food for men and beasts. A considerable item in this expense is to cover the demand for wheat, corn and hay, and yet the farmer, of this State, has on his lands the means for giving his stock excellent pasturage in a green, succulent state almost throughout the entire year. Plenty of hay will supply our markets with well fed mules, horses and cattle, and the rearing of animals will enrich the soil to increased production. The poor, thin mules and shadowy cattle to be found in so many localities are true evidences of the lack of cultivated grass fields. Cheap food is essential for the prosperity of our people, and this must be produced near the place of consumption. It will not do, therefore, to attempt to raise stock and buy all the hay from distant markets—the profits will be eaten up.

In the preparation of this bulletin liberal use has heen made of the following authorities: "The Agricultural Grasses of the United States," issued by the Department of Agriculture; "Flint on Grasses," "Rural Enclyclopedia," "Loudon's Cyclopedia of Plants," "American Weeds and Useful Plants," "Darby's Botany of the Southern States," "Chapman's Flora of the Southern States," "Gray's Botanies," "Beal's Grasses of North America," and many agricultural and scientific periodicals.

The plates that illustrate this paper are copies of those issued in the Annual Reports of the United States Department of Agriculture.

GRASSES OF ALABAMA AND THEIR CULTIVATION.

P. H. MELL, BOTANIST.

Judicious management of pastures will bring in more money to the farmer than any other portion of his farm. The chief requirements for success in cultivating pastures are selection of the right kinds of good seeds, thorough drainage, where it is necessary, application of manures, and the careful eradication of all weeds, bushes, and useless plants. The question of drainage is of very great importance. The grass does not thrive near so well on wet land as on moderately dry soil. Moreover, when stock are required to eat grass growing on very wet marshy land they frequently suffer with diseases of the liver and other vital organs. The food is not so palatable as that produced on well prepared land. What is true concerning pastures holds also good concerning the making of hay for winter use.

Grass lands do not require rotation as with lands planted in other crops; but careful cultivation must be the rule. Suitable manures must be applied at the proper time, and the pasture must not be injured by permitting stock to graze too closely when the land is wet; and the grass must be mowed before it goes to seed so as to prevent the exhaustion of the energy and life of the roots.

When top dressing is to be resorted to it should be done in autumn, because when applied in spring the strength of the manure is lost, to a considerable degree, by the evaporation caused by the warm sun and March winds. In autumn, however, the rains soon wash the manure into the soil so that the roots of the grass can readily utilize the ingredients. Even under the best conditions for top dressing there is a loss in the value of the manure by the evaporation of the ammonia.

When compost or stable manure is broadcast over the land, it is best to mix it either with powdered charcoal or plaster, so that the ammonia, and other volatile substances, may be absorbed and held ready for the plant as its needs demand. Phosphate of lime in the shape of ground bone, or one of the commercial fertilizers containing phosphoric acid and lime, will produce a luxuriant growth in grass. An excellent fertilizer is also obtained for grass fields or lawns by composting well rotted stable manure with leaf-mould obtained by raking the surface from the forests. Ashes or lime is a useful application once in three or four years, where the soil is not calcareous. It is well to give a top dressing of compost after each mowing, if the best results are to be obtained. This method of treatment will enable the rains to carry down to the roots a quantity of nutrition, and will prevent the ground from baking and getting dry and hot.

A reliable and careful observer states, that in preparing land for grass seed, the soil should be worked not less than two feet deep about the beginning of September, and thoroughly incorporated with well rotted manure. In the furrows, as deep below the surface as possible, should be placed long straw litter or rubbish, and the whole covered up and smoothed over. The straw will serve, not so much for manure as a means for retaining moisture during a dry season. The roots of the grass are thus induced to penetrate deep in the soil and will stand a much better chance for obtaining food for the rapid and luxuriant growth of the plant. As soon as the fall rains set in the grass seeds should be sown.

It is best to mix most grasses so as to give a continuous growth for pasturage, and also to permit of frequent cutting for hay. I give several formulæ, either of which will make good pasturage when seeded on well prepared land.

The formulæ give proportions to be used on one acre:

Blue grass (*Poa pratensis*) 16 quarts.
Timothy (*Phleum pratense*) 4 quarts.
Red top (*Agrostis vulgaris*) 8 quarts.
White Clover (*Trifolium repens*) 2 quarts.

If orchard grass (*dactylis glomerata*) is substituted for timothy and red top, one bushel will be required.

Timothy and clover make a good combination by using 14 to 16 quarts of the first to 8 quarts of the latter per acre. Timothy is sown in spring with barley or wheat and clover in

March or April with spring wheat. Light, dry soils require more seed than moist lands. Seed should not be spared if a thick growth of grass of fine quality is desired. In preparing the land for this mixture and all others it is always best to have it thoroughly cleared from all weeds.

Another mixture is as follows :

Red clover (*Trifolium pratense*) 8 lbs. or 4 quarts.
Timothy (*Phleum pratensis*) 8 quarts.
Red top (*Agrostis vulgaris*) 1 bushel.

When the land is unfavorable for clover, this seed should be omitted and the herds grass increased to 12 quarts and red top to 5 pecks.

A good formula for early and late pasturage is obtained by using the following:

Kentucky blue grass (*Poa pratensis*) 1½ bushels..
Texas blue grass (*Poa orachnifera*) 1½ bushels.

Another formula for dry land of medium quality:

Red clover (*Trifolium pratense*)	2 quarts.
White clover (*Trifolium repens*)	2 "
Blue grass (*poa pratensis*)	8 "
Red top (*Agrostis vulgaris*)	2 pecks.
Timothy (*Phleum pratensis*)	1 peck.

Red clover should be omitted on wet land and red top increased.

An excellent formula for making a permanent lawn is, as follows:

Red top, 1 bushel.
June grass, 2 bushels.
Orchard grass, 1 bushel.
White clover, ½ pound.

Formula for general pasture and stiff lands:

Orchard grass, 1¼ bushels.
Red clover, 12 pounds.

Killebrew recommends the following formula for worn out fields containing gullies, he says:

"The long creeping roots will swing down into the gullies and will soon put a stop to washes, and the immense herbage will, after awhile, renew the fertility of the soil."

Blue grass, 4 lbs.
Orchard grass, 4 "

Gama grass, 1 peck roots.
Bermuda grass, 1 " "
Means grass or Johnson grass, ½ bushel of roots.
Red clover, 8 pounds.

The above formula may be changed with considerable advantage by substituting other grass seeds for those mentioned, .as for instance, Paspalum laeve may be used in place of red top. The following species may be also used as substitutes for the red top and timothy—Digitaria sanguinale—Panicum gibbum—Setaria glauca—Tripsacum dactyloides (gama grass)—Phalaris intermedia var angustata—Alopecurus pratensis (meadow foxtail)—Arrhenatherum avenaceum (Tall meadow oat grass)—Cynodon dactylon (Bermuda grass) ; this grass, however, yields better results when given the entire land to itself—Elusine Indica (crab grass)—Bromus uniloides—Elymus Virginicus (Lyme grass)—Panicum Texanum.

For winter use these formulæ may also be modified so as to contain either tall oat meadow grass [*Arrhenatherum avenaceum*], orchard grass [*Dactylis glomerata*], Italian rye grass [*Lolium Italicum*], wild rye grass [*Elymus*], and wild meadow barley [*Hardeum pratense*]. These grasses will thrive well on moderately sandy soils, but yield much better results when seeded on rich uplands. The special value of orchard grass consists in the rapidity with which it springs up after being grazed down by stock.

September and October are months in which economical planters will endeavor to make and save much hay. Grass should be cut while in bloom, because then the changes of the nutritive matters would be arrested and the hay retaining them would be in the best condition for nourishing stock. In curing, the grass should be exposed to the heat of the sun only long enough to expel the water and leave the other substances in the best condition. It is evident, therefore, the hay should not be exposed to dews or rains. Portions of the sugar or mucilage would be dissolved by moisture and little be left beside fibrous tissues. A clear sky and bright sun will cure hay very soon if it is frequently stirred. The hay should be dried just to such a point so that not enough water remains to cause fermentation when housed. To prevent fermentation salt may be scattered over the hay as it is stored away, at the rate of four or five quarts to the two horse wagon load. When the seed ripens most of the sugar and mucilage have been changed and the hay is not so good. It is well to bear in mind that all dried grass does not compose hay; stock fed on hay cut while in flower and carefully cured will fatten almost as rapidly as when fed on green pastures.

There is a wide difference in the quantity of hay that should be fed to cattle. Some farmers give a fixed amount of all kinds of dried grass, hit or miss, in so far as the nutritive ingredients contained in the hay are concerned. Stock are thus sometimes scantily fed, because incorrectly cured hay may not contain enough food to satisfy them. In this day of scientific experimentation, the quantity of food measured to stock should be governed by the per centage of nutritive values the chemical analysis proves the food stuff to contain. Most farmers and stock raisers are rapidly becoming familiar with this idea, and greater demands are being made each year upon the scientific investigator for additional information upon this important subject of food.

Before entering upon a practical study of the grasses, there are a few terms it will be necessary for all parties to become familiar with, who expect to cultivate grasses for forage purposes. I have thought it best, therefore, to place here the definitions of some of the terms in most common use among botanists in describing grasses. In the body of this paper I have attempted to use as few scientific names as possible, but some are necessary, and I trust my readers will not become discouraged when they meet with them. The terms and definitions given below have been copied mostly from Gray's Botany.

Awn; the bristle or beard of barley, oats, etc., or any similar bristle like appendage.

Culm; the stem of grasses.

Floret; a diminutive flower.

The florets that are arranged on the culm in panicles, spikes or racemes, have neither calyx nor corolla, but instead are supported by two sets of bracts, the outer set being called the *glumes* and the inner set *paleae.* On one glume is sometimes to be found a slender filament called an *awn.* In many grasses, however, these awns are wanting and the absence or presence of the awn, together with its position and shape are all used in connection with other features, to designate the species of the grass. Stamens (fertilizing organs) and pistils (seed forming organs) are found in each floret, sometimes both are present in the same floret, and sometimes only one set of a kind in each floret, just as is noticed in other flowering plants.

The stamens are generally in threes or multiple of threes.

Glume; the husks or floral coverings of grasses, or, particularly, the outer husk or bracts of each spikelet.

Keel; A ridge on the palea or glume that resembles the keel of a boat.

Inflorescence; the arrangement of flowers on the stem.

Ligule; the little membranous appendage at the summit of the leaf-sheafs of most grasses.

Palea; chaff; the inner husks of grasses.

Panicle; an open cluster of flowers.

Pistil; the seed bearing organ of the flower.

Rootstock; root-like trunks or portions of stems on or under ground.

Sheath; the base of such leaves which are wrapped around the stem.

Spike; an arrangement of sessile flowers along a stalk.

Spikelet; a small or secondary spike.

Collecting and preserving grasses.

This work is necessary for the proper study of plants, and it is of great importance that the specimens should be collected while in full flower, for in determining the species of any grass recourse must be had to the flower and seed, because no other portion of the plant offers such little changes in form and structure. At the same time leaves, culms and roots are valuable to the analyst to enable him to correctly name the species, and care must be taken to obtain the entire full grown plant for examination and preservation.

The botanical analysis of plants require the knowledge of an expert botanist, but it is hoped that with the assistance of the descriptions and excellent illustrations contained in this bulletin, the intelligent farmer of Alabama will have but little trouble in distinguishing between the more common grasses that grow wild in the State. Analyses are necessary in pronouncing upon the value of the plant for forage purposes, because some grasses that look attractive to the eye are worthless when used for stock food. On the other hand, some of our most nutritive grasses are quite course looking and unattractive. If at any time difficulty is met with in determining the name of any grass, samples may be sent to the Botanical Department of the Experiment Station, and information will be furnished free of charge. The plants should be mailed in accordance with instructions contained in Bulletin No. 1, extracts from which are here given:

1. In the case of an herb or grass the entire plant must be sent including roots, stem, leaves, flowers and, if possible, the fruit also. Select fifteen or twenty vigorous, well grown specimens and place them between sheets of thick unsized paper, taking care to spread the leaves and adjust the flowers so that only a small proportion of the parts are folded and bent out of shape. Place a pressure of 30 or 40 lbs. on the paper and place aside to dry. When the plant is too long for the size of the paper, bend the stems until reduced to proper proportions.

2. Take careful notes of the plant surroundings. The character of soil, whether found on up land or low land, moist or dry land, forest or field, time of flowering and seeding, etc., height of plants. State whether the plants are in large or small numbers. Are stock known to eat them, etc.

3. In sending specimens through the mail or by express do not roll the papers, but pack them spread out as they come from the press. Lay the sheets containing the plants one on top of the other; place at the top and botton of the package stout paste board. Wrap all with strong paper and address to Experiment Station, Auburn, Ala., (Department of Botany.) In every shipment send notes, name and post office.

The grasses are best collected between the first of May and the first of October. Many plants mature their seeds by the first of June, and they must be collected early in the spring, just as soon as the flowers are formed well.

The following is a list of the grasses that have been found growing in Alabama, many of which have been analyzed in the Botanical Laboratory during the last few years. A number of these grasses are not natives of this State, but are nevertheless naturalized and may be found growing in a wild condition:

X - [illegible]

LIST OF GRASSES.

Scientific Names.	Common Names.	Time of Blooming	Place of Growth.
Alopecurus geniculatus, *L.*	Floating foxtail	May-June	Wet meadows.
" pratensis, *L.*	Meadow foxtail	May	Fields and pastures.
Agrostis perennans, *Puck.*	Thin grass	July-Aug	Moist, shady places.
" scabra, *Willd.*	Rough bent grass	July	Sandy soil.
" vulgaris; var. alba.	English bent grass	"	Fields and pastures.
" arachnoides, *Ell.*	Spider bent grass		Dry soil on sea coast.
Aristida gracilis, *Ell.*	Slender 3 awned grass	Sept.	Sandy fields.
" lanata, *Poir.*		Aug-Sept.	Sandy soil.
" purpurascens, *Poir.*	Beard grass, 3 awned grass	Aug.	Dry soil.
" purpurascens var. palustris, *Chap.*		Aug- Sept.	Margins of pine barren ponds.
" virgata, *Prin.*	Beard grass	August	Dry soil.
" spiciformis, *Ell.*		Aug-Sept.	Pine barrens.
Arundinaria macrosperma, *Mich.*	Cane	February	Banks of rivers.
" tecta, *Muhl.*	Reed	Feb-Mar.	Swamps.
Arrhenatherum avenaceum, *Beauv.*	Tall meadow oat-gras'	June-July	Fields and pastures.
Avena fatua, *Linn.*	Wild oats	June- Sept	
Anthaenantia villosa, *Beauv.*	Smaller crab grass	May-Oct.	Cultivated grounds.
Andropogon clandestinis, *Hale.*		Sept-Oct.	Wet or dry sandy soils
" dissitiflorus.	Virginian beard grass	" "	Barren soil.
" furcatus, *Muhl.*	Finger spike grass	"	Open woods.
" macrourus, *Mx.*	Clustered flower beard grass	"	Low pine barrens.
" scoparius, "	Purple wood grass	" Aug.	Dry, sterile soil.
" tener, *Kth.*		"	Dry, grassy, pine lands.
" tetrastachyus, *Ell.*			
" Elliottis, *Chap.*			
" Virginicus, *L.*			
Brachyelytrum aristatum, *Beauv.*	Awn'dBrachyelytrum	June	Sandy woods.
Bromus unioloides, *Willd.*	Rescue grass	August	Woods.
" ciliatus, *L.*	Fringed broom grass	April	Rich soils.
" secalinus, *L.*	Cheat or chess	June	Grain fields.
Cinna arundinacea, *L.*	Wood reed grass	July-Aug	Wet places.
Calamagrostis Nuttallii, *Beauv.*			
Chloris petraea, *Thurb.*	Seaside finger grass	May-Aug.	Damp soil along coast
Cynodon dactylon, *Pers.*	Bermuda grass	No seed	In all soils.
Ctenium Americanum. *Spreng.*	Toothache grass	July-Aug.	Low pine barrens.
Cenchrus echinatus, *L.*		July-Sept.	Fields & waste ground
" triuloides, *L.*	Burr grass	July-Oct.	Sands along coast.
Chrysopogon avenaceum, *B.*	Indian or wood grass		
Dactylis glomerata, *Linn.*	Orchard grass	April-May	Fields and pastures.
Distichlis spicatum, *Raf.*	Spike grass	Aug-Sept.	Low san'y soils on sea
Danthonia sericea, *Nutt.*	silky flower'd oat gr'ss	Mar- April	Dry pine woods.
" spicata, *Beauv.*		April	Dry barren soil.
Dactyloctenium Ægyptiacum *Willd.*			

LIST OF GRASSES—CONTINUED.

SCIENTIFIC NAMES.	COMMON NAMES.	TIME OF BLOOMING.	PLACE OF GROWTH.
Eatonia obtusata, *Gray.*		June	Dry soils.
" Pennsylvanica, var. filiformis, *Chap.*		"	Moist woods.
Eleusine, Ægytiaca, *Pers.*	Egyptian grass		Cultivated ground.
" Indica, *Gaert.*	Crab grass crowfoot	Aug-Sept.	" fields.
Eragrostis reptans. *Nees.*	Creeping meadow grass	Aug-Sept.	Low sandy places.
" poaeoides, var, megastachya, *Gray.*	Strong scented meadow grass	" "	Sandy fields.
" ciliaris, *L.*			Waste places.
" Purshii, *Schrad.*	Southern Eragrostis	June- "	" "
" Conferta, *Trinn.*		Aug- "	River banks.
" tenuis, *Gray.*	Branching spear gras'	" "	Sterile plains.
" Capillaris, *L.*	Hair panicled meadow grass	" "	Dry fields.
" nitida, *Chap.*		" "	Low grassy places.
" pectinacea, var. spectabilis, *Gray.*	Meadow comb grass	" "	Dry sterile soil.
" var. refracta, *Chap*			Damp soil.
Elymus Virginicus, *L.*	Lyme grass-Wild rye		River banks.
" striatus, *Willd.*	Slender hairy wild rice	July-Aug.	Rocky woods.
Erianthus alopecuroides, *E.*	Woody beard grass	" Oct.	Dry or wet soils.
" " var. brevibarbis.	Short bearded grass	" "	" " "
" " var. contortus.		" "	" " "
Eustachys petraea, *Desv.*			
Festuca myurus, *L.*			Dry sterile soil.
" tenella, *Willd.*	Small fescue grass	Mar-April	Sandy soil.
" parviflora, *Ell*		July	
" nutans, *Willd.*	Nodding fescue		Rich woods & banks.
" unioloides, *Willd.*			
Gymnopogon racemosus, *Beauv.*	Naked beard grass	Sept-Oct.	Dry sandy soil.
" brevifolius, *Trin.*			
Glyceria nervata, *Trin.*	Meadow spear grass; manna grass	July	Wet swamps.
Gymnostichum hystrix, *Schreb.*			
Hydrochloa Carolinensis *Beauv.*	Floating grass		Banks of streams.
Holcus lanatus. *Linn.*	Velvet grass—Meadow soft grass	April--May	Cultivated grounds.
Leersia Virginica, *Wild.*	False Rice or white grass	August.	Damp woods.
Leersia oryzoides, *Swartz.*	False Rice or Rice grass	"	Low, wet places.
Leptochloa mucronata. *Kunth*	Pointed slender grass	"	" " "
Leptochloa polystachya, *Kth.*			
Luziola Alabamensis, *Chap.*			
Lolium perenne, *L.*	Italian rye grass	July	
Muhlenbergia Mexicana, *Trin.*	Mexican Muhlenb'gia	August.	Low places.
" sylvatica, *Wild*	Sylvan grass	Aug- Sept.	Rocky woods.
" diffusa, *Schreb.*	Nimble will. Drop seed grass	Aug- Sept.	Dry woods.
" capillaris, *Kunth.*	Hair grass		Sandy soil.
" trichopodes, *Chap.*	Bunch hair grass	August.	Pine woods.

LIST OF GRASSES—CONTINUED.

SCIENTIFIC NAMES.	COMMON NAMES.	TIME OF BLOOMING	PLACE OF GROWTH.
Melica mutica, var. glabra, *Gray*	Melic grass	April	Dry open woods.
Phleum pratense, *L.*	Timothy	June- July	
Panicum clandestinum, *Linn.*	Hidden flower'd gr'ss	September	Dry sterile soil.
Panicum crusgalli, *Linn.*	Barn or crab grass	Aug- Sept.	Damp shaded soils.
" curtissii, *Chap.*			Ponds and swamps.
" depauperatum, *Muhl.*	Worthless panic gr'ss	June	Dry sandy soil.
" dichotomum, *Linn*	Polymorphous panic	Mar-May	Woods and fields.
" filiforme, *Linn.*	Slender crab grass	Aug- Sept.	Dry sandy soil.
" gibbum, *Ell.*	Spiked panic grass	July-Sept.	Swamps.
" gymnocarpon, *Ell.*		September	Muddy bank of riv'rs.
" latifolium, *Linn.*	Broad leaved panic	May	Dry rich soil.
" microcarpon, *Muhl*	Small seeded panic	May	Dry soil
" paspaloides, *Pers.*			
" scoparium, *L.*	Few flowered panic	May	Close damp soil.
" proliferum, *Linn.*	Prolific panic grass	September	Wet places near coast
" prostratum, *Lam.*			
" repens, *L.*			
" sanginale, *L.*	Finger grass, crab [grass	May-Oct.	Cult. and waste places
" verrucosum, *Muhl.*	Warty panic	September	Swamps.
" viscidum, *Ell.*	Sticky panic grass	May	Wet plac's near coast.
" amarum, *Ell.*	Bitter panic	September	Sands near coast.
" anceps, var. strictum, *Chap.*	Double headed panic	Aug- Sept.	Damp sterile soil.
" virgatum, *L.*	Tall panic, switch [cane	Aug-Sept.	Moist or dry soil.
" hians, *Ell.*			
" autumnale, *Bosc.*			
" maximum,			
" texanum,			
Paspalum fluitans, *Walt.*	Floating paspulum		River swamps.
" Walterianum,		Sept-Oct.	Low cultivat' ground
" dilatatum, *Poir.*		July-Aug.	
" digitaria. *Poir.*	Finger shaped grass		Open swamps.
" distichum, *Linn.*	Joint grass	July Sept.	Swamps and low [ground
" compressum, var. imberbe, *Munro.*		Aug- Sept.	
" leutiferum, *Lam.*			Pine barren swamps.
" laeve, *Mx.*	Smooth erect grass		Dry woods.
" Floridanum, *Mx.*		July-Aug.	Damp soil.
" racemulosum, *Nutt.*		Aug- Sept.	Dry sandy soils.
" plicatulum, *Mx.*		Aug- Sept.	Low cultivated gro'd.
" setaceum, var. ciliatifolium,	Hairy slender grass	September	Wet or dry soil.
" platycaule,	Louisiana grass		
Phalaris intermedia, *Bosc.*	Wild canary grass	April-May	Sandy places on coast
Phragmites communis, *Trin.*	Common reed grass	August.	Marshes.
Poa annua, *L.*	Annual spear grass	Feb-Mar.	Fields and pastures.
" cristata, *Walt.*		April	Dry soil.
" compressa, *L.*	Wire grass	May	Dry road sides.
" flexuosa, *Muhl.*	Southern spear grass	May	Rich shady soil.
" pratensis, *L.*	June or Kentucky blue grass	May	Rich soil around dwellings.
" arachnifera	Texas blue grass		
Rottboelia rugosa, *Nutt.*			
" corrugata, *Balb.*			

LIST OF GRASSES—CONTINUED.

SCIENTIFIC NAMES	COMMON NAMES.	TIME OF BLOOMING	PLACE OF GROWTH.
Spartina juncea, *Wild*	Rush salt grass	July -Aug.	Sandy marshy places
" polystachya, *Wild.*	Salt reed grass	Aug- Sept.	Brackish marshes.
" stricta, var. glabra: *Gray.*	Rough marsh grass	Aug- Sept.	Salt marshes.
Setaria glauca, *Beauv*	Bottle grass	July	Cultivated ground.
" glauca, var. laevigata, *Chap.*	Foxtail grass	July	Brackish swamps.
" Italica, *Kth.*	Bengal grass	July-Aug.	Swamps along coast.
Sorghum halapense, *L.*	Johnson; mean; cuba grass	September	Dry barren soils.
" nutans, *Gray.*	Indian grass	August.	Dry soils.
Sporobolus Indicus, *Brown.*	Wire grass		
" junceus, *Kunth.*	Smut grass	August.	Dry sandy soil.
" asper, *Kth.*	Rush grass	September	Dry sandy soil.
" vaginaeflora, *Poir.*	Hidden flower Vilfa	September	Dry sandy soil.
Stipa avenacea, *L.*	Feather grass	July	Dry woods—sparsely
Stenotaphrum Americanum, *Schkr.*	St. Augustine grass	June-Sept	Damp sandy places on the coast.
Trisetum palustre, *L.*	Marsh oat grass		Low grounds.
Tripsacum dactyloides,	Gama; sesame grass.	Aug- Sept	Rich soils.
Tricuspis sesslerioides, *Torr.*	Tall redtop	August.	Dry soil.
" ambigua, *Beuth.*		July.	Low pine barren.
" cornuta, *Gray.*	Horned sand grass	Aug-Sept.	Light soils.
" purpurea, *Gray.*	Sand grass	June	Sandy soil on coast.
Uniola latifolia, *Michx.*	Broad leaf spike gr'ss	June	Shaded fields.
" paniculata, *L.*	Spike grass	July-Aug.	Sandy coast.
" gracilis, *Michx.*	Slender spike grass	July-Aug.	Sandy coast.
" nitia, *Baldw.*		July- Aug.	Swamps.
Vilfa aspera, *Beauv.*			
Vilfa vagniaeflora,			
Zizania aquatica, *L.*	Indian rice or wild rice	July-Aug.	Low grounds.
Zizania miliacea, *Michx.*	Prolific or wild rice	July-Aug.	Wet places

The following grasses have been selected for special notice in this bulletin. As soon as experiments determine the values of others mentioned in the preceding table they will be described in future bulletins issued by the station.

Alopecurus pratensis [Meadow foxtail.]

The culms of this grass are about 2 feet high, and are smooth.

The flowers are arranged at the end of the stem in a dense cylindrical form about 3 inches long. The awns are long, extending some distance beyond the floret. The leaves are smooth, with a loose clasping sheath. This grass resembles timothy very closely, but can be readily distinguished by a careful examination. The chief difference consists in the number of palea, timothy having two and its glumes are awned. The root of the pratensis is a perennial. This plant makes its appearance earlier than most grasses and is an excellent early grazing variety for cattle at the opening of spring. One objection consists in the small amount of foliage presented by the plant. Cattle eat it with considerable relish, and it is possible that by cultivation it may be improved and good pastures obtained.

Its chief advantage lies in the fact that it will stand continued cropping, and presents a tender grazing, even after several cuttings.

Analysis:

Water	60.00	per	cent.
Ash	3.10	"	"
Fat	1.34	"	"
Nitrogen free extract	21.72	"	"
Crude fiber	9.51	"	"
Albuminoids	4.33	"	"

[*Plate I.*]

Arrhenatherum avenaceum. (Meadow oat-grass; tall oat-grass.)

This grass resembles the oat in several respects. Each spikelet has but two florets. The panicle is first contracted, but after the plant becomes older the inflorescence opens and becomes more spreading. The root is perennial and creeping. The stems grow to a height of 3 feet or more. On account of the rapid growth of this plant, and the lateness of its maturity it makes an excellent pasture for fall grazing. Its composition indicates a grass of good quality, and those farmers who have tried it speak in high terms of praise concerning its agricultural value. When mixed with other grasses sheep eat it with considerable relish. It is pronounced, by those who know, to be the best winter grass that can be obtained. The most favorable time for sowing the seed is from September to October. Not less than two bushels per acre should be used.

Analysis:

Water	14.30	per cent.
Ash	7.23	" "
Fat	2.44	" "
Nitrogen free extract	42.82	" "
Crude fiber	24.36	" "
Albuminoids	10.88	" "

[*Plate II.*]

Bromus secalinus. [Chess or Cheat.]

Bromus unioloides. [Rescue grass.]

These two grasses are related, and are getting to be quite common in the wheat fields of the south. Both may be called winter grasses. The *unioloides* has a more vigorous growth, and was first brought to the attention of planters by Gen. Iverson, of Columbus, Ga. in 1853, and was called by him, "Rescue grass."

Both of these plants grow to a height of 2 to 3 feet, and when fully matured have an open, drooping panicle, with showy spikelets, each containing from 5 to 10 flowers.

Prof. Phares pronounces *unioloides* to be an excellent grass for winter use, and that stock are very fond of it. It is ready for mowing about the first of January, and sometimes even earlier, and will stand cutting until Spring. It produces an abundant supply of foliage. The hay is pronounced to be good.

Analysis:	*B. secalinus:*	*B. unioloides:*
Water	14.30	14.30 per cent.
Ash	6.10	8.35 " "
Fat	3.49	3.07 " "
Nitrogen free extract	49.11	44.97 " "
Crude fiber	20.39	17.64 " "
Albuminoids	6.61	11.67 " "

Ash:	*B. unioloides:*
Phosporic acid	8.79 per cent.
Sulphuric acid	5.61 " "
Silica	4.84 " "
Chlorine	16.84 " "
Calcium oxide	4.43 " "
Magnesium oxide	4.64 " "
Potassium oxide	37.20 " "

[*Plates III and IV.*]

Cynodon dactylon. [Bermuda grass.]

It is not necessary to describe this grass, since every one who has contended with it, in and about the valued crops of corn and cotton, will quite readily distinguish the plant from all other grasses. It is not a native of this country, but was introduced from southern Europe and tropical regions. It throws out three or more slender spikes on which are arranged small sessile spikelets, each containing one flower, with a second imperfect one. The plant throws out a rank growth of leaves and numerous shoots from underground stems, and is very highly prized for pasturage.

The method of cultivation consists in cutting up the rhyzomas or rootstocks, into small fragments and scattering them broadcast. It is one of the few grasses that are able to withstand continued drought; its succulent underground stem furnishes sufficient moisture and nutriment to keep the plant alive. Hogs are very fond of the underground stems, and stock of all kinds eat its leaves with avidity.

The grass will grow even under the most flagrant neglect; while care and cultivation will bring out its characteristics to a marked degree, and well repay the cultivator for all his expense and trouble. Specimens have been exhibited that were over eight feet long.

It is an excellent grass to prevent the washing of land, for filling up gullies and preserving terraces. It makes one of the best lawns on account of its smooth and regular growth, and its power to withstand the heat of the sun. To bring out its best features, the grass should be mown three or four times each summer, or at least once per month. This will kill the weeds, and other plants that tend to choke it. The Bermuda grass is not so difficult to eradicate from the field as most farmers seem to think. Close cultivation in cotton for two or three years, and thorough pulverization of the soil will destroy this plant.

Analysis:

Water	14.30	per	cent.
Ash	7.81	"	"
Fat	1.34	"	"
Nitrogen free extract	45.09	"	"
Crude fiber	19.96	"	"
Albuminoids	11.50	"	"

Ash:

Phosphoric acid	9.20	per	cent.
Sulphuric acid	9.37	"	"
Silica	30.29	"	"
Chlorine	6.05	"	"
Calcium	13.44	"	"
Magnesium oxide	5.00	"	"
Potassium oxide	22.99	"	"
Potassium	6.66	"	"

[*Plate V.*]

Dactylis glomerata. (Orchard grass.)

Dr. Vasey says of this grass: "This is one of the most popular meadow grasses of Europe, and is known to most farmers in the Northern and Eastern States. It is a perennial, of strong, rank growth, about three feet high, the culm and leaves roughish, the leaves broadly linear, light green, and 5 to 6 on the culm. * * * *.

The herbage, when suffered to grow rank or old contains only half the nutriment of that which is of recent growth. Cattle, sheep and horses eat it with the greatest avidity when it is young, but will not touch it when old, hence the importance, when pastures have been understocked, of going over them with a mowing machine; the orchard grass will then stool out, and the cattle will be found eating first on the very spots that they had previously rejected."

Analysis:

Water	14.30	per cent.
Ash	7.63	" "
Fat	3.15	" "
Nitrogen free extract	44.70	" "
Crude fiber	21.40	" "
Albuminoids	8.82	" "

[*Plate VI.*]

Danthonia sericea. (Silky flowered oat grass.)

This grass flowers in March and April, and grows in moderately dry pine woods on sandy soils. The flowers are rough or bearded, and the spikelets, each seven flowered, are numerous and closely packed on an open panicle that is about four inches long. The plant grows to a height of two to three feet. The leaves are linear and numerous, with soft, hairy sheaths.

On account of some resemblance to the cultivated oat (Avena) it has been called silky flowered oat grass. Its agricultural value has not been determined, but its good growth of leaves and smooth flexible culm would indicate that the grass would be a valuable forage plant if properly cultivated. Inasmuch as it makes its appearance towards the close of winter, when grazing is so scarce, the farmers would do well to cultivate it and test its adaptation to stock raising.

[*Plate VII.*]

Eleusine Indica. (Yard grass; Crowfoot; Crab grass.)

This grass is very common all through the Southern States, and is readily recognized. It grows luxuriantly in the barn-yards, gardens and other spots that are rich around the premises. Long, strong, fibrous roots are thrown out, from which grows a thick, leafy culm. The culm is large and succulent, inclining, and terminated by 5 or more spikes that radiate from nearly the same point. The spikelets contain as many as 5 florets, the upper one being rudimentary. The glumes are awnless. The grass is an annual, and grows to a height of 12 or 15 inches. Hogs and cattle are very fond of it; and when it is properly cut, good hay is made. Just as with other grasses, the mowing must occur before the seeds mature, and while the stems are filled with juices. Care taken in maturing, it will yield excellent food for stock. It was introduced into this country from India, but it has become naturalized, and now grows everywhere with much greater facility than some of the native grasses. It seeds so rapidly there is no necessity to repeat the sowing to get a good stand for grazing purposes.

Analysis:			
Water	14.30	per	cent.
Ash	8.32	"	"
Fat	2.17	"	"
Nitrogen free extract	47.54	"	"
Crude fiber	18.19	"	"
Albunimoids	9.48	"	"
Ash:			
Phosphoric acid	9.68	"	"
Sulphuric acid	5.79	"	"
Silica	24.61	"	"
Chlorine	6.71	"	"
Calcium	56.13	"	"
Magnesium oxide	7.38	"	"
Potassium oxide	24.79	"	"
Potassium	7.39	"	"

[*Plate VIII.*]

Elymus Virginicus. (Wild rye grass.)

This is a perennial, and grows to a height of 2 or 3 feet, and produces a rank growth of leaves. The culms are large, and the spikelets are 2 to 5 flowered.

This grass starts early in spring and furnishes a green pasturage through the spring and winter. It is generally found in a wild state on the banks of streams, and loves a moist soil. The plant throws out in March a large tuft of broad, green leaves, and supplies good grazing at that season of the year when green forage is scarce. Its value is recognized by those who have tried it.

[*Plate IX.*]

Holcus lanatus. (Velvet-grass—Meadow soft grass—Velvet lawn grass.)

This grass grows from two to three feet high and presents a beautiful appearance to the eye. It is not considered to be valuable for hay or grazing, because stock are not fond of it, but it grows so well on poor land, where few other plants will produce anything, it may be found to be valuable to use on worn out lands until the soil becomes strong enough for more nutritive grasses. Its chief value seems to be for sodding down lawns. The beautiful velvety cast it gives, and evenness of texture, produces a pleasing effect on the eye. It stands drought well. When other grasses succumb to dry weather this remains green and attractive. It is also useful as a soiling plant. Some farmers in the south who have tried the grass for hay speak well of it, but most persons consider it worthless for stock raising.

[*Plate X.*]

Lespedeza Striata. (Japan Clover.)

Although this is not a grass, still its valuable features as a forage plant will permit of its discussion in this paper. It is an introduced plant, but within the past few years it has rapidly spread over the old fields and meadows of Alabama, until it is not incorrect to call it a wild clover. It is an annual, reproducing itself year after year by means of seed scattered by the winds just before the plant is destroyed by the frosts. Its value for forage purposes is greatly enhanced by the fact that it grows well on poor sandy and clay soils. It is supposed to have the power of restoring the fertility of worn out soils, and its great tenacity enables it to drive out other plants, even Bermuda grass. The analysis of a specimen obtained from Alabama yields the following:

Oil	3.30	per cent.
Wax	1.10	" "
Sugar	14.74	" "
Gum and dextrin	6.76	" "
Cellulose	23.77	" "
Amylaceous cellulose	14.67	" "
Alkali extracts	16.22	" "
Albuminoids	15.11	" "
Ash	4.33	" "
	100.00	

[*Plate XI.*]

Muhlenbergia Mexicana.
Muhlenbergia diffusa (Nimble Will Drop seed).
Muhlenbergia Sylvatica.

These grasses are mentioned together because they resemble each other in some general respects. They are perennials and flower in August and September. The *Mexicana* thrives best in bottoms in comparatively moist soils and is slow in maturing its seed. For this reason it fills a place among grasses, supplying tender grazing sometime after other grasses have matured their seeds. The roots take strong hold of the soil, rendering it quite difficult to eradicate from cultivated crops. This grass is eaten by cattle with relish. The *diffusa* is considered by some farmers to be equally as valuable as the Mexicana, while others look upon it as worthless. The plant has not, however, been fully tested, and no correct opinion can be given until careful experiments have been made. The analysis below would indicate a first rate forage plant, and inasmuch as it forms in many sections a large proportion of the pasturage on wood lands, it deserves more than a passing notice. In the Agricultural Report of Tennessee, Killebrew states that experimenters in that State consider it to be an excellent butter making grass, and that it gives a particularly fine flavor to this article of food.

Analysis:

Water	14.30	per	cent.
Ash	7.95	"	"
Fat	1.55	"	"
Nitrogen free extract	47.44	"	"
Crude fiber	20.19	"	"
Albuminoids	8.57	"	"

Ash:

Phosphoric acid	6.65	per	cent.
Sulphuric acid	3.39	"	"
Silica	39.98	"	"
Chlorine	8.21	"	"
Calcium oxide	11.95	"	"
Magnesium oxide	4.39	"	"
Potassium oxide	17.32	"	"
Potassium	6.78	"	"
Sodium	1.33	"	"

[*PLATE XII.*]

Paspalum laeve (smooth erect grass—Water grass.)

A tall erect grass, 1 to 3 feet high, with nearly smooth leaves, the lower ones being more numerous and crowded around the culm. The joints of the culm are smooth and purple. The florets are crowded along the axis in four rows, two on each side. There are a few slender hairs at the base of each spike.

Prof. Phares of the Agricultural and Mechanical College of Mississippi, who has made many valuable experiments on Southern grasses to determine their agricultural value, states, concerning this grass, that it produces good hay on land well prepared, and sends out a mass of thrifty roots that support a large growth of succulent stems and leaves.

This grass is quite nutritious as the chemical analysis below will indicate:

Water	14.30	per	cent.
Ash	6.60	"	"
Fat	2.36	"	"
Nitrogen free extract	46.13	"	"
Crude fiber	23.66	"	"
Albuminoids	6.95	"	"

Ash:

Phosphoric acid	6.18	per	cent.
Silica	44.65	"	"
Sulphuric acid	5.64	"	"
Chlorine	1.73	"	"
Calcium oxide	9.36	"	"
Magnesium oxide	5.26	"	"
Potassium oxide	25.44	"	"
Soda "	0.60	"	"

[*Plate XIII.*]

Paspalum dilatatum. (Hairy flowered paspalum.)

This grass is larger and taller than the preceding and resembles it very closely.

The dilatatum grass grows in tussocks three to four feet high, and will stand cropping finely because of its firm hold of the soil and long, strong roots. For a similar reason, it also stands a long drought better than most other grasses. Stock are very fond of it and eat it with avidity. Its many culms growing from the same root-clump, and numerous broad leaves, furnish considerable cropping for cattle. The excellent qualities of this grass ought to attract more attention to it on the part of stock raisers.

[*Plate XIV.*]

Paspalum platycaule. (Louisiana grass).

This grass is of equal value with the one last described, but its growth is not as rank, and the leaves and culms are not so long. Cattle are fond of it, and it stands browsing and trampling as well as Bermuda grass. It is said by some to stand drought well and grows satisfactorily on poor land.

Panicum Texanum. (Texas millet).

A grass that is attracting considerable attention in many sections of the south, and seems to well deserve the flattering notices given concerning it in the agricultural papers. It is an annual that prefers rich soils on bottom lands, and is said to stand drought well. It has such tenacity but few weeds and grasses can withstand its growth. It is said to stand drought better than most other plants, and is valuable for all purposes for which ordinary millets are used. It does not make good pastures but is excellent for hay; stock are exceedingly fond of it and will reject all other hay for it during the winter months. This grass may be used with great advantage in some of the *formulae* given in the first pages of this bulletin, and if care is taken to sow it with seed that produces plants that mature at different dates, the combination will yield hay in a green state throughout most of the year. The Texas millet is supplied with an abundance of rather short, broad leaves, coming from numerous culms produced by the same root. The roots do not reach any considerable depth below the surface, and in raking the hay care must be taken not to pull up the plants. For this reason it is readily destroyed if the land is desired for other crops. An illustration is given of the floret on the plate containing dissections of the grass flowers.

[*Plate XXIX.*]

Panicum sanguinale (crab grass.)

A common grass found in all cultivated fields, and grows from one to two feet high. It flowers from May to October. At one time this grass was considered to be a very troublesome plant to the farmer, because it was so quick in its growth in cornfields, choking the young corn. But its value as a forage plant has been recognized within a few years past. It yields a very fair crop of hay when mowed from between the corn ridges. Stock are very fond of it. If the field on which corn has been cultivated be plowed and harrowed, this grass will cover the ground with a growth that will soon produce excellent hay. The culms are bent near the ground and take root at the joint. The leaves are hairy, and the sheaths are shorter than the joints. At the summit of the culms are three to six slender flower stalks, with small spikelets growing thereon.

Analysis gives the following results:

Water	14.30	per	cent.
Ash	10.81	"	"
Fat	2.42	"	"
Nitrogen free extract	36.59	"	"
Crude fiber	27.50	"	"
Albuminoids	8.38	"	"
Ash:			
Phosphoric acid	6.40	"	"
Sulphuric acid	4.02	"	"
Silica	30.93	"	"
Chlorine	2.04	"	"
Calcium oxide	4.40	"	"
Magnesium oxide	7.98	"	"
Potassium oxide	33.56	"	"
Potassium	6.67	"	"

[*Plate XV.*]

Panicum crusgalli. (Barn-yard grass).

This is a coarse grass that grows in barn-yards and wherever there are wet, sour places about the premises. Its leaves are one-half inch broad, and, when growing well, one to one and a half feet long. The culm is stout and grows from two to ten feet high. The culms are branching and the spikes from one to two inches long and are crowded together, forming a long raceme. The spikelets are thickly clustered along the branches. The glumes have stiff awns (sometimes wanting, however,) that render the grass, when matured, very difficult to digest. If properly cut and cured it makes a good hay, and is much prized by many farmers as a substitute for fodder. In some sections the grass is looked upon as a worthless plant and efforts are made to destroy it. Flowers from August to September.

Analysis:

Water	14.30	per	cent.
Ash	9.58	“	“
Fat	2.58	“	“
Nitrogen free extract	49.44	“	“
Crude fiber	24.78	“	“
Albuminoids	6.66	“	“

Ash:

Phosphoric acid	4.27	“	“
Sulphuric acid	3.69	“	“
Silica	42.18	“	“
Chlorine	11.48	“	“
Calcium	7.23	“	“
Magnesium oxide	5.52	“	“
Potassium oxide	13.26	“	“
Potassium	12.00	“	“
Sodium	0.37	“	“

[*Plate XVI.*]

Panicum Virgatum. (Tall panic grass—Switch grass.)

The culms are from 3 to 5 feet, and the leaves are reedy. The panicles are large and loose, and the spikelets are scattered, very small, and of a purplish hue. The spikelets are ovate and sharp pointed. This grass grows in moist places and makes a good hay, furnishing, when cut soon, palatable food for cattle. When allowed to grow too old it becomes harsh.

Analysis:

Water	14.30	per	cent.
Ash	3.20	“	“
Fat	1.65	“	“
Nitrogen free extract	52.23	“	“
Crude fiber	24.70	“	“
Albuminoids	3.92	“	“

Ash :

Phosphoric acid	5.50	per	cent.
Sulphuric acid	3.56	“	“
Silica	51.17	“	“
Chlorine	4.93	“	“
Calcium	7.87	“	“
Magnesium oxide	3.63	“	“
Potassium oxide	18.76	“	“
Potassium	3.36	“	“
Sodium	1.22	“	“

[*Plate XXIX.*]

Panicum Gibbum. (Spiked panic grass)

A perennial grass growing in wet places with decumbent and branching culms. The leaves are smooth and about 8 inches long, when under good conditions.

The inflorescence is considerably oppressed and from 3 to 5 inches long. Spikelets are oblong and obtuse. The color of the plant is deep green. Flowers from July to September. This is a good grass for agricultural purposes. The analysis shows a large per cent. of nutritive food. The farmers of the State would do well to sow the seed of this grass on well prepared ground and test its value as a forage plant.

Analysis :

Water	14.36	per	cent.
Ash	7.31	“	“
Fat	3.56	“	“
Nitrogen free extract	43.65	“	“
Crude fiber	20.71	“	“
Albuminoids	10.47	“	“

[*Plate XVII.*]

Panicum proliferum. (Prolific panic grass, sprouting crab grass.)

The culms of this grass are thick and succulent. The flowers are in large panicles, and bloom from August to

September. The culms ascend from a procumbent or bent joint, and are branching and covered with long leaves. It grows from one to three feet high. The spikelets are ovate and acute, and are crowded on the branches. This grass makes excellent hay and will stand frequent cuttings until frost. All kinds of stock eat it with much relish.

Analysis:

Water	14.30	per cent.
Ash	9.58	" "
Fat	2.58	" "
Nitrogen free extract	43.42	" "
Crude fiber	20.63	" "
Albuminoids	9.49	" "

[*Plate XVIII.*]

Poa Compressa. (Wire grass—Blue grass.)

It is incorrect to call this blue grass, because its growth is more decumbent and the stem is more flattened. The grass is found growing in old fields on sandy soils and generally poor land. It does not produce an abundance of leaves, but the hay that is made from it weighs more than other grasses because it loses little in drying. The yield from an acre is very even, and manuring will largely increase the production of hay. Stock eat the grass with relish, and J. S. Gould says that sheep and horses fatten as readily on it as when fed on timothy. This grass is a perennial and grows to one foot or more in height. Very little attention is paid to it by the farmers of Alabama, but it is worth an experiment.

[*Plate XIX.*]

Phalaris intermedia, var. *angusta*; Canary grass; Stewarts Canary grass ; California Timothy grass.)—

This grass resembles timothy in the manner in which it heads. It has a luxuriant growth of leaves. The spike is also like the foreign Canary grass that is used for feeding birds, and it grows to a length of 2 to 3 inches. The spikelets contain two sterile and one perfect flower. The culms are about 10 inches high and quite slender. The grass is pronounced, by those who have given it a careful test, to be valuable for winter pasturage. It dies down in April or May and springs up at the opening of winter, furnishing an excellent green sward during the season of the year when pasturage is most acceptable to cattle. It is worthy a trial by the farmers of Alabama.

Analysis:

Water	14.30	per	cent.
Ash	9.99	"	"
Fat	3.52	"	"
Nitrogen free extract	37.23	"	"
Crude fiber	21.29	"	"
Albuminoids	13.67	"	"

Plate XX.

Phleum pratense. (Timothy)

Dr. George Vasey says, concerning this plant: "This is one of the commonest and best known grasses. For a hay crop it is, perhaps, the most valuable. * * * * * This grass, as known in cultivation, is supposed to have been introduced from Europe, but it is undoubtedly indigenous in the mountain regions of New England, New York and the Rocky Mountains. It is said that about the year 1711 a Mr. Herd found this grass in a swamp in New Hampshire and cultivated it. From him it took the name of Herd's grass. About the year 1720 it was brought to Maryland by Timothy Hanson and received the name of Timothy grass. It is now the favorite and prevailing meadow grass over a large part of the country."

Mr. Charles L. Flint says: "As a crop to cut for hay it is probably unsurpassed by other grasses now cultivated. Though somewhat coarse and hard, especially if allowed to ripen its seed, yet if cut in the blossom, or directly after, it is greatly relished by all kinds of stock, and especially so by horses, while it possesses a large percentage of nutritive matter in comparison with other agricultural grasses.

* * * *. Timothy thrives best on moist, peaty 'or loamy soils of medium tenacity, and is not suited to sandy or light, gravelly lands * * * *. It grows very rapidly and yields very large crops on favorable soils. It is cultivated with ease, and yields a large quantity of seed to the acre, varying from ten to thirty bushels on rich soils."

Analysis:

Water.	14.30	per cent.
Ash	5.90	" "
Fat	2.84	" "
Nitrogen free extract	48.77	" "
Crude fiber	21.71	" "
Albuminoids	8.48	" "

Phragmites Communis. (Reed grass)

This is one of the largest grasses found in the State and is aquatic in its habits—growing along the margins of ponds and marshes. It is quite coarse and does not furnish a good hay, but stock eat the young, tender leaves when the plant first comes up. As the grass grows older, however, the culms and leaves become hard and tough and stock reject it. The culms or stems make very good thaching and wicker work. The plant is very showy when in full flower, and at a distance resembles sugar cane.

[*Plate XXI.*]

Richardsonia scabra. (Mexican clover—Pigeon weed—Poor toes—Florida clover—Spanish clover)

The plant is not a grass, but on account of its use for forage purposes a discussion of its merits comes appropriately in this connection. It is an introduced species—first making its appearance on the sea board a number of years until now it is to be found all over the fields throughout southern Alabama. Opinions regarding its value for stock food are very contradictory, but a large number of persons who have tried the plant for grazing claim that its fat forming properties are high in the scale. It is not a clover, but belongs to the same family to which coffee and madder belongs, viz: Rubiacæl. It is a hardy plant and grows well on poor, sandy soil.

[*Plate XXII.*]

Sorghum halapense [Johnson or Means' grass.]

This is not a native grass, but was introduced into the State years ago. It has been so extensively used in some portions and has obtained such a strong and permanent hold it has become naturalized. It has a rhyzoma or root stock that takes a very firm hold of the soil and gives considerable trouble to eradicate if the land is desired for other crops. The grass grows to a height of six or seven feet and has a panicle a foot or more in extent, open and large. The longer branches of the panicle are five or six inches long. The flowers and seed resemble, in many respects, those of broom corn. Farmers living in the middle portion of the State are very familiar with this plant without a minute description. The name "Johnson" is given to this grass because Wm. Johnson who lived near Selma, first introduced it into the State many years ago.

The grass originally came from Turkey, brought to this country by governor Means of South Carolina in 1835, and was first designated by the name of Means' grass. Five or ten years after Mr. Johnson brought it to Alabama. This grass must not be confounded with Guinea grass because the two belong to different genera. It has an excellent reputation as a forage plant, and cattle are very fond of it both in the green and dry state. To make good hay it should be cut while quite young, two or three feet high, and several times during the season. The grazing of cattle on the grass should be managed with caution.

Analysis:

Water	14.30	per	cent.
Ash	6.92	"	"
Fat	2.43	"	"
Nitrogen free extract	44.77	"	"
Crude fiber	21.47	"	"
Albuminoids	10.11	"	"

[*Plate XXIII.*]

Sorghum nutans [Indian grass—Wood grass.]

This grass grows something similar to the last, and reaches a height of two to four feet with a panicle one to two feet long. It is generally found on dry barren soils growing from perennial roots. There are two varieties of this grass that differ but slightly from each other. When cut early the hay is nutritious and the chief objection that is offered to it is the thin bed of grass it forms in its wild state. This, however, may be overcome by cultivation.

Analysis:

Oil	1.57	per cent.
Wax	0.10	" "
Sugars	7.27	" "
Gum and Dextrin	3.75	" "
Cellulose	36.70	" "
Amylaceous Cellulose	27.25	" "
Alkali extract	14.44	" "
Albuminoids	3.29	" "
Ash	5.63	" "

The ash contains 6.74 per cent. of potassium, 61.55 per cent. of phosphoric acid, and 2.92 per cent. calcium oxide, with other ingredients that are of less value. The sample analyzed was obtained from Texas.

[*Plate XXIV.*]

Setaria Italica. [Hungarian grass; German millet; Belgium grass.]

This grass is an annual. The leaves are very long and the spikes are close together, with the spikelets containing many florets, The culms grow from eight to ten feet in height, and are smooth and branched. The grass flowers from July to September. It makes an excellent green food for cattle. The leaves are sometimes as much as eighteen inches long and rather broad. The ligule is beard like. The panicle is densely contracted. The bristles are yellow and sometimes longer than the spikelets. In cutting this grass for hay, care must be taken not to let rain fall on it after it is mowed. It should be cut as soon as it begins to bloom—because after the seed are formed the stem makes inferior food and the land is considerably exhausted. When the seed are fed to stock a quantity of indigestible food accumulates in the stomach and the animals are sometimes injured thereby. The seed, therefore, should not be allowed to mature if hay is desired.

Analysis;

Water	14.30	per cent.
Ash	6.43	" "
Fat	2.32	" "
Nitrogen free extract	47.80	" "
Crude fiber	21.02	" "
Albuminoids	8.13	" "

Seteria Glauca. [Bristly fox-tail grass—Bottle grass.]

The spike is cylindrical and in color it is a tawny yellow. The culms are two to three feet high and are sometimes branched. The stem and branches are smooth. The leaves are about twelve inches long with a few long slender hairs at the base. The ligule is small and beard-like, or in other words, contains around its margin a decided fringe. This plant is found in cultivated fields, and flowers from July to August. The stem is erect and somewhat compressed.

The awns or bristles are six to ten in a cluster. This grass is met with after wheat is mown, and generally appears in abundance.

The plate does not represent enough bristles. The grass is ranked equal to Hungarian grass in nutrition, and should be cut early, before the bristles become too hard and stiff. Fowls are very fond of the seed after they mature.

Analysis:

Water	14.30	per cent.
Ash	6.80	" "
Fat	2.62	" "
Nitrogen free extract	50.18	" "
Crude fiber	18.80	" "
Albuminoids	7.30	" "

[*Plate XXV.*]

Tripsacum dactyloides. [Gama grass; Sesame grass.]

Grows from five to seven feet high, with broad leaves resembling somewhat Indian corn. It grows on moist soils, and is stout, coarse and hardy. The culm is solid and grows from a rhyzoma or root stock. The flowers are in three clustered spikes. The spikelets have no awns and are arranged in jointed spikes. The upper florets are sterile, while the lower ones are fertile. This grass flowers from August to September. The quantity of forage that can be gathered from this grass is quite large, because it will stand cutting several times during the season. Stock are very fond of it, and the hay may be cured at an expense considerably less than that required for gathering corn fodder. After the roots have taken possesion of a field, the grass is quite difficult to eradicate. A yoke of oxen can scarcely move a plow through it. But the grass may be destroyed by close cropping when the roots will die, thus enriching the land.

Analysis :

Water	14.30	per	cent.
Ash	5.30	"	"
Fat	2.05	"	"
Nitrogen free extract	48.26	"	"
Crude fiber	22.72	"	"
Albuminoids	7.29	"	"

Ash :

Phosporic acid	2.52	per	cent.
Sulphuric acid	3.69	"	"
Silica	37.84	"	"
Chlorine	13.08	"	"
Calcium oxide	1.64	"	"
Magnesium oxide	1.07	"	"
Potassium oxide	29.06	"	"
Potassium	6.30	"	"
Sodium	4.47	"	"

[*Plate XXVI.*]

Trifolium Procumbens. (Small yellow clover.)

This is a small clover that is found growing in almost every old field throughout the State, reaching a height of three or four inches. Little attention has been paid to it, but the analysis indicates a fair forage plant, particularly when we consider that the sample grew without cultivation. In one hundred parts in a green state there were 3.9 per cent. of albumnious, or flesh forming principles, fatty matters 0.77 per cent., heat producing principles, such as sugar, gum, starch 7.25 per cent. In the sample of dried grass at 212° F. analysis showed the following per centages: Albuminous or flesh forming principles 20.48, fatty matters 4.67 ; heat producing principles 43.86.

It is probable that under cultivation this clover will yield good results and may be made to produce much larger plants.

[*Plate XXVII.*]

There are three other species that grow wild in Alabama, that are worthy of attention, viz :

Trifolium reflexum, Trifolium Carolinianum, and Trifolium repens. The first is called buffalo clover, the second white clover, and the last southern clover. The last two grow almost everywhere over the State, and supply very good cropping for cattle. The T. reflexum grows luxuriantly in Montgomery, and other counties of Middle Alabama, and is attracting attention among stock raisers.

Zizania aquatica. (Wild rice, Indian rice, Water oats, Water rice.)

A grass that resembles rice and grows very rank in marshes and along streams of the State. Stock eat it with great relish, birds are also very fond of the seed and flock in great numbers along the sea shore and fatten rapidly on the seed. It is thought by some persons that if it was cultivated as rice it would yield excellent results. But experience shows that the seed shed so readily before the plant is harvested, large crops cannot be obtained. The fact that stock are so fond of it would imply that its cultivation would well repay farmers. Much of the land that is now wasted along the banks of streams might be well reclaimed by planting down in this grass, thus giving a good range for cattle.

[*Plate XXVIII.*]

CONTENTS.

G.H.NICHOLS-ENG.

MARX-DEL.

ALOPECURUS PRATENSIS (Meadow foxtail).


NICHOLS-ENG
MARX-DEL.

H.H.NICHOLS. MARX.DEL.

BROMUS SECALINUS (Chess or Cheat).

Plate IV.

BROMUS UNIOLOIDES (Rescue grass).

CYNODON DACTYLON (Bermuda grass).

Plate VI.

DACTYLIS GLOMERATA (Orchard grass.)

ELEUSINE INDICA (Yard grass ; Crowfoot ; Crab grass).

Plate 1X.

MARX DEL.

Plate X.

H. H. Nichols.

Marx del.

HOLCUS LANATUS.—(Velvet-grass.—Meadow soft grass—Velvet lawn grass).

Plate XI.

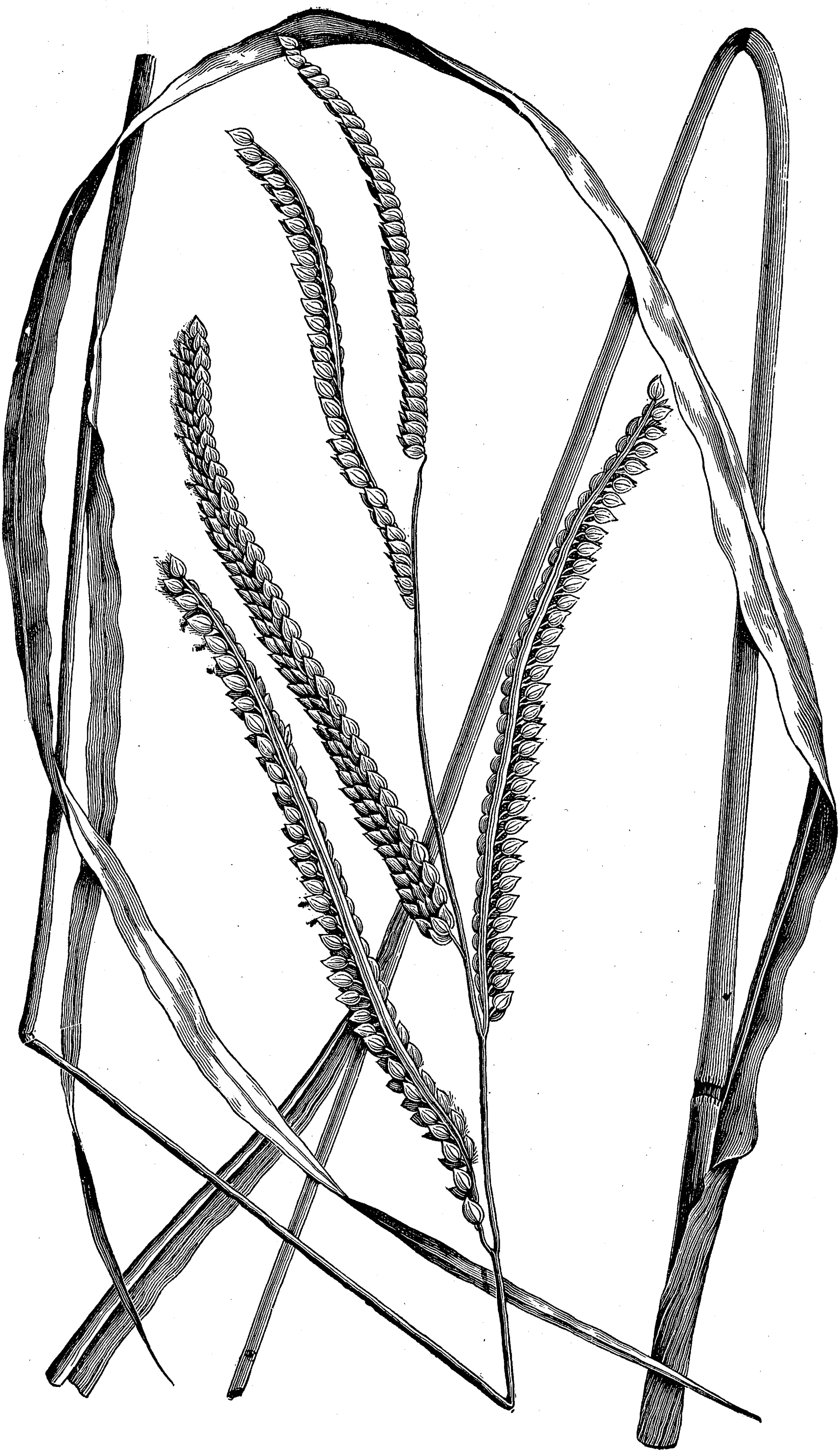
LESPEDEZA STRIATA (Japan Clover).

Marx del

MUHLENBERGIA MEXICANA.

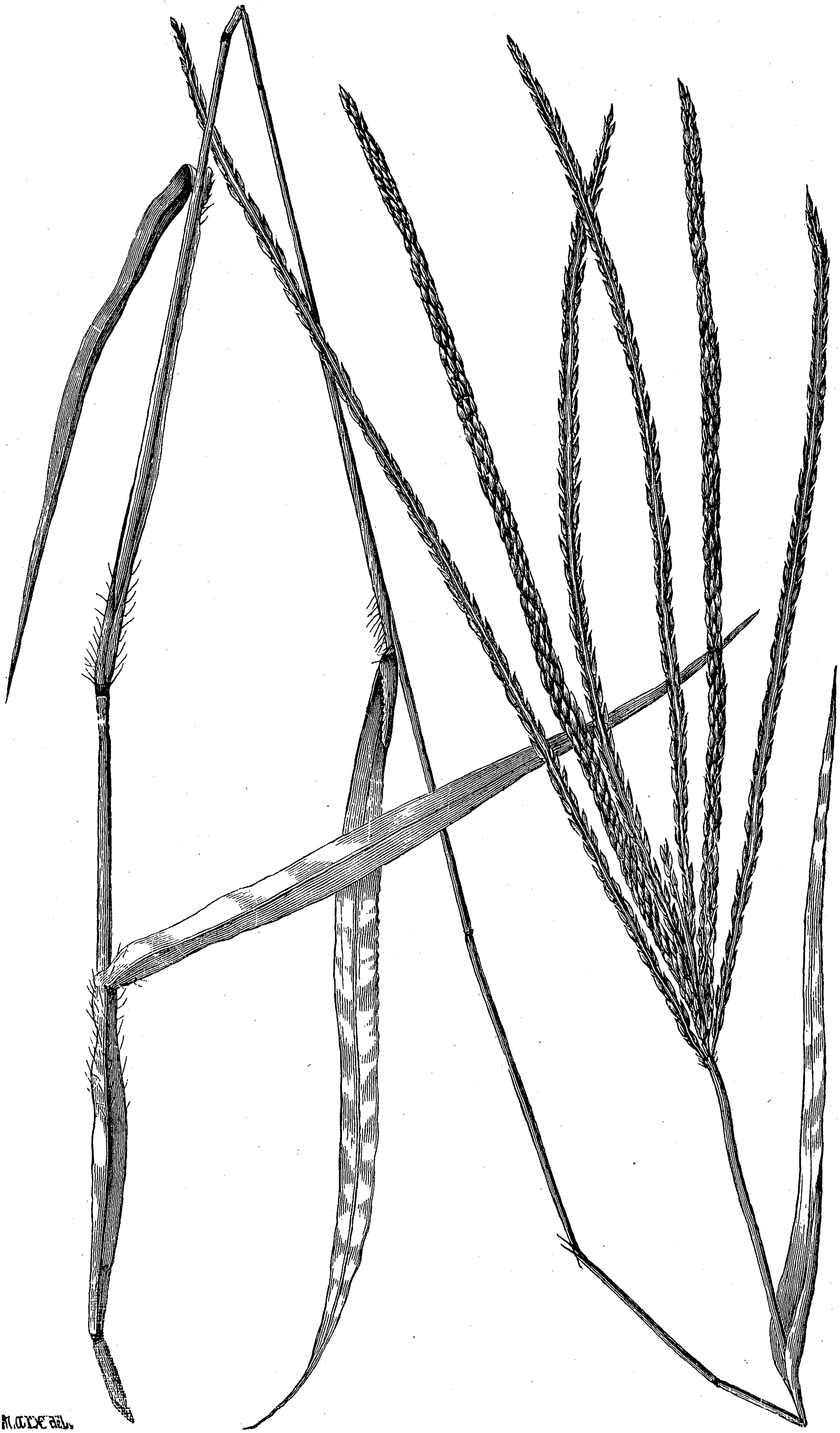
Plate XIII.

PASPALUM LAEVE (smooth erect grass.—Water grass).



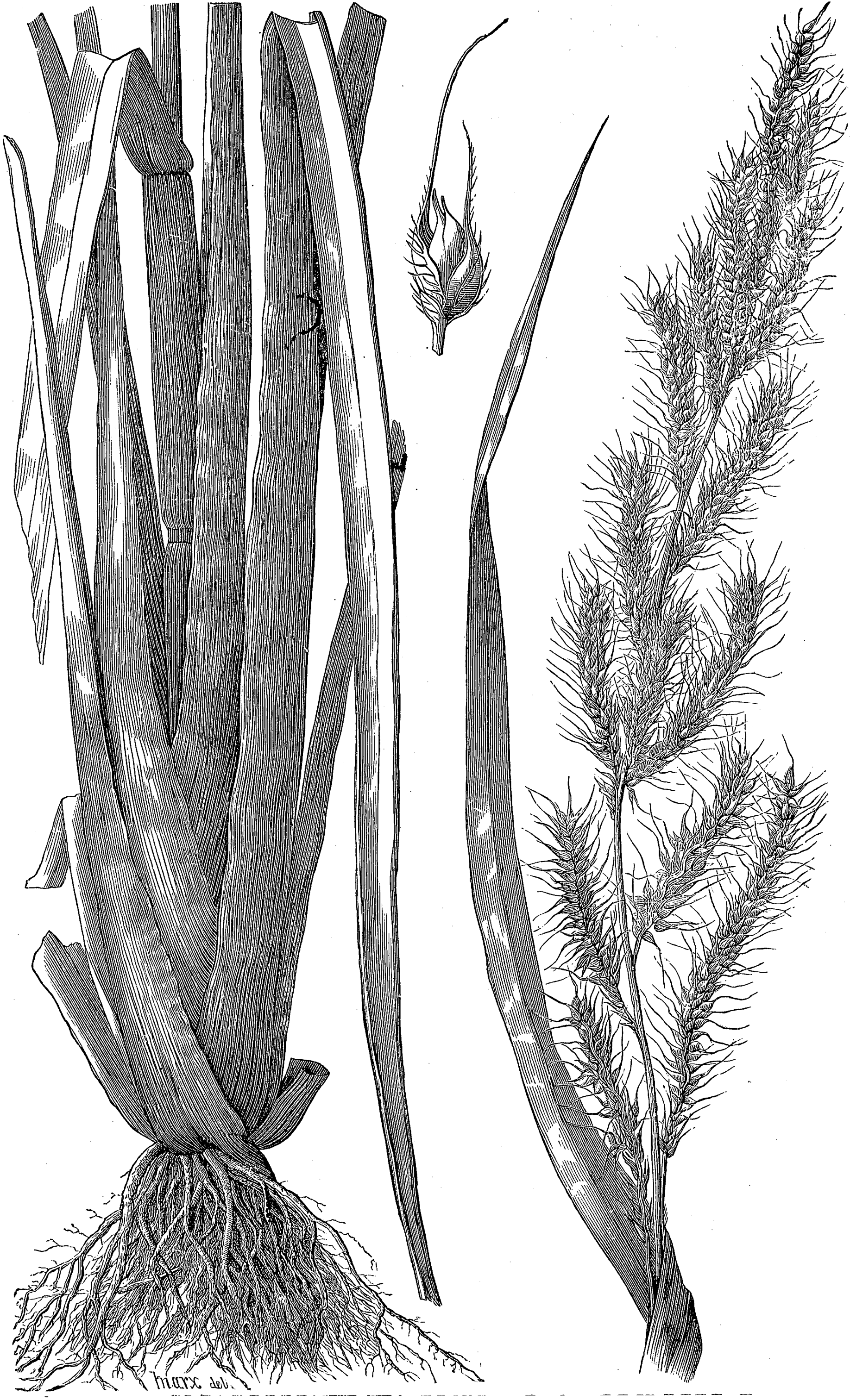
PASPALUM DILITATUM (Hairy flowered pàspalum).

Plate XV.



PANICUM SANGUINALE (crab grass).

Plate XVI.



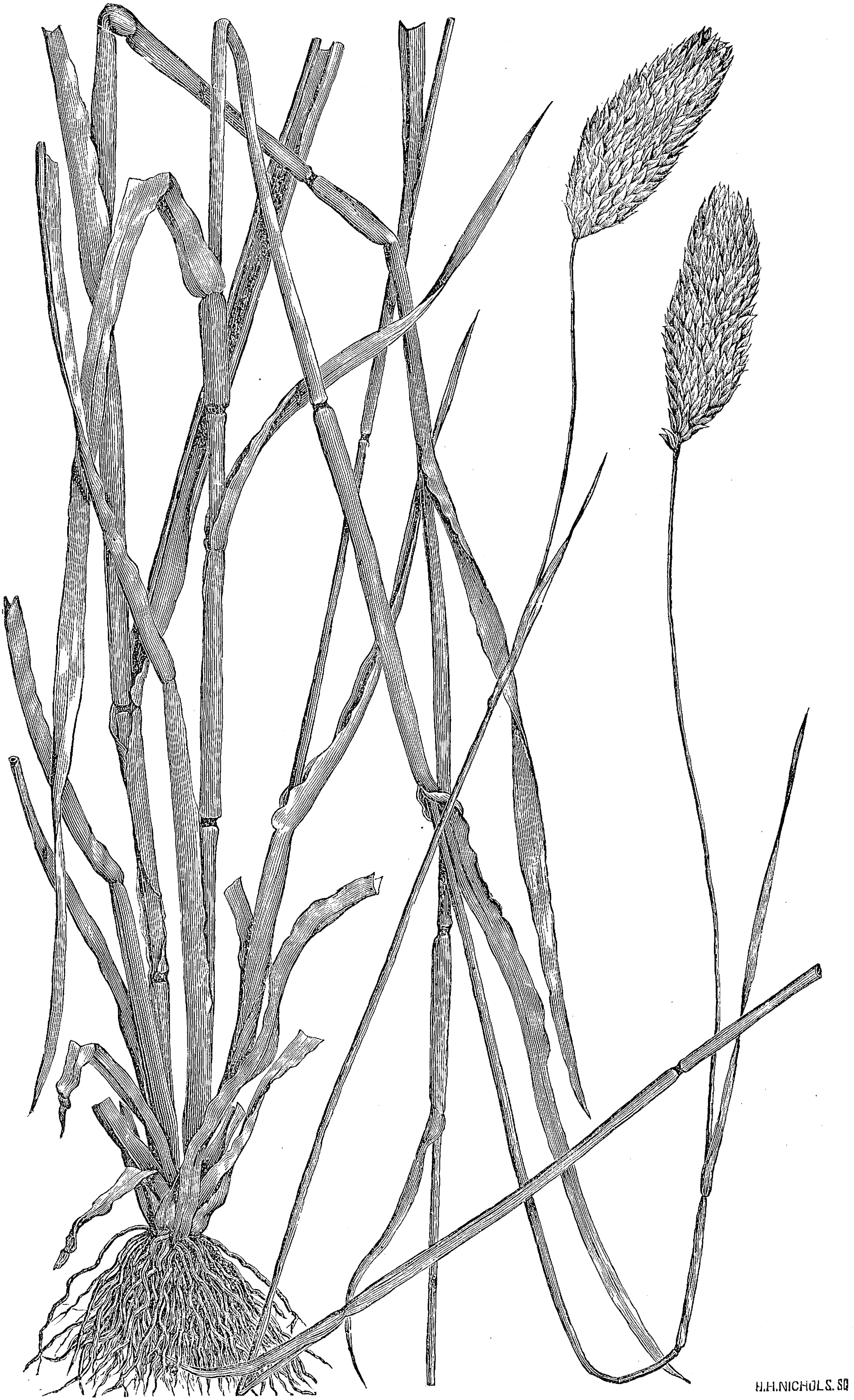
Plale XVIII.

PANICUM PROLIFERUM (Prolific panic grass, sprouting crab grass).

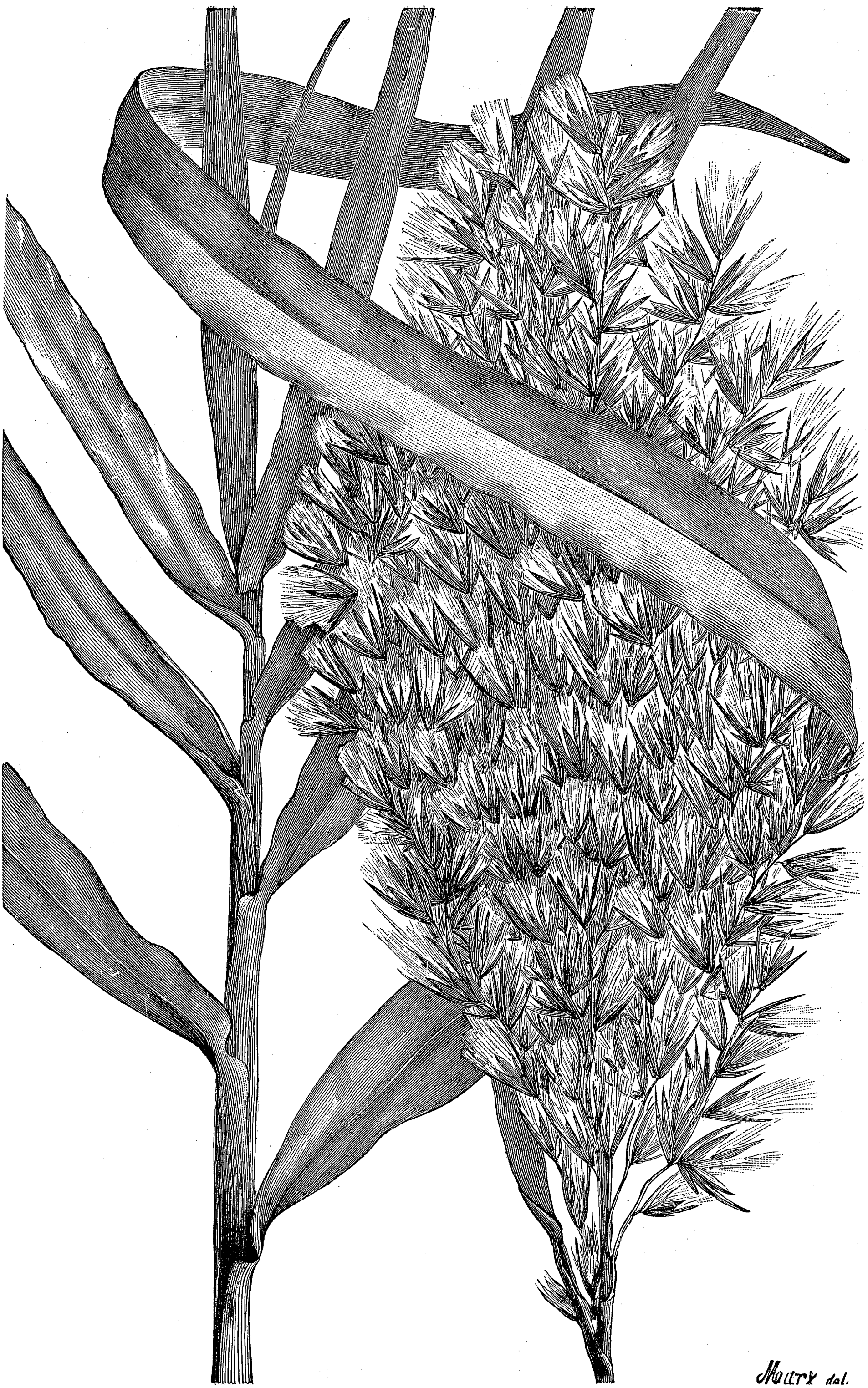
Plate XIX.

POA COMPRESSA (Wire grass Blue grass).

Plate XX.



PHALARIS INTERMEDIA, VAR. ANGUSTA (Canary grass ; Stewarts Canary grass ;



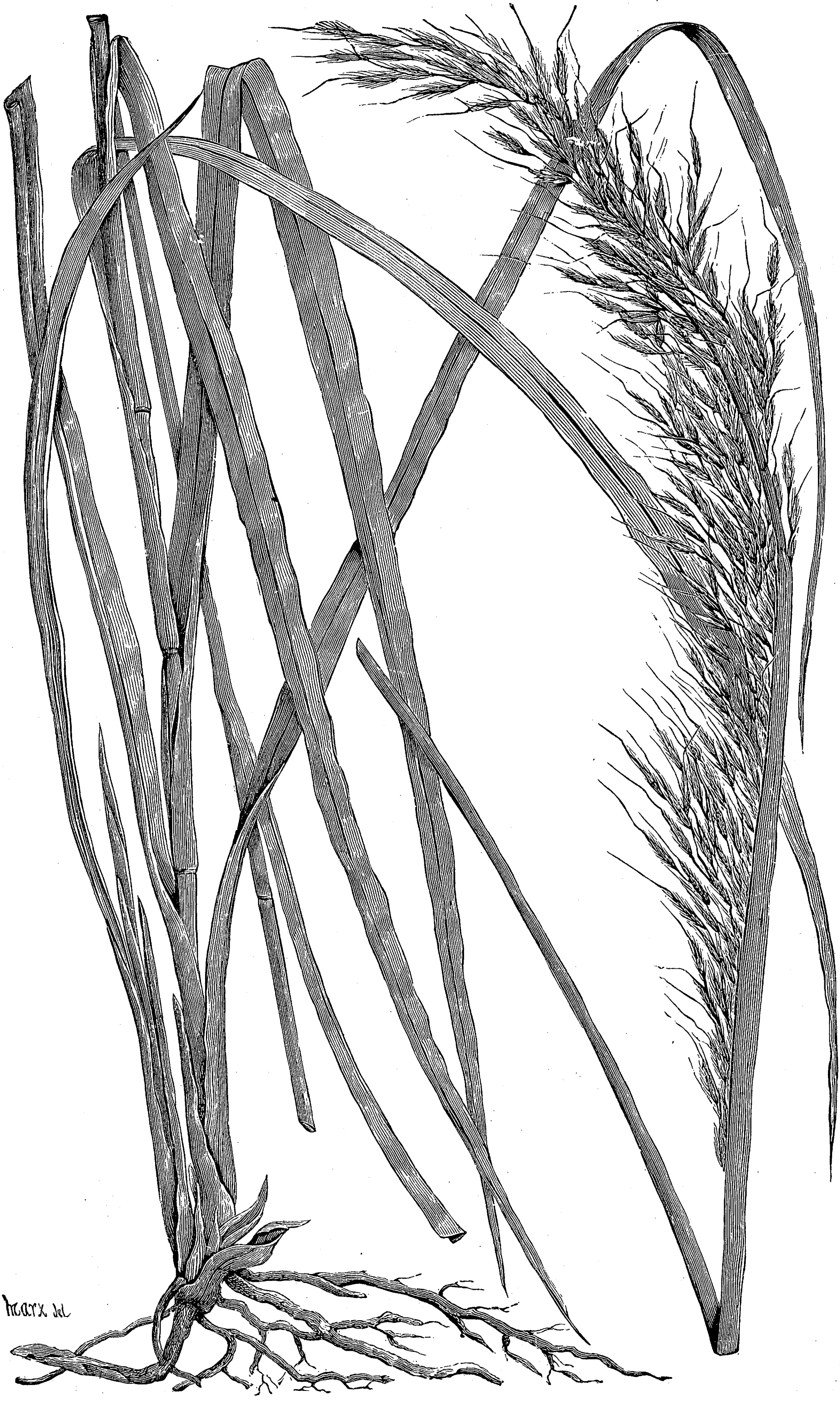
PHRAGMITES COMMUNIS (Reed grass).

Plate XXII.

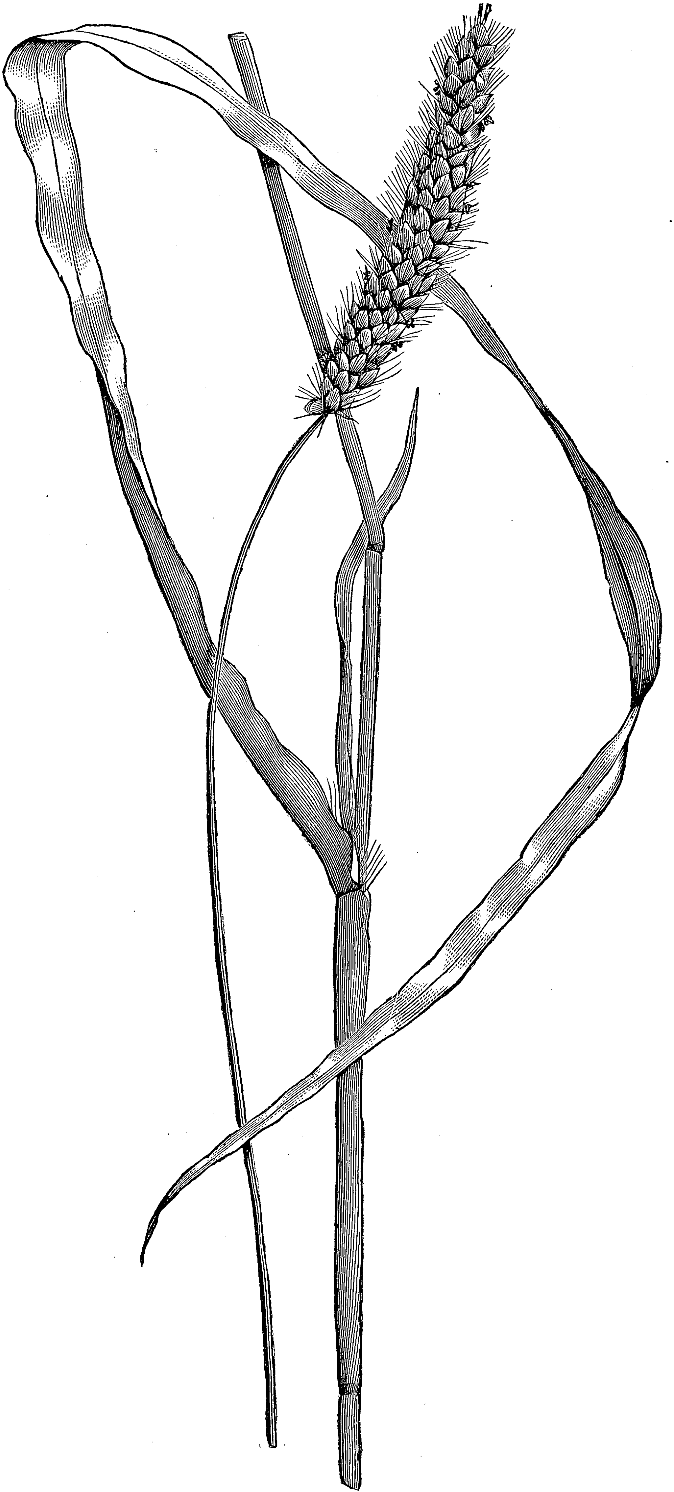
RICHARDSONIA SCABRA—(Mexican clover—Pigeon weed—Poor toes—Florida clover—

Plate XXIII.

Plate XXIV.



SORGHUM NUTANS.—(Indian grass; Wood



H.H.NICHOLS—ENG

MARX—DEL.

SETERIA GLAUCA (Bristly fox-tail grass—Bottle grass).

Plate XXVI.

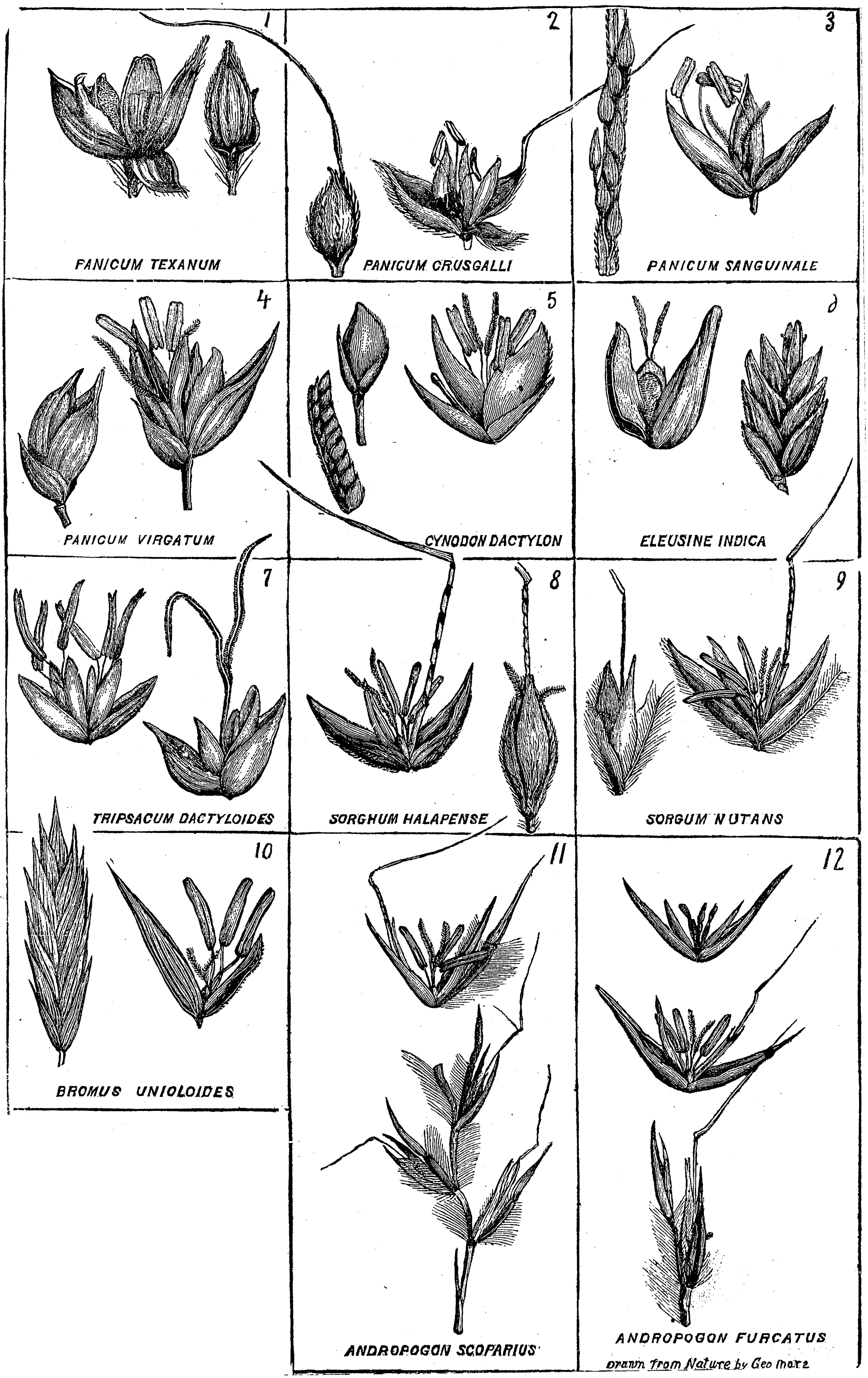
TRIPSACUM DACTYLOIDES (Gama grass: Sesame grass).

Plate XXVII.

Plate XXVIII.

ZIZANIA AQUATICA (Wild rice, Indian rice, Water oats, Water rice).

Plate XXIX



1 PANICUM TEXANUM

2 PANICUM CRUSGALLI

3 PANICUM SANGUINALE

4 PANICUM VIRGATUM

5 CYNODON DACTYLON

6 ELEUSINE INDICA

7 TRIPSACUM DACTYLOIDES

8 SORGHUM HALAPENSE

9 SORGUM NUTANS

10 BROMUS UNIOLOIDES

11 ANDROPOGON SCOPARIUS

12 ANDROPOGON FURCATUS

drawn from Nature by Geo Marx

BULLETIN NO. 7. NEW SERIES.

REPORT

—OF—

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA., OCT. 1889.

———o———

Contents:

HORTICULTURE—EXPERIMENTS WITH VEGETABLES.

DAIRY—METHODS OF SETTING MILK. Meteorology.
Dairying

The Bulletins of this Station will be sent free to any farmer in the State who desires them.

BULLETIN NO. 7,

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA., - - - - OCTOBER, 1889.

BOARD OF DIRECTION.

W. L. BROUN	President
J. S. NEWMAN	Director and Agriculturist
N. T. LUPTON	Vice-Director and Chemist
†P. H. MELL	BOTANIST
GEO. F. ATKINSON	*Biologist

ASSISTANTS:

ISAAC ROSS	1st Assistant Agriculturist, charge of Live Stock & Dairy
JAS. CLAYTON	Second Assistant Agriculturist
J. T. ANDERSON, PH. D	First Assistant Chemist
L. W. WILKINSON, M. SC	Second Assistant Chemist
P. L. HUTCHINSON, B. SC	Third Assistant Chemist
A. M. LLOYD, B. SC	Assistant Botanist

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†Prof. Mell has also charge of Meteorological Observations.

*The special work of the Biologist is the investigation of the diseases of plants caused by parasitic fungi and insects.

DAIRY DEPARTMENT.

———o———

AUBURN, ALA., Sept. 12th, 1889.

PROF. J. S. NEWMAN, DIRECTOR:

The following is the report upon the experiments recently conducted in the dairy in accordance with the instructions received from you. The experiments were continued for a period of six weeks, using the Jersey cows, Hattie Signal 2nd, Lady Toomer, and Kate Hazen.

Hattie Signal dropped last calf January 27, 1889.
Lady Toomer " " " Nov. 11, 1888.
Kate Hazen " " " Dec. 30, 1888.

All due to calve in Oct. and Nov.

The cows underwent no preparatory treatment before they were experimented with; and, during the time of the experiment, were kept in a small lot where there were a few shade trees.

Most Respectfully,
ISAAC ROSS, 1st Assistant.

COMMENTS.

The cows were kept in a small lot and fed three times per day what they would comsume without waste. They were watered twice daily. They were not in as good condition at the clase of the test as at the beginning. During the first week of the test the cows were fed green fodder corn, the balance of the time sorghum, both run through the cutter.

The result of the first week shows that less butter was made from the use of ice at an additional cost of 20c per day than during the week following from the use of well water without ice. This is accounted for to some extent by the separation of the three cows from the balance of the herd. They were much more fretful and nervous the first week than afterwards.

The results the second week would indicate that by the use of cool well or spring water a larger yield may be secured and at less cost than by the use of ice.

The results during the third week compared with those of the first and second indicate the propriety of setting in cold water when practicable.

The fourth week shows a small improvement over the third, but there is a loss of butter in placing the whole milk in cans or jars in the dairy for the cream to rise and sour, especially at a high temperature.

The fifth week gives less butter from churning the whole milk sour than was expected.

The result of the sixth week shows a poor yield from churning cream sweet; and, as compared to the preceeding weeks when the cream or whole milk was churned sour, is against churning the cream sweet. The churning was done in the forenoon. In all cases the butter was salted one ounce to the pound, and worked twice before weighing.

It will be noticed that the highest temperature occurred during the sixth and last week of the experiment.

EXPERIMENT WITH METHODS OF SETTING AND CHURNING MILK—CONTINUED.

Week.	Name.	Food Consumed			lbs of Milk per Week.	Manner of Setting Milk.	Range of Temperature in Dairy.	Amount of Butter.		Time Required in Churning.	Temperature of Milk or Cream.	Estimated Value of Butter per lb	Quality of Butter.
		Forage cut green. lbs.	Corn, Oats and Bran in equal parts. lbs.	Cotton Seed Meal. lbs.				lbs.	ozs.				
5th.	Hattie S........	43	5	3	110	36 hours without water, and cream churned sour.	72°	10	9	20 min.	65°	25 cts	Off in color, very much like No. 3.
	Lady T..........	38	4	3	66		to						
	Kate H..........	50	6	3	107		85°						
6th.	Hattie S........	43	6	3	110½	12 hours in deep cans, without ice or water. Cream churned sweet	79°	9	13	30 min.	68°	20 cts	Off in color, insiped, quickly turning rancid.
	Lady T..........	38	5	2	63		o						
	Kate H..........	50	7	3½	109		87°						

EXPERIMENT WITH METHODS OF SETTING AND CHURNING MILK.

Week.	Name.	Food Consumed			lbs of Milk per Week.	Manner of Setting Milk.	Range of Temperature in Dairy.	Amount of Butter.		Time Required in Churning.	Temperature of Milk or Cream.	Estimated Value of Butter per lb	Quality of Butter.
		Forage cut green. lbs.	Corn, Oats and Bran in equal parts. lbs.	Cotton Seed Meal. lbs.				lbs.	ozs.				
1st.	Hattie S........	45	6	3	127½	24 hours in water, using ice. Cost of ice, $1.40 per week.	71°	13	12½	25 min.	66°	30 cts	Color good, firm. Off flavor, supposed to be from cows eating bitter-weed.
	Lady T..........	38	4	2	67½		to						
	Kate H..........	50	7	3	120½		85°						
2nd	Hattie S........	43	6	2½	115½	24 hours in well water, changed twice daily.	66°	14	1½	21 min.	67°	30 cts	Little off in color, fair texture and firmness, but not equal to the average produce.
	Lady T..........	35	4	2	67½		to						
	Kate H..........	48	6	3	122½		84°						
3rd	Hattie S........	43	6	2½	112	24 hours in deep cans, without ice or water. Churned cream only.	73°	11	1½	18 min.	68°	25 cts	Off in color, containing curd-specks from too acid cream.
	Lady T..........	35	5	2	71		to						
	Kate H..........	46	7	3	115		84°						
4th	Hattie S.........	45	6	3	112½	36 hours whole milk set in deep cans on shelves. Churned sour.	71°	11	14½	35 min.	71°	25 cts	Off in color, soft, without any granular texture.
	Lady T..........	38	5	2	65		to						
	Kate H..........	52	7	3	107½		85°						

AN EXPERIMENT IN SETTING MILK.

By J. W. Hart, Dairyman.

To determine the difference in the yield of butter in using the De Laval horizontal hand separator and Cooley cans, an experiment has recently been made. Commencing Sept. 7th, the test was continued for six days; on three days the 7th, 9th, and 11th the separator was used, while the Cooley cans were used on the 8th, 10th, and 12th. The milk was the total yield of eleven registered Jersey cows. Pasturage being scanty, they were fed upon a small ration of coarse fodder with about thirty-two pounds of a mixture of corn, oats, and bran in equal quantities, and fifteen pounds of cotton seed meal morning and night. Milking commenced at 5:15, a. m., and 4:15, p. m., and was finished in about 45 minutes.

To facilitate churning, a quantity of milk was added to the cream obtained from the separator, which makes the amount of cream recorded in the table greater than the amount separated by the machine. Twelve hours before churning, the cream was mixed, thoroughly stirred, and allowed to ripen. In churning, the treatment of the cream in both cases was as nearly alike as the difference in the two methods of separation would admit of. The granular butter was washed twice in cold water, and the same number of times in strong brine, then salted at rate of ½ oz. to the pound and immediately pressed into pound prints.

On Sept. 8th the temperature was not reduced low enough to obtain all the cream. On Sept. 9th, the small amount of butter, 9 lbs. 2 oz , can be accounted for by the fact that the cream had not been ripened, being almost sweet.

From the results recorded in the table, it appears that there was little difference between the two systems in the amount of butter obtained. The butter, during the experiment, was uniform in quality, selling readily at 35cts per pound. In setting milk in the Cooley cans a little more labor was necessary. In the item of cost the advantage was on the side of the De Laval separetor. For each pound of butter made from the Cooley cream of Sept. 10th and 12th, 10cts was expended for ice, which tends to show that the use of ice in cream separation is altogether too expensive in this climate. Taking everything into consideration, the experiment demonstrates that under our conditions the centrifugal is more economical than the deep-setting system of creaming milk.

THE DE LAVAL HORIZONTAL HAND SEPARATOR.

Date.		Yield of milk in qounds.	Temperature when Separated.	Time required for Separation.	Cream in pounds.	Churning Temperature.	Time required for Churning.	Weight of Butter in pounds.	Pounds of Milk to pound of Butter.
Sept. 7.	Morning.......	80¼	94°	20 Minutes	18¾				
	Night.........	72	97°	18 "	20	66°	21 Minutes	10	15.225
	Total..........	152¼		38 Minutes	38¾				
Sept. 9.	Morning	76	96°	19 Minutes	20				
	Night....	71	98°	18 "	18½	66°	28 Minutes	9⅛	16.11
	Total....	147		37 Minutes	38½				
Sept 11	Morning.... ..	74½	96°	19 Minutes	18				
	Night......	77½	98°	18 "	19½	66°	18 Minutes	10⅛	15.012
	Total.........	152		37 Minutes	37½				

THE COOLEY CREAMER.

Date.		Yield of Milk in lbs.	Temperature when Submerged.	Temperature of water when milk was submerged.	Temperature of milk when skimmed.	Cream in pounds.	Churning Temperature.	Time required for Churning.	Weight of Butter.		Pounds of milk to pound of butter.	Pounds of ice used.	Cost of ice.
Sept. 8.	Morning.	71	95°	50°	63°	23¼						72	
	Night. ..	70¾	98°	56°	64°	20¼	69°	25 min.	8 lb.	13½ oz.	16.028	39	67c
	Total	141¾				43½						111	
Sept 10.	Morning.	75¾	96°	45°	56°	23¾						100	
	Night ...	75¾	98°	44°	59°	22	68°	27 min.	10 lb.		15.15	64	98c
	Total	151½				45¾						164	
Sept 12.	Morning.	72¾	95°	44°	51°	20½						94	
	Night ...	73½	98°	43°	57°	21	68°	20 min.	9 lb.	10 oz.	15.195	68	97c
	Total	146¼				41½						162	

Report of

EXPERIMENTS WITH VARIETIES OF VEGETABLES.

By Jas. Clayton.

A number of experiments has been made with different vegetables in the Horticultural department, to ascertain, if possible, the varieties best adapted to our soil and climate, and also to compare varieties with each other as to their productiveness, earliness, character of growth, and merit. A protracted drought retarded the plants in these experiments in May and the early part of June.

Amongst the varieties of tomatoes especial attention is called to the Acme, Golden Queen, Paragon, and several others of Livingston's varieties, as being all that any one could desire. The utmost care has been taken with the preparation of the soil, planting, cultivation and testing of these varieties. The seeds were planted in the green-house March 2nd, and transplanted April 11th. The yeild was enormus, and when in full bearing, the vines presented a picture of luxuriant growth not often seen. The greatest accuracy was observed in the classification of the varieties when testing their merits: the waste was ascertained by weighing a number of specimens of each variety: then cutting from the stem end just so much as would be discarded in an economical preparation for the table, the specimens were then re-weighed, and the difference divided by the number employed. The size of the tomato was obtained by cutting it in half and measuring the length from stem to blossom end, and then measuring the diameter at right angles to this.

In the Irish potato experiment, each variety was subjected to identical conditions in every respect. Twenty varieties were planted—five rows of each kind, and thinned to an equal number of hills to each plat. The Burbank, Mammoth Prolific, and Rose's New Giant are specially mentioned, as being prolific, smooth, and of good size, while the keeping qualities of the Burbank are unsurpassed.

Fifty-three varieties of Bush Beans and forty of English peas were planted, with satisfactory results. Many were found meritorious, being both vigorous and prolific.

In the following tables the terms "good, very good, and best," are used to express the degrees of excellence. It will be observed that some varieties which grade "best" in quality, on account of low grade in other respects cannot be recommended for general cultivation.

ACKNOWLEDGEMENTS.

The thanks of the Experiment Station are due the following firms, for seeds presented, for experimental test:

J. M. Thorburn, New York city; Livingston's Sons, Columbus, O.; Z. De Forest Ely, Philadelphia; Peter Henderson & Co., N. Y.; A. D. Perry & Co., Syracuse, N. Y.; J. C. Suffern & Co., Voorhies, Ill.; Northrup, Braslin & Gordwin Co., Minneapolis, Minn.; U. S. Dept. of Agriculture, Washington, D. C.

EXPERIMENTS WITH VARIETIES OF TOMATOES—TRANSPLANTED APRIL 11, 1889.

NAMES OF VARIETIS.	Seedmen.	Time of Ripening.	Av. Wgt. 6 specimens in ozs.		Corrugation.	Color.	Length in Inches.	Diameter in Inches.	Core.	Cavity Around Seed.	Average Waste in Ounces.	Flavor.	Remarks.
Acme	Thorburn.	June 19	4 5-6	Roundish	None	Pinkish Red	1¼	3	Slight	None	¼	Best.	
Alpha	Thorburn	June 19	6½	Flat	Distinct	Light Red.	1¼	3	Slight	None	¼	Very Good.	
BronzeFoliage Trophy	Thorbum	June 24	8	Very Irregular.	Very Decided.	Red	1½	3½	Very Slight	None	⅔	Very Good.	
Cardinal	Thorburn	June 19	5 5-6	Roundish	None	Light Red.	1¾	1⅞	None	None	5-12	Best.	
Cincinnati Purple	Ferry	June 24	6⅓	Roundish.	Slight	Pinkish Red	1⅞	2¾	Slight	None	⅓	Very Good.	
Conquerer	Thorburn.	June 19	5	Flat	Slight	Red	1⅜	2⅞	None	None	⅓	Good	
Dwarf Champion	Thorburn.	June 24	4 5-6	Roundish	None	Pinkish Red.	1¾	2¾	Slight	None	1-6	Best.	Medium choice.
Eearly Advance	Thorburn.	June 19	3	Roundish	None	Light Red.	2	2½	None	None	1-12	Very Good.	
Early King Humbert.	Thorburn.	June 19	2	Pear Shaped	None	Red	2	1⅝	Decided	None	0	Good	
Ely's King of the Earlies.	Ely	Sune 19	4 1-6	Flat	Decided	Pale Red	1¼	2¾	Slight	None	¼	Good	
Essex Hybrid	Thorburn.	July 1.	6½	Roundish	None	Pinkish Red.	2	3	Slight	None	¼	Very Good.	
Fulton Market	U. S. Dpt. Agr	June 24	5⅔	Roundish	Slight	Light Red	2	3	None	None	¼	Very Good.	
Golded Queen	Thorburn.	July 1.	6⅔	Roundish Flat	Slight	Bright Yellow	1¾	3	None	None	¼	Best.	Tinged with red.
Green Gage	Thorburn	June 24	2¾	Roundish.	None	Golden Yellow	1⅝	2	None	None	1-12	Very Good.	Small, but perfect.
Hundred Day	Thorburn	June 19	3	Flat	Very Decided.	Light Red.	1¼	2¼	Slight	None	1-6	Good	
Impr'v'd Large Yellow	Thoaburn	July 1.	12 1-6	V'ry l'rge&flat	Very Decided.	Yellow	1¾	3½	None	None	½	Very Good.	Fine and Large, but Irregular.
Improved Queen	Thorburn	July 1.	8⅓	V'ry l'rge&flat	Very Decided.	Deep Red.	2¾	3¼	None	None	⅓	Best.	

EXPERIMENTS WITH VARIETIES OF TOMATOES—CONTINUED.

NAMES OF VARIETIS.	Seedmen.	Time of Ripening.	Av. Wgt. 6 specimens in ozs.	Form.	Corrugation.	Color.	Length in Inches.	Diameter in Inches.	Core.	Cavity Around Seed.	Average Waste in Ounces.	Flavor.	Remarks.
Large Yellow	Thorburn	July 1	3⅔	Flat	Very Decided.	Golden Yellow	1¼	3½	None.	None	1-12	Good	
Livingston's Beauty	Livingston	June 24	7	Roundish	None	Pinkish Red	2	3	None	None	⅓	Best	Medium Size and a Perfect one.
Livingston's Ea. Acme	Livingston	June 24	5	Roundish	None	Pinkish Red	2	2¾	None	None	1-6	Best	
Livingston's Favorite	Livingston	July 1	4⅔	Flat	None	Pinkish Red	1½	3	None	None	¼	Very Good.	
Livingston's Favorite	Thorburn	June 24	6	Roundish Flat	None	Deep Red.	2	3	None	None	1-6	Very Good.	
Livingston's Beauty	Thorburn	July 1	4 1-6	Roundish	None	Pinkish Red	1¾	2½	None	None	1-6	Very Good.	
Liv'ston's G'ld'n Q'e'n	Livingston	July 1	4 5-6	Roundish Flat	None	Light Yellow	2	3	None	None	1-6	Very Good.	
Liv'ston's Perfection.	Livingston	July 1	4½	Roundish	None	Light Red	2	2⅞	Very Slight.	Non	⅓	Very Good.	
Liv'ston's Perfection.	Thorburn	July 1	5 2-6	Roundish	None	Deep Red	2	2¾	None	None	1-12	Very Good.	
Lorillard	Dreer	July 6	5⅔	Roundish Flat	None	Red	2	3	None	None	1-6	Good	Irregular.
Mikado	Thorburn.	July 1	6¼	Roundish Flat	None	Pinkish Red	2	3¾	None	None	⅓	Very Good.	
New Dwarf Champion	Henderson	June 24	4⅓	Roundish.	Medium	Deep Red.	1¾	2⅝	Slight.	None	1-6	Good	
New Jersey	Thorburn.	June 24	7⅔	Roundish Flat	None	Deep Red.	2	3½	None	None	⅓	Best	Small, but Prolific and fine flavor.
New Paragon	Thorburn.	July 1	5	Roundish Flat	VerySlight	Deep Red.	1⅞	3	None	None	¼	Best	
Optimus	Ferry	June 24	5	Roundish.	None	Red	1⅞	2⅞	None	None	¼	Best	
Optimus	Thorburn.	June 19	4⅔	Roundish.	None	Red	1⅞	2¾	None	None	1-6	Best	
Paragon	Livingston	June 19	4½	Roundish	None	Pinkish Red	1⅞	2¾	None	None	1-6	Best	

EXPERIMENTS WITH VARIETIES OF TOMATOES—CONTINUED.

NAMES OF VARIETIS.	Seedmen.	Time of Ripening.	Av. Wgt. 6 specimens in ozs.	Form.	Corrugation.	Color.	Length in Inches.	Diameter in Inches.	Core.	Cavity Around Seed.	Average Waste in Ounces.	Flavor.	Remarks.
Peach	Dreer	June 24	2	Rou	Slight	P'kish red with bloom.	1⅝	1⅞	Decided	Decided.	0	Good	
Peach	Thorburn.	June 24	2	Round	Slight	P'kish red with bloom.	1⅝	1⅞	None	Decided.	0	Good	
Potato Leaf	Livingston	June 24	6⅜	Roundish Flat	None	Pinkish Red	2	3	None	None	⅓	Best	Small, Prolific & Fine.
Puritan	Thorburn.	June 19	4⅔	Roundish Flat	None	Light Red	1¾	2¾	None	None	1-6	Best	
Red Apple	Ferry	June 19	5 5-6	Roundish Flat	None	Light Red	1⅞	3	None	None	¼	Best	
Red Mikado	Dreer	June 19	9⅓	Flat	Decided	Light Red	1¼	3⅜	None	None	⅓	Very Good.	Center very Firm.
Ring Leader	Dreer	July 6	19¼	Irreg'lar&Flat	Very Decided.	Light Red	2	3⅞	None	None	1	Good	Coarse & too Firm
Scovill's Hybrid	A. D. Terry.	June 19	5	Roundish Flat	None	Deep Red.	1⅞	2⅞	None	None	1-6	Very Good.	
Selected Trophy	Thorburn.	June 19	7⅔	Flat	Slight	Red	1⅞	3¾	None	None	5-12	Very Good.	
The Hovy	Thorburn	June 19	4⅓	Roundish.	None	Pinkish Red	1⅞	2⅞	None	None	¼	Very Good.	
Volunteer	Thorburn	June 19	6	Roundish.	None	Deep Red	1¼	3	None	None	1-6	Best	
Hayne's 64	Northrup & Co			No sample*									

*The seeds of Hayne's No. 64 were received too late to be planted with the first lot; hence no sample was ripe when the classification was made. It is medium in size, smooth, roundish, light red, very good in quality, plants vigorous and prolific.

VARIETIES OF ENGLISH PEAS—PLANTED MARCH 30, 1889.

Names of Varieties.	Seedmen.	Growth of Vines.	Productiveness.	Time Edible.	Time from Plant'g to Edible in days.
Abundance	Thorburn.	Dwarf	Prolific	May 28	58
Ahaska	Thorburn.	Dwarf	Not Prolific.	May 17	48
Alpha	Thorburn.	Dwarf	Not Prolific.	May 17	48
American Wonder	Thorburn	Dwarf	Poor	May 17	48
Bl'ckeyed Marrowfat.	Thorburn	Tall	Poor	June 11	72
Blue Beauty	Henderson	Dwarf	Poor	June 17	78
British Queen	Thorburn.	Tall	Poor	June 18	79
Carter's Anticipation	Northrup & Co	Medium	Medium	June 11	72
Carter's Strategem	Thorburn.	Dwarf	Prolific	May 30	60
Carter's Telephone	Thorburn	Tall	Medium	June 4	65
Champion of England	Thorburn	Medium	Medium	June 11	72
Culverwels Telegraph	Thorburn	Medium	Medium	May 30	60
D'l O'Rouke Improved	Thorburn	Dwarf	Poor	May 17	48
Dwarf Sugar	Thorburn	Dwarf	Medium	June 25	86
Eureka Extra Early	Dreer	Dwarf	Not Prolific	May 15	45
Ever Bearing	Thorburn	Medium	Very Prolific	June 1	61
First and Best	Thorburn	Dwarf	Not Prolific	May 17	48
Horsfords Market	Thorburn	Medium	Very Prolific	June 1	61
Kentish Invicta	Thorburn	Medium	Not Prolific	May 25	56
Lightning Pea	Dreer	Dwarf	Poor	May 17	48
M'Leans Advancer	Thorburn	Medium	Very Prolific	May 26	57
M'Cleans Blue Peter	Thorburn.	Dwarf	Poor	May 17	48
M'Cleans Little Gem	Thorburn	Dwarf	Poor	May 20	50
Melting Sugar	Thorburn	Tall	Very Prolific	June 4	65
Minimum Laxton	Thorburn	Dwarf	Poor	May 17	48
Philadelphia	Thorburn.	Dwarf	Poor	May 17	48
Premium Gem	Thorburn	Dwarf	Poor	May 17	48
Pride of the Market	Thorburn	Medium	Medium	May 30	60
Prince of Wales	Thorburn	Medium	Medium	June 1	62
Rural New Yorker	Thorburn	Dwarf	Not Prolific	May 17	48
Rural New Yorker	U. S. Dept. Ag	Dwarf	Not Prolific	May 17	48
Small French	Thorburn	Dwarf	Not Prolific	May 25	56
Summit Pea	NorthrupB&Co	Dwarf	Poor	June 17	78
Tall Butter Sugar	Thorburn	Tall	Prolific	June 11	72
Fall Sugar	Thorburn	Tall	Prolific	June 11	72
Telephone Pea	Dreer	Medium	Medium	May 28	58
Thorb'ns Extr Ea Mar	Thorburn	Dwarf	Not Prolific	May 20	50
Tom Thumb	Thorburn	Dwarf	Prolific	May 15	45
White Marrowfat	Thorburn	Tall	Medium	June 4	65
Yorkshire Hero	Thorburn	Medium	Medium	June 4	65

DEPARTMENT OF METEOROLOGY.

BY P. H. MELL.

The tables of soil temperatures printed in this bulletin furnish some interesting facts.

There are three sets of thermometers. Two on a hill; No 1 and No 2 in cultivated ground and one in bottom land on the banks of a brook, also in cultivated ground.

The average temperatures of the three sets, at one inch below the surface, is practically the same, during the month of January. Although the set in the bottom is slightly warmer. The average reading of the one inch thermometer was from 0°.2 to 0°.6 above the average reading of the air thermometer which was 46°.9.

The lowest temperature of the air for January was 23° while the minimum recorded by these soil thermometers was 31°.5, and that was given by the one inch thermometer on the hill, while the corresponding thermometer in the bottom was 1°.5 warmer. We conclude from this comparison that the soil is not rapidly effected by the sudden changes of the atmosphere.

As depth below the surface is reached the increase of temperature is about 1°.5. Near the surface the range between the monthly mean and maximum is respectively 17.°4, 16°.6 and 15°, while at 96 in. below, the range is 2°. This is also practically true for all depths below the 36 inch thermometer. We may also infer that practically little effect is produced in the soil below 36 inches by diurnal changes of the atmosphere.

It is not exactly correct to draw conclusions concerning frost lines from one months observations but it is interesting to note that for January the frost did not go below 9 inches.

In February the minimum temperature of air was 16°.5 while the lowest reading of the soil thermometer was 13.°5 above this, even at one inch below the surface.

The 96 inch thermometer varies but little during the months of January, February and March. On the 1st of January it read 59°.5 and gradually registered cooler temperatures until the close of the month when it recorded 56°.5. From the 17th Feb. until the 21st of March it read the same, 54°.5, after this date it gradually increased until July 31st when it reached 73°. The increase is so slight from month to month it shows that the change is brought about only by the transition from winter to spring and spring to summer.

DATA FROM SOIL THERMOMETERS FOR SIX MONTHS ENDING JULY 1, 1889.

		Set 1 on hill						Set 2 on hill surrounded by grass.						Set 3 in bottom.					
	D'pth in inches	Monthly mean.	Highest for month.	Date.	Lowest for month.	Date.	Range.	Monthly mean	Highest for month.	Date.	Lowest for month.	Date.	Range.	Monthly mean	Highest for month.	Date.	Lowest for month.	Date.	Range.
Jan.	1	47 1	64 5	17	31 5	29	33	47 4	64	17	32	29	32	47 5	62 5	19	33	29	29 5
Maximum Temperature air 67°; Minimum, 23°; Average, 46°.9.	3	47	61	17	33 5	29	27 5	47 3	63 5	17	33 5	29	30	47 6	60 5	17	35 5	29	25
	6	46 6	59 5	17	36	29	23 5	47 3	61	17	35 5	29	25 5	48 2	58 5	17	39	29	19 5
	9	46 4	57 5	17	38 5	29	19 5	46 8	58 5	17	37 5	29	21	47 9	57	17	41	29	16
	12	46 6	55	17	40	29	15	46 7	55 5	17	40 5	29	15	48 2	56	17	42 5	29	12 5
	24	49 5	53 5	18	46	30	7 5	49 2	52 5	18	46 5	30	6	50 8	54	18	48 5	31	5 5
	36	50 9	52 5	19	49	31	3 5	50 8	52 5	19	49	31	3 5	52	53	19	50 5	31	2 5
	48	52 3	53 5	2-4	51	31	2 5	52 5	53 5	2-4	51 5	31	2	53 4	54 5	3-4	52 5	31	2
	60	53 1	54 5	5	52	31	2 5	53 6	55	4-5	52	31	3	54 6	55 5	1-7	54	1-2-8	1 5
	72							54 7	56		54		2						
	84							55 9	57 5		55		2 5						
	96							57 5	59 5		56 5		3						
Feb.	1	47 1	69 5	17	30	7	39 5	47	69 5	17	30	7	39 5	46 2	68 5	17	33	7	35 5
Maximum Temperature air 75°; Minimum 16.°5; Average 46°.3.	3	46 9	68 5	17	32 5	7	36	46 8	69	17	32	7	37	46 1	67	17	35	7	32
	6	46 3	66	17	35	7	31	46 7	67 5	17	34 5	7	33	46 7	65	17	38	7	27
	9	45 9	63 5	17	37	8	26 5	46	64	17	36	7	28	46 3	62	17	39	8	23
	12	45 9	62	17	38	7	24	45 8	61 5	17	38 5	7	23	46 7	60 5	18	41	7	19 5
	24	48 2	57	18	44	8	13	47 7	57	18	43 5	8	13 5	49 4	57 5	18	46	8	11 5
	36	48 9	53 5	19	47	8-10	6 5	48 9	53 5	19	47	8-10	6 5	50 2	54	19	48 5	9-11	5 5
	48	50 2	52 5		49		3 5	50 3	53		48		5	51 6	54		50 5		3 5
	60	50 9	52		50		2	51 6	53		51		2	52 6	54		51 5		2 5
	72							52 4	54		51 5		2 5						
	84							53 4	55		53		2						
	96							55	56 5		54 5		2						
Mar.	1	57 5	75 5		36 5		39	56 7	74 5		36		38 5	55 2	70 5		39		31 5
Maximum Temperature air 76°; Minimum Temperature 30°; Average 53.1	3	57 2	74		39		35	56 4	73 5		37		36 5	54 7	69		41 5		27 5
	6	56	69		41 5		27 5	55 8	68		39		29	54 6	66 5		44		22 5
	9	55	64		44 5		19 5	54 7	65		41		24	53 8	65		45		20
	12	54 4	62		46		16	53 5	62		44 5		17 5	53 8	60 5		47 5		13
	24	54 4	59 5		50		9 5	53 4	58 5		49		9 5	54 4	58		51		7
	36	53 2	57		50		7	53 1	57		50		7	53 9	57		50 5		6 5
	48	53 1	56 5		50 5		6	53 2	56 5		50 5		6	54 3	57		51 5		5 5
	60	53 6	56		51		5	53 3	56		51 5		4 5	54 2	56 5		52 5		4
	72							53 3	55 5		52 5		3						
	84							54	56		53		3						
	96							54 8	56		54 5		1 5						

VARIETIES OF BEANS—PLANTED APRIL 2, 1889.

Names of Varieties.	Seedmen.	Growth of Vines.	Productive-ness.	Time Edible	Time from Planting to Edible in days.	Remarks.
Best of All............	Thorburn.	Medium.	Prolific........	May 30	55	
Blackeyed Wax.......	Thorburn.	Medium	Prolific........	May 27	52	
Blackeyed Wax.......	Henderson	Vigorous	Best...........	May 28	53	
Broad Windsor.......	Thorburn.	Erect....	Worthless.....	June 15	70	
Canadian Wonder....	Thorburn	Medium.	Medium.......	May 27	52	
Crystal Wax	Thorburn	Medium.	Not Prolific...	June 26	81	
Cylinder Black Wax..	Henderson....	Vigorous	Best..........	May 30	55	
Date Wax.............	Dreer..........	Vigorous	Best...........	May 27	52	
Detroit Wax..........	Terry..........	Vigorous	Bert...........	May 27	52	
Dun colored Bush.....	Thorburn. ...	Medium.	Not Prolific...	May 27	52	
Dwarf Black Wax....	Thorburn.	Medium.	Not Prolific...	May 27	52	
Dw'f Ivory Pod Wax	Thorburn	Vigorous	Not Prolific...	June 4	59	Mixed with Runing
Dwarf Mexican Tree.	Thorburn	Vigorous	Not Prolific...	June 11	66	
Dwarf White Wax...	Thorburn	Medium.	Not Prolific...	June 4	57	
Early China...........	Thorburn	Medium.	Not Prolific...	May 27	52	
Early Mazagan........	Thorburn	Erect....	Worthless.....	June 11	66	
Early Mohawk	Thorburn	Medium.	Not Prolific...	June 27	82	
Early Round 6 weeks	Thorburn	Medium.	Not Prolific ...	June 30	85	
Early Valentine	Thorburn	Medium.	Not Prolific...	June 4	95	
Extra Early Maine....	Thorburn	Medium.	Not Prolific...	May 30	55	
Fuhners Early Dwarf	Thorburn	Medium.	Not Prolific..	May 30	55	
Flageolet Wax.......	Henderson...	Vigorous	Best...........	May 27	52	
Galega....	Thorburn.	Vigorous	Not Prolific ...	June 18	73	
Golden Butter Wax...	Thorburn	Medium.	Not Prolific ...	May 27	53	
Golden Refegee.......	Thorburn	Vigorous	Not Prolific ..4	June 18	73	
Golden Wax Bush....	Thorburn	Vigorous	Not Prolific ...	May 27	52	
Im'd Green Flagoelet	Thorburn.	Medium.	Not Prolific ..4	June 18	73	
Imp'd Red Valentine.	Dreer..........	Medium.	Best...........	May 28	63	
King of Greens Flag't	Thorburn	Medium.	Not Prolific ...	June 11	66	
Large White Kidney.	Thorburn	Vigorous	Not Prolific ...	June 11	66	
Lemon Pod Wax......	Thorburn	Medium.	Not Prolific ...	June 22	77	
Long ea yellow 6 wk's	Thorburn	Vigorous	Not Prolific...	May 27	52	
Lows new Champion	Thorburn	Vigorous	Not Prolific ...	May 27	52	
Marble head Hort'lst	Thorburn	Medium.	Not Prolific ...	May 28	35	Mixed with Running
Ne Plus Ultra	Thorburn	Vigorous	Not Prolific...	May 30	55	
New Date Wax........	Thorburn	Medium.	Not Prolific...	May 27	52	
New White Valentine	Thorburn	Vigorous	Not Prolific...	June 18	73	

VARIETIES OF BEANS—CNTINUED.

Names of Varieties.	Seedsman.	Growth of Vines.	Productiveness.	Time Edible	Time from Planting to Edible in days.	Remarks.
Perfection Wax.......	Dreer..........	Medium .	Not Prolific. :	May 27	52	
Pride of Newtown....	Thorburn.	Vigorous	Not Prolific...	May 28	53	
Red Kidney...........	Thorburn.	Vigorous	Not Prolific...	June 18	73	
Red Flageolet Wax...	Thorburn	Medium .	Prolific........	May 27	52	
Refugee or 1000 to 1...	Thorburn	Vigorous	Prolific........	June 18	73	
Sword Long Pod	Thorburn	Erect....	Worthless.....	May 30	55	
Thorbs Ex Ear Refugee Bush..........	Thorburn	Vigorous	Very Prolific.	June 4	59	
Wardwell's D'fKidney	Dreer..........	Vigorous	Best...........	May 30	55	
Wardwell's New Dw'f	Thorburn	Vigorous	Best...........	May 27	52	
White Flagoelet......	Thorburn	Not Vig.	Not Prolific ...	May 30.	55	
White Marrow........	Thorburn	Vigorous	Not Prolific ...	June 4.	59	Mixed with Runing
White Scimeter	Thorburn	Vigorous	Not Prolific ..4	May 28	53	
Wonder of France....	Thorburn	Vigorous	Not Prolific ...	May 28	53	
Yosemite Mamth Wax	Thorburn.	Failed to Come.	....			
Elys Pro. D'f W'x	Ely............	Medium .	Not Prolific..	May 27	52	
Pale Dun..............	U.S. Dept Agr	Vigorous	Best...........	May 27	52	

VARIETIES OF IRISH POTATOES.

Names of Varieties.	Seedsman.	Total yl'd in lbs	Choice yl'd inlbs	Medium yld in lbs	Culls yl'd in lbs.	Scb'y yl'd in lbs.
Beauty of Hebron.....	Thorburn	37	23	6	2	6
Burfauk...............	Clayton........	36	14	3	2	6
Chas. Downing........	Thorburn	45	20	6	9	7
Clarks No. 1...........	Thorburn.	21	12	3	2	4
Dakota Red...........	Thorburn	26	14	4	2	6
Dictator..............	Thorburn	23	10	4	2	7
Early Albino..........	Thorburn	30	11	6	5	8
Early Puritan.........	Thorburn.	32	10	9	5	8
Early Sunrise..... ...	Thorburn	30	12	5	4	9
Garfield....	Thorburn	24	48	6	2	8
Great Eastern.........	Thorburn	23	8	4	2	9
Late Beauty of Hebron	Thorburn	13	4	3	1	5
May Flower...........	Thorburn	19	9	6	1	4
Morning Star.........	Thorburn	14	6	3	1	4
Mammoth Prolific....	Thorburn	36	21	8	1	6
Pearl of Savoy........	Thorburn	31	14	6	4	7
Roses Bt'y of Beaut's	Thorburn	35	13	7	2	13
Roses New Giant.....	Thorburn.	37	26	4	1	6
Rural Blush...........	Thorburn	22	11	3	1	7
Rural New Yorker....	Thorburn	21	10	6	1	4

DATA FROM SOIL THERMOMETERS—CONTINUED.

		Set 1 on hill						Set 2 on hill surrounded by grass.						Set 3 in bottom.					
	D'pth in inches	Monthly mean.	Highest for month.	Date.	Lowest for month.	Date.	Range.	Monthly mean	Highest for month.	Date.	Lowest for month.	Date.	Range.	Monthly mean	Highest for month.	Date.	Lowest for month	Date.	Range.
Apr.	1	68 6	85 5	....	50	....	38 5	67 2	84	....	48	....	36	67 9	85	....	47 5	......	37 5
Maximum Temperature air 82°; Minimum, 38°; Average, 62°.5.	3	68 1	83 5	....	51	....	32 5	67 1	82 5	....	48 5	....	34	66 8	81	....	48 5	......	32 5
	6	66 6	79 5	....	53	....	26 5	66 5	80	....	50	....	30	66 6	79 5	....	52	......	27 5
	9	65 2	76	....	55 5	....	20 5	65 5	77	....	52	....	25	64 5	74 5	....	54	......	20 5
	12	64 1	73	....	56 5	....	16 5	63 9	72 5	....	55 5	....	17	63 8	72	....	56	......	16
	24	63 1	68 5	....	59	....	9 5	62 6	67	....	58	....	9	62 6	67 5	....	58 5	......	9
	36	60 9	64 5	....	57 5	....	7	61 1	64 5	....	57 5	....	7	60 9	64 5	....	57	......	7 5
	48	59 8	63	....	56 5	.. .	6 5	60 9	63 5	....	56 5	....	7	60 6	64	....	57	......	7
	60	59 1	62 5	....	56	....	6 5	59	62 5	....	56	....	6 5	59 3	62 5	....	56 5	......	6
	72	....	....	....	....	...	....	58 3	61 5	....	55 5	....	6	....	....	....	....	......	....
	84	....	....	....	....	....	....	58 2	61	....	56	....	5	....	....	....	....	......	....
	96	....	....	....	....	....	....	58	60 5	....	56	....	4 5	....	....	....	....	......	....
May.	1	77 3	92	....	52	....	40	76 1	93	....	51	...	42	77 4	94	....	52 5	......	42
Maximum Temperature air 89°; Minimum 45°; Average, 70°.	3	77 1	90	....	54 5	....	35 5	76 7	92 5	....	52	....	40 5	77	91	....	55	......	36
	6	75 7	86 5	....	58	....	28 5	76 1	88 5	....	55	...	33 5	75 5	88	....	59	....	29
	9	74 6	83	....	61 5	....	21 5	75 3	87	....	58	....	29	74 5	84 5	....	61	......	23 5
	12	72	81 5	....	61	....	20 5	73 9	82 5	....	61	....	21 5	73 7	82	....	62 5	......	19 5
	24	71 7	76 5	....	64 5	....	12	71 6	76	....	64	....	12	71 1	75 5	....	65	......	10 5
	36	68 9	73	....	63	....	10	69 3	74	....	64	....	10	67 4	73	....	64	......	9
	48	66 8	71	....	62 5	....	8 5	66 7	71 5	....	63	....	8 5	66 3	71	....	63 5	......	7 5
	60	65 5	69	....	62	....	7	65 4	69	....	62	....	7	65 3	68 5	....	62 5	......	6
	72	....	....	....	....	....	....	64 2	67 5	....	61	....	6 5	....	....	....	....	......	....
	84	....	....	....	....	....	....	63 3	66 5	....	61	....	5 5	....	....	....	....	......	....
	96	....	....	....	....	....	....	62 4	65 5	....	60	....	5 5	....	....	....	....	......	....
Juue.	1	82 4	95	....	53 5	....	41 5	82 1	97	....	51	....	46	82 3	96	....	54	......	42
Maximum Temperature air 91°.5; Minimum Temperature 46°; Average 76.1	3	82 3	94	....	54 5	....	39 5	81 9	96	....	52	....	44	82	95	....	55	......	40
	6	81	92	....	57	....	35	81 3	91 5	....	55	....	36 5	81 5	91	....	58	......	33
	9	79 7	89	....	60	....	29	80 1	90	....	57 5	....	32 5	79 5	87	....	60 5	......	26 5
	12	78 7	87	....	62	....	25	78 3	87	....	62	....	25	78 5	85	....	63	......	22
	24	76 6	82	....	68 5	....	13 5	76 1	80	....	68 5	....	11 5	76 2	80	....	69 5	......	10 5
	36	74	77	....	69 5	....	7 5	74	77	....	69	....	8	73 8	77	....	69 5	......	7 5
	48	72 2	75	....	69	....	6	72 5	75	....	69 5	....	5 5	72 4	74 5	....	69 5	......	5
	60	70 7	73	....	68 5	....	4 5	70 6	73	....	68 5	....	4 5	70 2	72 5	....	68 5	......	4
	72	....	....	....	....	....	...	69 3	72	....	67 5	....	4 5	....	....	....	....	......	....
	84	....	....	....	....	....	....	68 5	70 5	....	66 5	....	4	....	....	....	....	......	....
	96	....	....	....	....	....	....	67 2	69	....	65 5	....	3 5	....	....	....	....	......	....

DEPARTMENT OF BIOLOGY.

DIRECTIONS FOR SENDING SPECIMENS OF DISEASED PLANTS, ETC., TO THE EXPERIMENT STATION.

The Experiment Station is desirous of communicating with parties in all parts of the State in regard to the diseases of plants that are caused by parasitic fungi or insects. The special work of the Biologist is the investigation of such diseases, the recommendation of remedies where they are known, and experimentation to discover remedies where unknown.

In furtherance of this important work the Biologist will be very glad to have the co-operation of any one interested in the disease of plants. Parties can aid in this work by sending specimens of the injured plants. Very often specimens are sent in such a condition that they are ruined by the time they reach their destination. For this reason the following general directions are given for sending specimens.

DISEASED PLANTS:—The roots of plants should be kept in a fresh condition. This can be done by packing in cotton or cloth, which is thoroughly dampened with water. They should then be wrapped in strong paper or placed in small boxes. When leaves are sent, if the sender is not very sure whether the disease is caused by a fungus or by an insect, they should be packed in the same way to keep them fresh. When it is certain the disease of the leaves is caused by a fungus they may be first dried under gentle pressure to keep them straight, or they may be packed between stiff paper, to keep them straight, and mailed immediately. If insects are found which are supposed to cause the trouble they should accompany the specimens. Fruits can be mailed in small wooden boxes, allowing a little ventilation.

INSECTS:—If the insect is in the larva stage (worm stage, or undeveloped) it should be put alive in a strong small wooden box, or in a small glass vial which itself must be securely packed in a wooden box when it may be sent by mail. A portion of the food plant should be put in with the larva for food.

If the insect is in the adult stage, as a fly, moth or beetle, it should be killed immediately. To do this quickly there is nothing so useful as a "cyanide bottle." This is made in the following way: Take a lump of cyanide of Potassium about the size of a medium sized marble and put it in an empty, wide-wouthed quinine bottle, half cover the lump with water and then put in plaster of Paris until the water is absorbed, the plaster pressed tightly to the bottom and surface even and dry. Set this aside, uncorked, in a dry, vacant room for one or two hours, then put in the cork, and always keep the bottle corked except when it is necessary to open it, while capturing or removing the insect.

The poisonous fumes from the cyanide of potassium arise through the porous plaster of Paris and fill the bottle. The insects should be left inside the bottle for a short time after they are quiet, to make sure they are dead. If the "cyanide bottle" is properly cared for it will last for a year without renewing. When the insect is dead, if one has not the regular Entomologist's pins it would be better to wrap it in soft paper before it gets dry and brittle, pack in a stout pasteboard box and mail. Moths and butterflies, insects with very fine scales (dust, powder) on their wings, should be handled very carefully for if the scales are rubbed off their wings they are ruined. They should be wrapped in rather stiff paper, first folding their wings up over their back.

Accompanying the speeimens of diseased plants should be any notes which the sender may think to be of value.

Correspondence is desired from any one in regard to these subjects, and further information about the collection or sending of specimens will be given upon inquiry.

We shall also be glad to receive specimens of fungi, or abnormal growths wherever found, upon wild as well as cultivated plants. All specimens and communications relating to diseased plants should be addressed to

GEO. F. ATKINSON,
Biologist, State Experiment Station.
Auburn, Ala.

Sept. 24, 1889.

BULLETIN NO. 8. NEW SERIES

REPORT

—OF—

AGRICULTURAL EXPRIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA., - - - - NOVEMBER, 1889.

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Commercial Fertilizers.

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The Bulletins of this Station will be sent free to any farmer in the State, on application to the Director.

BULLETIN NO. 8,

AGRICULTURAL EXPRIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA., - - - - NOVEMBER, 1889.

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†Prof. Mell has also charge of Meteorological Observations.

*The special work of the Biologist is the investigation of the diseases of plants caused by parasitic fungi and insects.

COMMERCIAL FERTILIZERS.

[BY N. T. LUPTON, CHEMIST.]

THEIR USE OF MODERN ORIGIN.

The use of fertilizers as articles of commerce is of modern origin. The fact that soils deteriorate by continued cultivation and removal of crops had long been observed before the cause was understood and the remedy applied. In the early history of this and other countries, the virgin soil produced abundantly and continued to do so without applications of any kind until the idea was prevalent that fertile soils are inexhaustible. The impoverishment however which eventually followed set men to thinking, and to devising means for the restoration of lost fertility. A close study of the soil, of the plant, and of the atmosphere, has revealed the relations they sustain to each other, and the conditions under which each can best contribute its part to the production of abundant crops.

THE COMPOSITION AND FORMATION OF SOIL.

An examination shows that soil is a mixture of more or less finely divided mineral and organic matter. This mineral matter consists of sand, clay, gravel, etc.; the organic matter of vegetable substances in various stages of decomposition. A closer examination, or analysis by the chemist, shows that these materials are composed of certain primary elements, united in fixed and definite proportions.

The geologist tells us of a time, in the far distant past, when the earth existed as a mass of melted matter, which, gradually cooling, formed a solid crust. Upon this was precipitated the condensed moisture of the atmosphere, loaded with all the waters of ocean, lake and river, in the form of aqueous vapor. The disintegrating action of this powerful agency, added to that of the atmosphere itself, acting mechanically and chemically, crumbled and pulverized the surface of this solid mass until it became ready for the introduction and growth of plants. These, at first scanty, germinated, matured, and decayed until vegetable mould had accumulated in sufficient quantity to sustain the growth of organic substances in rich profusion. The vast beds of coal, wherever found, result from masses of vegetable growth, accumulated long before man existed on the earth. The geological changes of the past, however great and long continued, were the same in kind as those now going on, and the same forces acting on similar materials are still producing corresponding results.

THE DETERIORATION OF SOILS.

The introduction of man into the world, with his varied material and artificial wants, modified to no little extent the conditions previously existing. At first, the earth spontaneously produced sufficient for his support, but as population increased, new wants were developed. Instead of consuming his food on the soil where it grew, and leaving there the residue to fertilize succeeding crops, he stripped the land of its growth and accumulated its products in towns and cities, and that which he did not consume was cast into the sea or wasted in many ways.

The forces of nature continued their renovating action by the production of new soil and by clothing the hills and valleys with vegetation, to supply the loss caused by man's extravagance, but eventually the richest lands of every civilized country were seen to be gradually but surely losing their power of production. This naturally led to an investigation of the conditions of plant growth and the means best adapted to restore and maintain a high degree of fertility. The results attained are the triumph of modern science and the boast of modern civilization.

THE COMPOSITION OF PLANTS.

The analysis of plants shows them to be composed of certain elements—from ten to fifteen in number. Ten of these are considered essential to plant growth, as follows:

Carbon, Nitrogen, Sulphur, Potassium, Magnesium,
Hydrogen, Oxygen, Phosphorus, Calcium, Iron,

Sodium, manganese, silicon, chlorine, with traces of bromine, iodine, flourine, and a few others, are generally found, but are not considered absolutely necessary to the growth of vegetation.

These same elements are found in the soil from which they are derived, and a few of them in the surrounding atmosphere. So abundant are most of them that only a few are likely to become exhausted where a proper system of cultivation is practised. These few constitute the valuable elements of

COMMERCIAL FERTILIZERS.

This term, as used in the Fertilizer laws of Alabama, "does not include common lime, land plaster, cotton seed, cotton seed meal, ashes, or common salt not in combination."

In estimating commercial values, only three constituents, viz., phosphoric acid in two of its forms of solubility, potash and nitrogen, are taken into account; not that these are more important to plant growth than others, but because they exist in such minute quantities in soils that they become exhausted very soon, and plants can not grow without them. So important for the manufacture of commercial fertilizers,are the raw materials containing these constituents that the earth has been searched and the seas explored to find localities where they exist. Millions of tons are used annually to supply the demands of modern agriculture.

SOURCES OF PHOSPHORIC ACID.

The chief sources of phosphoric acid are the bones of animals, guano, coprolites, or phosphatic nodules, mineral phosphates, and basic slag, generally known as Thomas' slag, or scoria.

The frame-work of vetebrate animals consists of bones composed of about one-third organic and two-thirds mineral matter. The mineral matter is almost entirely phosphate of lime, known to the chemist as tri-calcium phosphate. The organic matter found in fresh or raw bones undergoes rapid disintegration on exposure to the atmosphere, leaving the bone or tri-calcium phosphate as a white mass, insoluble in water. Now, the plant requires its food to be in a soluble condition before it can be appropriated, and science has met this demand by converting insoluble bone phosphate into a soluble form. Sulphuric acid, acting upon the ground bones, seizes upon a portion of the lime, unlocks the phosphoric acid and changes it to the desired form for plant food.

Following the teaching of science, numerous manufactories have been established for the conversion of these insoluble into soluble phosphates. The natural phosphates are not absolutely insoluble in water, and indeed are far from being so when in a finely divided state and in the presence of acids in the soil produced by the fermentation of organic matter. Hence ground bones, floats, and other forms of finely divided natural phosphates, have considerable value as fertilizers. Commercial acid phosphates are the results of the action of sulphuric acid on natural phosphates, which renders them soluble in water and better adapted to the necessities of plant growth. Phosphoric acid in commercial fertilizers exists in three forms of combination with lime, generally known as soluble, reverted, and insoluble. In Alabama these are called, in the act establishing the department of agriculture, *water soluble*, *citrate soluble*, and *acid soluble.*

The chemist, in analyzing a phosphate, first dissolves out and determines the phosphoric acid soluble in water, then acts upon the residue with a solution of ammonium citrate for thirty minutes, at a temperature of 65 degrees centigrade, to dissolve out the citrate soluble, then acts on the second residue with hydrochloric acid to find the amount called acid soluble. A fresh portion of the phosphate is now taken, and the total phosphoric acid determined. From this, the sum of the water soluble and acid soluble being taken, the remainder is citrate soluble.

The water soluble is easily converted into citrate soluble by means of lime, and, without the addition of anything, undergoes a gradual change, and hence is said to be *reverted.* These two forms, water and citrate soluble, are considered of equal value as plant food, and taken together are called *available* phosphoric acid. Animal charcoal, made from bones by driving off volatile matter, is known as bone black, and used in large quantities to decolorize and refine sugar and other organic products. This bone black, in the course of time, becomes too impure for further use and is turned over to the fertilizer manufacturers to be converted into acid phosphate.

Guano, the deposits and remains of countless flocks of birds which have inhabited from time immemorial the islands near the coast in tropical countries, is a prolific source of phosphoric acid. On some of these islands, such as the Peruvian, Patagonian, Falkland and Ichaboe, it seldom rains, and hence the phosphate from this source is rich in salts of ammonia. Its condition is such that plants readily appropriate its constituents as food.

Fossil bones, in connection with phosphatic nodules, in immense quantities, are found in South Carolina, and to some extent in other States and countries of the world. These are the remains of extinct animals which lived and died in the swamps, shallow seas and lakes of an age long anterior to the present.

It is estimated that over 4,000,000 tons of South Carolina phosphates have been used since their discovery some twenty or twenty-five years ago. These phosphates contain from 40 to 60 per cent. of phosphate of lime, and are now the most abundant source of phosphoric acid.

Mineral phosphates, such as apatite, phosphorite, etc., apart from those in connection with fossil bones, have not been used to any great extent in this country.

Basic slag, or Thomas' scoria, has of late years been used successfully as a source of phosphoric acid. Germany is said to have used 300,000 tons of this material during the past year. Many iron ores contain too large a percentage of phosphorus to be used in the manufacture of steel. Neither the smelting process, nor the ordinary process of converting pig iron into steel, removes the phosphorus contained in the ore. A few years ago a process was discovered in England and patented by Thomas and Gilchrist, which not only gets rid of the phosphorus in the steel, but leaves it in a condition to be used as a fertilizer. This process consists in converting the phosphorus into a phosphate of lime, by driving a powerful blast of air through the molten iron contained in a crucible lined with magnesian lime. The resulting lime phosphate contains from 15 to 25 per cent. of phosphoric acid in connection with a large per cent. of iron, and when reduced to a fine powder forms a good substitute for floats and ground bones. The iron ores of Alabama, similar to those in Europe, will doubtless in a few years be made to yield a slag sufficiently rich in phosphoric acid to serve as a commercial fertilizer. Experiments with this fertilizer, at the agricultural experiment station, have demonstrated its nature. Similar results have been obtained at other stations.

SOURCES OF POTASH.

Potash, a combination of the metal potassium and oxygen, is derived chiefly from kainit, muriate, wood and cotton seed hull ashes.

Kainit is found in some salt mines, notably in the mines of Stassfurt, Germany. It contains from 10 to 15 per cent. of potash in the form of sulphate, the remainder being salts of sodium and magnesium. In 1885, 87,635 tons were imported into the United States.

Muriate is also a product of salt mines, and contains from 40 to 50 per cent. of potash in the form of potassium chloride. In 1885, 21,196 tons of muriate were imported.

The ashes of all plants contain potash in considerable quantities, and furnish a limited supply for the manufacture of fertilizers.

SOURCES OF NITROGEN.

Nitrogen, the most expensive constituent of commercial fertilizers, exists abundantly in the atmosphere, but in a condition that renders it unavailable as plant food. It must for this purpose be in combination as nitrate, nitrite, ammonia or organic nitrogen.

Sodium nitrate, or Chili saltpetre, is extensively used as a source of nitrogen. In 1885, 55,902 tons were imported.

Ammonium sulphate from gas works is also used.

Refuse animal substances, such as dried *blood*, *tankage*, *fish scrap*, etc., are valuable sources of nitrogen, but in the South *cotton seed* and *cotton seed meal* are the most abundant sources of this element.

VALUE OF COTTON SEED AS A FERTILIZER.

A good sample of cotton seed meal contains about 7 per cent. of nitrogen, and in addition to this about 3 per cent. of phosphoric acid, and 1½ to 2 per cent. of potash. The cotton seed itself contains about 2½ per cent. of nitrogen, 1 1-5 per cent. of phosphoric acid and 1¼ per cent. of potash. One ton yields at the oil mill, on an average:

750	pounds of	meal.
1000	" "	hulls.
225	" "	oil.
25	" "	lint.

The hulls in one ton, when burned, yield about 15 pounds of ash. The oil and lint have no appreciable value as fertilizers, and very little more can be said of the hulls, as they contain a very large per cent. of woody fibre, and undergo decomposition slowly. Estimating the value of seed as a fertilizer, according to the valuation placed on its important constituents by the Department of Agriculture, it is worth $12.80 per ton, or 21⅓ cents per bushel. To the farmer, it has a greater value than this as a feed-stuff for cattle, and if the manure be carefully preserved, very little of its fertilizing value is lost in feeding. So the farmer, by careful management, can realize a double value from his cotton seed.

COMMERCIAL VALUES.

The law requires the Commissioner of Agriculture to publish an estimate of the commercial value of fertilizers offered for sale in the State, basing his calculations on the lowest per cent. of each constituent guaranteed by the manufacturer.

The following values are given for the ensuing season:

Water soluble phosphoric acid	7½	cents per pound.
Citrate " " "	7½	" " "
Nitrogen " " "	19½	" " "
Potash " " "	5	" " "

While these figures are only approximate, they are useful to the farmer in deciding the relative value of different goods, and are a safe guide in making purchases. The calculations may be made as follows:

Multiply the per cent. of water soluble and citrate soluble phosphoric acid by $1.50; the per cent. of nitrogen by $3.90; the potash by $1, and add the products together. The sum will be the commercial value of one ton of the goods.

Take a fertilizer which shows the following composition

Water soluble phosphoric acid	7	per cent.
Citrate " " "	2	" "
Nitrogen " " "	2	" "
Potash " " "	1½	" "

Then $1.50 by 9—$13.50, value of the phosphoric acid.
" 3.90 by 2— 7.80, " " nitrogen.
" 1.00 by 1½ 1.50, " " potash.

Total value..........$22.80.

The schedule of valuations adopted by several of the

Northern States for 1889, as published in the New Jersey Bulletin of July 15, is as follows:

Nitrogen in ammonia salts	19	cents	per	pound.
" " nitrates	17	"	"	"
Organic nitrogen	19	"	"	"
Phosphoric acid soluble in water	8	"	"	"
" " " " ammonia citrate	8	"	"	"
Phosphoric acid soluble insoluble	3	"	"	"
Potash as sulphate	6	"	"	"
" " muriate	4½	"	"	"

These do not differ materially from the values in Alabama, and, as stated in the bulletin, "are intended to represent the retail cash cost of these constituents in the raw materials before they are mixed to form a complete fertilizer." The nitrogen in cotton seed meal at $20 per ton is worth only a little over 14 cents per pound, and at this price is the cheapest form in which nitrogen, having a high agricultural value, can be gotten.

THE MANUFACTURE OF FERTILIZERS.

Any farmer can buy the raw materials, mix them together and thus manufacture his own fertilizers at much less cost than the same goods sell for in the market.

Composts are the cheapest of such mixtures, and indeed are the most satisfactory form in which fertilizing materials can be used, especially for permanent improvement of the soil. An excellent compost for general use may be made of cotton seed, barn yard manure, and acid phosphate, in the following proportions:

700 pounds of barn yard manure.
700 " " cotton seed.
600 " " acid phosphate.

Several methods are in vogue for mixing the materials. The most satisfactory is that used at the Experiment Station, and consists in mixing them on the smooth ground, one ton at a time. The barn yard manure and cotton seed are first mixed and thoroughly moistened with water, then rolled or mixed with the acid phosphate. The mixture is spread out from six to ten inches deep, another ton thoroughly moistened and mixed, is placed on this, and so on until the heap is from 4 to 6 feet high. This is allowed to stand at least six weeks before using.

The old method is to spread the barn yard manure on the ground from 3 to 4 inches deep, then the cotton seed, then acid phosphate. Add layer after layer until the heap is from 4 to 6 feet high, watering the mass until it is quite moist, and let stand about six weeks before using. When chopping down for use mix thoroughly.

A third method is to open a deep furrow, scatter in it the materials, either one at a time or previously mixed, and bed on them, thus dispensing with the compost heap.

To prepare a good commercial fertilizer for general application, a floor is needed upon which to mix the materials, and a hoe or a wooden mixer for stirring them together. Acid phosphate, cotton seed meal, and kainit or muriate are the materials required for a "complete" fertilizer, and may be mixed in the following proportions:

1000 pounds of acid phosphate.
800 " " cotton seed meal.
200 " " kainit.

If the land needs more phosphoric acid and less potash, use 1200 pounds of acid phosphate and 100 of kainit, or none at all, and if nitrogen is greatly needed in the soil, use 1000 pounds of cotton seed meal.

In the above formula, the per cent. of phosphoric acid, nitrogen and potash in the mixture will be about as follows:

1000 lbs. of phosphate containing 15 per cent. water and citrate soluble acid, yield	150	lbs. phos. acid.
800 lbs. of cotton seed meal with 3 per cent. phosphoric acid, yield..................................	24	" " "
800 lbs. cotton seed meal with 7 per cent. nitrogen, yield	56	" nitrogen.
800 " " " " " 1.75 per cent. potash, "	14	" potash.
200 " kainit with 12 1-2 per cent potash yield........	25	" "

Thus we have in one ton 164 lbs. available phos. acid--8.70 per cent.
" " " 56 " nitrogen............—2 80 " "
" " " 39 " potash............—1.95 " "
Commercial value $25.92

THE ANALYSIS OF FERTILIZERS.

The law requires the manufacturer who sells his goods in Alabama to brand on each bag, or package, his guaranteed analysis of the fertilizer contained therein. To protect the farmer against fraud, an "official chemist" has been provided by the State, whose duty it is to furnish the Commissioner of Agriculture, a correct analysis of every sample of fertilizer sent to him by the commissioner, and every farmer in the State can obtain the services of the chemist, free of cost, to test the guarantee of the manufacturer, and if the goods do not come up to the guarantee, the law releases the purchaser from any obligation to pay for the fertilizer. Before this law went into operation, worthless fertilizers were brought into the State and sold without hindrance.

Protection is now afforded to both farmers and manufacturers, and very few attempts are made to misrepresent the composition and value of fertilizers offered for sale.

The analyses made in the laboratory since the last report, issued the 1st of April, and contained in this bulletin, embrace a variety of fertilizers which may be classed as follows:

Complete fertilizers........	79	Natural phosphates........	24
Acid phosphates............	19	Miscellaneous................	22
Marls..............................	9		

PHOSPHATES WITH NITROGEN AND POTASH.

Station No.	NAMES OF FERTILIZERS.	BY WHOM SENT.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
1236	Fertilizer	C F Walker, Alexander City, Ala	8.29	3.11	2 21	1 68	1.11	$24 76
1238	Guano	John Day. Cotton Hill, Ala	5 20	6.62	4.48	1.96	1.12	26 49
1250	Fertilizer	W R Hunnicutt & Son, Heflin, Ala	9.40	0 70	2 97	1 68	2.10	23 80
1251	"	W W Newberry, Dothan, Ala	6 95	2.48	1.76	1.75	2 45	23 41
1252	"	T J Cook, Bartlett, Ala	11.13	2.19	1.73	1.71	1 28	27 92
1253	Standard Fertilizer	J H Cash, Fernbank, Ala	5.52	2.13	1.81	2 94	2.65	25 58
1255	Eddystone Guano	R S Williams, Wetumpka, Ala	8.31	2.69	3.64	1.68	1 55	24 60
1256	Rainbow Guano	" " " "	8 40	3.85	2.39	0.98	1.64	23 83
1257	Home Mixture	W A Miller, Hardwicksburg, Ala	7.35	1.54	1.30	2.87	2.73	27 25
1262	Fertilizer	J Cochran Williams, Belcher, Ala	9.36	2.06	2.07	2.10	2.38	27 70
1263	"	A J Whitten, Sr, Alexander City, Ala	8.03	1.79	1.08	2 38	3.16	26 57
1264	"	W J Reynolds, Montevallo, Ala	8.25	1.72	1.95	1.75	1 78	23 55
1279	Webb's Excelsior	D W Proctor, Dillsburg, Ala	1 76	1.08	0.41	4.90	2 34	25 75
1267	Fertilizer	W J Reynolds, Montevallo, Ala	3 80	4.64	2.84	1.96	0 86	21 16
1268	"	S F Proctor, Dillsburg, Ala	5.16	1.99	1.68	3.57	1.69	26 33
1269	" (2)	W W Morris, Daleville, Ala	8.29	1.04	0.53	2.80	2.21	27 12
1270	" (1)	" " " "	9.42	1.70	2.10	1.40	1.00	23 14
1271	Bowker's Fertilizer	J R Caldwell, Chulafinnee, Ala	8.23	1 91	2.32	1 82	1 02	23 32
1272	Baker's Fertilizer	" " " "	6.72	3.35	2.10	1.68	1.54	23 19
1273	Soluble Pacific Guano	" " " "	6.43	3.80	2.90	1.96	0.96	23 94
1274	Eddystone Guano	" " " "	6.58	4.61	2.23	1.75	0 55	24 15
1275	Aurora Am. Phosphate	" " " "	7.14	1.97	1.08	2.66	1.68	25 71
1276	Ga. State Standard Superphosphate	W M Hardwick, Hardwicksburg, Ala	9.63	1.03	1.71	1.82	0.94	24 04
1277	Home Mixture Guano	" " " "	6.50	1.35	0.91	2.66	2.31	24 45
1280	Fertilizer	W C Menefee, Orion, Ala	8.23	2.50	4.01	1 96	0 89	24 62
1280	"	W W Morris, Daleville, Ala	9.81	5.14	2.24	1.89	1 38	26 67
1282	Sea Fowl Guano	W C Watson, Oakville, Ala	8.48	2.72	2.41	2.24	1.14	26 67

PHOSPHATES WITH NITROGEN AND PHOSPHATES—CONTINUED.

Station No.	NAMES OF FERTILIZERS.	BY WHOM SENT.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
1283	Tinsley's Standard Fertilizer	H A Seale, Columbiana, Ala.	5.41	2 00	2.88	2.10	0.52	19 82
1284	Ammoniated Dis. Bone	W H Rhodes, Edwardville, Ala.	7.66	1.08	3.62	2.17	1.66	23 33
1285	Furman's Dis. Bone.	“ “ “ “	8.17	1.98	1.31	1.26	0.87	21 00
1286	Old Hickory Guano	Jordan, Manning & Co, Guntersville, Ala.	7 87	2.27	3.03	1.96	0.70	23 55
1287	“ “ “	“ “ “ “	7.98	1.84	3.04	1.96	1.63	23 00
1288	Buffalo Bone Guano	J R Hicks, Weaver Station, Ala.	8 79	3.09	0.88	2 80	1.95	30 69
1289	Scott's A. A. Bone Guano	Albert R Head, Joy. Ala	9.13	3.16	2 64	1.68	0.98	24 46
1290	Patapsco Guano	R Nation, Bluntsville, Ala	9 15	0 82	3 20	1.61	1.00	22 22
1291	Horse Shoe Brand Animal Dis· Bone	W A Brown, Walnut Grove, Ala.	4 66	3 53	4 11	2.45	0.27	22 10
1292	Ga. Test Guano	J D Alen, Haleburg, Ala	8 21	2.00	2.86	2.26	1.13	25 25
1293	Potapsco Guano	W S Johnson, Haleburg, Ala.	5.74	3.19	3.74	2.17	1.46	23 34
1194	Pacific Guano	“ “ “ “	9 00	1.36	1 31	1.82	1.60	24 23
1295	Farmer's Stand. Phosphate	A S Davis, “ “	7.25	1.91	1.63	1.96	1.44	22 82
1296	Americus Guano	“ “ “ “	3 26	4 07	4 53	2 52	1.35	22 16
1297	Farmers Standard	J J Jackson, Hardwicksburg, Ala.	7.62	2.17	1.49	1 75	1 92	23 42
1299	Fertilizer	J R Lewis, Oatston, Ala	9.12	0.60	1.32	2.66	3 44	28 39
1300	“	W A Lee, “ “	7 68	2.50	1.58	2.10	3 55	26 81
1301	Pure Dis. Animal Bone	W E Bradley, Abbeville, Ala.	11.80	2 65	1.48	1.40	...	27 13
1304	Fertilizer	Robert Nuckolls, Berry Station, Ala.	5.72	2.55	2.30	2.59	3 30	25 80
1305	Patapsco Guano	J H Grace, Hardwicksburg, Ala.	9 19	1.41	2.41	1 96	1 02	24 56
1306	Gossypium Guano	E N Willis, “ “	6.72	1 89	2.43	2.24	1.92	23 56
1310	Fertilizer No. 1	A J McMurraine, Riverside, Ala.	7 25	1.85	1.32	2 26	1.37	25 37
1311	“ “ 2	“ “ “ “	8.54	1.78	1.00	2.17	1.68	25 62
1312	“	R E Conyer, Hackneyville, Ala:	9.77	1.36	1.17	2.59	2 85	26 79
1313	Ammoniated Dis. Bone	J A Faulk, Hardwicksburg, Ala.	10.15	3.24	0.64	1.91	3 68	31 20
1314	Farmers Am'd. Dis. Bone	E A Chambers, Zornville, Ala.	7 48	1.74	2.79	1.96	1.19	22 66
1315	Home Mixture	T J Farmer & Co, Shortersville, Ala	7.04	1.61	0.95	2.31	3.14	25 10

1316	Gossypium Phospho	J T McDuff, Berry Station, Ala	7.39	2.05	1.69	2.24	2.14	25 03
1317	Farmers Standard Phosphate	A G Blackshear, Haleburg, Ala	6 72	3.43	1.08	1.68	1 96	23 73
1322	Ga. State Standard Superphosphates	E W Chambers, Zornville, Ala	8.65	0.98	2 67	1.75	2 37	23 63
1323	Compost	J S Newman, Auburn, Ala	2 51	3 08	1.18	3 01	1.17	21 28
1324	Ga. State Grange	T P Smith, Smithville, Ala	9.40	0 71	2.63	1.75	2.60	24 58
1325	Ga. State Grange Fertilizer	Howe Bros, Edwardsville. Ala	8.71	1.18	5.64	1.54	2.18	23 01
1340	Home Mixture	James Holton, Wesley, Ala	6 02	1.82	1.14	2.24	2.64	23 13
1342	Fertilizer	A J Conway, Peters, Ala	8.04	2.74	2.73	1.96	1.78	25 50
1343	"	J J Hester, Waverly, Ala	7.94	0 65	1.18	2.10	2 69	23 91
1344	Old Hickory	J R Brusher, Baileyton, Ala	7.56	2.32	2.46	1.96	1.05	23 51
1346	Old Hickory	E W Robertson, Joppa, Ala	6.87	2.77	3.66	2 03	0.94	23 31
1347	Zell's Guano	J P Raines, Peters, Ala	8.56	2 48	2.38	1.40	0.77	22 79
1348	B. S. Guano	Noah Carroll, Ozark, Ala	5.91	5.03	2 09	2.10	1.86	26 46
1351	Guano	Geo W Mott, Catalpa, Ala	7.66	0.93	2.93	2.24	0 96	22 57
1352	John Merryman & Co.'s Guano	W J Beverly, Rosewood, Ala	6.39	2.35	3.89	2.38	1.62	24 01
1353	Southern Am'd. Dis. Bone	" " " "	7.94	2.86	2 16	1 96	1.33	25 17
1354	Fertilizer	G B Langford, Barnes X Roads, Ala	9.06	2 32	1.65	1.96	1.65	26 36
1355	Eutaw Fertilizer	O T Jeter, LaFayette, Ala	7.41	2.57	2.82	2 24	1.50	25 20
1356	Fertilizer	J G Wester, Plano, Ala	6.31	2.15	1.29	1.82	1.03	20 81
1361	"	T L Woodham, Ozark ,Ala	0.65	6.93	5.16	3.36	0.40	23 80
1376	"	W R Sims, Newton, Ala	9 00	1 99	1.47	1.96	2.91	27 03
1381	"	R D Richards, Belcher, Ala	2.15	7.75	5.05	2 24	0.78	24 36
1382	Baker's Stand. Guano	J T Adams, Chulafinnee, Ala	2.86	4 71	2 43	1.77	1 42	19 67
1384	Ober's Guano	Jos Gunierly, Haleburg, Ala	3.85	3.27	2.24	1.68	1.35	18 58
1489	Guano	S M Adams, Troy, Ala	7.85	1 80	2.59	1.89	1 00	22 84

ACID PHOSPHATES.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
1239	Eng'h Acid Phosphate	W.S.Herman, Autaugaville Ala	12.34	3.17	1.76	23.36
1246	Etiwan Dis. Bone...	Col. J. S. Newman, Auburn, Ala	9.65	4.06	3.53	20.56
1247	Dissolved Bone Black	" " " " "	13.97	3.00	0.07	25.45
1254	Phosphate..........	A. J. Bradley, Maple Grove, Ala	6.48	5.78	2.48	18.39
1259	Dissolved Bone Phos.	A. J. Huston, Talladega, Ala..	10.01	3.80	2.08	20.76
1261	Tinsley Acid Phos...	W. S. Merony, Montevallo, Ala	12.15	2.86	3.19	22.50
1278	Patapsco Acid Phos.	G. W. Hamil, Troy, Ala......	11.67	3.51	1.08	22.77
1298	Phosphate..........	W. B. Wingard, Glee, Ala ...	11.13	1.88	1.87	20.51
130,	Scott's Acid Phos...	E.N.Willis, Hardwicksburg, Ala	10.08	4.02	2 41	21.15
1308	Dissolved Bone Phos.	W. E. Brown, Haleburg, Ala..	7.68	3.02	1.68	16.05
1318	Phosphate..........	G. W. Hamil, Troy, Ala......	4.08	6.86	5.52	17.31
1339	Dissolved Bone Phos.	J. H. Patterson, Dean St'n, Ala	10.36	4.05	2.25	21.61
1338	Sterling Acid Phos..	C. C. Grout, Auburn, Ala...	11.88	2.63	0.69	21.71
1341	Sun'y So. Acid Phos.	Rainer Brothers, Troy, Ala...	3.84	8.61	3.37	18.66
1345	Dissolved Bone Phos,	D. L. Campbell, " "	12.07	4.86	1.79	25.37
1349	Phosphate..........	Thos. B. Kelly, Cluttsville, Ala	13.20	3.21	1.56	24.69

MISCELLANEOUS FERTILIZERS.

Station No.	Name of Fertilizers.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
1248	Natural Phosphate..	Columbus Fert'zer Co., Ga	....	....	36.13	....	....
1249	" "	" " "	....	....	16.62	....	...
1258	Sulphate of Potash..	F.C.Potter, HainesCity, Ala	....	....	....	..	21.45
1260	Sodium Nitrate......	F. S. Roberts, Mobile, Ala	....	....	....	16.38	....
1302	Kainite.	W. E. Bradley, Abbeville	....	....	....	....	14.30
1326	Swan Island Guano..	F. S. Roberts, Mobile, Ala	0.18	5.71	14.14	....	....
1375	Carib Guano........	J. C. Webb, Demopolis, Ala	....	....	21.42	0.56	0.12
1379	Muriate of Potash...	E.Ala.Fert'zer Co., Clayton	....	....	....	....	49.18
1383	Cotton Seed Meal...	Cent'l Oil Co., Montg'y, Ala	....	....	3.22	6.79	1.96
1394	Tankage	Columbus Fertilizer Co., Ga	....	....	9.64	8.19	....
1395	Tankage No. 1 conc'td	S. D. Rees, Mobile, Ala..	....	....	1.07	11.67	....
1396	" No. 2 ground	" " "	...	....	17.80	5.67	....
1397	" No. 3 crush'd	" " "	...	....	17.45	5.67	....

MARLS.

Station No.	Name of Substance.	By Whom Sent.	Insoluble Matter.	Carbonate of Lime.	Phosphoric Acid.	Potash.
1239	Green Sand Marl...	J. M. Carter, Oateston, Ala. .	....	...	0.19	0.19
1265	Shell Marl	A. R. McDonald, Montg'y, Ala	....	87.60	0.21	....
1319	Clay & shells (white)	Knabe & Scott, Montg'y, Ala	...	54.00	0.21	....
1320	" " (black)	" " " "	...	36.00	0.09	....
1380	Marl.	W. J. Jones, Allenton, Ala ...	36 29	53.76	0.51	....
1385	Marl.	A. B. Parks, Mt. Meigs, Ala..	28.50	57.86	0.19	....
1386	Marl.	" " " " "	75.90	5.67	0.15	....
1387	Marl.	J. M. Marshal, Allenton, Ala..	49.25	33.63	0.07	....
1390	Marl.	J. E. Rushing, Troy, Ala	36.45	49.86	trace	....

Fertilizers used on Experiment Station, Auburn, Ala,

1240-1247.	Phosphoric Acid.			Nitrogen.	Potash.
	Water Soluble.	Citrate Soluble.	Acid Soluble.		
Kainite.......	....	.....	.....	......	10.18
Muriate..............	....	......	....	......	52.51
Sulphate of Ammonia	....	......	......	20 44	.....
Nitrate of Soda...........................	.....	......	....	15 40	.....
Dried Blood..............................	.....	......	.....	5.11	.....
Cotton Seed Meal.........................	....	.....	3.52	7.35	1.61
Etiwan Dissolved Bone......................	9.65	4.06	3 53	....	.....
Dissolved Bone Black....................	13.97	3 00	0.17	....	.....

Natural Phosphates from Florida.—H. Bussey, Columbus, Ga.

1326-1334.	No. 1	2	3	4	5	6	7	8	9
Phosphoric Acid.......	0.36	2.50	1.03	1.13	0 94	0.94	0.73	1.25	36.84
1336-1337 Phosphoric Acid......	0.46	0 65		...	....	..	...	..	.....

Bat Manure from F. D. Tinsley, Selma, Ala.

1358-1360.	No. 1.	No. 2.	No. 3.
Phosphoric Acid......................................	2 88	18.30	7.09
Nitrogen...	4 83	...	...
Potash...	0 56	0.80	0.32

Rocks Supposed to be Phosphatic from L. M. Bashinsky, Troy, Ala.

1351-1373.	No. 1	2	3	4	5	6	7	8	9	10	11
Phosphoric Acid........	0 70	0.12	0 12	0 01	0.06	0.05	0 21	0.12	0 15	0 15	0.18

These specimens are varieties of Marl and Rotten Limestone and of no commercial value.

Science Contributions. Vol. I., No. I.

BULLETIN NO. 9. NEW SERIES

REPORT

—OF—

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA., DEC., 1889.

Contents:

BIOLOGY.—NEMATODE ROOT-GALLS—A Preliminary Report on the Life History and Metamorphoses of a Root-Gall Nematode, Heterodera radicicola (Greeff) Müll., and the injuries produced by it upon the Roots of various Plants.

—o—

The Bulletins of this Station will be sent free to any farmer in the State, on application to the Director.

SCIENCE CONTRIBUTIONS

FROM THE

Agricultural Experiment Station,

Alabama Polytechnic Institute,

AUBURN, ALA., - - - - DECEMBER, 1889.

VOL. I., NO. I.

A Preliminary Report upon the Life History and Metamorphoses of a Root-Gall Nematode, *Heterodera radicicola* (Greeff) Müll., and the Injuries caused by it upon the Roots of various Plants.

BY GEO. F. ATKINSON.

Whenever subjects of any special scientific interest arise in the original researches of the Departments, it is purposed to publish them under the name of "Science Contributions".

BULLETIN NO. 9,

OF THE

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA., - - - - DECEMBER, 1889.

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NEMATODE ROOT-GALLS.

By GEO. F. ATKINSON.

I.

INTRODUCTORY.

The purpose of the present paper is to put in the form of a preliminary report the results of some investigations made this autumn, in the neighborhood of the Experiment Station, upon the nature and cause of the abnormal growths found upon the roots of various plants. These deformities are popularly termed "root-knot". Soon after entering upon my new field of labor here, my attention was called to the subject by the Director, Prof. J. S. Newman who showed me tomato plants the roots of which were exceptionally "knotty."

The investigations were begun the first of October, 1889, and continued for about six weeks when the subject matter of this preliminary report was sent to the press.

At the time the work was undertaken I was unaware that a Bulletin was being published by the Division of Entomology, U. S. Agr. Dept., under the direction of Dr. C. V. Riley, embodying the results of investigations made by Dr. J. C. Neal of the Florida Experiment Station. The first notice I had of this work was from INSECT LIFE*.

That work† has since been distributed, and has reached me just about the time of going to press. Unfortunately there are many errors in the part dealing with the structure and life history of the nematode, though some of the economic suggestions possess value. It is but just to Dr. Riley to say that he is not personally responsible for the errors contained in the Bulletin, since he states in an introductory paragraph (loc. cit.) that the nematodes "do not, in a Zoölogical sense, strictly belong to the Division work. * * * The Bulletin makes no pretense to be a scientific treatise

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*Vol. II., No. 3, Washington, 1889.

†Bulletin No. 20. Division of Entomology, U. S. Dept. of Agr., The Root Knot Disease of the Peach, Orange, and other Plants in Florida, Washington, 1889,

on the life history of these worms, but is in the main an effort to ascertain a suitable remedy. The general literature on the subject has not been at Dr. Neal's command, and my time is so fully occupied otherwise that I can do little or nothing at present in the way of identification of species or of comparing Dr. Neal's results with those of European investigators, which, as a matter of fact, are of little practical importance."

The conditions this autumn at Auburn have been quite favorable for determining a number of interesting facts relating to the development and transformations of this nematode, as well as the duration of a life cycle showing the number of successive generations in a year.

II.

EXTERNAL CHARACTERS OF THE DISEASE.

By a reference to Plates I., II. and III. the external characters of the disease can be seen. These Plates represent respectively "knotted" specimens of the roots of the Irish potato, tomato, and parsnip and salsify. Plates I. and III. are natural size; Plate II. is reduced to two-thirds natural size. All are from average specimens. The abnormal growths on the tomato root appear as irregularly fusiform, knotty, or nodulate enlargements, two to ten times the natural diameter of the roots. The surface of the gall is at first smooth, more or less undulate, or papillate, but becomes later roughened, scurfy, or cracked and finally decay of the tissues sets in. The tap root and the earlier lateral roots were attacked early in the season and when the photograph was taken they were partially decayed and falling to pieces. When the roots begin to die they send out new roots in the efforts of the plant to recover from the effects of the disease. These roots in turn are attacked and deformed as represented in the figure. Other plants were found with the tap root still alive, very much enlarged and cracked, and the disease in an active state. The enlargements of the roots of the Irish potato are similar in form to those of the tomato, though on specimens I have examined they are not so large or numerous. The surface of affected tubers first presents minute elevations usually at the point on the surface corresponding to a lenticel. The minute elevation soon grows to be quite a large convex elevation and finally cracks. In the seed potato in the figure, Plate I., the cracks can be seen, while on the young potato represented in the upper left hand corner the projections are still quite smooth. These characters of the disease in the tubers will be referred to again.

There is great variation in the form of the galls even on the roots of a single species. Plate V., figures 31 and 32 represent respectively the galls on the roots of the cotton plant and peach. The fibrous roots of the peach possess short ovoid, usually lateral galls; sometimes they are symmetrical. As the root becomes older and the disease spreads the external appearance is more as represented by the larger root in the figure, the surface irregularly enlarged, roughened and cracked.

This description of the external characters of the disease will serve to introduce the subject. A more detailed comparison of the variations in different plants will be given below.

III.

MICROSCOPIC CHARACTERS.

Upon examination the enlargements proved to be the galls produced by the presence of a nematode worm, *Heterodera radicicola* Müll.[*] (*Anguillula radicicola Greeff*[†], *Anguillula arenaria N.*[‡] *ex parte*). If we cut directly across one of these tomato root galls, make a very thin shaving from the cut end and prepare it for examination with the microscope the micro-characters of the disease will be revealed. Fig. 36, Plate VI., represents such a preparation magnified. *a* and *b* represent two female cysts; *a* is mature, *b* is in an earlier stage of development. If the female cyst is very old the cavity in the tissues of the root will be seen to be occupied by young thread-like worms—the larvæ—and eggs in different stages of development, floating in a semi-fluid, granular, gelatinous substance, the amorphic remains of the parent worm.

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[*] Mittheilungen über unseren Kulturpflanzen schädliche, das Geschlecht Heterodera bildenden Würmer, Landwirthschaftliche Jahbücher. Band XIII., Hef I., S. 1-42, Berlin, 1884.

[†] Sitzungsbericht. der Marburg Gesell. z. Beförd. d. Naturwiss. 1872, S. 169.

[‡] Bulletin No. 20, U. S. Department of Agriculture, Division of Entomology, Washington, 1889.

See fig. 37, Plate VI. If the knife in making the section should pass through a young female cyst, the cavity would seem to be occupied by granular protoplasm and numerous small fat globules, or as in many instances is the case, the long tubes of the uterus and ovaries with young ova in different stages of development may be seen. If the knife should pass by the side of the animal without injuring it the cavity would then contain a perfect animal variable in form according to age or the character of the surrounding tissues of the root. See fig. 29, *a* and *b*, Plate V.; figs. 36, *a* and *b*, 40, *a*, and 41, *a*, Plate VI.

In order to understand the real nature of the cysts and the effect produced upon the growth and structure of the deformed root, it will be well to note the form and general characters of the mature female cyst, and then follow with a detailed account of the development, transformations and habits of the sexes, which forms one of the most wonderful and interesting subjects it has ever been my lot to investigate.

IV.

GENERAL CHARACTERS OF THE MATURE FEMALE CYST.

I have selected the mature female cyst as a preliminary study because of its comparatively large size as compared with the males or young, because it is so much more easily found than the males, and almost any one who has a low power microscope at hand can demonstrate with ease the general characteristics here given.

When the galls on the roots of some plant, which has tender tissues like the roots of the tomato, are badly cracked and in the incipient stages of decay if one is broken there will usually be seen whitish, or dull yellowish irregularly oval bodies, from one-fourth to one-half of a millemetre (one-hundredth to one-fiftieth of an inch) in diameter, that are easily differentiated with the unaided eye from the discolored and broken surrounding tissue. Usually the unaided eye can detect also the head end projecting as a minute point on one side giving to the object the appearance of a minute "gourd", or "crooked neck squash", or a minute inflated bladder. With the aid of a small hand glass at least this peculiarity of form can be seen. These are the gravid female cysts.

Placing some of these cysts so that they can been seen under the microscope and magnifying them about 100 times they will appear something like figs. 34 and 35, Plate VI; or 27, Plate IV. The resemblance now to a small "gourd" is easily seen. The head is at the small end. In the mouth hole can be seen a short slender cylindrical spear broadend at the base which ends in three short lobes. This spear is hollow, the anterior end lies in the mouth opening at the middle point of the head end of the animal. It is capable of extension at the will of the animal and is moved by pairs of muscles directly attached to it. Fig. 34, *a*, Plate VI. The spear of the male nearly agrees in form. This is represented more highly magnified in plate IV., fig. 21z, *c*, and fig. 25, *a*. In this latter figure only two of the lobes at the base of the spear are represented. The mouth opening is cylindrical and behind broadens into the mouth hole.

In the males the anterior end of the exsertile spear is supported by six lamellæ the ends of which form the anterior end of the head and fit around the spear. A front view of the arrangement of the lamellæ presents a radial, stellate figure, which is shown in fig. 24, Plate IV., drawn also from the male. The œsophagus begins at the base of the exsertile spear. The anterior part is a long slender tortuous channel which looks like a dark line reaching to near the swelled portion of the cyst where is the middle part of the œsophagus. The middle part of the œsophagus is an ovoid or ellipsoidal transparent muscular bulb, which has a fibrillate structure, the fibrillæ radiating from the centre. Seen in side view this bulb looks very much like a small wheel. In Plate VI. fig. 34, *b* is the bulb, or middle part of the œsophagus. The slender tortuous channel forming the anterior part is represented connecting this with the base of the spear *a*. The posterior part of the œsophagus connects with the alimentary canal, neither of which are represented in the figure, as the mass of fat globules usually renders the body too opaque at this age.

Were it not for a slight movement of the apparatus just described, or a trifle "nodding" of the head there would be nothing to suggest what we ordinarily consider a sign of life. Occasionally even while the cyst is under microscopic examination the exsertile spear is thrust slowly out at the mouth, and then drawn back, at the same time the anterior part of the œsophagus being connected with it is also moved. Sometimes the apparatus slides far enough so that the tortuous anterior part of the œsophagus is straightened and the bulb is moved a little forward and backward. Sometimes there appears also a slight sidewise movement of the anterior part of the head, a sudden "jerkey" motion. This sidewise movement of the head is probably from force of the habit of the worm in its larval stage when movement from place to place is accomplished by a constantly changing tortuous motion of the body. Müller* speaks of an expansion and contraction of the middle part of the œsophagus which he has observed. By this means nutriment from the plant is sucked in through the lumen of the spear into the œsophagus and thence into the alimentary canal. Now turning the eye upon the large part of the body the first thing to attract attention is the presence of two long cylindrical objects coiled within. Usually at this age of the cyst the development of numerous fat globules on the interior of the body renders it so opaque that the terminations of these tubes and their connection with the body wall cannot be seen. Figs. 34 and 35, Plate VI., represent such opaque cysts. In some parts of the tube, however, can be seen polygonal cells, the faces where they meet making a zigzag line along the tube. Towards the posterior end of the cyst there can usually be seen oblong bodies lying within the tube or free in the body cavity. If these bodies are lying on their side they resemble a bean in shape. They are the *eggs*, and the long objects coiled within the body are the *genital tubes.*

By examining a number of mature female cysts from the galls of plants with soft tissues there will be found occasionally one which is not very opaque, as the fat globules are less numerous. Having found such a cyst we can see that the two tubes unite near the posterior part of the body and form a common passage, of a greater diameter, but quite short, which extends to an opening, the *vulva.* Then by following with the eye the sinuous course of the tubes in the other direction the anterior ends will be found

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*Mittheilungen über unseren Kulturpflanzen schädliche, das Geschlecht Heterodera bildenden Würmer, 1884.

lying free within the body near the anterior portion. From the part where the tubes fork for nearly half their length is the *uterus*. The anterior free ends are the *ovaries*; the middle part functions as the *oviduct* and *receptaculum seminis*. Fig. 27, Plate IV., represents a cyst not very opaque, *d* is the vulva, *e* the uterus, and the free ends in the anterior portion the ovaries. The anal opening in the mature female cyst becomes displaced; it is represented in fig. 27 at *f*. Fig. 28, Plate IV., represents the uterus and ovaries very highly magnified.

V.

DEVELOPMENT AND METAMORHOSES.

(*See Plate IV.*)

EGGS.—The young ova are developed in great numbers in the ovaries. Fig. 28 represents them when some are full grown and the genital tubes are crowded for nearly their entire length. They are very tender and plastic, and when free are spherical. But packed and confined as they are in several rows inside the wall of the ovaries they are held in a polygonal form. Each one contains a large nucleus and a distinct nucleolus. When quite young they are nearly hyaline, and transparent. Near the anterior ends of the ovaries they are several layers, deep across its diameter. As they grow in size the increased pressure forces the elongated mass of young ova slowly toward the uterus, since they cannot escape at the anterior ends of the ovaries. Then because the diameter of the posterior ends of the ovaries and the uterus is but little greater than the anterior ends of the ovaries the ova must be arranged in a decreasing number of rows, until a single ovum is equal in diameter to the inside diameter of the uterus. If we count the number of ova which stand in a superficial transverse row across a well developed ovary, near the anterior end there will be four or five; now looking along the ovary toward the uterus, we will count three, two and finally one. With the increase in size of the ovum there is an accompanying development of yolk globules. The first change is the appearance of very fine granules. Then yolk globules are developed, a few at first, but become very numerous as the growing ovum passes into the uterus when it is quite opaque. The globules seem to be more numerous in a peripheral plane. The ova are held in polygonal form until one only occupies the diameter of the uterus, when they are at first rectanglar in outline. From this form, as they grow in size they simply elongate until their length is about two or three times their diameter. The ends of the egg are gradually rounded off,and it becomes slightly curved so that it is shaped very much like a bean. At first the ovum possesses a very delicate wall. The covering of the egg becomes stronger as it passes down the uterus. The fully developed egg possesses a double wall, a delicate inner membrane and an outer tough membrane.

Just the precise stage when the ovum is fertilized I have not determined, but I have found spermatozoa in the posterior part of the ovaries. The nucleus in the fully developed egg is quite distinct, though not so prominent as in the young ovum. It is largely hidden by the mass of yolk globules. It is of a pale violet color. An examination of fig. 28, Plate IV., will show many of these changes. A few of the eggs in one uterus have undergone various stages of segmentation preparatory to the development of the embryo. In dissecting living specimens very frequently the ovary or uterus becomes ruptured, in which case the ova in various stages of development escape from the great pressure exerted upon them by confinement, and not being entirely free from each other are held in beautiful grape-like clusters. Some of these are represented in fig. 28.

The mature egg is from .08mm to .10mm long (three to four thousandths of an inch), exceptionally I have found them .12mm long. Thus far its development has been an increase in size, a profuse development of yolk globules, and a change in form. Its development from this point is the multiplication of cells by division, beginning with the single cell enclosed within the egg membrane. (See fig. 1, Plate IV.) Complete but somewhat irregular segmentation takes place. The nucleus first divides in two parts, forming two nuclei. Each nucleus moves a short distance towards its end of the egg. A transverse constriction now appears about the middle of the cell which progresses until the cell is divided into two cells (fig. 2). The process is now repeated in each of these new cells resulting in four cells (fig. 4). Sometimes one of these cells is completely divided before the other begins so that there may be three cells (fig. 3). Occasionally the first line of fission is oblique so that the two resulting cells are shaped as in fig. 2'. The egg now divides into six, eight, ten cells and so on. Usually the first division is such that one cell is larger than the other, but sometimes they seem to be about equal in size. Occasionally the first division results in two cells one of which is only about one-third or one-fourth so large as the other. I have watched the cell division up to the stage represented in fig. 7. Up to this point there is great variation in the disposition of cells at the different stages resulting from variations in the somewhat uneqnal segmentation. From this point up to that represented in figs. 8 and 9, I have not, owing to the limited time over which my observations have as yet extended, carefully determined the progress of development. Figs. 8 and 9 probably represent the stage where the larger endoderm (internal) cells are completely surrounded by the smaller ectoderm (external) cells, just prior to the invagination (sinking in) of the head end to form the mouth and œsophagus.

According to *Strubell, in *Heterodera Schachtii*, the first two unequal cells into which the egg divides represent primary cells of two different groups of cells which result from farther division. The larger primary cell divides more rapidly and forms small cells, which grow around the more slowly formed larger cells which result from the division of the other smaller primary cell. The growing over proceeds first down the convex side of the egg and the ectoderm cells fold over the opposite end of the embryo, the mass of endoderm cells. Thus the "prostom" (the open space between the converging edges of the enveloping ectoderm cells) is on the concave side of the egg, and because the ectoderm cells on the concave side of the head end have grown but little it (the prostom) occupies the entire concave (ventral) side of the young embryo. At this stage if we turn the egg so that we are looking directly at the concave side the ectoderm cells will be in a boat-shaped mass, and in this boat-shaped mass of ectoderm cells will be the larger endoderm cells. The "prostom" (open part of the boat-shaped mass of ectoderm cells) now begins to close by the growth and increase of the cells at the margin. This closure takes place more rapidly at the posterior end and advances toward the head end so that after awhile there is only a small opening through the ectoderm cells near the head end of the concave side. This is finally closed so that the endoderm cells are completely enveloped by the smaller ectoderm cells.

This is probably the stage which I have figured in figs. 8 and 9, Plate IV. The larger, endoderm, cells can be seen in the center:

Untersuchungen über den Bau und die Entwickelung des Rübennematoden, Heterodera Schachtii Schmidt. Bibliotheca zoologica, Heft 2, 1888.

the smaller, ectoderm, cells on the out side. Invagination of the ectoderm cells now takes place at the head end, that is, the cells sink inward as if pushed in by some outside force. This is represented in figs. 9x and 10. By this process the mouth and œsophagus are developed. I have only studied the external changes in the embryonic development. From this point up to the fully developed larva the changes are represented in figs. 11 to 15. Beginning with figs. 10 and 11 the head end appears hyaline and finely granular and is larger in diameter than the rest of the young embryo, which at this stage is of equal length and diameter with the inside ot the egg membrane. It next begins to elongate and become more slender. This forces it to double up inside the egg membrane. It does so by turning its tail end by degrees around to its ventral side (fig. 11, 12). In some cases the tail end for a time does not move. This causes the embryo to double up midway, and sometimes to be coiled in a spiral manner for awhile. It now continues to elongate until it is coiled twice (fig. 13), then three times (fig. 14), and finally four times (fig. 15) within the egg membrane.

I have watched the egg and embryo under the microscope pass through all these changes. Sometimes the embryo would double its length in eight or ten hours. When it has reached this stage it remains a day or so still within the egg membrane while the cuticle, the tough transparent body wall is being perfected, and the slender pointed end of the tail is formed. Now by its writhing and twisting it ruptures the tough egg membrane and is set at liberty. At this stage the larva passes through its first moult, either just as it is coming from the egg membrane or very soon afterward. Fig. 16 Plate IV. represents the larva in the act of coming from the egg membrane. It is moulting at the same time. The thin larval skin can be seen slipping off its head and tail.

As the female remains in a cystic state and the cyst is surrounded by the tissues of the plant the eggs when crowded in the uterus rupture it and finally the numbers of them completely fill the body cavity of the cyst. In a few cases after freeing a cyst I have observed eggs pass out at the vulva.

Segmentation of the egg begins before it leaves the uterus, and e find in the body cavity of live female cysts eggs in all stages f development, and free larvæ, so that the female may be said to be oviviparous.

Larval Stage.—The larval stage begins with the hatching from the egg. The moult which takes place at the same time is the first moult of the larva. The young thread-like worm is from .3mm to .4mm (12 to 16 thousandths of an inch) long; it tapers gently to the blunt head end, and gradually into a slender pointed tail (fig. 17). In this form it resembles what are called "vinegar eels". In the head end we notice the exsertile spear, with its tri-lobed base, the long, slender tortuous channel of the anterior part of the œsophagus, and the ellipsoidal muscular bulb, the middle part. The lumen of the alimentary canal can also be seen, and it opens at the beginning of the hyaline space near the tail end. (See fig. 17, Plate IV.) The embryo and for a time the young larva possesses a cellular matrix inside the body wall, except at the head and tail ends. This soon develops numerous fat globules which are clustered around the alimentary canal.

The young worms, when ushered into life, find themselves imprisoned by walls of plant tissue which formed at once the prison house and tomb of their parent. (See fig. 37, Plate VI.) How to escape these bars is their first concern. Perchance fortune may favor them if the cyst is near the surface of the gall so that a crack, or partial decay of the tissues may liberate them. When not thus favored there are sometimes two courses open to them, more often only one. If the cyst opens into any of the large channels of the vascular tissue of the root, which is frequently the case, the larvæ may make their exit through these to other parts of the same root. In a majority of instances the worm must face the only alternative of starvation, and actually *batter* a hole in the wall through which it may escape. Taking position with the head end against a cell wall it thrusts forward the exsertile spear which strikes the cellulose wall forcibly, when it is drawn back and thrust out again. This process is repeated until a hole is made through the wall large enough to admit the body of the worm, into which it passes and by successively battering down the cell walls of the surrounding tissues it makes its way to freedom on the outside of the gall or to a fresh portion of the same root.

Having escaped from its confinement by one of these three courses it immediately selects another part of the root or a fresh young rootlet for attack and places itself in position for the siege. Bringing into play its exsertile ram it forcibly gains entrance to the healthy tissues of the root. The plant not able to expel the invader bends its energies in a vain endeavor to repair the injury to the roots. Increased development of cells takes place, and normal ones are turned from their proper position and function and also very much enlarged. The result is the formation of a gall, an increase of tissue in the root which supplies food and protection for hundreds of the worms, all which lessens the energies of the plant normally directed to the production of leaf and fruit.

The larvæ wander for a time through the tissues and finally come to rest. Plate VI., fig. 39, represents a larva as it is wandering through the tissues of a potato tuber. It now moults the second time and passes into a truly parasitic condition.

Cystic State.—The larvæ locate at various depths in the tissues. The body now begins to enlarge except at the two ends. Speaking vulgarly it would be said to "swell up". Almost before any increase in size of this part of the body is noticed the worm becomes rigid and could not move if it would. Its body may be turned or twisted in very curious shapes when this rigidity or fixedness comes upon it. (See Plate IV., fig. 17x.). The enlargement begins close behind the muscular bulb of the œsophagus, and for a little time this part of the body is larger than the posterior part. Very soon the enlarging takes place all along the body to the hyaline space near the tail end, and this portion of the cyst becomes generally of a greater diameter than the anterior part. The cyst is at first rudely spindle-shaped, then clavate (or club-shaped) with a very small sharply pointed process, the tail, at the larger end. Fig. 18 represents the spindle form, 19 the clavate form. Up to this point it is difficult to distinguish the sexes, but from this point they sharply diverge. The female cyst continues to enlarge, while the male undergoes a wonderful transformation and returns to the thread-like, or *anguillula* form.

TRANSFORMATION OF THE MALE.—The body of the male at this point is the same size as the interior of the cyst, very stout in proportion to its length. The first sign of a transformation is the slipping of the head from the wall of the head end of the cyst. At the same time the thick body of the male begins to elongate and double up inside the cyst while the tail end, stout and blunt, begins to curve around. This makes the third moult. (See fig. 21, Plate IV.) While the male is elongating and coiling up in the cyst it begins to moult again making four moults. The very thin skin can be seen partly slipped off the worm while yet within the cyst (fig. 21). The male continues to elongate and become more slender until it is coiled three, four, or more times, dependent on the length of the cyst, within the walls of the cyst, which still retain perfectly the shape of the cyst when the transformation began. Even the exsertile spear moults for its "mould" is left in the head end of the cyst, while the skin of the larval tail still projects as a slender process. The male coiled within this perfect wall of the cyst is a very beautiful object. Figs. 21x and 22 represent these. During this transformation the sexual organs of the male have become matured. It now breaks through the wall of the cyst and the surrounding tissue and travels blindly through the maze of cells until it comes to its mate when it pairs and then dies. Fig. 23 represents a male coming from its cyst. Fig. 21z a male of *H. radicicola* removed from a cyst.

STRUCTURE OF THE MALE.—It may be well now to note some things about the structure of the male which were not described in the Section upon the "General Characters of the Female Cyst". It is from 1mm to 1.5mm (one twenty-fifth to one seventeenth of and inch) long and about .043mm (seventeen one-thousandths of an inch) broad near the middle. Its body a little less in diameter at the posterior end; the anterior half of the body gradually tapers to the head end which is about half the diameter of the middle. The body wall is beautifully marked by prominent transverse striæ broader and much more distinct than in the larval stage. The head, exsertile spear and œsophagus have been described. The excretory canal on the ventral side opens a little posteriorly to the muscular bulb. The caudal end (tail end) is slightly curved, and very near the end are the two curved *spicules*.

The *generative organ* is paired, the long slender *testes* lying on either side of the alimentary canal reach by their free anterior ends to about the middle of the body. See fig. 21z, Plate IV. Some little distance from the caudal end of the body they unite into a *common canal* which itself near the spicules unites with the alimentary canal forming the cloaca. The *spermatozoa* are spherical. The cellular structure of the testes resembles that of the ovaries to some extent. The cells are polyhedral, and in side view the lines separating them are zigzag. See fig. 21z, Plate IV. In live males the spherical spermatozoa are easily seen at and near the common passage, but they are developed in the anterior ends of the testes. By boiling infested potatoes to soften them so that I could remove the cysts and mature males without cutting or mashing them, I found that it toughened the tissues of the animals, and made the cellular structure very distinct. I possess several microscopic mounts of the males and one with the male in the act of coming from its cyst.

DEVELOPMENT OF THE FEMALE.—About the time the cysts have reached the stage when the male begins its transformations it is quite easy to distinguish the female cyst. The alimentary canal is very large and up to this time in both sexes has occupied nearly the entire cavity of the cyst. Now it begins to deteriorate and the ovaries begin to come to maturity while the cyst continues to enlarge. While the female cyst still possesses the slender tail process*, the irregular, slender hyaline cornua of the generative organs may be seen one on either side of the large intestine which is covered with fat globules and is quite opaque, or more so than the genital tubes. See figs. 19 and 19z, Plate IV. The vulva, the opening for the uterus, is at the point in these figures where the tail process joins the cyst. The cyst continues to enlarge, or "swell", until the tail part is cast and thrust aside. The vulva is now at the posterior end, and in some cases the body is so much enlarged that a depression is formed at this point (see fig. 27, Plate IV.). The ovaries continue to elongate; and fertilization takes place long before the cyst has ceased enlarging. The ova begin to develop

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*Probably the remains of the second moult.

while the cyst is comparatively small. Before the ovaries are fully developed they are capable of a slight independent motion. Frequently in examining those dissected from living cysts I have noticed a marked twisting and tortuous motion probably due to a contraction of muscles in the walls. The body wall of the female is marked by irregular transverse striæ, but not so prominent as in the male.

LENGTH OF LIFE CYCLE.—This completes a life cycle of our *Heterodera radicicola.* It passes through all these changes, from the development of eggs, successively through the larval and cystic state until eggs are again developed in about one month. This I was able to determine by watching the development of the worms in the roots of "volunteer" potatoes which sprouted about the first of October and were infected from the soil and the "seed" potatoes. Thus in favorable seasons there would be at this latitude seven or eight successive generations in a year. Farther south where the season is longer probably the number of generations is increased. When we consider the number of eggs one female is capable of producing, from one hundred to two hundred or more, it will be seen that the worms multiply with startling rapidity. The periods of transformation of different individuals do not altogether co-inside so that at almost any season we may find worms in every stage of development.

BRIEF RECAPITULATION OF THE LIFE HISTORY.—*Egg*—The oblong, bean-shaped egg, .08mm to .10mm long, developed in the anterior part of the ovaries, after fertilization, enclosed in a double-walled membrane, undergoes partial or complete segmentation while yet within the uterus. From the beginning of segmentation to the fully developed larva 5 to 7 days are required. The thread-like larva is coiled three or four times within the egg membrane. *Larva*—At the time of hatching or soon thereafter it moults for the first time. It is "thread-like", blunt at the head end and narrowly pointed at the tail end, .3mm to .4mm long. In the head end can be easily noted the exsertile spear and the long tortuous channel of the anterior part of the œsophagus extending to a prominent ovoid or ellipsoid muscular bulb, the middle part of the œsophagus. From this point the lumen of the alimentary canal can be seen extending down through the middle of the body, in which is a matrix that develops many fat globules, the anus is situated at the beginning of the hyaline portion of the tail end. The larva now leaves the cyst cavity and enters a fresh root or different place in the same root. It wanders for a time when it comes to rest, moults a second time and then being fixed enlarges, or "swells up" into a cyst with a flask-like body, the head projecting at one end and the slender pointed tail at the other. At this time prominent sexual transformations take place. *Male*—The male moults again (3rd time) leaving the outer wall of the cyst intact, while the body of the male elongates, narrows and becomes coiled three or four times within the cyst. While this change is going on the male moults again (4th time). It is now from 1mm to 1.5mm long, anguillula like, blunt at each end, slightly curved at the caudal end where are two curved spicules: In the middle line of the body runs the alimentary canal, in the posterior half of the body are the paired testes, which are united into a common duct near the caudal end and at the cloaca this unites with the intestine. On each side within the body is a muscular cord extending the entire length of the worm. *Female*—The female does not moult again, but continues to enlarge enormously until it is gourd-shaped, and the paired generative organs, opening by a common passage at the vulva in the posterior part of the body, form long tubes which lie coiled in the body of the cyst, free at their anterior end. As the embryos are developing the body of the cyst breaks up into an amorphic gelatinous mass in which the young larvæ and eggs are found floating within the cyst cavity. Length of life cycle, one month.

METAMORPHISM OF HETERODERA.—One of the features of the greatest morphological interest in *Heterodera* is its singular metamorphic character. This metamorphism finds its completest analogy in some forms of the *Coccidæ** where the larvæ, after pursu-

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*Strubell, Ad. Untersuchungen über den Bau und die Entwickelung des Rübennematoden, Heterodera Schachtii Schmidt. (Bibliotheca Zoologica. Originalabhandlungen aus dem Gesammtgebiete der Zoologie, hrsg, von R. Leuckart u. C. Chun. Heft 2.) 4°. 50 pg. 2 Taf. Cassel (Th. Fischer) 1888.

Centralblatt für Bakteriologie und Parasitenkunde. Bd. VI., No. 15, pp. 423-429, Jena, 1889.

Müller, Mittheilungen über unseren Kulturpflanzen schädliche, das Geschlecht Heterodera bildenden Würmer. Landwirthschaftliche Jahrbücher, ing for a time a wandering life undergo a metamorphosis†, accompanied by what appears to be a retrogression, so that the creatures lack the power of locomotion. At the third moult of the male it is transformed again into a more highly organized being, possessing wings and capable of seeking its mate. On the other hand the female remains fixed and incapable of locomotion and after impregnation by the male becomes enormously distended with eggs. It must be borne in mind, however, that this analogy is only superficial. *Heterodera* des not lose its power of locomotion through any retrogression of form like the loss of organs which occurs in the *Coccidæ*, though according to Strubell some parts of the head undergo retrogression. It is because of the rigidity and distention of the body of both male and female so that it cannot perform the undulatory movements of the body by which locomotion in the larval state and in the adult male is accomplished. The fact that the cyst is surrounded by the tissues of the plant does not interfere with its independent locomotion.

The cyst‡ differs morphologically from that of *Nematodes* like *Trichina* where the larva becomes encysted in the muscles of its host and does not undergo any remarkable change of form in the formation of the cyst, the walls of which are formed from extraneous and excreted matter. It somewhat resembles in its origin and earlier stages the earlier stages of certain of the *Cestodes* like *Tænia*§ where the embryo after it is located in the tissues of its host develops by distension into a vesicular body. Here, however, the resemblance ceases, and the walls of the *Tænia* cyst by invagination or evagination produce the head of the worm, or scolex, or in some cases the brood capsules, from which several heads are produced. In *Heterodera* the vesicular distension of the larva

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Bd. XIII., Heft I., 1884.

Sorauer, Pflanzenkrankheiten, Zweite Auflage, Erster Band, pp. 852-854, 1886.

Strubell, Ad. Ueber den Bau und die Entwickelung von Heterodera Schachtii Schmidt. Zoolog. Anzeiger, No. 242, 17, Januar 1887. pg. 42-46, und no. 243, 31, Januar 1887, pg. 62-66.

Centralblatt für Bakteriologie und Parasitenkunde. Band I., pp. 603-604, Jena, 1887.

†Comstock. An Introduction to Entomoloy, Ithaca, N. Y., 1888.

Ann. Rept. U. S. Dept. Agr. 1880.

‡My use of the term cyst is mainly for convenience.

§Text Book of Zoology, Claus and Sedgwick.

begins after a period of wandering through the tissues of its host. Instead of invagination the wall of the male vesicle is cast, and retains the cystic form while the worm elongates and coils within it. In its "pupa" condition the male more nearly resembles *Echinorhynchus* where the embryo after a wandering state comes to rest in the tissue of its host, develops a small elongated larva which is surrounded by its firm external skin as a cyst.* The female vesicle continues to distend until in age its body is filled with eggs and young larvæ. This condition of the female has been termed by some† a "brood capsule" but it of course bears no morphological semblance to the brood capsules of certain *Cestoda.* I regret that I find it necessary here to call attention to some serious errors on the part of some of our American investigators.

One of these errors is that into which Dr. Neal‡ has fallen in his treatment of the life history of this parasite. He speaks of the eggs as "cysts." This may have been due to the fact that he regarded the numerous yolk globules in the ovaries as cells, for he speaks of the cysts (loc. cit.) which were at first without any "epidermis", being formed by "an agglomeration of cells". What he represents in Plates IX. and X. as segmentation of the "cysts" is only a representation of the first stages of segmentation of the egg.

It appears that Prof. Scribner made a similar mistake in speaking of the "cysts" and "eggs" of the nematode which causes the new disease of the §Irish potato described by him. What he speaks of as the "cysts" are the egg membranes still containing the young larvæ. What he figures as the mature worm is a young one and the round granules which he speaks of as eggs are probably fat globules. I have found potatoes here affected with a similar disease while also attacked by *Heterodera radicicola.* I have found the worms representing all stages of development. It appears that they do not form cysts in the proper sense of the word. Fig. 46, Plate VI., represents a mature female of this worm. At *a* is

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*Text Book of Zoölogy. Claus and Sedgwick Vol. I., p. 362.

†Strubell, Ad. Untersuchungen über den Bau und die Entwickelung des Rübennematoden, *Heterodera Schachtii* Schmidt. Bibliotheca zoologica. Heft 2, 1888.

Centralblatt für Bakteriologie und Parasitenkunde. Band VI., No. 15, pp. 423-429, Jena, 1889.

‡Bulletin 20. U. S. Dept. of Agr. Division of Entomology, Washington, 1889.

§Bulletin of the Agr. Exp. Station, Tenn. Vol. II., No. 2. 1889.

a fully developed egg yet within the uterus, while *b* represents young ova not fully developed. In the body of the worm as well as in the eggs can be seen the round globules. Figs. 42 and 43 represent eggs, 43 an egg having undergone fission. Other eggs were observed in different stages of development up to the fully formed larva represented still within the egg membrane at fig. 44. Fig. 45 represents young worms of this species.

Fig. 47 represents a different species occasionally found accompanying these worms, but whether they are parasitic or not I have not yet had the time to determine.

Several of the worms which Dr. Neal has figured do not belong to *Heterodera.* Especially in decaying tissues one is apt to find species which are not parasitic. However, wherever they were found it is very clear that some belong to other genera than the worm in question. For example his figure 2, Plate XIII. (loc. cit.), is a mature female of another genus. An egg is represented in the uterus near the letter B, and the numerous yolk globules he speaks of as a peculiar arrangement of cells.

COMPARISON WITH HETERODERA SCHACHTII SCHMIDT.—There are many points of very close resemblance between *H. radicicola* and *H. Schachtii.* Both of these are European species, and each is known to attack widely different plants, so that the selection of a particular plant or family of plants, as a specific peculiarity is not their habit. Notwithstanding the points of resemblance there are a number of differentiating characters heretofore used the value of which can only be determined after careful study and experimentation, and even now some of these are known to be variants possessed by both species. The female of *H. Schachtii* is said to be ectoparasitic; the posterior part of its body being nearly or quite exposed. This results from the larva locating very near the surface so that its distended vesicular body breaks the surface and becomes exposed. This does not seem to be a character of very much value since many of the female cysts of *H. radicicola* are exposed.

The chief morphological differentiating characters which have been employed are as follows. The posterior part of the body of the female is rounded in *H. radicicola.* In *H. Schachtii** the posterior part of the body of the female projects into a short stout process in which is the vulva. According to Strubell (l. c.) the exsertile spear is somewhat differently constructed in the females of the two species. I have only found one female which possessed the stout process at the posterior part of the body. One of the most prominent differentiating characters used in the case of the males is the presence of the slender tail process in the cyst in *H. radicicola* and its absence in *H. Schachtii.* Dr. E. L. Mark, of the Museum of Comparative Zoölogy, Cambridge, Mass., who, before my copy of Strubell arrived, kindly compared for me some copies of my drawings, with those of *H. Schachtii* by Strubell, and aided me in the interpretation of some of the phases of egg segmentation, has made the suggestion that possibly the slender tail process in *H. radicicola* may be the result of the retention of the first larval skin which is lost in *H. Schachtii.* After this suggestion it has occurred to me that the first larval skin (at second moult) in those I have observed is cast at the time the larva comes to rest preparatory to passing into the cystic stage. In such moults I have only observed the skin as it was loosened from the anterior part of the body. Strubell says in the case of *H. Schachtii* (l. c. p. 44) that frequently the old larval skin remains attached to the hinder part of the larval envelope ("cyst") so that it has the appearance of being pointed. He is also inclined to think that the grounds for considering the two species distinct are questionable. In a foot note p. 11 he states that he is strengthened in his belief by the recent researches of Ritzema Bos in Wageningen (Biolog. Centralblatt, Bd. VII) who finds that such species as *Tylenchus devastatrix*, *allii*, *Havensteinii et Askenasyi* must be united into a single species.

That these two species of *Heterodera* are identical has been suggested by others†.

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*Strubell, Untersuchungen über den Bau und die Entwickelung des Rübennematoden, Heterodera Schachtii Schmidt. Bibliotheca zoologica. Heft 2, 1888.

Müller, C. Mittheilungen über unseren Kulturpflanzen schädliche, das Geschlecht Heterodera bildenden Würmer. Landwirthschaftliche Jahrbücher. Bd. XIII., Heft I. 1884.

†Sorauer, Pflanzenkrankheiten, Zweite Auflage, Erster Band. Foot note pp. 854-855.

During my study of *H. radicicola* I have been strongly inclined to consider it identical with *H. Schachtii* since many of the variations of the two species tend to reconcile the above mentioned differences. However, since my copy of Strubell's work has arrived and I have had an opportunity to compare it carefully with my own researches I find there exists a difference in the structure of the males of very great morphological importance. Strubell states that the genital apparatus of the male is an unpaired tube,* the single tube occupies the ventral side of the body cavity for half its length, the posterior end unites with a short efferent duct which itself unites with the intestine to form the cloaca. As I have stated in a former paragraph the genital apparatus in the males I have studied is paired, the two tubes unite near the posterior end of the body to form the efferent duct. It is difficult to see how Strubell could have overlooked a second tube, if it existed, since his work was done under the ægis of Leuckart. This character possessed by comparatively a few Nematodes seems of too great importance for specific variation. To reassure myself I referred again to my microscopic mounts of the male. Müller's (loc. cit.) imperfect study of the male leaves us no clue as to the structure of the genital apparatus in *H. radicicola.* Until the European species is studied it will be impossible to say whether mine is a distinct species.

My figures 21, 23, 25, and 26, Plate IV., represent a male which differed from *H. radicicola* mainly in the presence of a short curved caudal process represented at *a*, fig. 26. At first I thought this might possibly be a different species from *H. radicicola*, but as I only found one specimen I have concluded it may possibly be an accidental variation.

All of the males which I have studied were found in potatoes. My impressions are that the species in all the different galls found here are identical. More than this at the present time could not be said. As this report is only preliminary, and it has been impossible for me during the very short period of my observations to find and carefully study the males where we must probably

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*"Bei unserer Heterodera präsentiert sich derselbe als ein einfacher Schlauch,' etc., p. 22. See also his fig. 1, Taf. I.

look for the most satisfactory specific characters, in the different galls, I hope to continue these investigations during the coming year. This will also afford me an opportunity to study more fully some structural features necessarily passed over in the present work.

DISTRIBUTION OF HETERODERA.—The genus *Heterodera* is world wide in its distribution. It has been long known in central Europe where *H. Schachtii* was discovered by Schacht* in 1859 and named by Schmidt† in 1871. *H. radicicola* was first recorded in 1872 and named as *Anguillula radicicola* by Greeff‡, and transferred to this genus by Müller§ in 1884. It has been found in Java in the roots of sugar cane by Treub‖ who named the species *H. Javanica*, the characters being based on some differences in size of the females from *H. radicicola.* Beijerinck¶ doubts if it is distinct from *H. radicicola.*

It was known in Brazil in the year 1878§§ in the roots of the coffee tree, and has since been studied and published under the generic name *Meloidogyne* by Golbi‖‖. Leuckart is of the opinion that this is a species of *Heterodera* (see foot note in Centralblatt für Bak-

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*Ueber einige Feinde der Rübenfelder. Zeitschrft. d. Ver. d. Rübenzuckerindustrie, Bd. IX., S. 175-179, 1859.

†Ueber den Rüben-Nematoden (Heterodera Schachtii A. S.). Zeitschr. d. Ver. f. d. Rübenzuckerindustrie im Zollverein. Bd. XXI., S. 1-19, 1871. (Both cited by Müller, Mittheilungen über unseren Kulturpflazen schädliche Würmer.)

‡Sitzungsbericht. d. Marburger Gesellschaft z. Beförd. d. Naturwiss. S. 169, 1872. (Cited by Müller, Mittheilungen, etc.)

§Mittheilungen über unseren Kulterpflanzen schädliche, das Geschlecht Heterodera bildenden Würmer. Landwirthschaftliche Jahrbücher, Bd. XIII., Heft I. 1884.

‖Quelques mots sur les effets du parasitisme de l' Heterodera Javanica dans les racines de la canne à sucre. Ann. d. jardin bot. d. Buitenzorg. Vol. VI., Part I., pp. 93-96, Leide, 1886. Abstract in Bot. Centralblatt, Bd. XXVIII., p. 269, 1886.

¶The Gardenia-root diease. Gard's. Chron. ser. III., Vol. I., p. 488-489, 1887 Abstract in Bot. Centrabllatt. Bd. XXXV. p. 92, 1888.

§§Sur une maladia du Cafeièr observèe au Brèsil. Compt. rend. hebd. acad. sc. Paris, 1878, T. LXXXVII., No. 24, S. 941-943. Abstract in Bot. Jahresbericht (Just) p. 173, 1878.

‖‖Relatorio sobre a molestia do cafeeiro do Rio de Janeiro. Bd. VIII., Archivos do Museo nacional do Rio de Janeiro.

Biologische Miscellen aus Brasilien, VII. Der Kaffeenematode Brasiliens, Meloidogyne exigua G. Zoolog. Jahrbücher, abth. f. System., Geogr. u. Biol. d. Thiere, Bd. IV. Hft. I., pp. 262-267, Jena 1889.

Abstract in Centralblatt für Bakteriologie und Parasitenkunde, Bd. V., pp. 839-840. 1889.

teriologie und Parasitenkunde. Bd. V. p. 840, 1889). It is also known in Scotland according to W. G. Smith*.

Dr. Neal† states that it cannot survive the cold of severe winters in America north of about the January isotherm of 50° as shown in the No. 2 Isothermal Lines of the U. S. Signal Service, 1881. I do not know that any experiments have been conducted to demonstrate this. If it can survive the winters in Scotland it can endure the winters of all our Gulf and South Atlantic States. The January isotherm of 50° strikes the Atlantic coast just below Savannah, includes the southeastern corner of Georgia, the very southern limits of Alabama, and a corner of Louisiana. The isotherm of the same month and year which passes near this place is 45°. It starts above Charleston, cuts Georgia through the center and passes a little south of Montgomery. The isotherm of 40° starts near the boundary corner of Virginia and North Carolina, passes north of Atlanta, and includes the major part of Alabama, Mississippi, Louisiana and Texas. The average temperature of Edinburgh, Scot., during the month of January is about 39°, so that we might fully expect the root-gall nematode, if once introduced, to thrive as far north as the January isotherm of 35°, or even farther. This isothermal line starts in at the coast north of Norfolk and runs through middle Tennessee. Indeed I am inclined to think if a favorable opportunity should occur for its introduction into our States even so far north as New York and Ohio that from its habit it might easily pass the winter in sufficient numbers to become a terrible pest. On long rooted plants like the parsnip I have found them in great numbers fifteen inches below the surface of the ground. On tomato roots, which were placed in the soil very deep to get them if possible out of the way of the attacks of the worms, I have found them so low as eighteen inches below the surface. This depth would protect them from the frost in the very severe winters of some of our northern States.

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*Disease of Oats. Heterodera radicicola Müller. Gardeners' Chronicle. New Ser. Vol. XXI., p. 172, 1886. Abstract in Bot. Centralblatt, Bd. XXXI., p. 247, 1878.

†The Root-knot Disease of the Peach, Orange, and other Plants in Florida, due to the work of Anguillula. Bulletin No. 20, Division of Entomology, U. S. Dept. Agr. Washington, 1889.

There is to some extent a natural barrier to the spread of the root-gall nematode from the southern to the northern States, which is explained by the fact that very few, if any, perennials grown in the south are transported north for cultivation. However, the subject is of sufficient importance to the northern States to justify an inquiry into the possibility of its being successfully carried through the winter under the conditions I have stated.

VI.

STRUCTURAL CHARACTERISTICS OF THE DISEASED ROOTS.

NOMENCLATURE.—The abnormal growths on the roots, caused by *Heterodera radicicola* have long been termed popularly, in this country "root-knot". In Scotland they are known as *"root-ill", "thick-root", "tulip-root", "segging"; while in Germany they have long been known under the name "Wurzelgallen". The tubercular swellings on the roots of Leguminous plants (see comparison of root galls with the tubercles of the *Leguminoseæ*, at close of this Section) have long been known and published in Germany as "Wurzelknöllchen" (root-knot). In order to avoid a confusion of the tubercle with the abnormal growths dealt with here I shall use the term nematode root-gall, or root-gall. There is a tendency with some writers to use the term "gall" only for those abnormal growths which have their origin through the irritating presence of animals†. These nematode root-galls would belong to the same class of abnormal growths sometimes denominated *Helminthocecidien*. The writer does not mean by the use of the term root-gall, that it has priority to the use of the term root-knot, but in view of the appropriateness of the word, teratologically, and for the reason stated above he would recommend its adoption.

EXTERNAL CHARACTERS.—For the purpose of preparing the reader for a study of the life history and transformations of the parasite, Section II. was introduced in which attention was called to the general external morphological characters of the galls in a few plants. It is now in order to discuss more at length

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*Smith, G. W. Disease of Oats. Heterodera radicicola Müller. Gardeners' Chron. New Ser. Vol. XXVI., p. 172, 1886. Abstract in Bot. Centralblatt, Bd. XXXI., p. 247, 1887.

†Sorauer, Pflanzenkrankheiten. Zweite Auflage. Heft I.

the variations in form of the galls, and then to point out the special histological changes induced.

The external form of the gall is to a great extent dependent upon the number of worms and their distribution in the tissues of the roots, as well as upon some specific peculiarities in the growth of the roots or habit of branching. If the worms are numerous and the attack is made pretty regularly in a peripheral plane at a particular point in the root the gall will be symmetrical, and either short and ovoid or elongate and fusiform according to the extent of their distribution along the axis of the root at that point. If fewer worms attack at a given point the gall is more likely to be lateral, owing to the less certainty of an even peripheral infection. Often, however, lateral galls may be so near as to unite into one, when the appearance is that of a very irregular and knotty gall, the enlargements passing by abrupt changes on different sides of the root.

For the forms of the galls in the roots of the tomato, potato and peach the reader is referred to Section II.

The galls found in the "poke-weed" (*Phytolacca decandra*) were very large, lateral and ovoid. In a species of the plant called coffee weed (*Cassia obtusifolia*) lateral galls were found on the tap root near the surface of the ground. On the grape the fibrous roots usually possessed small ovoid lateral galls, while the galls on the larger roots were irregularly fusiform and not very prominent. The galls on the cow pea (*Dolichos catiang*) are quite peculiar. They are usually irregularly pyriform and mostly lateral, with the larger end of the gall below. When a root is attacked it appears in many cases to die just below the point of attack so that the gall is abrupt at this end while there is an opportunity for the worms to distribute themselves in a diminishing ratio a short distance above the gall which makes the sloping narrowed portion of the pyriform body. The size and irregularity of the larger end of the gall is increased by one or more lateral roots which develop very near the lower end of the gall, and continue the direction of growth of the main root which died. This in turn may be attacked, develop a gall, die below the gall and produce a branch, and so on successively until several pyriform galls are formed on successive branches appearing like a string of pyriform beads, the string of which runs obliquely through them. In badly infected specimens this is more marked and presents a very singular appearance. The galls on bird's foot clover (*Lotus corniculatus*) are short and ovoid, or more usually by the very close proximity of several, elongated and very irregular in outline. This irregularity is increased by the numerous small rootlets put out by the diseased root into the bases of which worms distribute themselves and form small convex elevations on the larger gall.

In the roots of *Amarantus retroflexus* the worms were quite abundant but the galls were not prominent. On the larger roots they were irregularly fusiform, slightly twisted, and while in some cases one half inch, one inch or more in length, the diameter of the root was not greatly increased. In places the surface possessed small brownish or dirty white pustules in which were cysts located very near or quite in the surface of the gall, while in the same gall other cysts were imbedded in the central cylinder.

It is unnecessary to detail farther in this preliminary report the forms of the galls on the other diseased plants. Enough has been said to show that great variation prevails and to give the typical forms about which all may be easily grouped. A list of the diseased plants which have thus far been found in this section will be given in Section VIII. while a comparison of the disease with some other characters and diseases of plants with which it might be confounded upon external examination, will be made after the discussion of the microscopic details of the diseased tissues.

HISTOLOGICAL CHARACTERS (*See also references below**).—The worms locate preparatory to passing into the cystic state at various depths in the tissues of the root. They are not confined to any par-

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*Goodale, Physiological Botany. Vol. II., Gray's Botanical Text Books.

Van Tieghem, Traité de Botanique, Deuxieme Edition, Fascicule 5.

Müller, Mitthleiungen über die unseren Kulturpflanzen schädliche, das Geschlecht *Heterodera* bildenden Würmer. Landwirthschaftliche Jahrbücher, Bd. XIII., Heft I. 1884.

Jahresbericht für Wiss. Bot. (Just) 1876, p. 1235.

Idem, 1877, pp. 516-517.

Idem, 1878, p. 174.

Idem, 1878, p. 169.

Sorauer, Pflanzenkrankheiten, Zweite Auflage, Vol. I.

Frank, Krankheiten der Pflanzen, and others.

ticular tissue element or system but locate in the vascular tissue of the central cylinder, the cambium, parenchyma or even in the bark so that the body of the mature female cyst is frequently only protected by a thin layer of the dead peripheral tissue, or sometimes is even exposed. They seem to flourish better, however in or near the softer tissues of the root. It is a very common thing to find dead undeveloped female cysts, the majority of which I have always found in the woody tissue of the central cylinder. Possibly surrounded as they are by the harder, more compact tissue there is less certainty of the male reaching them for fertilization. This, however, is only a suggestion. I have not demonstrated it. All of the tissue elements in the diseased roots undergo hypertrophy, while some of them are subject to special changes in form as well as direction of growth.

The parenchyma cells which normally have their tangential diameter greater than the radial are so changed that the radial diameter is the greater. This change in form of the parenchyma cells seems to obtain in nearly all of the parenchyma in the gall whether very near a cyst or distant from it. The increase in number of the wood and vascular cells of the central cylinder takes place though the cyst may not be located in or very near it. In such cases the fibres and ducts have their normal longitudinal direction. But if a cyst is located in or very near the central cylinder the ducts are turned in their direction of growth perpendicular to the axis of the root, bent around the cyst and then converge on the peripheral side, when, left without any controlling influence over their direction of growth they often perform very curious evolutions through the parenchymatous tissue in all directions.

A glance at figures 29 and 30, Plate V., will show at once a great difference in the arrangement of the tissue elements and the form of the cells of diseased roots compared with the same in a healthy root. These figures represent sections of roots of the cotton plant. Fig. 29 is from a section through a gall on a small lateral root, while fig. 30 is from a healthy lateral root of the same size as the non infected portions of the root from which fig. 29 was taken. Both are drawn to the same scale and the natural size of the lateral root from which fig. 29 was made is represented in fig.

31. In the healthy lateral root (fig. 30) it will be noticed that the differentiation of the woody tissue, which contains the large tracheal vessels, with the parenchyma is not so marked as in most roots so that the stellate appearance is not well represented. One of the most marked of the deformities is the displacement of the liber fascicles. In fig. 30 they are shown in normal position at *e*. In fig. 29 only one group is in what would be the normal position if the root were not diseased and of its normal size; this group is shown at *e*, fig. 29. *e'*, *e'*, *e'*, *e'*, represent displaced groups; that is in the rapid and abnormal increase of wood cells from the central cylinder they have been pushed far out of their normal position while cells of the parenchyma on the one side, and wood cells on the other have grown around the group *e*. *e''* represents one group not displaced but turned to grow in a tangential and radial direction, while *e'''* represents one group not only displaced but turned also in a tangential direction. *c* represents cells of vascular tissue which are turned in a tangential direction around the cavity of a cyst which is just below and was removed in making the section. *d* also reprsents cells of vascular tissue turned out of their normal course by the near presence of a cyst. At *a* is a cyst located in the edge of the vascular tissue of the central cylinder bordering on parenchymatous tissue; behind the cyst the cells of the vascular tissue are turned tangentially and this part of the bundle reaches over outside of the parenchymatous tissue bordering the liber fascicle *e*. The parenchyma cells between the cyst and the liber fascicle *e* are elongated radially instead of having their tangential diameter the longer.

In plate VI. figs. 36 and 37 represent the structural characters of the galls on tomato roots. The cysts *a* and *b* are seated in the parenchyma, the cells of which have long radial diameters and converge around the cyst. The parenchyma cells in this section in a peripheral plane are longer radially than tangentially. At *c* is represented a dead cyst, probably not impregnated, which lies in the woody tissue of the central cylinder. The pitted ducts can be seen to lie radially or perpendicular to the axis, turned from their normal longitudinal direction. Behind the cyst by turning in a tangential direction they converge from either side and meet.

Fig. 37 represents a section through a mature cyst lying in the vascular tissue, the cavity of the cyst at *a* is filled with eggs and young larvæ. At *b* are represented the vascular cells which lie in a normal direction cut transversely. On either radial side the ducts curve around closely following the contour of the sides of the cavity. At *c* the outer tangential side of the cyst cavity the ducts from both sides and from below converge and meet.

Fig. 36 represents a section from a moderately sized young gall. In older ones where the cysts are numerous there is often presented an intricate maze of these pitted ducts coursing in all directions.

In potato tubers the parenchyma cells are elongated so that their longer diameter is perpendicular to the surface at that point (see fig. 38, plate VI.). When the potatoes remain in the ground for some time, or have been infested for some time during their growing condition large warty growths are sometimes formed as represented in the upper right hand figure in Plate I. Again the tubers which have lain in the ground after maturity and sprouted ("volunteers"), being badly infested the young sprouts are attacked and large galls produced on them close to the surface of the tuber. In these cases pitted ducts are developed to a very great extent and a large majority of the mature female cysts are surrounded by an intricate net work of these ducts. In making sections of such galls many of these cysts are cut through and by removing the remains of the cyst, there is the appearance of a beautiful microscopic basket woven from the ducts and imbedded in the looser parenchymatous tissue close by. In the galls of the peach root beside the special structural derangements which could be classed under the head of the foregoing characters there appears in many of the nearly mature, or old female cysts a secondary growth of pseudoparenchymatous tissue from the inner periphery of the cavity which in some cases nearly fills the cavity with tender loosely compacted cells, so that the cyst is often deformed by the pressure of these ingrowing cells, and in very old ones the larvæ lie in different places in the tissue. It requires in some cases very careful search to find a female cyst which can be removed and recognized as the female of *Heterodera.*

Comparison of the External Appearance of the Root-Gall Disease of the Potato with "Potato Scab".—In some of the peculiarities of the disease in the potato tubers caused by *Heterodera radicicola* there is a striking resemblance, especially in the earlier stages, to the effects of the disease called "potato scab" and attributed by Brunchorst[*] to the action of a parasitic organism of very simple structure which he calls *Spongospora Solani*, and considers to be closely allied to the organism called by Woronin[†] *Plasmodiophora Brassicæ* which causes the disease of cabbages and turnips vulgarly known as "club-foot". The surface of a healthy potato is quite smooth with here and there minute rounded elevations which are usually of a little lighter color than the ground color of the surface and slightly roughened or granular. These are known as the "lenticels", the cork cells of which being loose and rounded have many intercellular spaces and permit an easy interchange of gasses between the cells of the potato and the outside. It is supposed that the potato scab disease begins in the vicinity of these lenticels. An increase in the tissue of the potato takes place here so that a low convex elevation is formed the surface of which becomes "scurfy" by the pealing off of the outer coats. From this the tissues break down and decay sets in and unless the disease is arrested the whole surface of the potato is affected. It appears that the larvæ of *Heterodera radicicola* mainly attack a potato in the vicinity of these lenticels for the first external sign of the presence of the parasite is the enlargement of these lenticels until elevations of considerable size are formed which are scurfy on the surface. Finally the elevation cracks, decay sets in and in many cases the external appearance strongly resembles a "scabby" potato. Usually, however, when the disease is arrested, the tissues being softened gradually shrivel and the potato has a wrinkled and shriveled appearance which I never saw in a potato affected by what is called the "scab". Usually also the roots will present the irregularly fusiform or ovoid galls. For the purpose

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[*] Ueber eine sehr verbreitete Krankheit der Kartoffelknollen. In Bergens Museums Aarsberetning for 1886, p. 219.

See also "Potato scab". J. E. Humphrey, Mass. State Exp. Station, 6th Annual Report 1888.

[†] Pringsheim's Jahrbücher für wissenschaftliche Botanik, Vol. XI., p. 548.

of comparing "scabby" potatoes with those infested by the *Heterodera* requests were made of several gentlemen in Alabama and in some of the Northern States for "scabby" potatoes from their respective sections. Specimens were received from *Peter Collier, Director of the New York Agr. Exp. Station at Geneva, N. Y.; from Prof. E. S. Goff, Horticulturist of the Wisconsin Agr. Exp. Station at Madison, Wis.; from Mr. Clarence M. Weed, Entomologist of the Ohio Agr. Exp. Station at Columbus, Ohio; from Mr. Wilson Newman, Asst. Director of the Canebrake Station, Uniontown, Ala.; and from Prof. T. M. Watlington, Abbeville, Ala.

From the last named place the specimens received were very badly infested with the *Heterodera radicicola*, and with a few of the nematodes which cause the disease described by Prof. Scribner†. I did not find the *Heterodera* present in the potatoes from any of the other localities. When the potatoes remain in the ground for a long time the fissures in the elevations become so deep and in some places the corky growths are so large and prominent as to be easily distinguished from the appearance of "scab" in any of the potatoes the writer has seen. In Plate I. the upper left hand figure represents the very early stages of the disease caused by *Heterodera radicicola*, while the upper right hand figure represents one which has long been infected.

COMPARISON OF ROOT-GALLS WITH "CLUB-FOOT" OF CABBAGE.—It will be of great interest to compare the diseased condition of the cabbage roots caused by *Heterodera radicicola* with the disease of the roots vulgarly known as "*club-foot*" of cabbage, since in many respects the external characters are very similar while the two diseases are caused by very widely different organisms. The one which causes root-gall, *Heterodera radicicola*, is, when compared with organisms of a lower grade, an animal of quite a complex and high organization. The one which causes "club-foot" is one of the slime moulds, a plant of the very lowest organization, called by Woronin‡, who first discovered it to be the cause, *Plasmodiophora Brassicæ*. This parasite when in its ma-

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*The author wishes to express his obligation to these gentlemen for their kindness.

†Bulletin Agr. Expt. Station, Tenn. Vol. II. No. 2, 1886.

‡Pringsheim's Jahrbücher für wissenschaftliche Botanik, Vol. XI., p. 548.

ture state consists of numerous very minute rounded bits of protoplasm, each independent and protected by a thin covering or wall. These remain in a resting condition through the winter in the diseased roots or in the soil. In the spring by decay of the roots these spores are freed. Under proper conditions of temperature and moisture they absorb water until the wall cracks and the bit of protoplasm is set free as a swarm cell, that is, a microscopic bit of plastic protoplasm with a very slender cilium, or hair-like process. After a time it loses this cilium and then the plastic bit of protoplasm moves slowly about in the damp soil by a streaming movement in various directions. It is capable of streaming out in such very fine threads as to enter the roots of the cabbage along with watery solutions of nutriment. Once within the root it locates in a cell and commences to appropriate the living matter of the root to itself. In this way it grows in size still remaining a very plastic body of simple protoplasm. Thousands of these enter the roots of a single cabbage. Not only do they appropriate to themselves the living matter of the root but they cause the root of the cabbage to produce an increased number of cells, so that oval or fusiform enlargements are formed. The cells of the root in which these parasitic masses of protoplasm are seated increase greatly in size compared with those which do not contain the parasite. The plasmodium, for so this mass of protoplasm is called, is yellowish in color. Late in the season it divides up into countless minute bits of protoplasm each of which secretes a protective wall about itself, and its life cycle is completed. The diseased cabbages become sickly, turn yellowish and either die or do not head.

Now in external appearance these enlargements of the roots which are called "club-foot" very much resemble the enlargements called root-galls which are produced by the nematode. Unless one was pretty certain of the locality from which the diseased specimens came, and knew the history of the disease in that locality it would be venturesome to undertake to say whether it was root-gall or "club-foot" until after a microscopic examination of the parasite, or of the structural characteristics of the diseased root.

I have some very fine specimens of "club-foot" before me which I obtained from Eastern North Carolina nearly a year ago. Having been placed in strong alcohol the enlargements are a little wrinkled and shriveled. But so closely do they resemble, especially in a fresh condition, the root-galls that when I collected specimens of cabbages here this autumn with enlargements on the roots I expected to find *Plasmodiophora Brassicæ* until after I had made the microscopic examination and found the cause to be a worm. Perhaps the enlargements of "club-foot," before they begin to crack, are a little more even in contour than those of root-galls and in the specimens I have seen those of "club-foot" are larger, especially on the tap root where very large lateral growths are formed. But if we take a thin transverse section of an enlarged root of each and compare them all resemblance vanishes. In a cross section of "club-foot" the first thing to attract attention is the great number of yellowish plasmodia, or else the spore masses within large cells, distributed all through the tissues. If the section is from an enlargement of a lateral root, unless very large, there will be little else to attract the attention when compared with a healthy root unless it be a slight enlargement of some of the other cells. The general character of the root structure is but little changed. The tracheal tissue of the axis cylinder, but little attacked is arranged in the same stellate form which we find it in a healthy root. The ducts, even when immediately in contact with cells containing plasmodia, are not turned from their longitudinal direction, or if so only slightly. The cells are not elongated and curved around the enlarged cells containing the plasmodium, but resemble the normal arrangement of small cells around a large one. Nor is the radial diameter of the parenchymatous cells proportionately increased, but if the cells are enlarged it is usually a proportionate or nearly symmetrical enlargement. In the section from the root-gall here and there is a cyst, or the amorphic remains of one containing eggs and larvæ. The color is not so yellowish as that of the plasmodia nor are the cysts so numerous. Indeed the most striking feature in the appearance of the cross section is the twisted, curved and distorted condition of the cells, especially of the tracheal vessels. In some places these are beautifully wreathed about a cyst, and by their side run very much elongated parenchyma cells, while in another place a labyrinth of vessels is woven with the parenchymatous tissue, giving to the section as a whole, viewed with the compound microscope, the appearance in miniature of a heavy field of grain after a driving storm, when the stalks of grain are twirled in all directions and matted in inconceivable ways.

When very large lateral "clubs" are formed, as on the tap root the tracheal tissue is turned in an outward direction and curved in various ways. But even then it is confined to more or less recognizable bundles, is rarely sharply curved, and never is wreathed around the plasmodia as around the cyst in the root-gall.

COMPARISON OF THE ROOT-GALLS WITH THE "TUBERCLES" OR "WURZELKNÖLLCHEN" OF LEGUMINOUS PLANTS.—To remove all possibility of a confusion of the root-galls with the tubercles (or Wurzelknöllchen) of the *Leguminoseœ*, which has probably sometimes occurred, this comparison is introduced.

These tubercles, which recent experiments* seem to show play an important rôle in the acquisition of atmospheric nitrogen by Leguminous plants, are irregularly oval enlargements of the roots, from the size of a pin head to a large pea, or sometimes elongate, or clavate and very much branched and convoluted. The root-galls will usually not be mistaken for the tubercles by one familiar with these bodies. The tubercles are formed only on the very youngest roots, so that they are connected with the root from which the diseased one branched by a very slender attachment. Sometimes, however, the attachment is very stout. Usually the surface of the tubercle, though it may be greatly convoluted or lobulated, is smoother and does not present the scurfy or cracked appearance so common, especially in age, on the surface of the root-galls. The

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*Atwater, W. O. Atmospheric Nitrogen as Plant Food, Bulletin No. 5, Storrs' School Agr. Exp. Station Conn. Oct. 1889.

Bertholet, M. Expériences Nouvelles sur la fixation de l' azote par certaines Terres Végétales et par certaines plantes. Ann. de Chim. et de Phys. 6me série, T. XVI. Avril, 1889.

Hellriegel und Wilfarth, Unterschungen über die Stickstoffnahrung der Gramineen und Leguminosen. Beilagehaft z. d. Zeitsch. d. Ver. f. d. Rübenzucker-Ind d. D. R. Berlin, 1888.

Abstract in Bot. Centralblatt, Bd. XXXIX, pp. 138-143, 1889.

root-galls may occur on proportionately large roots, and in a majority of cases the attack is made some distance from the end of the root, so that the root continues to grow beyond the gall and several galls may be formed on the same root in succession. The root also continues to enlarge so that few of the galls are attached by such slender pedicels as the attachments are in the case of tubercles I have seen. Since the tubercles vary greatly on the roots of different species* there are probably cases in which it would be difficult from an external examination to say whether the enlargements were root-galls or "tubercles". The structural characters are, however, so very different that it will not be out of place here to note briefly the chief structural characters of the tubercles, and give a short résumé of the leading opinions regarding their function.

Very different views have been entertained from time to time as to the nature and significance of these tubercular swellings. The interior of these tubercles is composed of a loose parenchymatous tissue. In the younger parts of this tissue all observers agree as to the presence of strands, or threads of a very plastic nature, with no cross partitions, which course between and through the cells, often sending short flask-like branches into the cells. These possessing a resemblance to the strands of *plasmodia* or threads of certain fungi, were so regarded by Ericksson†, Kny‡, Frank§, Lundström‖. In the older parenchymatus tissue all agree in observing in the plasmic contents of the cells bacteria-like bodies of variously branched forms, forked, or Y and X forms. These were regarded by Woronin¶ and others as bacteria. Brunchorst** be-

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*Sorauer. Pflanzenkrankheiten. Zweite Auflage. Erster Band. p. 743.

†Studier öfver Leguminosernas rotknölar, Lund, 1874; Bot. Zeitung, S. 381, 1874; cited by Sorauer, Pflanzenkrankheiten, Zweite Auflage, Erster Band, p. 744; and by Frank, Krankheiten der Pflanzen, Zweite Hälfte, p. 650, 1881.

‡Sitzungsber. d. bot. Ver. d. Prov. Brandenburg. 28 April, 1878; cited by Sorauer (l. c.).

§Krankheiten der Pflanzen (l. c.).

‖Ueber Mykodomatien in den Wurzel der Papilionaceen. Bot. Centralblatt, Bd. XXXIII., pp. 159-160 and 185-188, 1888.

¶Mem. Acad. imp. de Scienc. d. St. Petersbourg, X., 1866. Cited in Sorauer, Pflanzenkrankheiten (l.c.).

**Ueber die Knöllchen an den Leguminosenwurzeln. Bericht. d. Deutschen bot. Gesellschaft, Bd. III., pp. 241-257, 1885. Abstract in Bot, Centralblatt, Bd, XXIV., pp. 333-334, 1885.

lieved the tubercles (Knöllchen) were normal structures, and that the bodies which Woronin and others assumed to be bacteria were formed by a differentiation of the plasmic, protein contents of the cells into these forms, since they were found to be very rich in protein matter, and not accepting them as bacteria he called them "*bakteroids*". He regarded the "bakteroids" as reserve material which at fruiting time was absorbed by the plant. Supporters of this view were found in Schindler[*], Tschirch[†], and others. Many observers have noticed in these plasmic "strands", or fungal hyphæ (hyphenpilzen) minute rod-like bodies very closely resembling bacteria. These were first called bacteria by Beijerink[‡], who regarded the plasmic strands in which they were found as the remains of nuclear division in the cells of the tubercle. Ward[§] regarded these "strands" or "hyphæ" with their contained rod-like bodies as fungi in some respects resembling the smuts, or *Ustilagineæ*. Vuillemin[‖] also believed the tubercles to be caused by a fungus, but classed it with the *Chytridiaceæ*, with affinities for the genus Cladochytrium and he named it *Cl. tuberculosum*. He claims to have studied the sporangia and zoöspores. Prazmowski[¶] first considered the tubercles to be caused be a parasitic fungus in some stages resembling *Plasmodiophora Brassicæ* Wor., but after later researches[‖‖] he comes to the conclusion that the organisms in question are bacteria.

One of the most interesting of recent views, and that held by Prazmowski, Ward, Vuillemin (l. c.) and others, supported also

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[*] Ueber die biologische Bedeutung der Wurzelknöllchen bei den Papilionaceen. Jour. f. Landwirth. Henneberg, XXXIII., pp. 325-336.

Abstract in Bot. Centralblatt, Bd. XXVII., pp. 108-109, 1886.

[†] Beiträge zur Kenntniss der Wurzelknöllchen der Papilionaceen. Bericht. d. Deutschen bot. Gesellschaft. Bd. V. 1887. Cited by Sorauer, Bot. Centralblatt. Bd. XXXI., p. 308.

[‡] Die Papilionaceenknöllchen. Bot. Zeit. p. 726, 1888. Abstract in Bot. Centralblatt, Bd. XXXVIII., No. I., pp. 458-459, 1889.

[§] On the tubercular swellings on the roots of Vicia Faba. Philosophical transactions, Roy. Soc. London, Vol. 178, B. pp. 539-562, 1887. Abstract in Bot. Centralblatt, Bd. XXXIV., p. 305, 1888.

[‖] Les tubercles radicaux des Légumineuses. Ann. des. Sc. agron. franc. et étrang. 8^{o}, p. 96, 1888. Abstract in Bot. Centralblatt, Bd. XL., pp. 123-125, 1889.

[¶] Ueber die Wurzelknöllchen der Leguminosen. Bot. Centralblatt, Bd. XXXVI. pp. 215-219, 248-255, 280-285; 1888.

[‖‖] O istocie i znaczeuiu biologicnem brodawek Korzeniowych grochu. Bericht aus den Sitzungen der k. k. Akademie der Wissenschaften in Krakau. Juni, 1889. Das Wesen und biologische Bedeutung der Wurzelknöllchen der Erbse, Bot. Centralblatt, Bd. XXXIX., pp. 356-362, 1889.

by the best experimental evidence is that certain microörganisms, either fungi of a very simple organization or bacteria, by an endoparasitism produce the abnormal growths, and for a time live at the expense of the host plant, but being locked within the peculiar structure of the tubercle, dissolution of their bodies takes place followed by an absorption of their protein contents by the plant, so that not only nearly all of the substance which the plant yielded to the parasitic organism is thus finally restored, but in addition a more costly element, atmospheric nitrogen, which the organisms have assimilated and prepared for their host.

The chemical and physiological researches of Hellriegel and Wilfarth*, Bertholet†, and Atwater‡ show that the plants with tubercles on their roots grown in a soil with very little nitrogenous substance gain more nitrogen than the soil contains, but when grown in a sterilized soil no such gain is made. The experimental researches of Prazmowski (loc. cit.) were directed to the biological nature of the parasitic organism as well as to proving that they were the specific cause of the tubercles. The plants experimented with were peas, but he draws the inference that the rest of the "Papilionaceen" are not essentially different in the character of their tubercles.

In brief the results of his later researches§ are as follows. The root-knots (Wurzelknöllchen) of peas are not normal structures, for in sterilized media protected from accidental infection they are never formed, but they always result from infection.

The infecting knot-organisms are bacteria identical with them in form and characters. The bacteria were taken from young knots and increased through many generations by culture in nutrient media. The causal connection between the bacteria thus isolated and the root-knots was proven by a long series of careful

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*Untersuchungen über die Stikstoffnahrung der Gramineen und Leguminosen. Beilagehaft z. d. Zeitsch. d. Ver. f. d. Rübenzucker-Ind. d. D. R Berlin, 1888. Abstract in Bot. Centralblatt, Bd. XXXIX., pp. 138-143, 1889.

†Expériences Nouvelles sur la fixation de l'azote par certaines Terres végétale et par certaines plantes. Ann. de Chim. et de phys. 6 me série, T. XVI., Avril, 1889.

‡Atmospheric Nitrogen as Plant Food. Bull. No. 5, Storrs School Exp. Sta. Conn., Oct. 1889.

§Berichte aus den Sitzungen der k. k. Akademie der Wissenschaften in Krakau, Juni, 1889.

Bot. Centralblatt, Bd. XXXIX., pp. 356-362, 1889.

experiments wherein infection was produced through the inoculation of cultivated plants with bacteria, originally taken directly from the knots, and cultivated through many generations. The formation of the knots occurs only on the youngest roots and their branches.

The knot-bacteria make their way through young cell-membranes into the root hairs and epidermal cells of the root and multiply there at the expense of the plasmic contents of the cells. After the bacteria have increased to a considerable extent in the root-hair they unite near the point into grape-like clusters of colonies which lie very close together, become enveloped in a tough, glistening membrane by means of which they are united with the cell membrane of the root-hair. There arises now near the point of the root-hair, on the inside of its wall, a glistening knob-like projection. Around this bacteria knob curls the end of the root-hair in the form of a shepherd's crook, or of a screw. Out of this enveloping screw at the base of the root-hair grows the bacteria-knob as a hypha-like, or thread-like tube, which is surrounded by a glistening membrane and filled with bacteria. From this time on until the formation of the knot and the differentiation of its tissue the bacteria-tube resembles a real non-septate fungus filament; it grows at the apex and produces branches.

After growing out of the enveloping root-hair the bacteria-tube enters the epidermis of the root, pierces the rind and grows sometimes so deep as the endodermis of the central cylinder. In its growth and branching it passes between the cells splitting the membrane between two cells and crowding the two lamellæ apart, forming more or less prominent distended places in the tube, the outside of which is bounded by the two lamellæ and the inside filled with bacteria. The bacteria tubes also send short branches through the cell membranes into the cells which grow towards the nucleus, were formerly considered to be haustoria, and in unstained preparations are very difficult to distinguish from the cell contents. These Beijerinck* took to be the remains of nuclear division. In the early stages of the development of the knot no

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*Die Papilionaceenknöllchen. Bot. Zeit. p. 726, 1888. Abstract in Bot. Centralblatt, Bd. XXXVIII., pp. 458-459, 1889.

bacteria are found free in the contents of the cells, they are all enclosed in the bacteria-tube.

In consequence of the presence of the bacteria-tube in the deep layers of the rind the cells lying near begin to increase in number by division, slowly at first, but soon in rapid succession. At the same time the bacteria-tube grows into this newly formed tissue and branches profusely. Following this division of cells there arises at this point a meristematic, or growing, tissue which through rapid increase becomes of considerable size, in which now the characteristic tissue of the knot is differentiated. In the midst of this meristematic tissue there arises a parenchymatous tissue, of large cells, into which the bacteria-tube grows and branches profusely in all directions. Later through the dissolution of the tube the bacteria are set free in the parenchymatous tissue which now becomes the so called "bacteroid tissue." The outside of the knot is differentiated into the rind, a few layers of cells with little plasmic contents disposed radially, the outside layer of which becomes corky. Between the bacteroid tissue and the rind is a zone of small-celled tissue capable of division and growth and free from bacteria, the meristem or growing point of the knot. On the inner periphery of the meristem a zone of fibrovascular bundles is formed which originates as branches from the central cylinder of the root. Between the fibrovascular zone and the bacteroid tissue a layer of starch containing cells exists. As the knot, or tubercle, enlarges the meristematic zone by growth advances in a peripheral plane. The peripheral part of the parenchymatous, or bacteroid, tissue also continues to advance by growth, and the peripheral part being younger contains the bacteria-tubes with their rod-like bacteria contents, and these bacteria-tubes continue to grow and follow up the advancing peripheral portion of newly formed parenchymatous tissue while behind follows up the process of dissolution of the membrane of the tube and the liberation of the bacteria into the plasmic contents of the cells making the bacteroid tissue.

From several series of experiments conducted with every precautionary measure he reaches the conclusive proof that by means of infection with knot-bacteria the plants (peas) even when grown in a soil deprived of all nutriment and providing for the exclusion of all other organisms, could provide the necessary nutriment from the store of nitrogen in the atmosphere. But whether from nitrogen in combination, or as Hellriegel (l. c.) claims from the elementary nitrogen of the atmosphere the researches have not yet been carried far enough to say.

If bacteria taken out of the knots in peas are cultivated in suitable nutrient media they increase for an unlimited time by fission retaining a rod-like form. In the knots under the influence of the plant they increase in the same way and possess the same form until the time when dissolution of the membrane of the bacteria-tube takes place and they are set free in the bacteroid tissue. In the plasmic contents of the cells of the bacteroid tissue they increase for a time but change their form and branch in a forked manner forming X and Y forms. At last their bodies become hyaline and dissolution takes place. The plant begins to empty the older cells of the bacteroid tissue by appropriation of their contents for its own use. The time when this absorption of the contents of the bacteroid tissue begins and the energy with which it proceeds bears a distinct relation to the amount of nitrogenous matter in the soil at the command of the plant. When the soil is well supplied with it the knots grow to considerable size, the bacteroid tissue is filled with bacteria and bacteria-tubes and presents a flesh-red color, and remains in this condition until the maturity of the plant. The dissolution of the bacteroids and the emptying of the bacteroid tissue proceeds very slowly and irregularly. On the other hand when there is a scarcity of nitrogenous matter in the soil at the command of the plant the dissolution of the bacteroids and the emptying of the bacteroid tissue begins early and proceeds rapidly while the bacteroid tissue has a greenish color.

In both cases the emptying begins in the oldest part of the bacteroid tissue and advances towards the meristematic zone. Even in the oldest part of the bacteroid tissue remain numerous living bacteria and tubes containing bacteria which with those in the peripheral zone of the parenchymatous tissue escape into the ground upon the decay of the knot and there increase and perpetuate the infectious character of the soil.

In knots partly eaten by insects, which is quite common, the masses of bacteroids become surrounded anew by a membrane and the bacteria-tube thus formed, by sprouting divides into successively smaller colonies surrounded by membranes, which Prazmowski first took to be a kind of spore formation when the real nature of the organisms were unknown to him.

The structure of the knot is adapted to favor the symbiotic relation which exists between the host plant and its parasite. The corky layer of the rind prevents not only the ingress of foreign organisms but prevents the escape of the bacteroids, while the fibrovascular tissue which surrounds the bacteroid tissue provides the channel of communication between the plant and the contents of the knot. The plant being the master imprisons the bacteroids within the tissues of the knot, for a time nourishes them with the material which is the product of carbon assimilation in the leaf and the willing·bacteroid slave assimilates atmospheric nitrogen producing protein matter, when finally the plant completely overpowers them, dissolves their bodies and carries off their protein contents for its own use.

VII.

TREATMENT.

The following discussion of the treatment of the root-gall nematode is mainly suggestive, and anything farther must be preceded by careful experimentation.

DIFFICULTY OF REMEDIAL APPLICATIONS TO PLANTS ALREADY DISEASED.—It is evident from the endoparasitic habit of the worms that direct applications of vermicides to the roots will not destroy them without fatally injuring the plants themselves. When the worms first enter the tissues of the roots they are so minute that no channel is left large enough for the entrance of any poisonous fumes which might be applied in the soil. Also the hypertrophy of the tissue of the roots incident upon the presence of the parasites would effectually close up any aperture made. Dr. Neal* in some experiments conducted by him under the direction of Dr. Riley has shown that the application of bisulphide

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*Bulletin 20, U. S. Dept. Agr. Division of Entomology.

of carbon, kerosene emulsion and various arsenical solutions, in quantities sufficient for the destruction of the worms was generally fatal to the plants themselves, while the use of alkaline fertilizers, like hard wood ashes, muriate and sulphate of potash, kainite, etc., produced a hard growth less susceptible to attack.

STERILIZATION OF THE SOIL BY STARVATION.—The cheapest and probably at the same time the most effectual mode of sterilizing the soil will be to starve out the worms by a rotating system applied to the selection of fields, or plats of ground, upon which are grown only such plants as are positively known to be insusceptible to attack. A real difficulty arises even here for so many plants in widely different families are known to be susceptible to the disease, and plants that are absolutely insusceptible can in some cases only be determined after a series of trials. Dr. Neal reports (loc. cit.) that according to his experience *Amarantus spinosus* is the "most dreaded and destructive agent in the spread of the root knot." In this section, even in the immediate neighborhood of other plants badly diseased I have found this species free so far as examined, while *Amarantus retroflexus*, growing side by side with it, is diseased. Similar cases in the habit of a related species of *Heterodera* (*H. Schachtii* Schmidt) are reported from Europe. This species is very destructive to sugar beets and many other plants. Among a number of plants which were supposed to be insusceptible was barley*. Upon a piece of land very badly infected by the "Rübennematode" barley was sown for three years successively. The first two years no injury was noticed, but in the third year the crop was destroyed a short time before harvest by severe attacks of the worms. Dr. Neal (loc. cit.) also speaks of the Japan Clover (*Lespedeza striata*) as a substitute for the Cow pea (*Dolichos catiang*) as a forage plant and fertilizer. In this vicinity *Lespedeza striata* ranks as one of the species slightly affected, while "birds foot clover" (*Lotus corniculatus*) is very badly affected. It is evident that thorough investigations must be made to determine the useful plants which are very nearly, or quite, insusceptible to the attacks of the worms. By growing such crops upon selected ground for a period of a few

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*Quoted from Sorauer, Pflanzenkrankheiten, Zweite Auflage, Vol. II., p. 853.

years, exercising at the same time great caution in not allowing any weeds or grasses, which may be susceptible, to grow, the area selected could be sterilized. Now by taking up successively different areas and treating them in the same manner a persevering farmer could practically rid his land of the worms. So far as observed here buckwheat and alfalfa are among the insusceptible plants which could be experimented with.

Rotation of Crops.—Here we find occasion again to emphasize the oft repeated necessity of a judicious rotation of crops, but with special reference to a wise alternation of insusceptible with susceptible plants. It is evident that if we start with a sterilized soil and grow for one year an annual which is liable to the disease there is little danger of infection of the ground. If the following year this is followed up by the cultivation of another nearly or quite free from attack the soil will with greater safety bear another crop of the plant grown the previous year.

Clean Cultivation.—The absence of clean cultivation is one of the most fruitful sources of the thorough impregnation of the soil with the worms. It was of course impossible to make an application of this principle to the enemy in question before that enemy was known, and especially before the time required for its complete development from the egg had been determined. Now that these facts are known and since we know many of the plants subject to the disease it is to be hoped this method will be employed by those desirous of subduing the worms. Not only should an effort be made to prevent the growth on arable land of all plants growing wild which are liable to serious infection, but so soon as a crop has been gathered, or it is found that the crop will not be worth gathering, from any cultivated plant liable to serious infection the farther growth of the plants should be stopped, or what is better the roots of the plants should be gathered and burned when possible. In gardens this would not be a serious task compared with the benefit to be derived. I have noticed cabbages, tomatoes and potatoes, all which are seriously susceptible to the disease, growing in an abandoned condition for two months in the latter part of the season, all the while providing for the rapid development and multiplication of the parasites. During this time two successive generations of the worms are developed. Each female egg would on the average, making no allowance for fatalities, produce in the first generation 200 young. Allowing 50 per cent of these for males there would be 100 to start the second generation for every one at the beginning of the first. These would then on the basis of a similar computation produce 20,000 young or 10,000 females to be the producers of the third generation. Then during the time of the abandoned growth of these diseased plants every productive parasite has produced 10,000 productive parasites.

TREATMENT OF PERENNIALS.—The greatest care should be exercised in the cultivation of perennials like the grape, peach, fig, etc. The young plants should be obtained from sources where it is known they have been grown in non-infected soil. The orchard or grapery should be selected and by a system of cultivation of insusceptible plants be rendered sterile by starving out the worms. Then the practice of cultivating either for forage or as a fertilizer plants liable to the disease in the orchard should be discontinued. Where orchards or graperies are so seriously injured as to interfere with the productiveness of the trees or vines, they might be preserved for a few years while the orchard is renewed in soil freed from the worms, when they should be destroyed.

The peach trees and grape vines which I have examined in the vicinity of Auburn, while slightly affected do not appear yet to suffer any serious consequences. Young trees and seedlings are more seriously affected. The most badly diseased grape cuttings I have seen were those grown very near diseased cabbages and tomatoes. Care should also be used in the cultivation of seed potatoes which are not infected.

TRAPPING THE WORMS.—In Germany cultivators of the sugar beet have resorted with a degree of success to trapping the worms of a related species (*H. Schachtii*)* from badly infected soils by the cultivation of plants very susceptible to the disease, and then gathering the roots before the worms are fully developed and destroying them. Such plants they call "catch plants" ("Fangpflanzen").

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*Sorauer, Pflanzenkrankheiten, Vol. II., p. 854.

Composts.—If roots are ever used in the making of composts great caution should be used since there is danger of infecting soil hitherto free from the worms by fertilizing such land with compost material containing diseased roots. [illegible]nn* has shown that such infection does take place in the case of related species, *Heterodera Schachtii* Schmidt, and also states that the material may be rendered innocuous by placing unslacked lime in layers with the infected refuse of plants which may be used in compost. For distribution see close of Section V.

VIII

Plants Affected.

The following list of plants affected with the Nematode root galls is by no means complete. It comprises only such as with limited time I have been able to determine thus far in the vicinity of Auburn. From the foregoing study and comparison of the root-galls with externally similar teratological root-growths it will be seen that two essential characters must be determined before in all cases we can say the abnormal growth is a nematode root-gall: a microscopic examination to detect the presence of the worm and the histological changes accompanying its parasitism. Both of these tests have been applied in making up this partial list. Those marked with a * are badly affected.

1 Amygdalus Persica (peach).
2 Ficus Carica (fig).
3 Vitis vinifera (grape, several varieties).
4 *Solanum tuberosum (potato).
5 Solanum esculentum (egg plant).
6 *Lycopersicum esculentum (tomato).
7 Physalis sp.
8 *Abutilon sp.
9 Gossypium herbaceum (cotton).
10 Hibiscus esculentus (okra).
11 Sida spinosa.
12 Modiola multifida.
13 Cassia obtusifolia (coffee weed).
14 *Dolichos catiang (cow pea).
15 Phaseolus.
16 Lespedeza striata (Japan clover).
17 *Lotus corniculatus† (bird's foot clover).
18 Melilotus alba.
19 Ipomœa tamnifolia.

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*Die Rüben Nematode. Zeitschrift des landwirthschaftlichen Central-Vereins der Provinz Sachsen. No. 12, pp. 332-335, 1870.

† Determined by Dr. G. W. Vasey.

20 Ipomœa lacunosa.
21 Clematis sp.
22 Phytolacca decandra.
23 *Helianthus annuus (sunflower).
24 *Citrullus vulgaris (watermellon).
25 *Cucumis melo ("nutmeg melon," "citron").
26 Beta vulgaris (beet).
27 Amarantus retroflexus (spineless careless weed).
28 Chenopodium Anthelminticum (worm seed).
29 Zea mays (corn).
30 *Brassica oleracea (cabbage).
31 Brassica Rapa (turnip).
32 *Brassica campestris rutabaga (rutabaga).
33 Marrubium vulgare (horehound).
34 *Pastinaca sativa (parsnip).
35 Lactuca sativa (lettuce).
36 *Tragopogon porrifolius (salsify).

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The following ist of works is not intended as a complete bibliography upon the subject, but is a list of those which have been consulted by the author during the preparation of this report. Those marked by a * were not seen in the original, but abstracts in either the Bot. Jahresbericht (Just's), the Bot. Centralblatt, or the Centralblatt für Bakteriologie und Parasitenkunde.

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EXPLANATION OF PLATES.

[All the Plates are original, and except the first two, which are from photographs, were drawn by the author from nature. In Plates IV, V and VI, all the figures are magnified except 31 and 32].

PLATE I. IRISH POTATOES (*Solanum tuberosum*).—The cracks in the large potato (seed potato), result from the increased growth of cells at the points where the Heterodera exists. The upper left hand figure is a small young potato taken from this same plant, the elevations and projections caused by presence of the Heterodera. The enlargements on the roots of the potato are the galls. (Natural size, from photograph.)

PLATE II. Tomato root showing root-galls two-thirds (natural size, from photograph.)

PLATE III. Parsnip and Salsify, showing root-galls, natural size.

PLATE IV. Development and transformations of Heterodera radicicola (Greeff.) Müll.

Figs. 1-9 different stages in segmentation of mature eggs; 10 invagination at anterior pole; 11, young embryo of the length of the egg, beginning to elongate and coil inside of the egg membrane, the caudal end, which is below in the figure, turning toward the ventral side, the cephalic end, above, granular and nearly hyaline; 12, 13, 14 farther elongation of embryo, 15 mature larva coiled five times within the egg membrane.

Fig. 16. Larva coming from egg membrane, and moulting at same time, the partially cast skin can be seen slipped from the head and tail. At the boundary between the hyaline and strongly granular portion near the tail end can be seen the anal opening.

Fig. 17. Sexually immature worm, larva; 17x same not so greatly magnified in one of the various forms sometimes found prior to the cystic state; 18, 19, 19z various degrees of distention of the larva; 20 young female cyst, showing ovaries; 21 male undergoing metamorphosis; 21x and 22 same with metamorphosis complete, in pupa state; 23 emergence of sexually mature male from cyst; 24 front view of head of male showing the position of the lamellæ around the spear; 25 anterior end of female, *a* exsertile spear, *b* anterior part of the œsophagus: 26 posterior end of a male (see page 25), *a* caudal appendage (probably an accidental variation), *b* spicules; 21z sexually mature male very greatly magnified, showing the paired testes.

Fig. 27, Mature female cyst, *a* middle part of œsophagus (suctorial bulb), *b* anterior part of œsophogus, *c* exsertile spear, *d* vulva, *e* genital tubes, the anterior ends of which form the ovaries.

Fig. 28. Genital tubes of female cyst with mature eggs still farther enlarged; *a* vagina; the uterus extends from the vagina a little more than one-third the length of the tube, near the middle is the *receptaculum seminis*, the oviducts and ovaries occupy a little more than one-half of the free ends. The small ova are very tender and flexible, but by pressure of the mass are held in a polygonal form within the ovaries. If the ovary is broken at a point as at *b* or *c* the young ova escape and assume a spherical form, and not yet being free cells are held together in a beautiful cluster as represented in the figures. As the young ova increase in size by growth, the pressure causes them to move toward the oviducts, they gradually develop numerous yolk globules which darken their appearance, passing through the receptaculum seminis are fertilized, and entering the uterus segmentation begins, finally the mass of developing eggs in the genital tubes ruptures them and the eggs and embryos are set free within the body of the cyst.

PLATE V. Structural effects of the disease in roots of cotton and peach.

Fig. 29. Cross section of gall on lateral root of cotton plant; *a* female cyst showing ovaries, etc., *b* old female cyst showing eggs and young larvæ in the amorphic remains of the parent, *c* deformed vascular tissue by the side of a

cyst, *d* deformed vascular tissue, the tubes turned in a radial and tangenital direction to the axis of the root, *e* liber fascicle in normal position of healthy root, e′ liber fascicle displaced, and, by increased growth of parenchyma and vascular tissue, carried far out from normal position, e″ liber fascicle deformed and growing in a radial direction, e‴ liber fascicle displaced and growing in a tangential direction.

Fig. 30. Cross section of healthy lateral root of cotton plant, magnified but in proportion with Fig. 29.

Fig. 31. Galls on lateral root of cotton plant (natural size).

Fig. 32. Root-gall of Peach, natural size, but small specimens.

Fig. 33. Section through female cyst in root of Peach, showing the ultimate growth of soft, pseudo-parenchymatous tissue which sometimes entirely fills the cavity before the larvæ have all escaped, *a* amorphic remains of female cyst showing eggs and part of genital tubes, *b* original outline of cyst, *c* hypertrophied tissue from surface of cavity of cyst.

PLATE VI. Female cysts and structural effects of the disease in roots of the Tomato, and the tubers of the potato (excepting Figs. 42-47). All magnified.

Fig. 34. Mature female cyst, *a* exsertile spear, *b* middle part of œsophogus, *c* ovary, *d* eggs escaped from the uterus,

Fig. 34. Mature female cyst of a different form.

Fig. 36. Cross section of diseased root of Tomato, *a* and *b* female cysts, *c* dead cysts which probably failed to be fertilized.

Fig. 37. Section still more magnified, *a* cyst cavity of female showing eggs and larvæ in amorphic remains of the parent, *b* normal vascular tissue in cross section, *c* deformed vascular tissue turned in a radial and tangential direction around the cyst.

Fig. 38. Section of outer portion of potato tuber showing *a*, female cyst external, with head end only in the tissues; *b* radial elongation of cells.

Fig. 39. Sexually immature larva making its way through cells of the potato tuber.

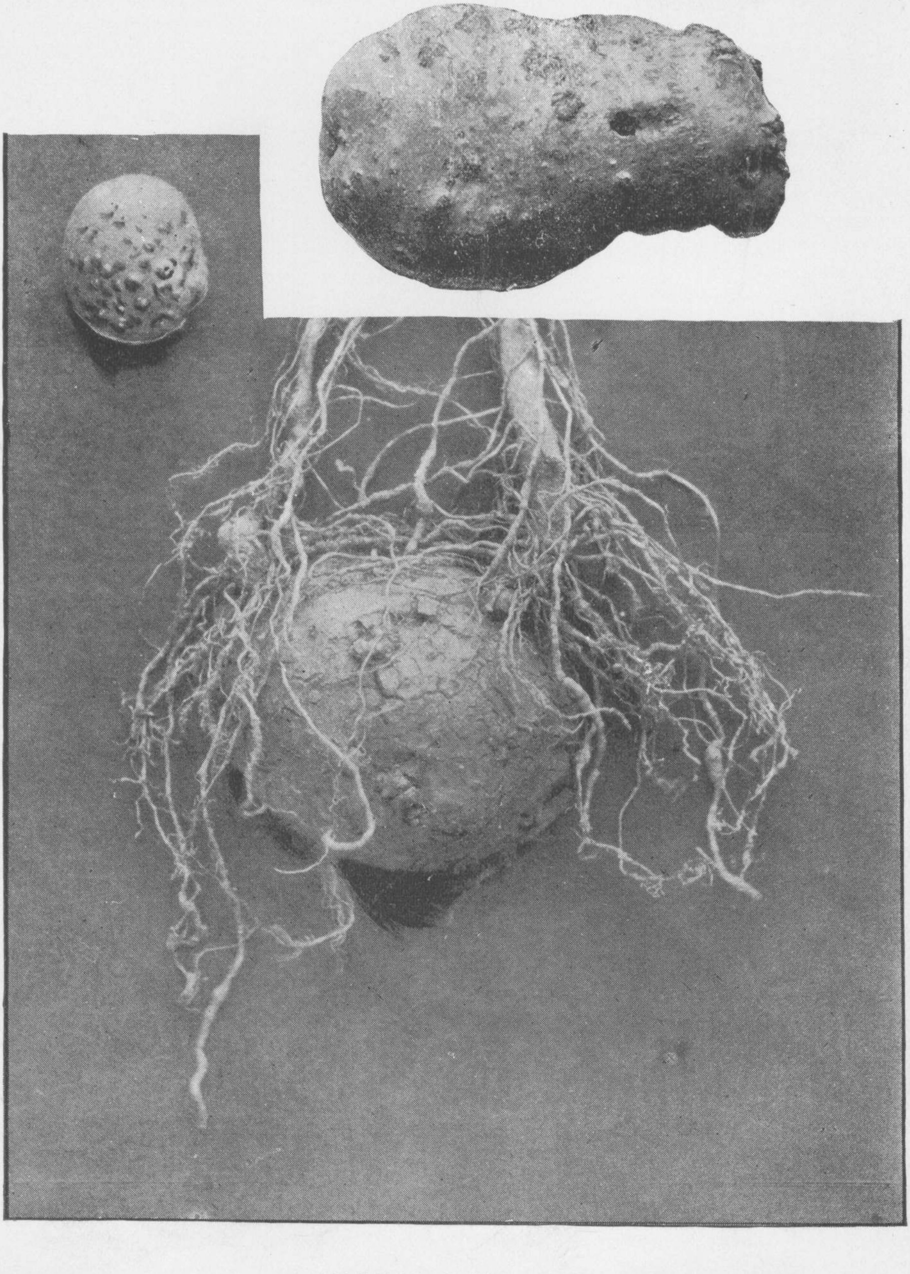
Fig. 40. Section of outer portion of potato, *a* young cyst in situ, *b* cork cells of lenticel (the section was through the side of a lenticel).

Fig. 41. Section of outer portion of potato tuber where decay of the tissues has begun, *a* female cyst in situ, *b* cyst cavity containing amorphic remains of parent, and young larvæ and eggs.

Fig. 42. Egg of 46; 43, cell division of same in process of development; 44 young larva in egg membrane; 45 young larva after hatching; 46 mature gravid female, *a* mature egg, *b* young ovum (Figs. 42-46 illustrate the egg, larva and mature female of the nematode which produces the disease of the Irish potato characterized by Prof. Scribner).

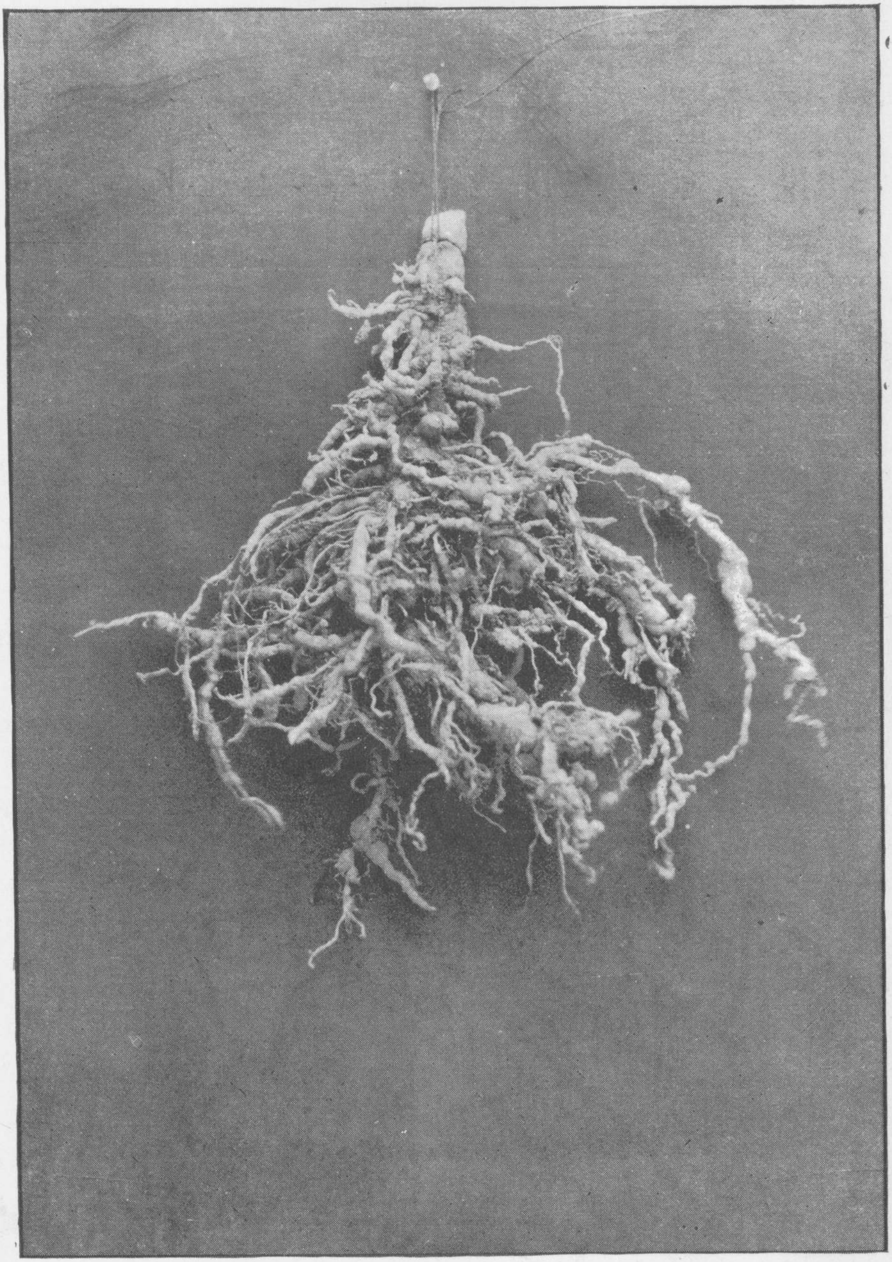
Fig. 47. Mature female of a different genus found sometimes associated with the former.

PLATE I.—NEMATODE ROOT-GALLS.



IRISH POTATO.

PLATE II.—NEMATODE ROOT-GALLS.



TOMATO.

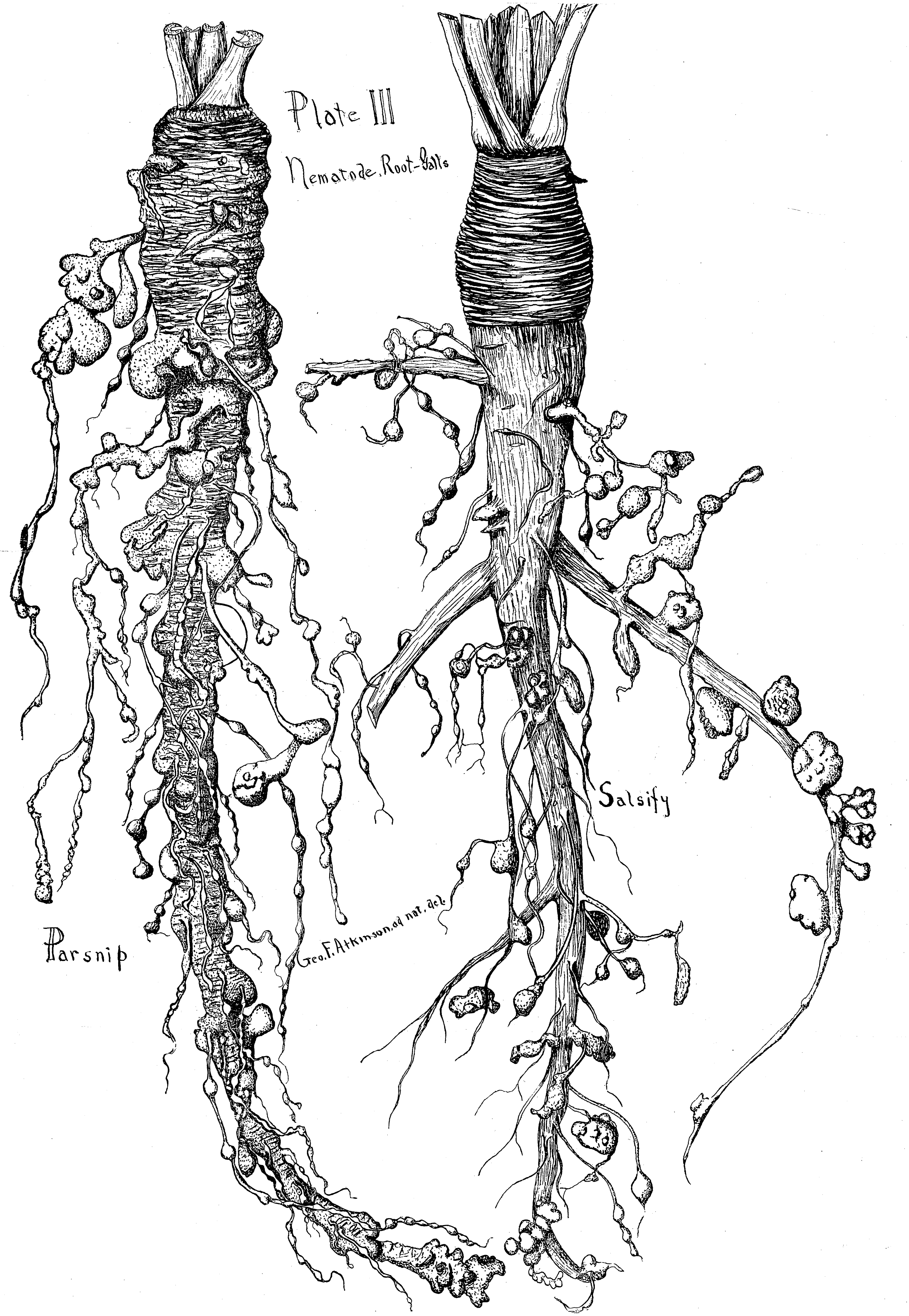
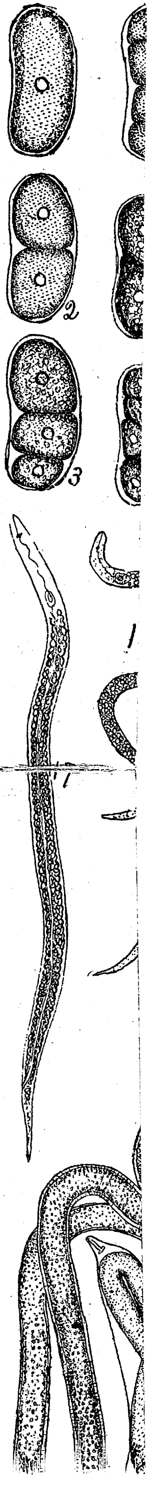


Plate III
Nematode Root-Galls
Parsnip
Geo. F. Atkinson, ad nat. del.
Salsify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3
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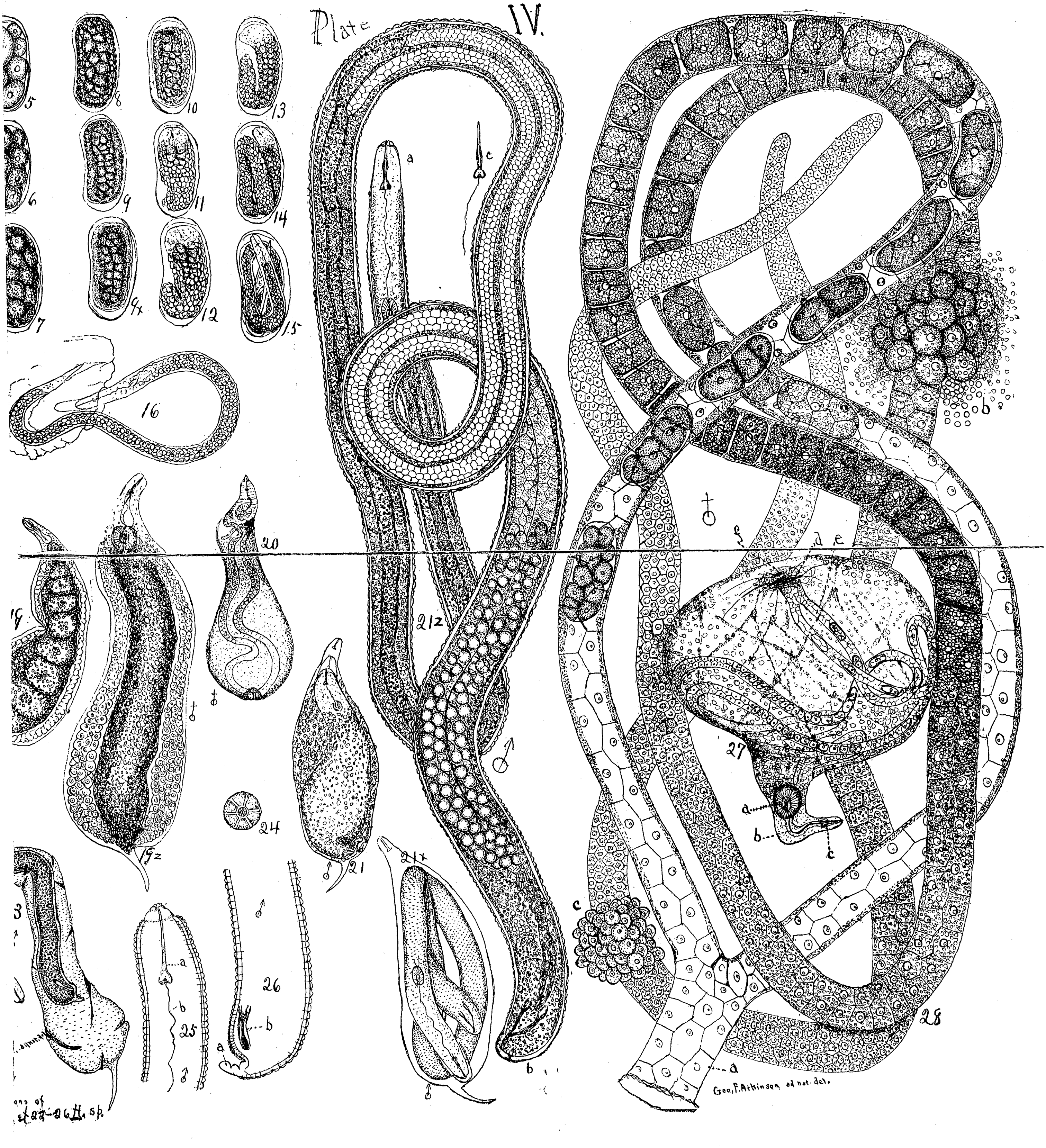
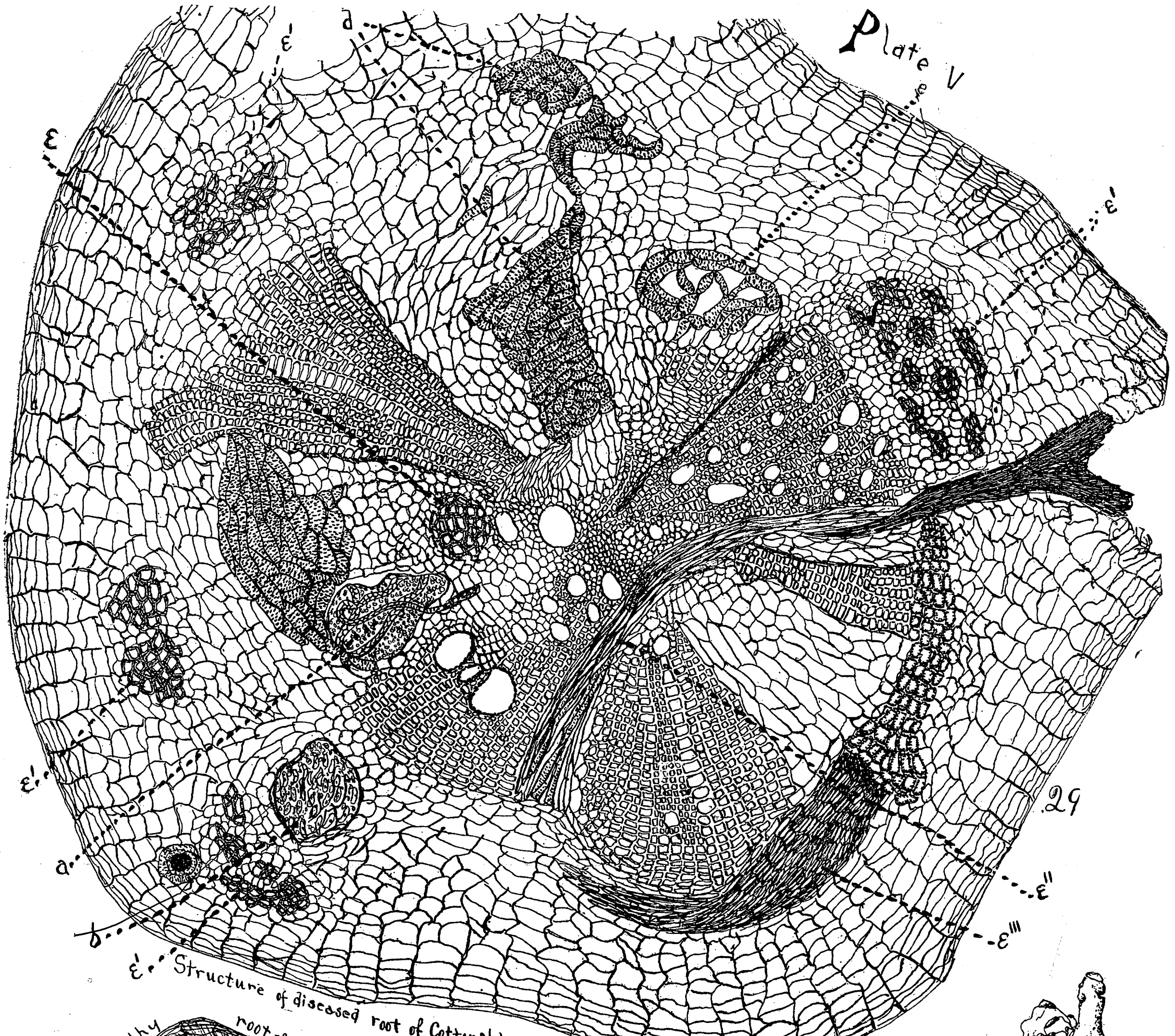
Plate IV.

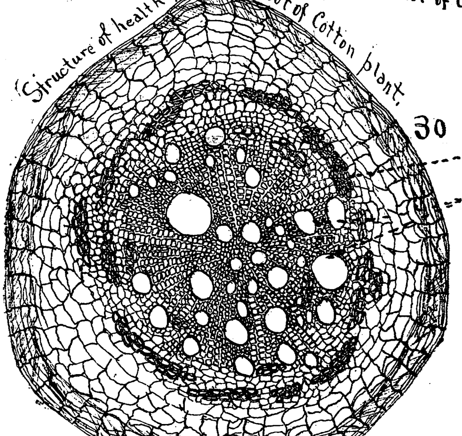


Geo. F. Atkinson ad nat. del.

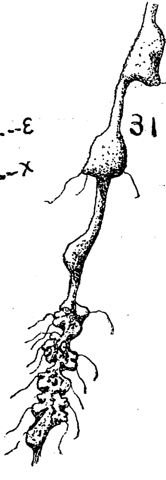
Plate V

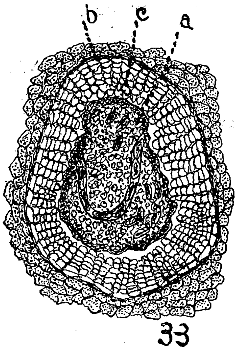


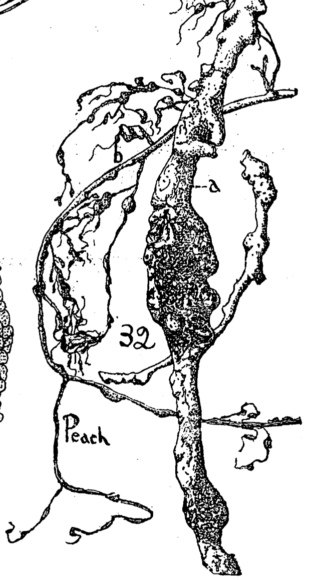
Structure of diseased root of Cotton-plant



Structure of healthy root of Cotton plant.

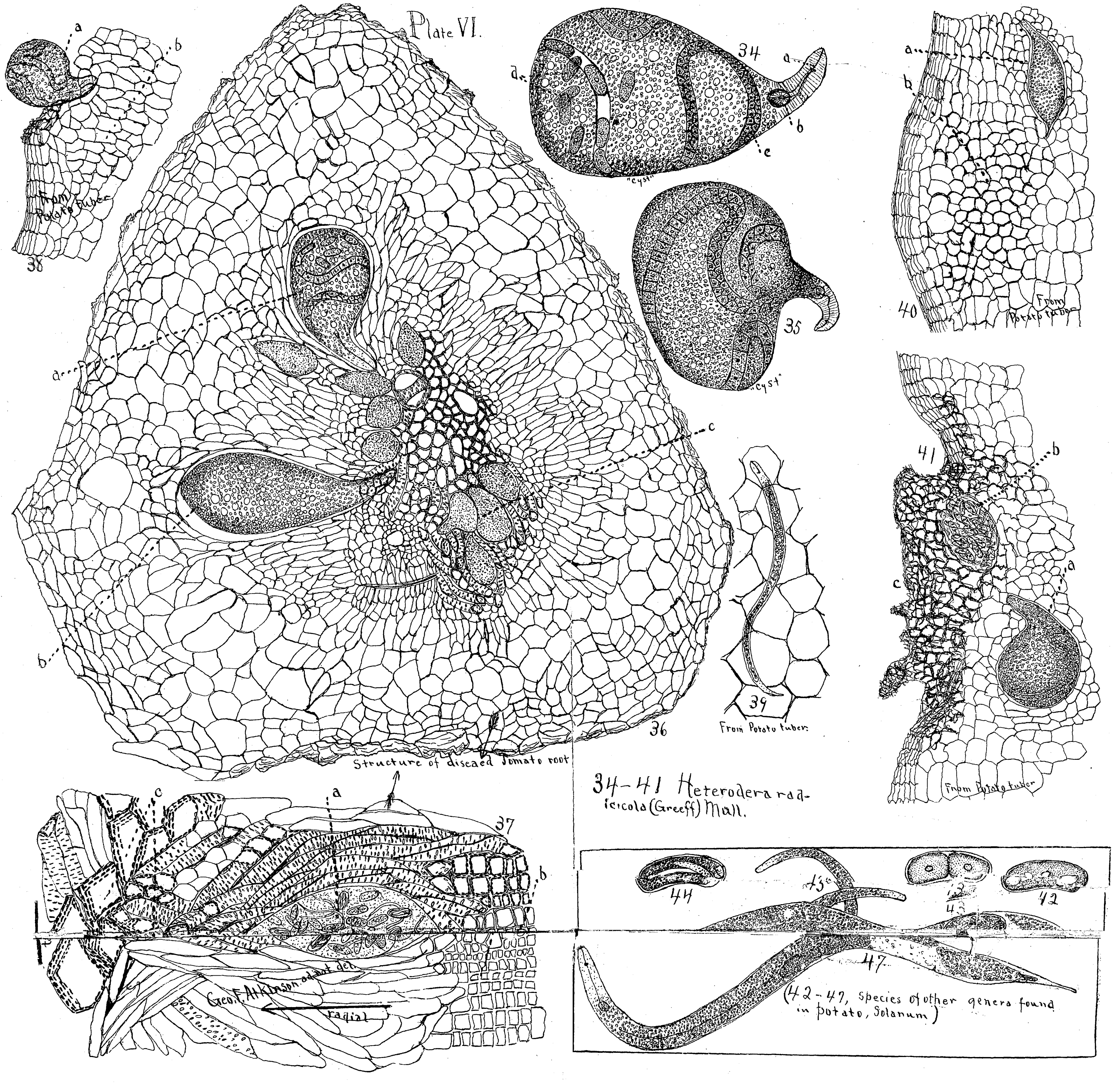






Geo. F. Atkinson ad nat. del.

Plate VI.



34-41 Heterodera radicicola (Greeff) Mull.

(42-47, species of other genera found in potato, Solanum)

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BULLETIN NO. 10. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - JANUARY, 1890.

GRAPE CULTURE.

☞The Bulletins of this Station will be sent free to any farmer in the State who desires them.

THE BROWN PRINTING CO., PUBLIC PRINTERS AND BOOK BINDERS.

BULLETIN NO. 10,

Agricultural Experiment Station,

Agricultural and Mechanical College,

AUBURN, ALA. - - - - JANUARY, 1890.

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†Prof. Mell has also charge of Meteorological Observations.

SOME FACTS FROM THE STATION VINEYARD.

[BY J. S. NEWMAN, AGRICULTURIST.]

LOCATION AND EXPOSURE.

In order to satisfy the skeptics who did not believe grapes could be grown successfully on this soil, a most unprepossessing north hill side, of what was known as "worn out" land, was selected for a vineyard. The remark was often heard, "If you can grow grapes there they will grow anywhere." Three large gullies, from three to four feet deep and from six to ten feet wide extended through a part of the acre selected for the experiment vineyard, and from another portion the soil had been so completely washed off that the surface was entirely bare of vegetation. Such was the unpromising area upon which the reputation of the Experiment Station was risked in grape growing.

FILLING THE GULLIES.

In February, 1886, the reclamation of this waste land was commenced by filling the gullies with brush and plowing down their sides.

The horizontal lines for terraces were then laid off and the spaces between the gullies broken between the lines.

The soil thus loosened, was drawn into the gullies with a railroad scrape, until they were sufficiently filled to allow mules to cross them, taking the soil mainly from the upper part of the terrace spaces.

With a two-horse hill side plow, the terrace spaces were broken three times, turning the surface down hill each time until the terrace lines were built up two feet high.

PREPARATION FOR PLANTING.

Early in March, furrows were marked off eight feet apart, following the lines of the terraces. The land was then subsoiled for a space of two feet on each side of these furrows and a ton of compost per acre thoroughly incorporated with the soil over these areas four feet in width.

In the centre of these spaces deep and wide furrows were opened for the reception of the vines, which were planted, six of a variety, eight feet apart in the rows. In the space of four feet in the middles not fertilized for the grapes, two rows of peas were planted at the proper season. To these two hundred pounds per acre of cotton seed meal and acid phosphate, mixed in equal parts, were applied in the drill.

CULTIVATION AND PRUNING.

The grapes and peas were cultivated shallow with heel scrape, until the pea vines covered the ground.

Only one cane was allowed to grow upon each vine. This was tied to a stake and pinched back when three feet long, to induce a more stocky growth. The next winter these were cut back to three eyes or buds.

In February following, the dead pea vines were raked into the row of grapes as a mulch, and the intermediate space plowed with hill side plow, set to run just two inches in depth, throwing a little soil over the mulch. Again peas were planted in the middles, and fertilized as before. Posts were planted sixteen feet apart in the grape rows and two strans of No. 12 wire stretched tightly upon them for trellis. One wire is two feet from the ground and the other four feet.

Unless the vines were unusually strong only two canes were allowed to grow the second season. On very vigorous vines three were left. As soon as long enough these were trained to the wires and all bunches of fruit clipped off to devote all the energies of the plant to its establishment and development. When four feet long the canes were pinched to induce stocky growth and to stimulate the growth of laterals. If three canes were left, one was trained to the top wire.

The vines have now had two years in which to establish themselves preparatory to bearing fruit, and the next pruning must look to that end.

The renewal and spur systems have been combined with very satisfactory results.

We have now either two or three very vigorous canes well supplied with laterals. To secure plenty of new wood for next year's fruiting, one cane is cut back to three or four eyes and the others to four feet, and the laterals to one eye each.

The new canes which grow from these laterals thus "spurred" will each produce three bunches of grapes the next season. The number of bunches to be produced may therefore be estimated with a considerable degree of accuracy in advance.

To supply the means of greatest fruitfulness, a ton of compost, two hundred pounds of cotton seed meal, two hundred pounds of acid phosphate, and two hundred pounds of cotton seed hull ashes, were sown broadcast and turned in two inches deep with hill side plow. No peas were planted the third year, but the middles kept free from grass and mulched with loose earth by frequent stirring with heel scrape. It should have been stated that during the first two years enough peas were gathered to pay for the manure and cultivation, and the vines and roots left to feed the grape vines.

The standard varieties, such as Concord, Ives and Perkins, produced the third year an average of twelve pounds per vine or four tons per acre.

From one Perkins vine fifty-six pounds of marketable grapes were picked and sold at five cents per pound. Many of the new canes grew twenty feet in length during this the third season.

To prevent over-bearing, as soon as sufficient growth was made in spring to make the selection, the feeble canes were rubbed off leaving only the vigorous ones either to bear fruit or produce bearing wood for the next season.

This brings us to the third winter, preceding the fourth growing or the second bearing season, when the vines may be permitted to bear a full crop. To enable them to do this the substance removed in the crop of the previous season, and that taken in the vines, removed by pruning, must be restored and additional provision made for the tax of a still larger crop.

For this purpose, after the pruning was finished and before plowing, an application of three hundred and fifty pounds of cotton seed meal, 700 pounds acid phosphate, and 350 pounds cotton seed hull ashes per acre, was made broadcast.

In pruning more bearing wood was left than before, bearing canes being now trained to both wires in each direction from the vine. This nearly doubled the bearing area, but owing to an unfavorable spring did not double the yield.

Early in June an additional supply of plant food was given in a mixture of two hundred pounds each of acid phosphate and kainit per acre. This was sown broadcast between the rows and mixed with the soil by a heel scrape run very shallow. Notwithstanding the fact that some of the varieties under experiment were not prolific, nearly seven tons of grapes were gathered, besides those destroyed by birds, which cannot be estimated. This is a brief history of the Experiment Vineyard during the four years since planting. In view of the unfavorable conditions under which it was commenced, the results are quite satisfactory. It has been given in detail in response to a popular demand for facts concerning the management of vineyards. There has been much interest excited in grape-growing by the work of this station, that at Uniontown, and by a few progressive gentlemen, especially at Greenville and Huntsville. No home is complete without its vineyard. Nothing will afford greater pleasure or profit in proportion to the labor and expense bestowed. Much of the work can be done by those incapable of severe labor. A large portion of Alabama is well adapted to grape culture. It is now oppressed by unfriendly legislation. There are millions of acres in the State better suited for vineyards than that on which the one just described is planted. Success need not be expected upon lands not well drained, either naturally or artificially. Alabama is capable of producing from vineyards, values equal to those now realized from her cotton fields.

SOME ENEMIES TO BE OVERCOME.

The principal enemies to the grape are birds, insects, mildew and black rot. The grapes may be protected from these by covering the bunches with paper bags as soon as the berries are well set, at a cost of six-tenths of one cent. per lb. Except for extra large bunches, the ordinary two pound bag used by retail merchants is used. These are slipped over the bunches, the corners folded and pinned around the stem of the bunch. A boy twelve years old can pin on fifteen hundred per day if the vines are properly trained on the trellis. The bags cost $1.20 per thousand, and if carefully removed from the ripe bunches may be used the second time. The bags are put in packages of five hundred each, and these in fifties. Before opening these packages an opening should be made in the bottom of each bag by driving a sharp chisel through the ends of the packages of fifties. With one stroke of the mallet the openings are thus made in fifty bags. The object of making this opening is to allow the escape of any water which may find access to the bags. A large number of bags have been used during the last two seasons upon many varieties for the purpose of eliciting the following information :

(a) Will the bags protect from birds, insects and fungi ?
(b) Will the use of bags prolong the marketing season ?
(c) What varieties are profitably bagged ?
(d) Will bagging pay on a commercial scale ?
(e) When is the proper time to put on the bags ?
(f) Will it pay to use them the second time ?

We have found the protection complete if they are applied just after the berries set upon the bunches. If not applied until the berries are nearly grown, they do not protect against black rot, but do protect against birds and insects.

The results of observations upon the second question, made in 1888, have already been published. The price was increased from 4½ cents to ten.

In 1889 the difference was still greater. This is especially true of the Ives variety. The third question will be answered in the discussion of the varieties.

The fungicides protect from the rot and mildew but not against birds and insects; the bags against all. It is not profitable, however, to bag any except the choice bunches.

After two years' fruiting of the varieties under observation, a reasonably fair estimate can be made of their comparative merits and their adaptation to particular purposes. The following classification will convey to the inexperienced the information necessary to guide them in making a selection of varieties :

NOTES ON VARIETIES OF GRAPES.

Agawam.—(Rogers No. 15), Hybrid—black rot on leaf May 31st—on berries June 29th—vines vigorous but not prolific—ripe July 25—bunch medium and irregular berries large, dark-red—good, kept well in bags—rotted and mildewed without—many better varieties ripe at the same time and hence not needed.

Beauty.—Labrusca type—rot slight on leaf May 30th, but did not attack the berry. Vines vigorous and prolific, ripe August 10th—bunch medium, compact—berry medium size, light purple color. Improved in color and size in bags—no rot—quality *very good.* A desirable variety for amateur culture. The grapes have a bouquet peculiarly their own.

Berckman's.—Hybrid—no rot—vine vigorous and prolific—ripe July 22d. Bunch and berry medium and both very similar to Delaware, one of its parents; no rot with or without bags—quality best. A very promising new variety—grapes nearly as good as Delaware and the vine much more vigorous.

Brighton.—Labrusca type—Black rot on leaf May 31st, but none on berry until July—vines moderately vigorous and prolific—ripe July 22d—bunches large, compact and very showy—berry large, red—greatly improved by the bags—some rot on those not bagged—quality best. A desirable variety for amateur culture, but not reliable without bags.

Catawba.—Lab. Vines vigorous and prolific—ripe August 20th—bunches medium, open—berry medium, red, not benefitted by the bags—no rot—quality very good—not reliable—disposed to shed its leaves before the berries ripen. Superior for market, table and wine if successfully grown.

Champion.—Lab. Vigorous and prolific—ripe July 12th; bunches large, compact, berries black, large. Improved by bags—no rot—quality good--not needed, as other and better varieties ripen with it.

Concord.—Lab. Very vigorous and prolific—ripe July 25th—bunches very large and compact, shouldered—berries very large—blue-black, with bloom—skin very thin and cracks easily, benefitted by bags—no rot but badly attacked by birds and insects unless bagged—very good. This is one of the most reliable standard varieties, which succeeds under conditions fatal to many others.

Delaware.—Hybr. Lab. Not vigorous but exceedingly prolific—ripe July 25th—bunches medium, very compact, and generally shouldered on one side—berries medium, red, best. This is the standard of excellence—a standard, reliable variety for market, table and wine. Requires rich or highly fertilized soil and severe prunning. Without the latter the vines are injured by over bearing. Not benefited by bags in prolonging the season—as soon as ripe the stems die and the berries shrivel in the bags—the benefit of the bags ceases as soon as the berries ripen.

Duchess.—Hyb.—rot on leaves May 14th—on leaf—stalks and stems of bunches May 31st—on berries, not bagged, June 29th. Vines not vigorous, but prolific—ripe August 10th—bunches large, compact and shouldered—berries medium, white. Very fine and showey in bags—rotted badly without—quality best. A delicious grape, suited for amateur culture—*must be bagged*—blooms late.

Eldorado.—Hybr. Vines vigorous but not prolific--ripe August 1st. Bunches large, compact, shouldered, and very showey—berries above medium—white, very tender—quality best—beautiful in bags—all rotted without. Suitable for amateur culture only.

Elk Eagle.—Æstivalis type. Black rot on leaves May 14th, when in full bloom—rot on berries June 29th—very vigorous and prolific. Ripe July 31st—bunches very long and open. Fertilization of the flowers seems imperfect—berries very large, black, skin thin. Well preserved in bags, all not bagged rotted—quality very good. The best black grape in the list. Bunches so long that 6 lb. bags were required to cover them. Desirable for amateur culture only.

Goethe.—(Rogers' No. 1.) Hybr. Rot on leaf May 30th, on berries June 29th—vines vigorous and prolific—ripe August 15th—bunches medium—berries very large, oblong, light red—ripen irregularly on the bunch—much benefited by bags—some rot and mildew without—quality best. Desirable on account of ripening late and superior quality. Valuable for local market and amateur culture.

Grein's Golden.—Riparia. Vigorous and prolific—ripe August 10th—bunches small and compact, berries above medium, golden yellow, pulpy—wilted in bags as soon as thoroughly ripe—rotted and mildewed without, quality good. Not needed on our catalogues.

Hartford.—Lab. Vigorous and prolific—ripe July 10th—bunch medium, rarely shouldered—berries large, black—season prolonged by bags—rotted some without. (In 1888 all unbagged rotted). Quality good. Berries drop from the bunch in shipping. Valuable mainly on account of its earliness—superseded by Moore's Early and Perkins.

Iona.—Lab. Berries attacked by rot June 29th—neither vigorous nor prolific—ripe July 30th—bunch, medium, compact, berries large, red, well protected by bags, rotted without—quality very good—recommended for amateur culture only.

Ives.—Lab. Very vigorous, hardy and prolific—ripe July 20th—bunches, large, very compact and shouldered on one side—berries large, black, with thick skin—season prolonged four to six weeks by bags—no rot but great loss by birds. This is one of the standard varieties for market and wine. The berries have the habit of turning black two weeks before they are ripe and are usually marketed before edible. This has injured the reputation of this valuable variety. Sold from bags at 10 cents per pound the last two seasons after the local crop was exhausted. The vines have a tendency to grow most vigorously from the extremities of the old canes, and thus, unless properly pruned, making the bearing wood too far from the root. Though not of first quality the Ives should have a place in every vineyard.

Irving.—Lab. Black rot on berries July 29th—not vigorous nor prolific—ripe July 30th—bunches very large and compact—very showey—berries large, white—very fine in bags—rot and mildew without—quality very good. Desirable for amateur culture—must be bagged.

Jefferson.—Hyb. Vigorous and prolific—ripe August 1st—bunches large and compact—berries large, red with decided individuality of flavor—improved by bagging until ripe—then injured—no rot—quality very good—desirable for amateur culture.

Lady Washington.—Hyb. Black rot on leaf 14th May—on leaves and stem of bunch May 31st, and on berries June 29th—vines not vigorous but prolific—ripe August 10th—bunches very large, shouldered and compact—berries medium, white—kept well in bags making very showey bunches—both rot and mildew without bags, quality very good, canes disposed to die back in winter—desirable for amateur culture only.

Lindley.—(Roger's No. 9). Hyb. Neither vigorous nor prolific—ripe August 1st—bunches long, open—berries bright red and very showey—beautiful in bags—some rot and mildew without—very good. This variety emphasizes the ripe persimmon flavor peculiar to Roger's Hybrids—first flavor delicious but "farewell" suggests persimmon. Desirable for amateur culture—very ornamental for table use.

Martha.—Lab. Not very vigorous but prolific—ripe last of July—bunches small, compact—berries medium, white, not profited by bagging—wilted in bags when fully ripe—improved in appearance until ripe—no rot, quality very good. This is a seedling of the Concord—for amateur culture desirable.

Mason's Renting.—Lab. Vigorous and prolific—ripe August 10th—bunches medium, compact—berries medium, white, well preserved in bags and improved in color—good without and no rot—quality good—a meaty berry—amateur culture only.

Maxatawney.—Lab. Neither vigorous nor prolific—blooms late—ripe 1st August—bunches small and open—berries medium, oblong, amber—benefited by bagging—rot and mildew without—quality best. A desirable variety for amateurs—canes die back in winter.

Meno.—Vigorous and very prolific—rot appeared on leaves last of May—ripe August 10th—bunches small and compact, berries medium, amber—well protected by bags—rotted and mildewed without—quality good—not a desirable variety,

Merimac.—(Rogers' 19.) Hyb. Leaves and stem of bunches badly affected by rot May 31st, and June 29th on berries—neither vigorous nor prolific—ripe July 30th—bunches small, open, berries very large, black—well protected in bags—without, both rot and mildew—quality good—amateur culture, but less desirable than others which ripen with it.

Moore's Early.—Lab. Vigorous and prolific—ripe July 10th—bunches small, compact—berries large, black, protected and season prolonged by use of bags—no rot—quality good. Best early, black, market variety. Takes place of Hartford prolific on account of better shipping qualities and less liability to rot.

Niagara.—Lab. Vigorous and prolific—ripe August 1st—bunches large, shouldered, compact—very showey—berries large, white—no rot—appearance improved by bags—quality good—promises to become a standard white market variety.

Norton's Va. Aestivalis.—Exceedingly vigorous and prolific—ripe August 10th—bunches large, shouldered, compact, berries small, black with bloom, no rot—very much improved by bags—those without bags destroyed by birds, quality good—standard red wine grape—is not readily propagated by cuttings—wood very hard—layering usually practiced to propagate. This makes an ornamental vine trained on veranda of dwelling.

Pearl.—Riparia. Vigorous and prolific—ripe 10th August—bunches small and compact—berries medium, amber—not benefitted by bags enough to justify their use—rotted and mildewed—good—not worthy of cultivation.

Perkins.—Lab. Very vigorors and prolific—ripe July 12th—bunch large and very compact—berries large, pale red—not benefited by bags in prolonging the season, but color is improved by them—should be consumed before thoroughly ripe—too foxey when fully ripe—no rot or mildew—quality good. One of the standard, hardy and reliable varieties—very showy and sells well—ripe with Moore's Early, but more attractive and sells better.

Pocklington.—Lab. Not worthy of cultivation—does not ripen before the leaves fall.

Prentiss.—Lab. Not vigorous nor prolific—ripe July 31st—bunches small and compact—berries medium, white—beautiful in bags—no rot, quality best. This is a choice variety for amateur culture—has a pleasant cherry flavor.

Rogers' No. 11.—Hyb. Very subject to both rot and mildew. Should be discarded.

Telegraph.—Lab. Vigorous and prolific—ripe August 1st—bunches small with very short stems, and very compact—berries medium, black—no rot—some mildew—difficult to bag on account of short stem—benefited by them—quality very good. Better varieties ripen at the same time.

Triumph.—Hyb. Not vigorous nor prolific—ripe July 30th—bunches very large, compact, showy—berries large, white—well protected by bags till ripe, berries then wilt—quality very good. A superior variety for amateur culture.

Vergenes.—Lab. Rot on leaf May 31—on berries June 29th—very vigorous and prolific—ripe July 31st—bunches medium, open—berries large, red—perfectly protected by bags—both rot and mildew on those not bagged—very good. A superior variety for amateur culture.

Wilder.—(Rogers' No. 4), Hyb. Rot appeared on leaves as early as May 14th—May 31st badly on leaves and stems of bunch, and June 29th on berries—vigorous but not prolific—ripe August 1st—bunches small, open—berries very large, black—perfectly protected by bags but mildewed and rotted without—quality very good. For amateur culture only.

Warden.—Lab. Vigorous and prolific—very similar to Concord, its parent, but not quite so well flavored and ripens five days later. Fruit catalogues say it ripens earlier, but it ripened later here for the last two seasons. It is so nearly like the Concord with less merit, there seems to be no room for it. It has inherited the bad habit of its parent in having perfectly green berries on ripe bunches.

Wyoming red.—Lab. Not vigorous but very prolific—ripe July 12th—bunch small, moderately compact—berries medium, red--no rot—benefited by bags—lost some leaves by mildew—quality best—but little inferior to Delaware—sweeter with less bouquet. It is by far the best early grape for market and table use. Like Delaware, it should be liberally fed and severely pruned. Will produce nearly as much as Moore's Early and sell better.

PROPAGATION.

All of these varieties have been propagated on the grounds of this station successfully, except the Norton. This is a hard wood variety, which, while it may be grown from cuttings under favorable circumstances, is better grown by layering.

Delaware does not grow so readily as other varieties, but we have had as much as sixty per cent. of the cuttings planted to make vines. We have found that the cuttings take root much more certainly if cut just below a bud at the lower end and just above at the upper end. The cuttings are then placed erect in the soil and entirely covered with earth to reduce evaporation. The top bud will burst through an inch of soil, and if thus covered there will be but one cane from each cutting. This saves much labor in handling the vines the first year. Only one cane should be allowed to grow.

A mulch of straw that has been trampled by stock, applied in March will prove beneficial in preventing bad effects of spring drouth. If no mulch is used the soil should be kept constantly stirred among the cuttings.

Many make the mistake of ordering vines, from the nursery, two years old. A one-year vine is better because it can be removed with more fibrous roots attached than those that are older.

TREATMENT OF ROTUNDIFOLIA (OR MUSCADINE TYPE.)

Seven varieties of this type of grapes were planted in 1886 and have been trained on a wire trellis and regularly pruned. Two objects were had in view:

(a) To have the vines in more convenient shape for gathering the fruit.

(b) To give better exposure of fruiting parts of the vine to air and sunlight, and, while concentrating the energies of the vine upon a smaller area, to improve the quality of the berries and size of the bunches.

The fruiting this season sustained the anticipated results.

The vines of this class must be pruned as promptly as practicable after the leaves fall. If delayed until winter they will bleed severely and often cause death.

The vines are trained upon wire trellis, which has four instead of two wires, as for the other types. The laterals are spurred back in a manner somewhat similar to that used on other types. While vines of this type propagate readily by layers—the usual method—we have succeeded nearly as well with cuttings as with other types--better than with the Norton. The Scuppernong is a variety of this type.

BULLETIN NO. 11. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - FEBRUARY, 1890.

PEACHES AND PLUMS.

☞ The Bulletins of this Station will be sent Free to any citizen of the State who desires them.

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†Prof. Mell has also charge of Meteorological Observations

NOTES FROM THE EXPERIMENT STATION ORCHARD.

[BY THE AGRICULTURIST.]

PEACHES.

In March, 1885, thirty-six varieties of budded peaches were planted upon a sandy ridge which produced in 1884, only 136 lbs. of seed cotton per acre without manure. By the side of these, 22 seedling trees, grown from selected seed out of choice seedling peaches, were planted. Next to these one row was planted with seed from which a dozen healthy trees were grown and left where they sprang up.

The object in view was to compare the productiveness, hardiness and longevity of transplanted budded trees, transplanted seedlings and seedlings not transplanted, and at the same time to secure a record of the habits, peculiarities and merits of the varieties of budded fruit.

All of the trees were well grown one year's growth from the bud. These were planted, after having the roots examined to see that they were free from borers, in well prepared soil, liberally manured in the drill with compost and kainit. The trees were all cut back to two or three feet when transplanted and have been pruned each spring since by the classes in the school of agriculture. The objects had in view in pruning have been :

(a) To train each tree to shade its own body to prevent sun-scald.

(b) To distribute the growth of limbs uniformly around and above the body, to secure symmetry and to have the weight of fruit uniformly distributed around the point of support.

(c) To strengthen the limbs by shortening back to enable them to sustain a crop of fruit.

(d) To reduce the quantity of fruit by a judicious shortening of the shoots bearing the fruit buds.

(e) To so direct the growth that the crop of fruit could be gathered by a man standing upon the ground.

All of these objects have been attained in nearly every specimen.

Notwithstanding the immense crop of fruit borne last summer the trees were neither broken nor rendered ill-shapen, while trees not pruned were often stripped of all of their branches.

THE BORER.

In October each year the earth is removed from the collar of the tree until the large roots are exposed; a careful search for borers is then made and the tree left thus exposed until the following March, when another search is made for borers and the earth raised around the bodies of the trees a few inches above the general surface. When the earth is removed the collar is scraped free of soil and gum and the knife freely used to find and destroy the borer. Any not found at that time may be readily detected a few days later by the brown castings at the entrance to their dens. A second examination should always be made in five or six days after removing the earth. The borer works just under the bark and may therefore be readily destroyed with a pocket knife. If not removed, they eventually destroy the trees by girdling them just below the surface of the soil. Thousands of peach and plum trees are thus destroyed, without a suspicion on the part of their owners of the cause of death.

The trees have been slightly affected by what is commonly known as root-knot which is supposed to be caused by nematode worms.* Though present upon the roots of many of the trees no serious injury seems to have resulted.

Another enemy, often mistaken for the yellows, (which does not affect peach trees in the cotton States), has recently made its appearance and is proving quite disastrous in

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* See Bulletin No. 9 of this station.

some localities. This is the lava of a small brown beetle, which deposits its eggs near the buds on the new growth and at the base of small limbs upon older wood. The lava burrow under the bark and destroy the tree. This enemy is known to entomologists as *scolytus rugulosus.* It has not appeared in the orchard of this station but is destructive in its neighborhood. Trees infested with this enemy should be burned.

DO SEEDLINGS BEAR WHEN BUDDED TREES FAIL.

The affirmative of this question is frequently asserted with the confidence of positive knowledge. In 1887 and 1888 the peach crop on the station was practically a failure because of late frosts. Several varieties of the budded trees bore from one-third to one-half crop each year while there were none on the seedling trees.

In 1889 all bore full crops, but the seedling fruit was so far inferior to the budded varities that no one would eat the seedlings. Again the seedlings all ripened within a month, while the budded fruit of different varieties supplied excellent ripe fruit from the 6th of June to October 15th. A census of the trees now living shows that we have lost 2 8-10 per cent. of the budded trees, 23 per cent. of the transplanted seedlings and none of the seedlings left to grow where the seed germinated.

But little notice is taken of the death of a scrub cow, but the death of a petted Jersey attracts much attention. Hundreds of seedlings die without attracting attention because of their inferior fruit and the fact that they cost nothing. Greater regrets are felt at the loss of a budded tree for the opposite reason. Both are short lived if neglected or mistreated. The lives of both are prolonged by proper care and attention.

TIME OF FLOWERING AND SIZE OF THE FLOWERS.

A record of the date and duration of blossoming of each variety has been kept for two seasons and notes made upon the size of the flowers for the purpose of inquiring what relation, if any, either bore to fruitfulness or power of resisting or escaping frost. During the unfavorable seasons of 1887 and 1888 the only varieties which bore fruit were either late bloomers or those which had very large petals.

A very general impression prevails that early varieties blossom late and late varieties early. An examination of the following reports will show that this is not true, and that there is no uniform relation between the date of flowering and season of ripening.

NOTES ON VARIETIES OF PEACHES.

The dates given for flowering denote the beginning and the close of inflorescence. Those for ripening denote the season during which the variety affords fruit naturally ripened. No note was made of specimens ripened prematurely on account of injury by worms or otherwise.

The following account of the varieties, based upon careful, painstaking observations and comparisons, will enable the reader to make intelligent selection of varieties adapted to the purposes for which they are desired. The perfection attained by the peach during the last season was favorable for such observation upon all except a few late varieties, which ripened during a very severe drouth :

Annie Wylie.—Flowered in '88, March 2d to 16th ; in '89, 5th to 19th. Petals very small, fruit large, skin white with red blush white-red at the seed—Clingstone—tender and jucy—very good.* Ripe August 1st to 12th ; comes in when few varieties as good are ripe. Desirable in family orchard.

Alexander.—Synonym, Amsden. Flowered in '88, March 19th to April 4th. In 1889, March 15th to 27th; petals large. Size of fruit, medium, skin red, flesh white, semicling, flesh firm, good. Ripe June 6th to 25th. A standard early market variety. In cool seasons ripens imperfectly next to the pit.

Bernard, early.—In flower March 2d to 23d in 1888, 8th to 19th in 1889. Petals very small, fruit small, skin yellow

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*In classifying as to quality, I follow the time-honored and practical method of the American Pomological Society, viz : *good, very good,* and *best,* as conveying to the reader a clearer conception than grading from 1 to 10.

mixed with red, flesh yellow, red at seed ; free, texture fine, firm—best. Season July 6th to 22d—amateur culture.

Bustions Oct.—In flower March 2d to 28th in '88, 9th to 22d in '89. Petals large, fruit medium, skin and flesh white; cling, firm, very good. Season Sept. 16th to Oct. 14th. A good late variety for the family orchard.

Chinese Cling.—In flower March 8th to 21st. Petals very large and showey. Fruit very large, skin white striped with red; flesh white, tinged with red near the pit; cling, flesh firm, tender and exceedingly juicy. Ripe July 20th to 30th. This is the largest peach grown and of best quality but is subject to rot; was free from blemish last season. When perfectly developed, good for all purposes.

Chinese Free.—In flower in '88, March 2d to 24th; in '89, 7th to 20th. Petals smalls, fruit large, white with red blush; flesh white, red at seed. Free, firm, very good; Ripe July 10th to to 25th. A good market variety.

Coggin's Early.—Bloomed in '88 March 19th to April 4th; in '89 March 19th to 28th. Petals large, fruit medium, red, flesh white, firm; semi cling, good. Season June 6th to 29th.

Columbia.—Pace ; in flower in 1888, March 9th to 21st in '89, 14th to 25th. Petals very large, fruit large, skin rough, dingy red mixed with yellow, flesh yellow, coarse, firm, free, quality best. A standard variety for the family orchard, but its appearance is not sufficiently attractive for market.

Connor's White.—In flower '88 March 2d to 16th; in '89, 1st to 15th. Petals very large, fruit medium, white with tinge of red; flesh white, red at seed ; cling, flesh very firm, good. Ripe July 17th to 22d. Better varieties ripen with it and last longer.

Crawford's Early.—In flower '88, March 5th to 23d; in '89, 14th to 22d. Petals very small, fruit large, oblong and pointed, skin yellow with red cheek, flesh yellow, firm, best, ripe July 16th to 31st. Excellent for all purposes, one of the standard market varieties until superceded by Elberta. Should have a place in every family orchard.

Crawford's Late.—Flowered in '88, March 2d to 24th ; in

'89 March 8th to 19th. Petals very small, fruit very large. Similar to Crawford's early, but ripens ten days later. A standard market variety.

Deming's September.—In flower '88, March 5th to 28th ; in '89, March 7th to 18th. Petals very small, fruit large, yellow ground striped with red, free, flesh yellow, soft and coarse, good. Ripe August 20th to 30th.

Downing.—In flower '88, March 19th to April 2d ; in '89, 16th to 26th March. Petals large, fruit medium, red, flesh white, semi-cling, firm, good. Ripe June 6th to July 5th.

Duff's Yellow.—Bloomed in '88, March 5th to 21st ; in '89, 8th to 19th. Petals small, fruit large, yellow, tinged with red, flesh yellow, fine and firm, cling, good. Ripe July 16th to 31st.

Duggar's Golden.—In flower '88, March 2d to 19th, in '89, 8th to 20th. Petals very small, fruit large, yellow with tinge of red, flesh yellow, fine and firm, cling, very good. Ripe July 17th to 31st. A very choice variety.

Duggar's White.—In flower '88, March 2d to 21st ; in '89, 7th to 21st. Petals large, white, fruit medium, white, flesh white, very firm ; quality good, ripe July 16th to 22d. Not prolific.

Eaton's Golden.—In flower '88, March 9th to 30th ; in '89, March 14th to 25th. Petals very large, fruit medium yellow, flesh yellow, firm, juicy, cling ; best. Ripe August 18th to 27th. A very choice variety. The best of its season. Excellent for canning and preserving.

Elberta.—In flower '88, March 2d to 19th ; in '89, 7th to to 19th. Petals small, fruit large, yellow with red blush, flesh yellow, texture fine and firm and of best quality. free ; ripe July 15th to August 6th. The most popular market variety. Best freestone of its season for home use.

Foster.—In flower '88, March 5th to 19th ; in '89, March 10th to 21st. Petals small, fruit medium flesh yellow, fine grained, firm and juicy, very good, free. Ripe July 10th to 31st. A very desirable variety for family use.

Stonewall Jackson.—In flower '88, March 2d to 24th. In

'89, 9th to 21st. Petals large. Fruit large and very similar in appearance and quality to its parent, Chinese cling, but ripens earlier.

General Lee.—Flowered '88, March 2d to 28th; in '89, 8th to 21st. Petals very large, fruit almost identical with Stonewall Jackson. This is also a seedling of Chinese Cling. Both are less liable to rot than their parent.

General Taylor.—In flower from 2d to 19th March in 1888, from 9th to 19th in 1889. Petals small, fruit medium, dark red, cling, flesh red and white, fine grained and firm, very good; ripe June 29th to July 22; a very desirable variety.

Hales Early.—In flower in 1888, March 19th to April 2d; in 1889, March 15th to 25th. Petals very large, fruit medium, red, semi-cling, flesh white and very firm, good; ripe June 22d to July 15th. Twenty years ago, this was the earliest peach and a standard market variety. A number of its seedlings now ripen a month earlier. Liable to rot on good land.

Hudson's November.—In flower March 15th to 28th. Petals very large, fruit medium, white tinged with red, cling; flesh white, red at the seed, firm, good. Ripe in October. Too much injured by drouth to determine limits of its season.

Indian Blood.—In flower in 1888, March 2d to 30th; in 1889, 12th to 22d. Petals medium, fruit medium red, cling; flesh red, firm, slightly acid, good. Ripe August 13th to 19th. Not first class in quality, but hardy and reliable.

Lady Parham.—In flower '88, March 7th to April 2d; in '89, March 15th to 22d. Petals very large; fruit medium, white, slightly tinged with red, free. Flesh white, red at seed, soft, good, ripe September 10th to October 10th. A very desirable late variety

Lemon Cling.—In flower in '88, March 5th to 21st; in '89, 8th to 22d. Petals very large; fruit large oblong-lemon shaped, yellow with red blush, cling; flesh yellow, firm, very good. Ripe, August 1st to 20th. A very desirable variety, rarely fails to bear some fruit even in most unfavorable seasons.

Muscogee.—In flower in '88, March 5th to 16th; in '89, 10th to 18th. Petals small; fruit medium, white, free. Flesh white, red at seed, fine and firm, good. Ripe July 31st to August 20th.

Mixon's White—In flower '88, March 2d to 24th; in '89, March 8th to 22d. Petals medium, fruit medium, white, cling; flesh firm, white, very good. Ripe September 10th to 25th.

Rivers' Early.—In flower 1888, March 9th to 30th; in '89, March 14th to 24th. Petals very large, fruit above medium, white, tinged with red; semi-cling, flesh white, tender and very jucy; very good; ripe June 17th to July 7th. A choice variety for family use; too tender for marketing.

Royal George.—In flower '88, March 2d to 16th; in '89, 1st to 15th. Petals very small, fruit above medium, white with red flush, free, flesh white, red at stone, tender and juicy; best. Ripe June 26th to July 8th. A very desirable variety for the family orchard.

Stevenson's Oct.—In flower in 1888, March 5th to 24th; in '89, 15th to 23d; petals very large, fruit medium, white, tinged with red, cling, flesh white, red at seed, firm, good. Ripe September 10th to October.

Stump the World.—In flower 1888, March 14th to 30th; in '89, 14th to 21st; petals very small, fruit large, white with red blush, free, flesh white, red at seed, firm and juicy; best. Ripe July 8th to 22d. A standard variety for family use and for market.

Thurber.—In flower in 1888, March 2d to 21st; in 1889, 7th to 19th; petals very small, fruit medium, white, tinged with red, free; flesh white, red at seed, tender but coarse; very good. Ripe July 13th to 25th.

Tillotson.—In flower 1888, March 2d to 19th; in '89, 4th to 15th; petals very small, fruit medium, white, nearly covered with red, free, flesh tender and juicy, best. Ripe June 28th to July 8th; blossoms too early to be a sure bearer, but the quality of the fruit gives it a place in every collection. Before the introduction of Hale, this was the earliest variety.

Tuskena.—In flower in 1888, March 2d to 16th; in 1889, 6th to 20th; petals very small, fruit medium, red, cling; flesh yellow, firm, good. Ripe July 10th to 27th.

CLASSIFICATION OF VARIETIES WITH REFERENCE TO USE.

For Shipping.—Alexander, Thurber, Chinese Free, Crawford's Early, Chinese Cling, Elberta, Crawford's Late, Jackson, Lee, and Stump the World.

For Canning.—Bernard, Chinese Free, Columbia, Crawford's Early, Elberta, Crawford's Late, Deming's Sept, Duff's Yellow, Duggar's Golden, Foster, Lemon Cling, Mixon's White, Stump the World, Chinese Cling, Jackson and Lee.

For Family Use.—Alexander, Bernard, Chinese Cling, Chinese Free, Columbia, Crawford's early, Duff's Yellow, Duggar's golden, Eaton's golden, Elberta, Foster, General Lee, Stonewall Jackson, Hale's Early, Lady Parham, Lemon Cling, Mixon's White, Rivers, Royal George, Stump the World, Tillotson, Bustion's Oct.

If only a small number is desired selection may be made of those ripening in succession. For market, it is better to plant only a few varieties which ripen at different dates and which uniformly command the best price. The Elberta is the most noted market variety. Some growers plant hundreds of acres in Elberta alone.

PLUMS.

The following varieties of improved Chickasaw plums have been fruited—some of them three years in succession.

The Hattie and Marianna grow readily from cuttings and are being used as stocks for peaches. They seem to be less subject to attack by the peach borer than either the peach or other varieties of plums.

The Missouri and Cumberland, on account of late flowering, escaped frost in 1887 and 1888 when the fruit on all other varieties was killed.

NOTES ON VARIETIES.

Brill.—In flower March 9th to 21st. Fruit small, round, very dark red when fully ripe, has a sweet cherry flavor, Texture soft. Ripe June 1st to 22d. Free, a thrifty compact grower.

Cumberland.---In flower March 26th to April 6th. Fruit large, oblong, yellow, firm, good. Not of as good quality as some others, but valuable on account of ripening after others are gone. Ripe July 31st to August 26th.

Hattie—In flower March 15th to 25th. Fruit, large, red, roundish, firm, best. Ripe June 15th to July 8th. Tree vigorous and compact grower. Comparatively exempt from attack of peach borer.

Hendricks.—In flower March 17th to 22d. Fruit medium, round, yellow with blush of red, tender, very good. Ripe June 6th to 22d. Tree vigorous, symmetrical grower.

Hughes.—In flower March 19th to 26th. Fruit medium, round, light, red, tender, good. Ripe July 8th to August 22d. Tree low and spreading in its habit. Disposed to overcrop itself.

Indian Chief.—In flower March 20th to 26th. Fruit medium, red, oblong, firm, good. Ripe June 25th to July 15th.

Marianna.—In flower March 9th to 20th. Fruit large, roundish, purplish red, firm, good. Ripe June 17th to July 8th. Tree vigorous, compact grower, comparatively free from attack of peach borer. Grows well from cuttings. Is used as stock for peaches.

Missouri.—In flower March 25th to April 6th. Fruit medium, oblong, glossy red, firm and good. Ripe July 8th to August 20th. Desirable on account of late flowering and late ripening.

Newman.—In flower March 18th to 24th. Fruit medium, oblong, bright red, firm, good. Ripe July 8th to Aug. 25th. Tree low, spreading. Tendency to overbear.

Southern Golden.—In flower March 20th to 28th. Fruit medium, oblong, yellow, tender, best. Ripe June 25th to July 8th. Rather a feeble grower.

Weaver.—In flower March 16th to 22d. Fruit small, oblong, red, firm, good. Ripe June 25th to July 20th.

Wild Goose.—In flower March 21st to 26th. Fruit large, oblong, bright red with specks of white, very firm, very good. Ripe June 8th to July 5th. Tree open, straggling grower. All of these varieties, except Brill and Hendricks, should be picked when they commence coloring, and ripened in the house if for family consumption, or packed, if for market, as soon as gathered. They ripen en route, acquiring a brilliant color and better flavor than when ripened on the tree. The plum is one of the most profitable fruits for shipping to northern markets. The Wild Goose has brought from $6.00 to $10.00 per bushel in the New York market for the last ten years.

BULLETIN NO. 12. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - FEBRUARY, 1890.

CO-OPERATIVE SOIL TESTS.

☞ The Bulletins of this Station will be sent Free to any citizen of the State who desires them.

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CO-OPERATIVE SOIL TESTS---1889.

[BY THE DIRECTOR.]

For the purpose of studying the needs of the different soils of the State, nine intelligent farmers, who owned different typical soils, were selected to co-operate with the director of this station in studying, through experiment, the chemical deficiencies of their soils. The substances furnishing nitrogeon, phosphoric acid and potash were weighed and mixed in the quantities and proportions in which they were to be used and delivered to the experimenters so labeled as to prevent mistakes in their use. Sulphate of ammonia and cotton seed meal were used as sources of ammonia. Dissolved bone black supplied the phosphoric acid and kainit the potash. The localities selected were in the following counties : Clarke, Conecuh, Colbert, Etowah, Madison, Pike, Talladega, Tallapoosa and Tuscaloosa.

The following instructions were mailed to each experimenter as his guide in conducting the inquiry :

Directions for Conducting Soil Tests.

SELECTION OF GROUND.

The area for conducting the experiments should be level or nearly so. The soil should, if practicable, be of the character which generally prevails in the section intended to be represented. Select, by preference, that which has received no fertilizer for several years, or better still, that which has not been fertilized at all, but not freshly cleared.

ARRANGEMENT OF PLOTS.

If cotton is the plant experimented with measure plots seventy yards long and fourteen feet wide. This will make one-fifteenth of an acre and will accommodate four rows three and one-half feet wide and seventy yards long. Number the plots 0, 1, 2, etc. To that marked 0, apply no manure; apply the contents of the bags to the plats to which their numbers correspond and apply no manure to the next and mark it 00. To the next apply early, in the drill, sixty-four pounds of green cotton seed. To the next apply sixty-four pounds of green cotton seed and thirteen and one-third pounds of acid phosphate. To the next apply 200 pounds of stable manure. On the next plant a variety of field peas which produces much vine; gather the peas when ripe and let the vines rot on the land.

If the experiment is made with corn make the same arrangement of plats, except that they shall be twenty feet wide, instead of fourteen, to accommodate four rows of corn five feet wide. Distribute the fertilizers as evenly as possible in the four rows in each case, and when the crop matures weigh the product of the two middle rows of each plat as the test of the effects of the different fertilizers. Weigh separately the product of each outside row on each plot to ascertain to what extent they were affected by the manure applied to the adjacent plots.

Note in a book, kept for the purpose, the date and manner of the preparation of the land; date of applying the fertilizers and preparing the seed-bed and date and manner of planting. Keep a record of rainfall and temperature, if practicable; if not, note the seasons in terms usually employed by farmers. Make a record of the character of the soil and subsoil, depth of soil, condition as to wetness or dryness every time it is plowed. Record the crops grown upon the land for three years past and quantity and kind of manure, if any, applied to each crop. Note the kind of implements used in preparing, planting and cultivating. Note date of securing a stand on each plot and the appearance of the plants. Note the time and manner of every operation performed in the cultivation of the crop, and every two weeks during its growth make notes of the comparative size and appearance of the plants upon the different plots.

Note difference, if any, in effects of excessive rainfall or drouth upon the plants to which different manures are applied.

Before the crops mature, blanks on which to record results will be furnished, accompanied with detailed instructions for accurately interpreting the answers given in the products.

In all operations upon the plots the manner and time of treatment of all of the plots must be as nearly as possible the same, the only difference between them resting in the fertilizers applied.

As was to be expected with inexperienced experimenters, mistakes and omissions were made by some, which rendered their work valueless. The results of experiments made in some sections, however, are valuable indications of the needs of those particular soils.

Tallapoosa County—J. P. Oliver, experimenter.—Soil, sandy—loam, with clay subsoil. The land had been cleared and in cultivation seven years.

Preparation—The land was broken April 18th, with three inch scooter; rows opened three and one-half feet apart and fertilizers applied April 19th, and land bedded with Johnson combination plow. Seed planted April 20th.

Cultivation—This was done with heel scrape and hoe, very shallow, so that the land was laid by nearly level. Seasons favorable, except slight drouth in latter part of July.

The following statement of results shows effects of fertilizers in hastening maturity and increasing the yield :

Report of Results of Experiments with Fertilizers.

TALLAPOOSA COUNTY.

TWO INSIDE ROWS—YIELD IN SEED COTTON PER PLOT.

No. Plot...	POUNDS FERTILIZERS PER ACRE.	1st Picking.	2nd Picking	Pounds seed cotton per acre.
0	Manure	9	11	600
1	Sulphate of amonia, 80	12	11	690
2	Nitrate of soda, 100	24½	13	1125
3	Dissolved bone black, 200	23½	13	1095
4	Kainit, 100	13½	13	795
5	Cotton seed meal, 200	16	12	840
6	Sulphate of ammonia, 80 Dissolved bone black, 200	26	14	1200
7	Sulphate of ammonia, 80 Kainit, 100	15½	13	855
8	Cotton seed meal, 200 Dissolved bone black, 200	22¼	12	1027½
9	Dissolved bone black, 200 Kainit, 100	24	15	1170
10	Sulphate of ammonia, 80 Dissolved bone black, 200 Kainit, 100	24½	10	1035
00	No manure	14	12	780
11	Green cotton seed, 960 Dissolved bone black, 200	24½	13	1125
12	Green cotton seed, 960	18	12	900
13	Stable manure, 3,000	20	14	1020

Mr. Oliver had pursued a judicious rotation of crops upon this land which secured a liberal supply of vegetable matter, which preserved a favorable mechanical condition of the soil and, decomposing during the growth of the crop, furnished the needed supply of nitrogen.

In consequence of these conditions, we find but little increase from the application of substances furnishing nitrogen except in the case of nitrate of soda, the yield from which so far exceeds those from sulphate of ammonia and cotton seed meal, as to suggest that some undiscovered cause affected the yield upon plot No. 2.

The effect of phosphoric acid, supplied in the Dissolved Bone Black (acid phosphate furnishes the same) is marked and uniform, showing very plainly that this particular soil not only needed phosphoric acid, but that it needs little else. Its effect is made especially conspicuous in comparison with an application of 30 bushels of green cotton seed per acre on plot No. 12, and 3,000 lbs. of stable manure per acre on plot No. 13.

Mr. Oliver's lands lie northwest of Dadeville, one and a half miles from the town, in what is geologically known as the metamorphic region.

These lands are so rolling that neither a supply of vegatable matter nor the surface-soil can be retained without terracing.

The contrast between the condition of his lands which were terraced soon after they were cleared and those near by, which were not, is most striking.

ETOWAH COUNTY, J. J. NORRIS, EXPERIMENTER.

Mr. Norris describes the land selected, as follows: "Land selected was an old sedge field with a growth of small pines on it. Had not been in cultivation for eight or ten years. Soil sandy—land slopes gently to the south. Soil three to four inches deep—subsoil varies from white sandy to yellow (sandy) clay."

The preparation was very thorough. After breaking with turn plow it was harrowed four times before applying the fertilizer.

On account of failure to secure a stand of plants from the first planting, a second was made on the 9th of May, which resulted in a good stand on the 23rd.

A frost occurred June 1st but did not seriously injure the cotton. The cultivation was shallow and very thorough, the season too wet for cotton.

It proved too wet for plots ten to fourteen, inclusive, injuring the stand and dwarfing the plants which survived. Plot No. 6 was also affected by poor stand. The stand in the remaining plots was reasonably uniform and the comparison of the effects of the different fertilizers reliable.

Mr. Norris reports that as early as July 1st the appearance of the plants on the plots to which the Dissolved Bone Black was applied gave promise of better results than those to which none were applied. He says: "July 1st; a difference has begun to show very decidedly in favor of plots

Nos. 2, 5, 7, 8 and 9, the plants on which are a good deal stronger and healthier looking than the rest.

The weights of the first picking show that the phosphoric acid of the Dissolved Bone Black both hastened maturity and increased the yield.

The results of the two inside rows of each plot are given. Those of the two outside rows were gathered and reported separately, but the difference is too slight to render necessary the publication of both.

Phosphoric acid seems to have been the principal element of plant food needed by Mr. Norris' soil, after a rest of ten years.

The effects of nitrogen would have been, perhaps, more marked upon soil under continued cultivation. The season and subsoil were unfavorable for results from nitrogenous manures. The frequent heavy rains probably carried much of the nitrogen through the porous subsoil, while the phosphoric acid remained in reach of the roots of the plants.

Mr. Norris reports the following results:

Report of Results of Experiments with Fertilizers.

ETOWAH COUNTY.

INSIDE ROWS—YIELD OF SEED COTTON PER PLOT.

Plot Number.	LBS. FERTILIZERS PER ACRE.	1st picking. Date, Sept 25.	2nd picking. Date, Oct. 18.	3rd picking. Date, Nov. 5.	4th picking. Date, Dec. 5.	Seed Cotton per acre—lbs.
0	No Manure....	....	1	2	2½	165
1	Sulphate Ammonia........ 80	....	½	1	1	75
2	Dis. Bone Black..........200	5½	5	7	2	585
3	Kainit.................... 100	....	2	2½	1½	180
4	Cotton Seed Meal.........200	1½	1	3½	1½	225
5	Sulphate Ammonia..... 80 Dissolved Bone Black...200	7½	4½	6½	2	615
6	Sulphate Ammonia,.... 80 Kainit...................100	....	3½	3½	2½	285
7	Cotton Seed Meal.......200 Dissolved Bone Black...200	9½	5	5	1	615
8	Dissolved Bone Black...200 Kainit...................100	5	3½	5	1½	450
9	Sulphate Ammonia. ... 80 Dissolved Bone Black...200 Kainit 100	10½	5½	6½	2	705
10	Dissolved Bone Black.....200	5	2½	3½	1	360
11	960 lbs. Green Coton Seed....	....	2	2	1	150
12	960 lbs. Green Cotton Seed. 150 lbs. Am. Sup. Raw Bone	....	5	4½	2½	360
13	3,000 lbs. Stable Manure.....	....	3½	2½	3	270
14	200 lbs. Am. Raw Bone Sup..	......	5	4	2½	345

TUSCALOOSA COUNTY, A. V. ALBRIGHT, EXPERIMENTER.

Soil—Brown loam with red clay subsoil ; the latter resting upon pebble. Land prepared and cotton planted in the usual way—cultivated shallow with hoe and wide sweeps. After the May drouth of four weeks, rains were excessive and frequently accompanied by severe wind. Last frost 31st May.

As in the experiments of Messrs, Oliver and Norris the difference between the yield of the two inside rows, and that of the two outside rows, of the plots of four rows, is very slight, indicating that the plants in the outside rows were not benefitted by the manures applied to the adjacent plots.

The soil, as in Etowah and Tallapoosa, seems to have been deficient in phosphoric acid. An examination of the weights in the first pickings shows that phosphoric acid hastened the maturity of the fruit, an important consideration in localities subject to ravages by the caterpillar.

Report of Results of Experiment with Fertilizers.

TUSCALOOSA COUNTY.

INSIDE ROWS—YIELD IN SEED COTTON PER PLOT.

Plot No.	LBS. FERTILIZERS PER ACRE.	1st. picking. Date. Aug. 29	2nd picking. Date. Sept. 14.	3rd picking. Date, Sept. 25.	4th picking. Date, Oct. 8.	Seed Cotton per acre—lbs.
0	No Manure	10	13	1	2	780
1	Sulphate Ammonia,....... 80	10	13	2	3	840
2	Dis. Bone Black..........200	13	18	3	2	1080
3	Kainit.. 100	10	13	2	1	780
4	Cotton Seed Meal.........100	10	12	2	1	750
5	Sul. Ammonia.......... 80 Dis. Bone Black........200	12	15	3	2	960
6	Sul. of Ammonia........ 80 Kainit...................100	11	16	1	3	930
7	Cotton Seed Meal.......200 Dis. Bone Black.... ...200	14	13	1	2	900
8	Bone Black ....200 Kainit...................100	14	15	2	1	960
9	Sul. of Ammonia........ 80 Dis. Bone Black........200 Kainit............ 100	15	14	4	3	1080
CO	No Manure................	7	10	1	2	600
10	Green Cotton Seed......960 Acid Phosphate.........150	15	16	1	2	1020
11	Green Cotton Seed........960	6	9	2	2	570
12	Stable Manure 3,000	16	18	1	1	1080

Seed of eleven varieties of cotton were sent to all of the experimenters, but Mr. Albright is the only one who made a successful comparison of their productiveness.

The following tabulated statement shows comparative earliness and productiveness of eleven varieties.

The Peerless leads in early maturing and is equaled only by Jones' improved, in yield, closely followed by Welborn's Pet and Zellner.

There is remarkable uniformity in both time of maturing and yield in varieties so distinctive, in characteristic as are most of them.

Report of Results of Experiments with Varieties of Cotton.

TUSCALOOSA COUNTY.

YIELD IN SEED COTTON PER PLOT.

Plot Number.	NAME OF VARIETY.	1st picking. Date, Sept. 5.	2nd picking. Date, Sept. 20.	3rd picking. Date, Oct. 11.	4th picking. Date. Nov. 1.	Seed cotton per acre in lbs.
1	Allan's Long Staple..........	17	8	4	2	930
2	Barnett....................	15	7	3	2	810
3	Cherry's Cluster...........	18	7	4	2	930
4	Hawkins' Improved........	18	9	3	3	990
5	Jones' Improved............	19	10	5	2	1080
6	King's Improved Prolific ..	14	14	1	1	900
7	Peerless	20	10	5	1	1080
8	Rameses....................	16	9	4	2	930
9	Truitt.......................	14	10	4	2	900
10	Welborn's Pet.	17	9	5	3	1020
11	Zellner	17	10	5	3	1050

SUMMARY.

1. On the three soils, in Etowah, Tallapoosa and Tuscaloosa the experiments *indicate* that phosphoric acid is the principal ingredient deficient.

Phosphoric acid hastened maturity.

DIRECTIONS FOR CONDUCTING SOIL TESTS WITH FERTILIZERS, 1890.

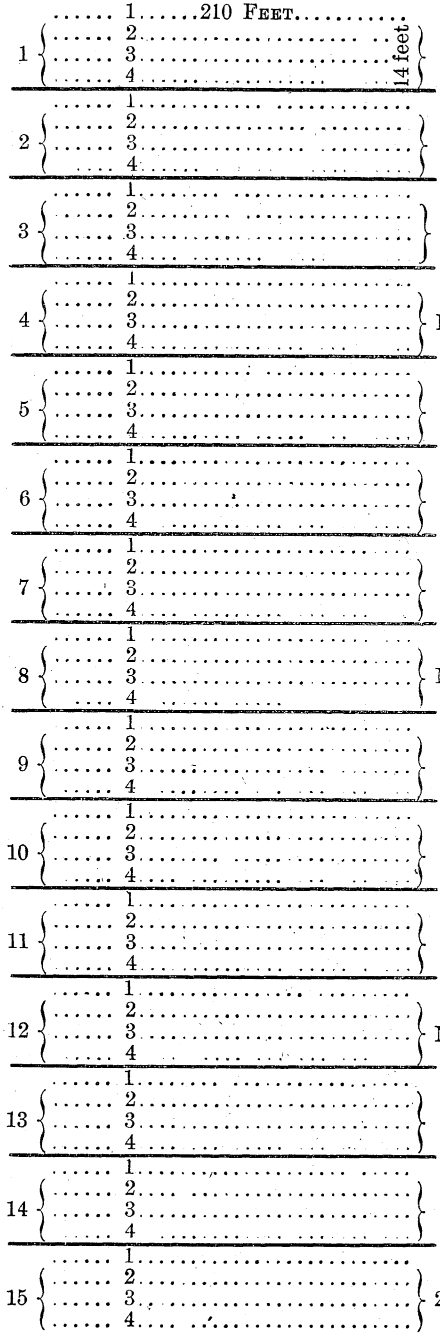
SELECTION OF LAND.

The area upon which the experiment is made should be level, or nearly so; should represent in character of soil and subsoil the section in which the experimenter lives, should not have been fertilized for several years, or better still, never at all, but should not be new or fresh land; the object being to learn what fertilizer the ordinary cultivated lands of the section need.

ARRANGEMENT OF PLOTS.

The accompanying diagram shows the arrangement of the plots. There will be fifteen plots of 1-15 of an acre each. For convenience, the "farmer's acre," seventy yards square, is used. Each plot is, therefore, 210 feet long and 14 feet wide, admitting of four rows of cotton 3½ feet apart. All of the experiments will be made with cotton this year.

DIAGRAM OF EXPERIMENT PLOTS.



1	6 lbs. Sul. Ammonia.
2	13 lbs. Dis. Bone Black.
3	10 lbs. Kainit.
4	No manure.
5	6 lbs. Sul. Ammonia. 10 lbs. Kainit.
6	6 lbs Sul. Ammonia. 13 lbs. Dis. Bone Black.
7	13 lbs. Dis. Bone Black. 10 lbs. Kainit.
8	No manure.
9	6 lbs. Sul. Ammonia. 13 lbs Dis. Bone Black. 10 lbs. Kainit.
10	20 lbs. Floats.
11	20 lbs. Floats. 6 lbs. Sul. Ammonia.
12	No manure.
13	53 lbs. green cotton seed.
14	53 lbs. green cotfon seed. 20 lbs. Floats.
15	265 lbs. stable manure.

FERTILIZERS.

The fertilizers are sent, *freight prepaid*, to the depot designated by each experimenter. That intended for each plot bears two labels—one showing its contents, the other the number of the plot to which it is to be applied. As shown in the diagram, each fertilizer is to be applied to four rows. Each row should receive as nearly as possible the same quantity. Numbers 4, 8 and 12 are to receive no fertilizer. The experimenter is expected to furnish the cotton seed for plots 13 and 14, and the stable manure for 15.

Apply the cotton seed in a deep furrow and distribute the floats over the seed in plot 14. In plots 13 and 15 distribute the cotton seed and stable manure respectively, and bed upon them as on the fertilizers in the other plots.

PREPARATION.

First break the land "flush," deeply and thoroughly after accurately measuring the area 210 feet square. Lay off rows *exactly* 3½ feet apart, distribute the fertilizers and bed with a good turn plow, making a high bed. Then draw a harrow or heavy brush across the beds. It is important to secure a perfectly uniform stand of plants and hence the seed-beds should be thoroughly prepared.

PLANTING.

Use the same kind of seed upon the whole area and plant all of the plots the same day. If a part was planted before and the rest after a rain, the experiment would be worthless. Use every precaution necessary to secure a full stand. If a uniform stand is not secured at the first planting, plow up promptly and plant again.

CULTIVATION.

As soon as the plants are large enough "side" with a scrape or sweep and, several days after, chop to *two stalks* every *two feet*. As soon as danger of loss by cold or cut worms has passed reduce the stand to *one stalk* in the hill. Rows 2 and 3 of each plot are to be gathered to determine the yield from each fertilizer. This reduces the "test area" to 1-30 of an acre. One missing stalk on this area would therefore represent 30 to the acre. To make the experiment reliable, therefore, there must be the same number of stalks upon each such "test area." To insure this when the plants are eight or ten inches high, count carefully the stalks in rows 2 and 3 of each plot. A perfect stand would give 105 stalks to the row or 210 on the rows 2 and 3.

Suppose the count shows that the number of stalks range from 210 to 190 to the test areas. *Reduce the number of plants to 190 in all of the test areas* (rows 2 and 3 of each plot), by pulling from each the number of stalks it was found to contain *above 190*. This is the only *reliable* way to secure uniformity of stand, without which the experiments *cannot be accurate*. Replanting, the method often resorted to, will not answer.

Let all the plots be cultivated on the same day and in exactly the same manner through the season. See that no tree stands within 100 feet of any of the plots.

MEMORANDA.

Record in a book kept exclusively for that purpose the time and manner of performing every operation connected with the experiment, from the preparation of the land to the gathering of the crop. Make weekly or bi-weekly notes on the appearance of the cotton on the plots. Note especially the effects of either excessive moisture or drouth upon plants of the different plots. Record any changes in the weather likely to affect the growth or fruitfulness of the cotton plant, such as unusually high or low temperature, excessive rainfall or continued drouth, and note the different effects, if any, upon the plots; keep a careful record of the "seasons" and their apparent effects upon soil and plants.

GATHERING.

Before the crop matures printed blanks upon which to record results will be furnished. The slightest mistake in gathering or weighing the seed-cotton will destroy the value of the experiment. The utmost care is necessary to prevent such mistakes. The picking and weighing of the product of the different plots must be done under uniform conditions.

Picking should not be commenced until the morning dew has disappeared from the cotton. If some plots are picked and weighed in the early morning and others in the afternoon, accuracy will be sacrificed. Each experimenter must exercise a sound judgment in these matters of detail, looking constantly to securing *perfect accuracy* in the comparison of the effects of the fertilizers. Experiments, like statistics, unless full and accurate, are misleading.

No account need be kept of the production of rows 1 and 4 as they being only 3½ feet from the adjacent plots to which different fertilizers are applied, receive, by the spread of their roots, the benefit of both fertilizers. The product of rows 2 and 3 will be used to compare the effects of the different fertilizers. The plants in these rows being seven feet from those to which a different fertilizer was applied, only the extremities of their longest roots will reach it, and hence will not be materially affected by it. Pickings should be made with sufficient frequency to avoid risk of having the experiment vitiated by storm. Record the weight and date of each picking. Record the average height of the stalks upon each "test area," rows 2 and 3 in each plot. Note the character and extent of injury to the plants by any casualty, such as storms, boll worm, caterpillar, rust or blight. When the plants are sufficiently advanced in growth to show plainly the effects of the fertilizers, invite the farmers of the neighborhood to inspect the plots at intervals during the season. This is important, since the object of the experiment is to benefit the farmers who cultivate the character of land upon which the experiment is made.

BULLETIN NO. 13. - - - - NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - MARCH, 1890.

Microscopic Study of Certain Varieties of Cotton.

☞ The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

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SYNOPSIS.

1. Species and varieties.
2. What is cotton fibre.
3. Questions considered in the investigation.
4 List of varieties examined.
5. Results of experiments.
6. Conclusions drawn from results obtained.
7. How can the grade of cotton be improved?
   a The improvement of the seed.
   b The character of the soil.
   c The best kind of fertilizer.
   d The best method of cultivation.
   e The condition of the weather most favorable.
8. Table showing detail results.

A MICROSCOPIC STUDY OF THE COTTON PLANT.

P. H. MELL, BOTANIST

I. SPECIES AND VARIETIES.

There are several species of the cotton known to botanists but only three are of special commercial importance. These three are called:

Gcssypium Bahma, or Egyptian cotton.

Gossypium barbadense, or *G. nigrum*, or Sea Island cotton, or long staple or black seed cotton.

Gossypium herbaceum, or *G. album*, or short staple, or upland or green seed cotton.

Monsieur Rohn also divides the species into—

1. Those with seeds rough and black.
2. Those with seeds brownish black and veined.
3. Those with seeds sprinkled with short hairs.
4. Those with seeds completely covered with close down.

The three species, above mentioned, have been multiplied into twenty or thirty so-called *varieties*, by certain kinds of cultivation and careful selecting in the hands of progressive planters. Some of these varieties are very good and worthy consideration, while others have no right to a new name.

G. Bahma originated in Egypt some years since, and is supposed to be a hybrid, made with a species of the Hibiscus and the native Egyptian cotton plant. The fibre of this plant is inferior in several respects to that produced by G. herbaceum, that furnishes more than nine-tenths of the staple of commerce. The Sea Island, or as it was formerly called in Georgia, "Persian cotton," requires a salt atmosphere, and is, therefore, confined to limited areas. Its largest production is made along the coasts of South Carolina, Georgia and Florida. The staple is also limited in its application, since it is mainly used in the manufacture of lace.

II. WHAT IS COTTON FIBRE?

When cotton is first taken from the boll it consists of seed with the germ surrounded by its food, a coating or covering called by oil manufacturers the "hull," and by botanists, outer and inner seed-coats, and an outside envelop of elongated threads or tubes that are attached to the outer seed-coat. These threads are, in fact, simply elongated cells of this coat. These cells cover thickly the whole surface of the seed, and in ginning it is necessary to tear them off by rupture at the portion near the seed coat. Seeds are cleanly ginned in proportion to the distance from the surface reached by the cutting edges of the teeth of the ginning saws. The thread or fibre in its young state is cylindrical, but upon maturing and becoming dry it collapses and assumes a more or less flat, ribbon-like, twisted form. The degree of twist given the fibre, its regularity in diameter and length determine the value of the cotton in the markets of New York and Liverpool.

III. LIST OF VARIETIES TESTED AND RESULTS OBTAINED.

During the past two seasons I obtained from the farm of the Experiment Station, a number of samples of cotton, representing eighteen varieties, two selected specimens from Savannah, Georgia, of the Sea Island cotton and a sample of the "Bailey" fibre from North Carolina. Careful studies have been made of these specimens under high powers of the microscope, and a number of interesting results were obtained. The following are some of the questions considered by me during these investigation:

1. How many real varieties of cotton exist?
2. In forcing the plant under high cultivation is the fibre improved, or is simply the "weed" enlarged to the detriment of the staple? Is it not often the case that the fruit of the cotton plant is damaged by too rapid maturing, just as the fruit of the peach is known to be immature at the centre in some early forced varieties?
3. The effect produced on the fibre when caught by frost just as the boll opens?

4. At what stage of the growth and maturity of the boll does the fibre attain its full development?

The last two questions will not be considered in this bulletin, because my investigations have not been carried far enough to warrant the publication of conclusions on those points. I intend to present them in some future bulletin.

The following are the names of the varieties that were subjected to the tests:

Gossypium herbaceum—

1. Peerless—permitted to degenerate, not fertilized.
2. Peerless—permitted to degenerate, fertilized with floats; blighted.
3. Peerless—permitted to degenerate, not fertilized, not blighted.
4. Peerless—permitted to degenerate, fertilized with floats and cotton-seed meal.
5. Peerless—permitted to degenerate, fertilized with floats and cotton-seed meal; blighted.
6. "Peerless"—fertilized with compost broad-cast, 1,000 pounds to the acre, composed of the proportions, 500 pounds cotton-seed meal, 500 pounds acid phosphate, and 1,000 pounds stable manure.
7. "Welborn's Pet"—fetilized like No. 6.
8. "Truitt"—fertilized like No. 6.
9. "Rameses"—fertilized like No. 6.
10. "Cherry's cluster"—fertilized like No. 6.
11. "Okra leaf cotton"—fertilized like No. 6.
12. "Hawkins' improved."
13. "Allen's long staple."
14. "Jones' improved."
15. Georgia ordinary upland, obtained from W. W. Gordon & Co., Savannah, Ga.
16. "Peterkin."
17. "Southern hope."
18. "Zellner."
19. "Barnett's short staple."
20. "King's improved prolific."
21. "Ellsworth."
22. "Bailey," (doubtfully placed under herbaceum.)
23. Sample obtained from Mr. W. N. Brandon, of Coffee Springs, Alabama; name of variety unknown.

Gossypium barbadense, or nigrum—

24. Sea Island No. 1, obtained from Mr. P. D. Duffin, commission merchant of Savannah, Georgia.
25. Sea Island No. 2. Obtained from W. W. Gordon & Co., commission merchants of Savannah, Georgia.

Many experiments were made on each one of the above samples to determine the diameter and regularity of fibre, the average length of the strands, the character of twist and the internal structure. Also several strands were selected at random from the bolls and the strain necessary to break them carefully determined by fastening one end of the fibre and weighting down the other until rupture was produced.

Sample number 1 was a poor grade of cotton that was obtained from stalks about ten to twelve inches high, growing on sandy soil unfertilized. Four tests of the strength were made with two strands in each test with the following results: 1st, Broke under a strain of 9.498 grammes; 2nd, 19.057 grammes; 3rd, 21.404 grammes; 4th, 11.635 grammes. Average for two strands 15.398 grammes (1 gramme is equivalent to 15.43 grains). Length of fibre 1st test, 22.4 millimeters (1 millimeter is equivalent to 0.039 of an inch); 2nd test, 24 millimeters; 3rd test, 23.2 millimeters; 4th test, 24.8 millimeters. Average length of fibre, 23.6 millimeters. The diameter ranged from 0.009 millimeters to 0.016 millimeters. These results indicate a lack of uniformity. When the fibres were placed under the microscope it was noticed that some were immature, some were only slightly twisted, while others, though well twisted, were small and weak.

Number 2 was obtained from the same field but from a plat that had been fertilized with floats. The stalk was small and badly blighted, but the fibre was about the same grade with number 1. The grade of both plants is so low in the scale, the injury to the fibre may be due largely to immature growth in the plant before the blight obtained headway. However, this is difficult to determine with these samples, as they were obtained so late in the season.

Number 3 was also obtained from the same field and the same plat from which No. 1 was drawn. The plant was not blighted, but the stalk was small. In the first test upon the strength of two strands the fibre broke under a load of 27.475 grammes; 2nd, 33.915 grammes; 3rd, 29.000 grammes; 4th, 45.176 grammes. Average for two strands, 33.891 grammes. Length of fibre 1st test, 25.6 millimeters; 2nd test, 20 millimeters; 3rd test, 23.2 millimeters; 4th test, 22.4 millimeters. Average length, 22.8 millimeters. Diameter of fibre, 0.016 millimeters. This is an improvement over the two preceding. The twist of the fibre is an average, but there was a good deal of waste in the boll.

Number 4 was obtained from the same plat that No. 2 came from, but was not blighted. Rupture: 29.151, 23.652, 21.061, 26.719 grammes. Average for two stands, 25.145 grammes. Length of fibre, 17.6, 21.6, 21.6, 21.6 millimeters; average length, 20.6 millimeters; diameter, 0.016 millimeters. The twist was medium. The resistance to rupture was more uniform than the preceding and the staple was a better grade.

Number 5 was another specimen of blighted cotton from the same field in the plat fertilized with floats and cotton seed meal. The fibre was quite imperfect in development, and the twist was inferior. Resistance to rupture: 13.990, 5.620, 11.237, 13.000 grammes. Average resistance, 10.962 grammes. Average length of fibre, 20.2 millimeters; diameter, 0.024 millimeters.

Number 6 represents the variety Peerless. The stalk was large, well developed and loaded with fruit. The field in which the plant grew was fertilized with compost, 200 pounds cotton seed meal and 200 pounds acid phosphate, 1,000 pounds to the acre. The diameter of fibre was 0.016 to 0.024 millimeters, the last measure predominating. The twist was about an average and the length ranged from 18 millimeters to 20.8 millimeters. Average 18.5 millimeters. The resistance to rupture: 23.142, 20.552, 28.044, 11.623 grammes. Average 20.840 grammes. This is a good grade of cotton, with even texture and uniform diameter.

Number 7, or Welborn's Pet, was fertilized in the same manner that was used with No. 6. The plant was large, well fruited and apparently healthy. Diameter of fibre, 0.016 to 0.024 millimeters. Length: 21.6, 23.2, 21.2, 22.4 millimeters. Average 22.1 millimeters. Resistance to rupture: 12.258, 15.850, 15.902, 11.430 grammes; average, 3.860 grammes. Twist of fibre average. The grade of this cotton is below that of the Peerless, because the fibres were irregular in diameter, yielding weak places in the strands.

Number 8, or Truitt, from the same field with the last and fertilized in the same manner. The plant was well grown and well fruited. Diameter of fibre, 0.016 to 0.024 millimeters. Twist excellent. Length, 22.4, 22, 21.4, 21.6;

average 21.8 millimeters. Resistance to rupture: 35.437, 28.472, 36.856, 20.525 grammes; average, 30.322 grammes. The strength of the fibre is high and the grade of the cotton excellent.

Number 9, Rameses, fertilized in the same manner as No. 6. Plant was well grown and heavily fruited. Diameter of fibre 0.019 to 0.024 millimeters. Length: 20.8, 17.6, 21, 20.8 millimeters; average, 20.1 millimeters. Twist excellent. Resistance to rupture: 25.566, 28.702, 29.212, 25.558 grammes; average, 26.758 grammes. The staple was of uniform strength and uniform diameter.

Number 10, Cherry's Cluster, same fertilization. Plant in good condition and well fruited. Diameter of fibre, 0.019 to 0.027 millimeters. Twist excellent. Length: 23.2, 22.4, 23.2, 20.8 millimeters; average, 22.4 millimeters. Resistance to rupture: 35.216, 18.695, 38.690, 25.310 grammes; average, 29.477 grammes.

Number 11, Okra or Forked Leaf, same fertilization. Plant in good condition and well fruited. Diameter of fibre, 0.016 to 0.027 millimeters. The last measuremen, predominated. The twist was poor. Length: 31.2, 33.6 28.8, 28 millimeters; average, 30.4 millimeters. Resistance to rupture: 17.933, 18.470, 10.471, 10.088 grammes; average, 14.240 grammes. The strength of this variety is not as great as the last by one-half. This was due to the fact that the twist was poor and the diameter was not the same throughout the length of the fibre, and the weak points quickly yielded to the strain applied.

Number 12, Hawkins improved, fertilized with cotton seed meal and acid phosphate, 200 pounds to the acre. Diameter of fibre, 0.008 to 0.016 millimeters. Twist poor. Length. 19.2, 16, 18.4, 16.8 millimeters; average, 17.6 millimeters; Resistance to rupture: 12.446, 2.991, 10.710, 8.333 grammes: average 8.620 grammes. These results indicate an inferior condition of the cotton. The fibres were irregular in diameter with weak points, and a number of strands on the seeds were immature in development.

Number 13, Allen's long staple, fertilized in the same way that was used with Hawkins'. Diameter of fibre, 0.016 to 0.024 grammes. Twist inferior. Length: 26.4, 25.6, 26.4, 27.2 millimeters; average, 26.4 millimeters. Resistance to rupture: 17.353, 14.539, 15.516, 23.975 grammes; average, 17.845 grammes. The fibre of this variety was more mature and even in diameter, although the twist was inferior, hence it withstood the strain quite well. But the grade can be considerably improved.

Number 14, Jones' improved, fertilized like Hawkins'. Diameter of fibre, 0.016 to 0.024 millimeters. Twist medium. Length: 22.4, 22.4, 23.2, 23.2 millimeters; average, 22.8 millimeters. Resistance to rupture: 23.083, 15.323, 25.448, 20.900 grammes; average, 23.338 grammes. The grade of this cotton is an improvement over the last.

Number 15, Zellner, fertilized the same way. Diameter of fibre, 0.016 to 0.020 millimeters. Twist good. Length: 21.6, 21.6, 23.2, 23.2; average, 22.4 millimeters. Resistance to rupture: 20.130, 28.106, 26.345, 15.644 grammes; average, 22.556 grammes. This is also a good grade of cotton.

Number 16, Barnett's short staple, fertilized in the same way. Diameter of fibre, 0.016 to 0.028 millimeters. Twist poor. Length: 22.8, 24.2, 23.2, 24.8 millimeters; average, 24.8 millimeters. Resistance to rupture: 10.960, 10.370, 12.050, 8.363 grammes; average, 10.436 grammes. The fibre was so weak it was difficult to handle without breaking. The strands were immature in development.

Number 17, King's improved, fertilized in the same way. Diameter of fibre, 0.012 to 0.016 millemeters. Twist good. Length: 17.6, 20, 15.6, 20 millimeters; average, 18.3 millimeters. Resistance to rupture: 15.720, 12.996, 16.490, 18.100 grammes; average, 15.826 grammes. Although the average resistance is low, still the strands were of uniform strength, and with higher fertilization, the plant may be made to produce excellent cotton.

Number 18, Ellsworth fertilized in the same way. Diameter of fibre, 0.012 to 0.024 millimeters. Twist good. Length, 21.6, 21.6, 21.2, 1.20 millimeters; average, 21.1 millimeters. Resistance to rupture, 20.330, 22.050, 20.685, 20.838 grammes; average, 20.976 grammes.

Number 19, Georgia ordinary upland. Sent to me by W. W. Gordon & Co., commission merchants of Savannah, Ga. Character of fertilizer not known. The fibre was received in a ginned condition and the number of seed to boll and weight of staple could not be determined. Diameter of fibre, 0.012, to 0.016 millimeters. Twist medium. Length of fibre could not be accurately determined, because the cotton was sent to me ginned. Resistance to rupture, 19.038, 17.597, 21.965, 13.650 grammes; average, 18.083 grammes.

Number 20, Peterkin. Obtained from farm of Experiment Station. Character of fertilization--1,000 lbs. compost per acre, in the drill. Diameter of fibre, 0.008 to 0.016 millimeters. Twist medium. Length, 22, 25.2, 23.2, 22.4 millimeters; average, 23.2 millemeter. Resistance to rupture, 20.757, 14.438, 11.490, 20.649 grammes; average, 16.834 grammes.

Number 21, Southern hope. Fertilized like Peterkin. Diameter of fibre, 0.016 to 0.020 millimeters. Twist good. Length, 27.2, 23.2, 23.2, 24 millimeters; average, 24.4 millimeters. Resistance to rupture, 13.363, 21.453, 29.903, 22.928 grammes; average, 21.912.

Number 22, Bailey. Obtained from the Bailey Cotton Co. of Raleigh, N. C. The sample was ginned, and hence, lengths of strand, number of seed to boll and weight of fibre were not determined. Diameter of fibre, 0.019 millimeters. Twist poor. Resistance to rupture, 18.683, 15.413, 12.066, 18.687 grammes; average, 16.212.

Number 23, sample obtained from Mr. W. N. Brandon of Coffee Springs, Alabama. The name of the variety was not furnished me, but the plants were thrifty and healthy and averaged three feet in height; well fruited. The fertilizer used was 1,200 pounds to acre of stable manure, with pine straw and leaves, and 125 lbs. of guano to acre in the furrows before bedding and 75 pounds to acre about the last of May. Diameter of fibre, 0.024 millimeter. Twist medium. Length of strands, 21.6, 16.8, 19.2, 20.8 millimeters; average, 19.6, millimeters. Resistance to rupture; 14.303, 24.556, 25.173, 17.500 grammes; average, 20.383 grammes.

Number 24. Sea Island No. 1, obtained from P. D. Duffin, commission merchant, Savannah, Georgia. Diameter of fibre, 0.016 millimeters. Twist average, with weak places. Length averages 37 millimeters, but this is only approximate, as the sample sent me was ginned. Resistance to rupture; 16.462, 23.726, 16.968, 9.606 grammes; average, 18.602 grammes.

Number 25. Sea Island No. 2, obtained from W. W. Gordon & Co., commission merchants of Savannah, Georgia. Mr. Gordon States that this sample is not genuine Sea Island, but that its quality has been somewhat changed by growing the plant in the interior of Florida. The cotton was ginned and the length, 48. millimeters, can only be approximate. The fibre was slightly stained with adhering particles of dust. Diameter; 0.016 to 0.024 millimeters. Resistance to rupture; 17.447, 12.156, 14.356, 7,506 grammes; average, 15.578 grammes.

It seems evident from the foregoing, that it is not always the large plant that produces the best condition of the fibre. Experiment seems to determine that the most excellent condition of the fibre is produced only on those plants that are healthy in all their functions, neither too rapid nor slow in their development, and that are given all the advantages of judicious cultivation with the proper fertilization and under the most favorable conditions of the atmosphere. In improving the grade of cotton, the following must also be carefully noted. The plant must be forced to produce fibre, that is—

1. Long, and as nearly as possible, uniform in length.
2. Of uniform diameter throughout.
3. Flat and ribbon-like, and well twisted.

The cells must not collapse until well matured, so that the collapsing and twisting will occur with equal intensity throughout the entire length of the tube.

I will state as a proposition : No plant has a right to a new name unless it is able to produce fibre closely approaching the above conditions. The cultivation of cotton is chiefly for the staple it produces, and every effort should be made to improve its quality.

Now, in order to secure the results desired, it is necessary to consider the following important steps:

1. The improvement of the seed.
2. The character of the soil.
3. The best kind of fertilizer.
4. The best method of cultivation.
5. The conditions of the weather most favorable.

1. The Improvement of the Seed.

The seed is the beginning of the new plant, and contains within itself all the future possibilties of the full developed plant it will produce. There is an old expression that what the child is, so will be the man. This is as true of the vegetable as of the animal kingdom. Imperfect seed must produce imperfect plants. The intelligent farmer has often noticed in his fields of cotton, some plants much larger than others, containing a larger number of well-formed bolls, and with fibre whiter, more silky, and better in quality than on any other plant in the field. If he would select from this plant the bolls that are the largest, the finest and most perfectly matured; and after ginning the cotton carefully select the seed, rejecting all that are blasted or imperfectly shaped; and then carefully protect them to prevent fermentation or becoming in any manner damaged until the next planting season, the first important step would be taken. There is no chance in this matter, if we follow closely the laws by which nature performs her perfect work. The cotton seeds that have thus been carefully collected from the first plant must be placed in the best prepared soil, under the best conditions and well cultivated. No cotton of an inferior grade must be planted in the immediate neighborhood. In fact, it does not pay to cultivate inferior cotton, and it is best to send all such seeds to the oil mills. When blooms of low grade cotton open, insects and winds will soon transport the pollen from them to the pistils of the selected variety and the germs will become depreciated by such inferior fertilization. There are a number of insects that visit the flowers of the cotton plant for the nectar they contain; and in the effort to reach the base of the flower where the nectar is found, their bodies become covered with pollen that is transferred to the stigma where they come in contact with pistils of other flowers. It is readily seen, therefore, that if plants of an inferior grade are growing and blooming in the immediate neighborhood of the selected varieties, the insects will soon convey the pollen from the inferior to the superior plant, and the seed that will be produced will contain a germ with qualities of the inferior plant. This work of the insects might explain to some extent why it is that improved seeds in a few years degenerate so badly. If the selection of the seed is repeated from year to year, and no inferior cotton planted near enough to vitiate with its pollen by means of insects or wind, and if seasons are favorable, there seems to be no reason why practically perfect plants may not be produced.

2. THE CHARACTER OF THE SOIL.

It goes without saying that a soil in the first place must contain those mineral elements of plant food in a most available form that the cotton necessarily requires for its full development and maturity. This information is obtained by a chemical analysis of the plant with all its products and a careful examination of the soil by means of tests made with the growing plant and fertilizers now so well understood by most intelligent farmers.

Besides the ingredients comprising the soil it should have certain physical properties, without which it would be wholly inadequate for the purposes of producing well matured plants. It should have the power to absorb and retain moisture, so that in times of drought, in August and September, when seed and fibre are to be formed, and when diminished leaf activity is desirable, the soil should have sufficient moisture in composition to enable the roots to draw it up into the plant at a time when most needed. The soil must be so friable that when rains fall the moisture will sink and not stagnate about the roots.

For the best kind of fertilizer, and the best method of cultivation, I will refer the reader to previous bulletins issued by the experiment station.

5. THE CONDITION OF THE WEATHER.

This factor we cannot control, but we can at least make the most of what the Creator has given us. This southern country is peculiarly adapted to the cultivation of cotton because of its sunny climate. This plant requires a warm atmosphere for its full development, and hence it produces fibre in diminished quantity and perfection in more northern than southern latitudes. The high heat of a midday summer's sun seems not to injure cotton as it does corn and other like plants. Cotton is decidedly a sun plant.

The proper supply of moisture is of equal importance with temperature. The plant will stand great heat, provided it is not growing in a very dry atmosphere, and is in a soil that can retain moisture. According to Mallet, moisture may be supplied to the cotton plant in several ways :

1. "The atmosphere may contain a greater or less amount of water in the state of vapor up to the so-called point of saturation.

2. The atmosphere may be supersaturated, or in other words, rain may occur.

3. The soil may contain greater or less amount of water intimately united with it, whether by adhesion or in chemical combination, such water as is rapidly absorbed from the air by dried soil and can only be expelled by high temperature. This water does not render the soil moist to the touch.

4. The soil may be supersaturated and rendered moist or wet. The larger amount of water that is taken by the cotton plant in the first (atmospheric vapor) and third ways (soil water absorbed from the air under ordinary conditions), and the smaller amount that it receives in the second (rain) and fourth ways (saturated soil) the more favorable will be the result. In water soaked soil cotton will not thrive. It scalds and looks sickly. In the early stages of its growth the plant receives with advantage a moderate supply of moisture in the form of rain (water in the second condition), but even then *heavy rains are injurious*, and later in the season *they are absolutely destructive* ; the bolls do not open but fall or rot on the branches ; a surface growth of weeds and grass accumulates so rapidly as to choke the crop ; the boll worm and other insects appear in great numbers, and the crop is considerably cut off. Dry years are emphatically those of the largest and best crops."

In a dry season, when the supply of moisture has been moderate, and the plant is young and vigorous, the tap root penetrates to great depth where the supply of soil water is not so much under the control of periodical or ordinary atmospheric changes. The plant is, therefore, enabled to withstand a long drought; and if the moisture from the atmosphere has been given in small quantities all along its growth, the fibre becomes long, even and soft, the bolls open wide and the fleecy staple hangs in long, silken folds from them. Much rain and rapid growth of grass in May and June prevent the full development of the tap root and encourage a great multiplication of surface roots ; and as soon as the hot, dry atmosphere of July and August sweep across the fields the plants wither and shed because there is little tap root to bring up moisture from below the surface of the soil.

Table Showing Results of Microscopical Examination of Cotton Fibre.

Number.	NAME OF VARIETY.	HOW FERTILIZED.	Four tests on strain required to rupture two strands, expressed in grammes.*				Average strain to rupture.	Width of fibre expressed in millimeters.*	Four tests to determine the length of fibre expressed in millimeters.*				Average length of fibre expressed in millimeters.*	Character of Twist.	Number of seeds per boll.	Weight of seed in one boll, expressed in grammes.*	Weight of fibre in one boll, expressed in grammes.*	Per cent. of seed to one boll.	Per cent. of fibre to one boll.
1	Peerless, Permitted to degenerate	Not fertilized	9.498	19.057	21.404	11.635	15.398	0.009 to 0.016	22.4	24	23.2	24.8	23.6 m.m	Poor.	....	......	......	....	....
2	" blighted	Floats	§	§	§	§	......	0.008 " 0.024	22.4	21.6	22.4	21.2	23.4 "	Poor	....	......	......	....	....
3	"	Not fertiiized	27.475	33.915	29.000	45.176	33.891	..... 0.016	25.6	20.0	23.2	22.4	22.8 "	Average	....	......	......	....	....
4	"	Floats and C. S. M.	29.151	23.652	21.061	26.719	25.145	..... 0.016	17.6	21.6	21.6	21 6	20 6 "	Medium	....	......	......	....	....
5	" blighted	Floats and C. S. M.	13.990	5.620	11.237	13.000	10.962	.... 0.024	....	....	....	....	20.2 "	Poor.	....	......	......	....	....
6	Peerless	200 lbs. cotton seed meal and 200 lbs. acid phosphate, applied broadcast 1,000 pounds per acre	23,142	20.552	28.044	11.623	20.840	0.016 " 0 024	20.8	18.8	18.4	18.0	18 5 "	Average	42	3.217	1.751	64.8	35.2
7	Welborn's Pet		12.258	15.850	15.902	11.430	13.860	0.016 " 0 024	21.6	23.2	21.2	22.4	22 1 "	Average.	34	1.312	0.890	59.6	40.4
8	Truitt		35.437	28.472	36.856	20.525	30.322	0.016 " 0.024	22.4	22 0	21.4	21.6	21 8 "	Excellent	33	5 029	2 419	67.6	32.4
9	Rameses.		25.566	28.702	29.212	25.558	26.758	0.019 " 0.024	20.8	17.6	21	20.8	20 1 "	Excellent	34	2.417	1.029	70.2	29.8
10	Cherry's Cluster		35.216	18.695	38.690	25.310	29.477	0.019 " 0 027	23.2	22.4	23.2	20.8	22 4 "	Excellent	42	3.917	2.190	64.2	35.8
11	Okra Leaf		17.933	18.470	10.471	10.088	14.240	0 016 " 0.027	31.2	33.6	28.8	28	30.4 "	Poor	31	2 852	1.857	60.6	39.4
12	Hawkins' Improved	200 lbs. cotton seed meal, 200 pounds acid phosphate, applied 200 lbs. per acre	12.446	2.991	10.710	8.333	8.620	0.008 " 0.016	19.2	16.0	18.4	16.8	17.6 "	Poor.	41	1.670	1.060	61.2	38.8
13	Allen's Long Staple		17.353	14.539	15.516	23.975	17.845	0.016 " 0.024	26.4	25 6	26.4	27.2	26.4 "	Inferior	45	3 722	2.035	64.7	35.3
14	Jones' Improved		23.083	15.323	25.448	20.900	23.338	0.016 " 0.024	22.4	22 4	23.2	23.2	22.8 "	Medium.	30	4.570	2.740	62.6	37.4
15	Zellner		20.130	28.106	26.345	15.644	22.556	0.016 " 0.020	21.6	21.6	23.2	23.2	22.4 "	Good	33	5.015	1.837	73.2	26 8
16	Barnett's Short Staple		10.960	10 370	12.050	8.363	10.436	0.016 " 0 028	22.8	24.2	23,2	24 8	23.4 "	Poor	27	3.115	1.737	64.2	35.8
17	King's Improved Prolific		15.720	12.996	16.490	18.100	15 826	0.012 " 0.016	17.6	20.0	15.6	20.0	18.3 "	Good	45	2.490	1 530	61.4	38 6
18	Ellsworth.		20.330	22.050	20 685	20.838	20.976	0.012 " 0.024	21.6	21.6	21.2	20.0	21 1 "	Good.	35	2.625	1.561	62.8	37.2
19	Georgia Ordinary Upland	Not known	19.038	17.597	21.965	13.650	18.083	0.012 " 0.016	‡	‡	‡	‡	....	Medium	....	......	......	....	....
20	Peterkin	1,000 lbs. compost per acre	20.757	14.438	11.490	20.649	16.834	0.008 " 0.016	22.0	25.2	23.2	22.4	23.2 "	Medium	45	3.826	2.499	60 5	39.5
21	Southern Hope		13.363	21.453	29.903	22.928	21.912	0.016 " 0.020	27.2	23.2	23.2	24.0	24.4 "	Good.	40	4 975	2.239	68 1	31.9
22	Bailey	Not known	18.683	15.413	12.066	18.687	16.212	..... 0.019	‡	‡	‡	‡	....	Poor	....	......	......	....	....
23	Sample from Coffee Sp'gs Ala	"	14.303	24.556	25 173	17.500	20.383	..... 0.024	21.6	16.8	19.2	20.8	19 6 "	Medium	†	†	†	†	†
24	Sea Island No. 1	"	16.462	23,726	16.968	17.251	18.602	..... 0.016	‡	‡	‡	‡	....	Average	....	......	......	....	....
25	Sea Island No. 2	"	17.447	12,156	14.356	18.352	15.578	0.016 " 0.024	‡	‡	‡	‡	....	Poor to averg'e	....	......	......	....	....

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*1 Gramme is equivalent to 15.43 grains, and 1 millimeter is equivalent to 0.039 of an inch. † Cotton was received extracted from the boll. ‡ Cotton received was ginned. § Differs but little from above.

From the foregoing it may be concluded that:

The strongest cotton fibre was produced by Truitt.

The largest fibre was produced by Barnett.

The smallest fibre was produced by No. 1, Hawkin's Improved and Peterkin.

The longest fibre was produced by Okra Leaf.

The shortest fibre was produced by No. 2.

The best twisted fibres were produced by Truitt, Rameses, and Cherry's Cluster.

The largest percentage of fibre per boll was produced by Welborn's Pet, Okra Leaf, Peterkin, Hawkin's Improved, King's Improved, and in the order named.

The largest percentage of seed per boll was produced by Zellner, Rameses, Southern Hope, Truitt, and in order named.

The best grade of cotton, taking all things into consideration, is Cherry's Cluster. The second best grade is Truitt.

DESCRIPTION OF PLATES.

The illustrations representing the longitudinal views of the cotton are given in order to show the *twist of the fibre*, and to indicate the relative sizes of the different strands. The measurements shown in the cuts are photographs made with Zeiss' ocular micrometer. These photographs were made with Bausch & Lomb's professional photo-micro camera, fitted with Zeiss' objective (0.30 aperture and 16 m. m. focus) and compensated ocular 6, with micrometer. For the correct diameters of the fibres see the table accompanying this bulletin.

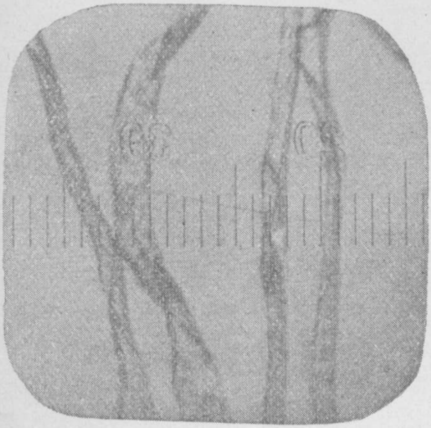
The cross sections shown in the illustration on Plate II, were magnified with Zeiss' microscope containing objective 16, and ocular 6. They were drawn by the aid of Zeiss' camera lucida (after Abbe). These sections are given to show what is known to be a well developed fibre, and one that is imperfectly formed. The well developed strand is shown by figure 4 (okra), and fig. 3 (chery's cluster), and imperfect fibres are noticed in figures 1 on the right, and also in the centre of the illustration. Figure 1 at the top of the cut is also quite immature.

The variety Truitt, on Plate I, is decidedly the best cotton, because the strands are not only of an uniform size, but they are also remarkably well twisted. Allen's Long Staple, on Plate II, is not so satisfactory. The twist is not as good, and the strands are irregular in size—some being quite small and weak. The two cuts representing Sea Island varieties show inferior grades of cotton, weak and a decided lack of proper twist.

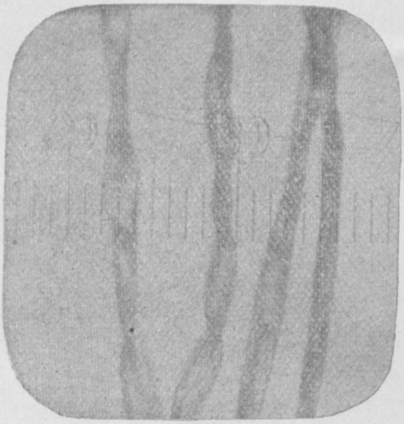
Each division on the scales represented in the cuts is equivalent to about 1-1600 of an inch.

PEERLESS.

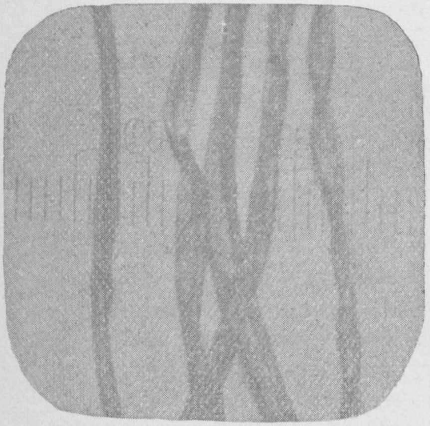
ELLSWORTH.



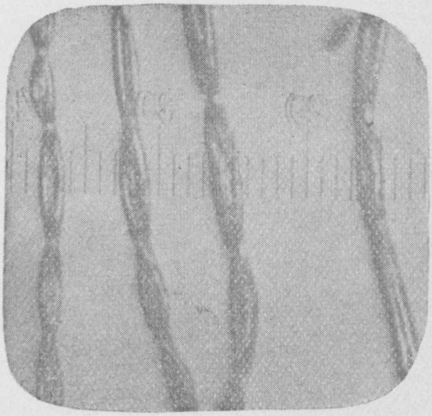
COMMON VARIETY—UNFERTILIZED.



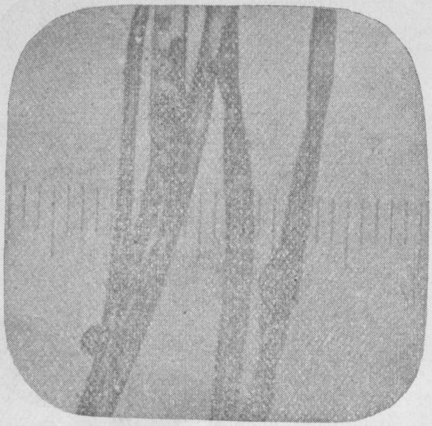
COMMON VARIETY—BLIGHTED.



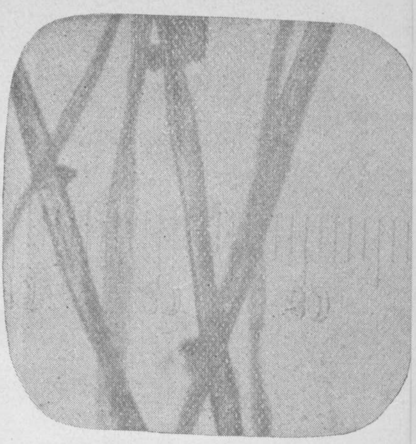
OKRA- OR FORK-LEAFED.



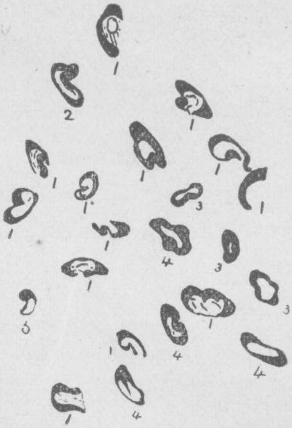
TRUITT.



SEA ISLAND—OR FLORIDA NO. I.

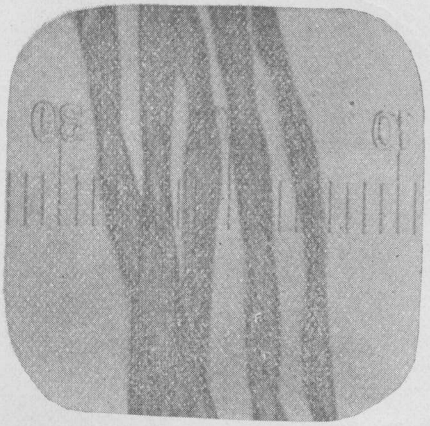


SEA ISLAND—NO. 2.

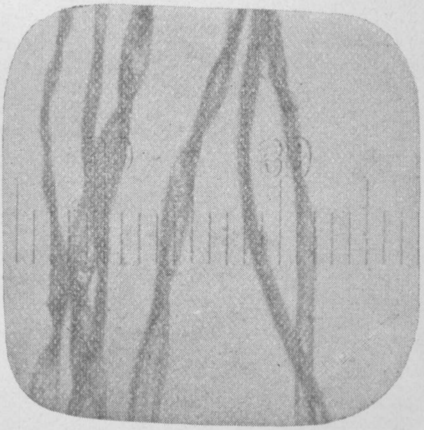


CROSS-SECTIONS OF COTTON-FIBRE.

Fig. 1. Common Variety.
" 2. "Rameses."
" 3. Cherry's Cluster.
" 4. Forked-Leaf or Okra.
" 5. Peerless.



"BRANDON"



BULLETIN NO. 14. - - - - - NEW SERIES.

REPORT

—OF—

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - APRIL, 1890.

PEA VINES AS A FERTILIZER.

☞ The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

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BULLETIN NO. 14.

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - APRIL, 1890.

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*The special work of the Biologist is the investigation of the diseases of plants caused by parasitic fungi and insects.

NITROGEN AS A FERTILIZER.

[N. T. LUPTON, CHEMIST.]

In estimating the value of commercial fertilizers, phosphoric acid, potash, and nitrogen are the only constituents taken into consideration. Of course, these are no more necessary for the growth of vegetation than other elements which enter into the composition of plants, but as they are more generally deficient in soils, especially after long continued cultivation, this deficiency must be supplied in order to produce abundant crops.

The bones of animals, both recent and fossil, with the immense deposits of phosphatic material found in this and other countries, have furnished the farmer a good supply of phosphoric acid at a reasonable price. The natural sources of potash have also been sufficient to keep the cost of this element within moderate bounds. The supply of nitrogen, however, is not so abundant, and hence it maintains a high value in the commercial world. In addition to this, nitrogenous materials very readily undergo decomposition, and the gaseous nitrogen passes into the atmosphere. Its chief sources as a fertilizer, are blood, tankage, fish scrap, cotton seed, cotton seed meal, animal manure, the salts of ammonia from gas works, and sodium nitrate, or Chili saltpetre. While about four-fifths of the atmosphere consists of nitrogen, this immense supply is virtually useless as a fertilizer. It must be in a state of chemical combination, as it appears from the most reliable investigations, before plants can use it. How this combination is brought about in the ordinary growth of vegetation, is an interesting question. The passage of electricity through the air is known to cause the union of minute quantities of nitrogen and oxygen, and some low organisms, called microbes, found on the roots of plants, are believed to change this element into a form suitable for use by the plant, but whether atmospheric nitrogen, under any circumstances, contributes directly to the nutrition of plants is a disputed question.

THE SOURCES OF THE NITROGEN OF VEGETATION.

The question of the supply of nitrogen to vegetation, says a recent writer in the Chemical News, is one of the utmost importance, not merely from a theoretical, but from a practical point of view. Put in a slightly different form, it means, are we, as far as the nitrogenous constituents of our frames are concerned, living on the earth's income, or, as in the case of coal, on its capital? Do plants deoend for their growth on the combined nitrogen present in the soil and sub-soil, supplied by manures and by the decomposing remnants of defunct organisms, or brought down by the rain in the form of ammonia or nitric acid? Or, are they able to fix in their tissues, directly or indirectly, any portion of the unlimited store of free nitrogen existing in the atmosphere? Such fixation might conceivably take place in various ways; by the direct oxidation of the plant, by the mediation of fungi or microbes, by some reaction of constituents of the soil, by the silent electrical discharge, etc.

The ablest scientific and practical investigators in the field of agricultural science have been studying this question for years past, but it must be confessed, results are not concordant. Some conclude from numerous experiments, that certain soils have the power, under peculiar circumstances, to fix free nitrogen; that is, to cause it to enter into chemical combination and serve as plant food; others like Berthelot, the distinguished French chemist, and the German chemists, Hellriegel and Willfarth, believe that free nitrogen requires the influence of living organisms, or microbes, which are found on the roots of some plants, to bring it into organic combination, while Boussingault is quoted in an article in the Chemical News, above referred to, as saying: "If there is in physiology a fact perfectly demonstrated it is the non-assimilability of free nitrogen of plants, even those of an inferior order, such as mycoderms and fungi."

Thus we see how different are the conclusions of the most skillful experimenters in this difficult field of investigation.

PLANTS AS COLLECTORS OF NITROGEN.

Whatever views may be held in regard to the relation of atmospheric nitrogen to the nutrition of plants, every educated farmer knows that certain crops collect this important element from some source and accumulate it in the soil. Prof. Wagner, Director of the Agricultural Research Station near Darmstadt, Germany, in a recent publication, divides plants into *nitrogen-collectors* and *nitrogen-consumers.* He concludes from many carefully conducted experiments that the nitrogen-collectors—peas, clover, lucerne, and leguminous plants generally—have the power to fix atmospheric nitrogen and by accumulating it in the soil, add to the capital of the farm, while cereals, grass, potatoes, turnips, tobacco, corn, cotton, etc., as nitrogen-consumers, have no such power, but take up from the soil, in the form of nitrogenous salts, all the nitrogen contained in the crop.

THE VALUE OF PEA VINES AS A FERTILIZER.

Pea vines and clover are universally recognized as enrichers of the soil, and are grown to some extent for purposes of fertilization. With a view of encouraging the growth of these valuable plants, especially of peas, and of answering some important questions, an investigation was undertaken a few months ago, to determine the real value of pea vines as a fertilizer, and the relative value of vines and roots. With the aid of Dr. J. T. Anderson, assistant chemist in the State Laboratory, some interesting results have been obtained. Several chemists have investigated the composition and value of *roots,* among whom may be mentioned Dr. Walker in England, Dr. Weiske in Germany, and Dr. Atwater in this country; but I have found no presentation of the comparative value of the vines and roots as fertilizers. To determine this question, four samples were taken October, 1889, from a crop raised on the experiment farm, as follows: Sample A was taken from a space one yard square. The vines were carefully cut, leaving the usual amount of stubble with the roots. A trench was dug around this square yard to a depth of several feet, and the earth washed away by a stream of water from a suitable hose. The roots were collected as completely as possible.

Samples B, C and D were from a cubic foot each, selected at random in the patch, the earth was removed entirely, dried, and then carefully sifted from the roots. Care was taken to secure, as far as possible, all fibres, however small. It was found that in this soil, a sandy loam with sandy sub-soil, the roots were virtually all included in the first foot in depth. Vines and roots with stubble attached were air dried, and weighed with the following results :

Weights Expressed in Grams.

	A.	B.	C.	D.
Weight of vines	210	137	58	69
Weight of stubble and roots	67	20	11	9

Calculated for one acre, these give in pounds :

	A.	B.	C.	D.
Weight of vines	2,236	13,128	5,558	6,612
Weight of roots	713	1,916	1,054	862

Thus we have in A a little more than three times as much vines as roots ; in B nearly seven times as much ; in C five and a half times as much ; and in D a little more than seven and a half times as much ; the average being six of vines to one of roots.

The vines and roots yielded as follows :

	A.		B.		C.		D.	
	per cent.		per cent.		per cent.		per cent.	
	Vines,	Roots	Vines,	Roots	Vines,	Roots	Vines,	Roots
Phosphoric acid	1.03	1.09	0 56	0.56	0.55	0.62	0.44	0.30
Potash	1.24	1.17	1.25	1.11	1.33	1.24	1 35	1.14
Nitrogen	2 62	1.09	1 73	0.75	1.45	0.54	1.45	0.36
Moisture	11.79	10.95	10.49	11.10	11.48	9.05	11.04	9.53
Crude ash	14 37	20.65	8.87	23·54	7 81	18.18	7.31	17.53

The amounts of phosphoric acid, nitrogen and potash, calculated for one acre, are given in the following table in pounds :

	A.		B.		C.		D.	
	pounds.		pounds.		pounds.		pounds.	
	Vines,	Roots	Vines,	Roots.	Vines,	Roots	Vines,	Roots
Phosphoric acid......	23.03	7.77	73.51	10.72	30.56	6.53	29.09	2.58
Potash	27.72	8.34	164.10	21.26	74.10	13 06	89.26	9.82
Nitrogen	58.58	7.77	227.11	14.37	80,59	5.69	95.87	3.10

Table expressing averages in pounds on one acre with commercial values, taking the yield of the four samples analyzed :

	pounds.		Value in dollars and cents.	
	Vines,	Roots.	Vines,	Roots.
Phosphoric acid..........................	39.05	6.90	$ 2.93	.52
Potash...	88.79	13.12	.89	.13
Nitrogen................................	115.54	7 70	22.53	2.50
			$ 26.35	3.15

To determine the loss of nitrogen caused by allowing the vines to lie upon the ground during the fall and winter, samples of dry vines were collected during the last weeks of December and January, and the percentage of nitrogen determined. The following table gives these results, and for comparison, the percentage of nitrogen in green vines is also given as previously obtained :

	Percentage of Nitrogen.			
	(1)	(2)	(3)	(4)
Green vines collected in October..........	2.62	1.73	1.45	1.45
Dry vines collected in December..........	0.81	0.88	....	....
Dry vines collected in January............	0.66	0.72	0.66	0.70

The leaves had mostly disappeared from the dry vines, and such changes had taken place by atmospheric agencies, that it was impossible to institute, with any degree of exactness, a comparison between the weight of green vines on a given area, air dried in the Laboratory, and the weight of same when dried in the field and gathered in December and January. The shrinkage from loss of moisture and decomposition by atmosperic agencies would, however, greatly increase the relative loss of nitrogen as exhibited in the above table.

CONCLUSIONS.

It is evident that much of the nitrogen collected by pea vines is lost when the crop is left exposed on the soil where it grew.

No experiments have been made to test the view of those who hold that more or less of this nitrogen becomes oxidyzed and passes into the soil as nitrate. The gaseous condition of nitrogen, ammonia, and other compounds of this element which result from the decomposition of organic substances, renders it, however, more than probable that the nitrogen escapes into the air. Many of our best agriculturists, however, condemn the practice of turning under the pea vines while green, in our climate, unless some other crop is to follow immediately, believing that the saving of nitrogen contained in the vines will not compensate for the loss produced by the exposure of the ploughed land to atmospheric agencies during the fall and winter.

An excellent plan would be to use the vines as a feed stuff, preserve the manure, and return it to the soil just before the time of planting.

The following conclusions are drawn from these results :

1. Pea vines contain a large percentage of phosphoric acid, potash and nitrogen, the three valuable constituents of commercial fertilizers, and are especially rich in nitrogen, which they accumulate directly or indirectly from the atmosphere and furnish as a fertilizer to other crops.

2. In these experiments the vines weigh about *six* times as much as the roots, and are about *eight and a third* times as valuable as a fertilizer, calculating their value on the basis of valuations used in Alabama for commercial fertilizers.

3. The vines lose a large percentage of their nitrogen when left on the ground during the fall and winter months.

No. 1519. COTTON SEED HULL ASHES FROM CENTRAL OIL CO., SELMA, ALA.

Moisture	11.00	per cent.
Organic matter	8.95	"
Insoluble matter (silica)	7.95	"
Oxide of iron and alumina	3.03	"
Lime, or calcium oxide	2.22	"
Magnesia, magnesium oxide	8.84	"
Potash	26.14	"
Soda	11.76	"
Phosphoric Acid (P_2O_5)	11.69	"
Sulphuric Acid (SO_3)	2.15	"
Chlorine	0.96	"
Carbonic Acid (calculated)	5.31	"
	100.00	"

A sample of fertilizer marked "Acid Phosphate with Potash "from Messrs. T. S. & J. P. Kirley, Scottsboro, Ala., was examined Feb. 6, 1890, and found to contain metallic lead in grains or particles varying in size from that of mustard seed to that of a buckshot. Eight ounces of the fertilizer contained one and one-sixth ounces of lead.

Another sample sent by the same parties was examined March 11th, which contained metallic lead as in the previous sample.

Analyses Reported by Dr. N. T. Lupton from October 1, 1889, to April 1, 1890.

PHOSPHATES CONTAINING NITROGEN AND POTASH.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
1399	Fertilizer	Rawls & Perry, Cuthbert, Ga	4.80	3.48	1.99	2.31	1.50	$22 92
1402	Georgia State Grange Fertilizer	Baldwin Fertilizing company, Savannah, Ga.	8.21	2.16	2.24	1.82	2.00	24 64
1403	Ammoniated Dissolved Bone	" " " "	9.44	0 85	2.32	1.78	2 04	24 41
1404	Ammoniated Dissolved Bone	John C. Cheney, Montgomery, Ala.	8.00	3 04	1.45	1.68	1.18	24 29
1405	Rock City Guano	" " "	6.73	2 69	1.44	2.17	1.92	24 51
1408	Fertilizer	J. C. Webb, Demopolis, Ala	2.72	2.19	0.83	2.31	0.85	17 21
1410	Troy Perfect Guano	Troy Fertilizer company, Troy, Ala	9.79	1.05	1.60	2.10	1.81	26 26
1411	Pike County Guano	" " " "	9.92	1.97	1 95	1 68	1.30	25 68
1412	Farmer's Alliance Guano.	" " " "	9.58	1.90	1.90	1.96	1 21	26 07
1413	F. F. I. Co. High Grade Guano	Adair Brother & Co., Atlanta, Ga	7 27	2.73	1.65	3.36	3.00	31 10
1414	Golden Grain Fertilizer	" " " "	8.08	2.82	1.31	3.01	3.31	31 39
1415	Buffalo Bone Guano	" " " "	7 16	3.69	1.72	2.73	2.20	29 11
1416	F. F. I. Co. Soluble Bone	" " " "	7.50	3 05	1 93	1.26	1 31	22 04
1421	Ammoniated Dissolved Bone	John Merryman & Co., Baltimore, Maryland.	7.56	2.65	3.69	1.89	2.06	24 74
1425	Phosphate & Crushed cotton seed	A. St. C. Tennille, Troy, Ala	6.33	0.76	6.13	1.12	0.08	15 07
1435	Webb's Excelsior	J. C. Webb, Demopolis, Ala	1.42	5.28	0.84	4.96	1.47	30 86
1439	C. S. Meal, Oil and Guano	Eufaula Oil and Fert. Co., Eufaula, Ala	7 94	2.83	1.51	1.40	3.39	25 00
1441	Southern Ammoniated Dis. bone	Maddox, Rucker & Co., Atlanta, Ga	10.02	0 61	0.50	2 38	2.15	27 37
1442	Old Dominion Guano	" " " "	10 92	0.82	0.91	2.80	2.08	30 61
1443	Farmer's Ammoniated Dissolved Bone	Hammond, Hull & Co., Savannah, Ga	9.06	1.20	2 23	1.75	1.02	23 23
1444	Old Reliable	" " "	8.50	1.99	2.68	1.82	0.42	23 24
1445	Ga. State Stand. Amm'd Superphosphate	" " "	8.42	0.94	2 90	1.75	2.37	23 23
1448	High Grade Veg. Fertilizer	" " "	6.99	0.92	0 80	4.75	5.55	35 93
1455	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala	4 45	4.10	3.00	2.66	1.82	25 01

1458	Carolina Fertilizer	Bradley Fert. Co., Boston, Mass.	8.83	2.27	1.01	1.89	1.13	25 15
1459	B. D. Sea Fowl Guano	" " "	8.81	2.19	1.03	2.31	1.59	27 09
1460	Eagle Ammoniated Dissolved Bone	" " "	8.79	2.24	1 56	1.82	0 79	24 42
1461	Bradley's Ammoniated Dissolved Bone	" " "	8 48	2 20	1.56	2.52	1.21	27 05
1462	Bradley's Patent	" " "	11.28	0.67	0.33	1.89	1.00	26 29
1465	Americus Guano	Williams & Clarke Fert. Co., N. Y.	8.04	1.52	1.72	1.68	1.06	21 95
1466	Eufaula Fertilizer	Eufaula Oil and Fertilizer Co., Eufaula, Ala.	8.04	1.40	1.84	1.68	3 70	24 41
1468	Fertilizer	S. E. Greenhill, Pleasant Site, Ala.	6 89	2 33	1.47	2.59	1.80	25 73
1471	Ammoniated Guano	Rasin Fert. Co., Baltimore, Md.	6 24	3.39	2.46	2.24	1.85	25 02
1472	Soluble Pacific Guano	W. J. Pollard, Augusta, Ga.	6 54	3.44	3 38	2 17	1 26	24 69
1475	Home Mixture	Columbus Fert. Co., Columbus, Ga.	7 29	2.01	1.24	2.03	1.82	23 68
1476	East Alabama Fertilizer No. 2	East Alabama Fertilizer Co., Clayton, Ala.	9.19	2.38	1 08	1 54	3.19	26 54
1477	East " " No. 1	" " " "	8.08	2.25	2 11	2.52	2.19	27 50
1478	Lister's Ammoniated Dissolved Bone	Lister's Ag. and Chem. Works, Newark, N. J.	7.78	1.55	2.42	2 10	1.48	22 66
1481	Atlantic Soluble Guano	Atlantic Phos. Co., Charleston, S. C.	7 10	1.85	1.47	1.96	1.73	22 79
1482	" Fertilizer	" " "	5.76	4.43	3.80	1.54	0.95	22 23
1483	Fertilizer	Albany Fertilizer Co., Albany, Ga	6 52	1.66	1.35	2 80	1.74	24 93
1486	M. S. Guano	W. J. Hudson, Mobile, Ala	5.76	4 43	3.80	1.57	0.95	22 35
1488	Gossypium Phospho	S. E. Greenhill, Pleasant Site, Ala.	6.40	2.08	2 46	2 66	1 64	24 73
1489	Home Mixture	J. W Crawford, Lawrenceville, Ala.	6.47	2.42	1.45	2.31	1 92	24 25
1490	Patent Pacific Guano	Southern, Phos. Co., Atlanta, Ga.	10.59	0.89	0 76	2.38	2 13	28 63
1493	Ashepoo Fertilizer	Ashepoo Fertilizer Co., Charleston, S. C.	7.66	2.20	2.60	1.61	1 14	22 20
1497	Ammoniated Disolved Bone	W. F. Vandiver, Montgomery, Ala.	6 89	3.75	3 93	1.33	1.65	22 79
1499	Fertilizer	Wight, Weloskey & Brown, Albany, Ga	8 54	1.81	0 74	2.80	1.40	27 84
1502	Americus Guano	Williams & Clarke Fert. Co., N. Y.	9.38	1.69	0.94	2.24	1.20	26 53
1503	Home Mixture	Columbus Fert. Co., Columbus, Ga.	6.02	3.44	1.08	2.10	2.28	24 66
1504	Fertilizer	Chattahoochee Fert., Co., Eufaula, Ala.	7.27	2.19	1.08	2.17	1.90	24 63
1505	Fertilizer	R. Q. Edmondson & Bro., Eufaula, Ala.	7.06	4.22	2.87	1.40	1.13	23 51
1509	Lee Fertilizer	M T. Trawick, Opelika, Ala.	7.08	1.75	1.80	2 10	1 94	23 37
1510	Farmer's Club Guano	" " "	7.66	2.26	1.58	2 03	2 38	25 17
1511	Coweta High Grade	Coweta Fert. Co., Newnan, Ga.	8 71	0.76	1.20	2.24	2.14	25 07
1512	Aurora Am'd Phosphate	" " "	8.14	0 71	1.11	2.10	2.73	24 19
1513	Fertilizer	J. C. Killebrew, Newton, Ala.	7 81	1.21	2.90	2.10	2.08	23 80
1514	Homestead Guano	Adair Bros. & Co., Atlanta, Ga.	8.85	0 72	0.87	1.82	.....	21 44
1515	Adair's Amd. Dissolved Bone	" "	8 23	1.63	2.02	2.66	1.97	27 13
1517	East Alabama Fertilizer No. 3	East Alabama Fert. Co., Clayton, Ala.	6.79	1.58	2.65	1.82	2.77	22 41

Analyses Reported by Dr. N. T. Lupton from October 1, 1889, to April 1, 1890—Continued.

PHOSPATES CONTAINING NITROGEN AND POTASH.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	PHOSPHORIC ACID. Citrate Soluble.	PHOSPHORIC ACID. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
1521	Ammoniated Dissolved Bone...........	Kennesaw Guano Co., Atlanta, Ga...........	6.45	1.92	4.16	2.24	1.77	23.01
1522	High Grade Ammoniated Guano.......	“ “ “	6.91	2.34	3.61	2.24	1.74	24.34
1524	Complete Fertilizer.............	Pike Martin, Montgomery, Ala.	1.07	3.04	1.01	2.52	0.13	16.11
1528	Crown Guano.....	Treadwell, Abbott & Co., Atlanta, Ga.	8.00	2.36	3.52	2.66	1.94	27.85
1531	East Alabama Fertilizer No. 5..........	East Alabama Fertilizer Co., Clayton, Ala.	7.10	1.92	2.52	1.75	2.72	23.07
1532	“ “ “ 6.........	“ “ “ .	6.77	2.41	2.70	1.75	2.96	23.55
1533	“ “ “ 7	“ “ “ ..	6.95	2.45	2.48	1.61	2.37	22.74
1535	Fertilizer.	Huntsville Fert. Co., Huntsville, Ala.	7.64	3.65	0.82	2.94	0.50	23.04
1539	Guano, lot No. 1	J. C. Killebrew, Newton, Ala	7.48	2.49	2.04	1.96	2.47	25.06
1540	Guano, lot No. 2.	“ “	7.94	2.33	1.97	1.96	2.37	25.41
1541	Guano, lot No. 3	“ “	8.33	2.22	2.29	1.82	2.15	25.06
1543	Soluble Pacific Guano................	W. L. Sampey, Clanton, Ala...	8.85	2.07	0.94	2.10	0.92	25.49
1544	Fertilizer, No. 5...	John H. Murphey, Mt. Pinson, Ala..	8.52	0.52	1.69	2.38	1.45	24.29
1546	Ammoniated Dissolved Bone........	Treadwell, Abbott & Co., Atlanta, Ga.......	6.79	2.03	3.98	2.73	1.41	25.28
1547	Bono Fertilizer......................	Bono Fertilizer Co., Baltimore, Md	6.85	3.96	0.88	1.96	2.28	26.13
1548	Gilt Edge Guano	G. Harnes, Trimble, Ala............	7.37	3.59	2.07	2.80	0.97	28.33
1549	Chatham Guano.	J. S. Lisenby, Echo, Ala............... . .	7.75	2.61	3.54	1.89	2.45	25.37
1552	Georgia State Grange Fertilizer.	O. W. Cooper, Oxford, Ala	7.12	1.75	4.51	1.75	2.07	22.19
1555	Guano...........	H. L. Steed, Haw Ridge, Ala........	5.95	1.83	1.03	1.89	1.52	20.57
1557	Fertilizer.	G. H. See, New Castle, Ala................	7.54	1.15	1.74	2.45	1.39	23.97
1559	Fertilizer No. 1	J. P. Darr, Millport, Ala.	7.66	2.39	2.31	1.75	1.50	23.41
1561	Fertilizer	“ “	5.74	3.12	1.87	3.01	2.57	27.57
1562	Fertilizer.	W. J Hudson, Mobile, Ala......	2.95	4.72	1.62	2.10	0.67	20.39
1563	Fertilizer.	Byars Coale, Carrolton, Ala	6.16	2.12	1.70	2.52	2.09	24.33
1567	Fertilizer............	J. H McGaha, Coal Fire, Ala	6.24	2.27	1.93	2.55	2.00	24.86

1569	Fertilizer	J. A. Gass, Benevola, Ala.	6 54	1.69	1.85	2.66	2.36	25 07
1570	Globe Guano	Geo. A. Folmer & Son, Lucerne, Ala.	1 59	8.70	1 24	4 34	5.05	37 40
1571	Rock City Guano	S. P. Barron, Andalusia, Ala.	6 98	2.27	1.06	1.82	1 21	22 17
1573	Fertilizer	J. Bradley, Beard, Alabama	7 08	2.06	2 36	2.38	2 40	25 39
1578	Southern Ammoniated Dissolved Bone	R. E. L. Bugg, Goldville, Ala	7.83	1 54	1 40	1.6	1 35	21 95
1579	Georgia State Grange Fertilizer	W. R. Hunnicutt & Son, Hefflin, Ala	7.56	1.58	4.26	2 10	2 15	24 05
1583	Mobile Standard Guano	J. M. Funderburk, Reform. Ala	3.05	4.82	2 84	1.82	1.60	20 49
1585	Troy Perfect Guano	Troy Fert. Co., Troy, Ala	9 13	0 76	1 78	2.24	2 73	26 39
1586	Georgia State Grange Fertilizer	S. J. Brown, Dadeville, Ala	7 35	2.19	4 93	1 89	1.95	23 63

ACID PHOSPATE WITH POTASH.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	Phosphoric Acid.			Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
1401	Bone and Potash	Baldwin Fertilizer Co., Savannah, Ga	10 54	2 22	1 85	4 02	$23 16
1407	Phosphate with Potash	John C. Cheney, Montgomery, Ala.	11.02	2 57	1 75	2 27	22 65
1417	Phosphate with Potash	Adair Brothers & Co., Atlanta, Ga.	7 66	4 15	1 7.	2 65	20 36
1529	Crown Acid Phosphate	Treadwell, Abbott & Co., Atlanta, Ga	10 90	3.43	1 56	2 47	23 96
1587	Dissolved Bone	J. B. Smith, Mulberry, Ala	10.56	2 36	0.21	0 67	20.05

Analyses Reported by Dr. N. T. Lupton from October 1st, 1889, to April 1st, 1890.

ACID PHOSPHATES.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	Phosphoric Acid.			Commercisl Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
1398	Phosphate	Tinsley Fertilizer Co., Selma, Ala	7.31	4.57	2.32	$17 82
1400	Georgia State Grange Acid Phosphate	Baldwin Fertilizer Company, Savannah, Ga	10 15	2 34	4 42	18 73
1406	Phosphate	John C. Cheney, Montgomery, Ala	11.88	2.43	1.80	21 46
1409	Troy Acid Phosphate	Troy Fertilizer Company, Troy, Ala	13.40	2 02	1.47	23 13
1418	Phosphate	Adair Brothers & Co., Atlanta, Ga	11.40	4.36	0.92	23 64
1419	Magnet Acid Phosphate	Davis, Marshall & Co., Mobile, Ala	11.92	2.39	1.92	21 46
1420	Phosphate	Tinsley Fertilizer Company, Selma, Ala	10.50	3.02	1.92	20 38
1422	Phosphate	McMillan & Harrison, Mobile, Ala	10.50	2 42	0.28	19 38
1424	Phosphate saturated with C. S. Oil	A. St. C. Tennille, Troy, Ala	8.65	5.61	4.47	21 39
1438	Phosphate	East Alabama Fertilizer Company, Clayton, Ala	6.79	7.68	2 50	21 70
1440	Southern Acid Phosphate	Maddox, Rucker & Co., Atlanta, Ga	13.63	1 24	0.14	22 30
1446	Georgia State Standard Acid Phosphate	Hammond, Hull & Co., Savannah, Ga	12.26	2.00	1 31	21 39
1449	English Acid Phosphate	W. F. Vandiver & Co., Montgomery, Ala	12.21	2.44	1.84	21 97
1463	Palmetto Acid Phosphate	Bradley Fertilizer Company, Boston, Mass	12.23	1.18	0.60	20 11
1467	Acid Phosphate	Chattahoochee Fertilizer Company, Eufaula, Ala	10 69	3.13	1.88	20 73
1469	Phosphate	C. A. Hughes, Get-up, Ala	10 06	5.78	2.76	23 70
1470	Acid Phosphate	Rasin Fertilizer Company, Baltimore, Md	13.44	2.08	1.28	23 28
1473	Tinsley's Phosphate	W. C Kennon	11.44	2.54	2.55	20 97
1474	Soluble Bone	Columbus Fertilizer Company, Columbus, Ga	10 56	3.15	2 01	20 56
1479	Atlantic Dissolved Bone	Atlantic Phosphate Company, Charleston, S. C.	12.44	1.50	2.09	20 91
1480	Atlantic Acid Phosphate	" " " "	11.07	1.58	1.50	20 00
1485	Berkley Phosphate	M. T. Trawick, Opelika, Ala	10.54	3.30	3.13	21 76
1487	M. S. Acid Phosphate	W. J. Hudson, Mobile, Ala	11.50	3.06	2.00	21 84

1491	Phosphate	C. A. Hughes, Get-up, Ala	9.35	4.83	3.04	21 27
1494	Ashepoo Phosphate	Ashepoo Phosphate Company, Charleston, S. C.	12 74	2.81	0.46	23 32
1495	XX Phosphate	W. F. Vandiver, Montgomery, Ala	11.50	2.66	2.33	21 24
1496	Diamond Solable Bone	" " "	11.78	2.70	2.30	21 72
1506	Berkley Acid Phosphate	Chattahoochee Fertilizer Company, Eufaula, Ala.	8 90	3.42	2.09	18 48
1516	Adiar's Acid Phosphate	Adair Bros & Co., Atlanta, Ga	11.82	3.54	1.22	23 04
1523	High Grade Acid Phosphate	Kennesaw Guano Company, Atlanta, Ga	9.75	3.68	3.79	20 14
1525	Berkley Phosphate	J. Burkes, Auburn, Ala	12 36	0.91	2.07	19 90
1527	Acid Phosphate	C. W. Williams, Bosenburg, Ala	3 55	7.39	4 20	16 41
1534	Dissolved Bone	East Alabama Fertilizer Company, Clayton, Ala.	11.67	1.83	2.26	20 25
1536	Phosphate No. 1	McQueen Smith, Prattville, Ala	12 55	3.84	2.31	24 58
1537	" " 2	" " "	13.03	4.08	0.53	25 66
1538	" " 3	" " "	9.77	5.65	3.08	23 13
1545	Wando Acid Phosphate	W. L. Sampey, Clanton, Ala	10.88	3.13	2.79	21 01
1550	Phosphate No. 9	McMillan & Harrison, Mobile, Ala	9.86	4.56	1.51	21 63
1551	" " 7	" " "	10.11	2.46	1.29	18 85
1553	Georgia State Grange Acid Phosphate	O. W. Cooper & Co., Oxford, Ala	9.19	2.00	3.74	16 78
-1556	Atlantic Acid Phosphate	O. T. Jeter, Boyd Tank, Ala	11.57	1 68	1.63	19 87
1560	Phosphate	J. P. Darr, Millport, Ala	12.36	4.42	1.82	25 17
1564	"	Ward & May, Cuba Station, Ala	11.90	2.62	2.08	21 90
1566	"	J. H. McGaha, Coal Fire, Ala	9.38	5.30	2.10	22 02
1568	"	J. D. Connell, Brundidge, Ala	12.13	4.12	1.29	24 37
1572	Acid Phosphate	S. P. Barron, Andalusia, Ala	9.60	3.70	3.71	19 95
1576	Phosphate	Farmers Alliance, Auburn, Ala	11.63	2.94	2.09	21 85
1577	"	J. H. Burgess, Beard, Ala	8.33	2.24	1.64	15 85
1580	"	H. B. Rives, Portland, Ala	10.17	1.98	3 82	18 22
1581	High Grade English Acid Phosphate No. 2	A. C. Lunni, Pine Apple, Ala	10.52	2.89	2.56	20 11
1582	Tinsley's Acid Phosphate No. 1	" " "	11.15	4.01	1.60	22 74
1584	Phosphate	E M. Rice, Auburn, Ala	6.89	4.37	3.60	16 80

MISCELLANEOUS FERTILIZERS.

St. No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrog'n	Potash.
			Water Soluble.	Citrate Soluble	Acid Soluble.		
1423	Kainite	McMillian & Harrison, Mobile, Alabama	....	. ...	....	... ..	12.96
1436	Cotton Seed Meal	East Alabama Fert. Co., Clayton, "	....	....	3.34	7.28	1.67
1437	Muriate of Potash	" " " " "	....	...	....	....	50.69
1447	Kainite	Hammond, Hull & Co., Savannah, Ga	....	....	....	......	12.44
1453	Muriate of Potash	Troy Fertilizer Co., Troy, Alabama	.....	....	...	....	50.24
1454	Concentrated Tankage	" " " "	....	....	1.20	11.83	.....
1456	Carib Guano	John Quite, Mobile, "	....	4 02	19.38	....	....
1457	" "	" " "	...	6.93	12 34	....	....
1484	Swan Island Guano	A. Adams, " "	....	8.50	12.33	....	....
1492	Green Sand	Foster M. Kirksey, Eutaw "	.....	. .	0 028	....	0.115
1500	Cotton Seed Meal	Montgomery Oil Works, Montg'ry, "	.. ...	...	3.20	7.28	1.71
1501	C. S. Hull ashes	" " " "	....	....	6 82	....	27.20
1507	Tankage	A. B. Mayer, Man'f Co., St. Louis, Mo.	....	..	4.78	2 52	.....
1508	Carib Guano	W. J. Hudson, Mobile, Alabama	.. ...	2.67	17.35	....	..
1518	Muriate of Potash	East Alabama Fert. Co., Clayton, "	.....	....	....	....	48.87
1526	Natural Phosphate	... .	......	....	1.13	...	..
1530	Cotton Seed Meal	Huntsville Fert. Co., Huntsville, "	......	....	2.75	4.90	1.29
1542	Swan Island Guano	A. Adams, Mobile, "	0.12	5.79	15.19	.....	......
1558	Bone Dust	W. G. Robertson, Carrollton, "	......	....	14.76	2.17	..
1565	Bat Manure	W. S. Wall, Richland Springs, Texas	....	. .	3 86	8 05	1.31
1574	Fertilizer	J. G. Stewart, Mobile, Alabama.	....	.. ....	19 82	....	.. ..
1575	Supposed Phosphate	Shelley, Booker & Co., Birmingham, "	....	......	0.88	......	.....

FERTILIZERS USED ON EXPERIMENT STATION, AUBURN, ALA.

Nos. 1588--1592	Cotton Seed Meal	.... ..	......	2 51	4.18	1.73
	Ammonium Sulphate	......	....	. ....	11.71	.....
	Dissolved Bone Dust	10.64	5.47	1 10	....	....
	Edisto Acid Phosphate	10.92	4.46	1.33	..	.....
	Kainit	....	....	....	......	12.75

Guaranteed Analyses of Commercial Fertilizers, as rendered to Commissioner of Agriculture by Dealers and Manufacturers---Season '89-90.

NAME OF FERTILIZER OR CHEMICAL.	BY WHOM REPORTED. NAME AND ADDRESS.	BY WHOM MANUFACTURED.	WHERE MANUFACTURED.	Weight of Package.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial Value.
						Water Soluble.	Citrate Soluble	Acid Soluble		
Cumberland Bone Sup. Phos. of Lime	Charles Ellis, Savannah, Ga	Charles Ellis	New York	200	1.50	6	3	1	1.50	20 85
Elliston Acid Phosphate	do do	do	New York	200		11.75	1.25	..	.....	19 50
Ammoniated Guano	Lorentz & Rittler, Baltimore, Md	Lorentz & Rittler	Baltimore, Md	200	2	6	2	2	3	22 80
No. 1 English Acid Phosphate	do do	do	Baltimore, Md	200	..	12	1	1	.....	19 50
Americus Guano	Americus Guano Co., Americus, Ga	Americus Guano Co.	Americus, Ga	200	2	7	2	2	1	22 30
John M. Green's Formula	do do	do	do	200	2	7	2	2	1	22 30
Americus Dissolved Bone	do do	do	do	200		10	3	2	.....	19 50
Eddystone Sol. Guano	do do	do	do	200	2	7	2	2	1	22 30
Magnet Sol. Guano	Davis, Marshall & Co., Mobile, Ala.	Davis, Marshall & Co.	Mobile, Ala	200	2.50	4	4	1	1	22 75
Magnet Acid Phosphate	do do	Edisto Phosphate Co.	Charleston, S. C.	200	..	6	6	1	.....	18 00
German Kainit	do do	Imported	Germany		..	......	..	..	10	10 00
Owl Brand	Davie & Whittle, Petersburg, Va	Davie & Whittle	Petersburg, Va	200	1.50	6	2	1	1	18 85
Owl Brand	do do	do	do	200	1.85	6	3	2	1 25	21 96
Webb's Excelsior S.	Jno. C. Webb, Demopolis, Ala	John C. Webb	Demopolis, Ala	200	4 41	3 16	2 44	0 25	2.68	27 53
Webb's Excelsior	do do	do	do	..	4 96	1 42	5.28	0.84	1.47	32 50
Standard Fertilizer	Columbus Oil Mills, Columbus, Miss	Columbus Oil Mills	Columbus, Miss.	100	2.85	6.27	3	1 60	3.11	28 13
Acid Phosphate	do do	do	do	100		12.52	2.67	2.08	.....	22 78
Perfection Guano	McMillan & Harrison, Mobile, Ala.	McMillan & Harrison	Mobile, Ala	200	2	3	5.25	2	1	21 17
Kainit	do do	Imported	do	200	..	..	..		12.50	12 50
Acid Phosphate	do do	do	do	200	...	10	2	0.25	......	18 00
Kennesaw High Grade Am	Kennesaw Guano Co., Atlanta, Ga.	Kennesaw Guano Co.	Atlanta, Ga	200	2	5	3 50	..	1 50	22 05
Kennesaw Am. Dis. Bone	do do	do	do	200	2	5	3 50	...	1	21 55
Kennesaw High Grade Acid Phos	do do	do	do	200	...	10	3.50	.	......	20 25
Mark Clayton's Choice Am. Dis. Bone.	do do	do	do	200	2	5	3.50	...	1.50	22 05
Clifton Complete Fertilizer	Clifton Chem. & Phos. Co., Atlanta, Ga.	Clifton Ch. & Phos. Co	do	200	2	8	2	2	1	23 80
Clifton acid phosphate	do do	do	do	200		11	2	2	....	19 50
Crown guano	Treadwell, Abbott & Co., Atlanta, Ga.	Walton & Whann Co.	Charleston, S. C.	200	1.50	6	3	1	1	20 35

Guaranteed Analyses of Commercial Fertilizers, as rendered to the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

NAME OF FERTILIZER OR CHEMICAL.	BY WHOM REPORTED. NAME AND ADDRESS.	BY WHOM MANUFACTURED.	WHERE MANUFACTURED.	Weight of Package.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial Value.
						Water Soluble.	Citrate Soluble	Acid Soluble		
Am. dissolved bone	Treadwell, Abbott & Co., Atlanta, Ga.	Bowker Fertilizer Co.	Brighton, Mass	200	1.50	6	2	1	1	18 85
Crown acid phosphate	do do	Walton & Whann Co.	Charleston, S. C.	200	...	8	3	1	1	17 50
T. A. & Co's. ammoniated dissolved bone	do do	do	do	200	1.75	5	2	2	1.25	18 57
Complete fertilizer	Scholze Bros., Chattanooga, Tenn	Scholze Bros	Chattanooga, T.	200	2	8	1	..	1.50	22 80
Acid phosphate	do do	Walton & Whann Co.	Charleston, S. C.	200	..	10	2	..	. ..	18 00
Coweta high grade	H. C. Fisher, G. M., Newnan, Ga	Coweta Fertilizer Co.	Newnan, Ga	200	1.85	7	1	1	2	22 71
Aurora am. phospho	do do	do	do	200	1.75	6 50	1.50	1	1.50	20 32
Georgia State grange fertilizer	Baldwin Fert. Co., Savannah, Ga.	Baldwin Fertilizer Co.	Port Royal, S. C.	200	1.75	8	2	1.50	2	23 82
Am. dissolved bone	do do	do	do	200	1.75	8	2	1.50	2	23 82
Bone and potash	do do	do	do	200	..	9	2	1.50	4	20 50
Georgia State grange acid phosphate	do do	do	do	200	...	10	2	2	.....	18 00
Bone compound	do do	do	do	200	1.75	8	2	1 50	......	21 82
Am. dissolved bone	Jno. Merryman & Co., Baltimore, Md.	Jno. Merryman & Co.	Barren Isl'd, N Y	167	1.65	6	2	2.50	1	19 43
Georgia Test	do do	do	do	167	1.65	6	2	2 50	1	19 43
High grade acid phosphate	do do	do	do	200	..	10	1	1	.....	16 50
Rock City guano	National Fert. Co., Nashville, Tenn.	National Fertilizer Co.	Nashville, Tenn.	200	1.65	6	2	1	1	19 43
Tennessee guano	do do	do	do	200	1.65	6	2	1	1	19 43
Old Hickory guano	do do	do	do	200	1.65	6	2	1	1	19 43
National dissolved bone	do do	do	do	200	.83	8	2	1	1	19 24
Am. dissolved bone	do do	do	do	200	.83	8	2	1	......	18 24
National tobacco fertilizer	do do	do	do	200	2 06	6	2	1	3	23 03
Nationnl vegetable fertilizer	do do	do	do	200	2.50	6	2	1	2	23 75
Acid phosphate	do do	do	do	200	...	10	2	1	.....	18 00
Acid phosphate with potash	do do	do	do	200	...	10	2	1	2	20 00
Edisto acidulated rock	Edisto Phos. Co., Charleston, S. C	Edisto Phosphate Co.	Charleston, S. C.	200	..	9	3	1 50	.....	18 00
Edisto dissolved bone	do do	do	do	200	....	9	3	1.50	......	18 00
Edisto am. sup. phos	do do	do	do	200	1.23	7	2	1.50	......	18 29

Edisto am. dissolved bone	do do	do	do	200	1.64	7	2	1.50	......	19 90
Edisto soluble guano	do do	do	do	200	1.64	7	2	1.50	......	19 90
Edisto am. fertilizer	do do	do	do	200	2.06	7	2	1.50	......	21 53
Edisto acid phosphate	do do	do	do	200	..	8	2	1.50	....	15 00
Lister's am. dis. bone phosphate	Lister's A. C. Works, Newark, N. J.	Lister's A. C. Works	Newark, N. J.	167	1.65	6	2	3	1	19 43
Standard am. sol. guano	Standard G. & Chem. Mfg. Co., N. O.	Standard Guano	New Orleans, La	200	1.84	4	4	0 50	2	21 18
Stern's am. raw bone sup. phos	do do	and Chem. Mfg Co	do	200	1.84	4	4	1	2	21 18
Champion farmers choice	do do	do	do	200	1 84	4	4	0 50	0.67	19 85
Dissolved bone	do do	do	do	200		13	0.50	..	.....	20 25
Alabama cotton grower	do do	do	do	200	2.25	4	4	..	2	22 77
Gossypium phospho	Geo. W. Scott Mfg. Co., Atlanta, Ga.	G. W. Scott Mfg Co.	Atlanta, Ga.	200	2	6	3	1	1 50	22 80
Scott's animal am. guano	do do	do	do	200	1 56	6	3	1	1	20 93
Scott's potasso. phospho	do do	do	do	200	..	7	5	1	2	20 00
Scott's high grade acid phos.	do do	do	do	200		7 50	5 50	1	.....	19 50
Bowker's cotton fertilizer	Jno. D. Weld, Savannah, Ga	Bowker Fertilizer Co.	Elizabethp rt, N J	200	1.75	7	2	2	1 25	21 57
Nassau guano	do do	do	do	200	1.75	7	2	2	1.25	21 57
Crown guano	do do	do	do	200	1.75	7	2	2	1.25	21 57
Bowker's dissolved bone phosphate	do do	do	do	200	..	9	2	2	1 25	17 75
Nassau dissolved bone phosphate	do do	de	do	200	..	10	3	2	....	19 50
Home mixture	Columbus Fert. Co, Columbus, Ga.	Columbus Fertilizer Co	Girard, Ala.	200	2 25	6	2	2	1.50	22 27
Soluble bone	do do	do	do	200	...	10	3	1	.....	19 50
Farmer's friend fertilizer	Read Fertilizer Co., New York	Read Fertilizer Co.	New York	200	1 85	6	3	2	1	21 71
Standard	Albany Fertz & F. I. Co., Albany, Ga.	Albany Ft. Co & F I Co	Albany, Ga.	200	2 75	6	1.50	1 25	1.60	23 57
Ammoniated bone	Slingluff & Co., Baltimore, Md	Slingluff & Co.	Baltimore, Md.	200	2	6	3	1	2	23 30
Baltimore dissolved bone	do do	do	do	200	1.50	7.50	3	1	2	23 60
High grade acid phosphate	do do	do	do	200	...	11	2	1	.....	19 50
Oskalimne	do do	do	do	200		9 50	3	1	3.50	22 25
Patapsco am. sol. phosphate	Potapsco Guano Co., Augusta, Ga.	Patapsco Guano Co.	do	200	2	6.75	2 25	1.50	1	22 30
Am. dissolved bone	do do	do	do	200	1 75	6 75	2.25	1.50	1	21 32
Patapsco acid phosphate	do do	do	do	200	...	9	3	1	1	19 00
Patapsco acid phosphate	do do	do	do	200	.	10	3	1	...	19 50
Ashepoo fertilizer	Ashepoo Phos. Co., Charleston, S. C.	Ashepoo Phos. Co.	Charleston, S. C.	200	1.85	6 25	2 25	2	1	20 96
Eutaw fertilizer	do do	do	do	200	1.85	6.25	2.25	2	1	20 96
Ashepoo acid phosphate	do do	do	do	200	....	8 50	2	1	.....	15 75
Eutaw acid phosphate	do do	do	do	200	..	8.50	2	1	.....	15 75
Kainit	do do	do	do	200	..	.....	.....	.....	11	11 00

Guaranteed Analyses of Commercial Fertilizers, as rendered to the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

NAME OF FERTILIZER OR CHEMICAL.	BY WHOM REPORTED. NAME AND ADDRESS.	BY WHOM MANUFACTURED.	WHERE MANUFACTURED.	Weight of Package.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial Value.
						Water Soluble	Citrate Soluble.	Acid Soluble		
Mobile standard guano	W. J. Hudson, Mobile, Ala.	W. J. Hudson	Mobile, Ala.	200	1.86	4	5	1	1	21 75
Mobile standard acid phosphate	do do	do	do	200	.	10	3	1	....	19 50
Goulding's bone compound	W. & H. M. Goulding, Baltimore Md	W. & H. M. Goulding.	Baltimore, Md	200	1.75	7	2	1	1	21 32
Am. dissolved bone	N. W. Fertilizing Co. Chicago, Ill	N W. Fertilizer Co	Chicago, Ill	200	1 75	2 50	5.80		.50	19 77
English acid phosphate	N. H. Holmes, Montgomery, Ala.	Imported	England	200	...	11	2	1	....	19 50
Holmes' formula	do do	N. H. Holmes	Montgomery, Ala	200	2 00	6	2	1	.50	20 30
Ivey's formula	do do	do	do	200	2 00	6	2	1	.50	20 30
Guanaco guano	do do	do	do	200	2	6	2	1	1	20 80
Zell's ammoniated bone super-phosphate	The Zell Guano Co., Baltimore, Md.	The Zell Guano Co	Baltimore, Md	200	1 87	6	3		1 25	22.04
Zell's economizer	do do	do	do	200	1.87	6	3		1 25	22 04
Zells calvert guano	do do	do	do	200	1 75	6	2	3	1	19 82
Brown's cotton and corn	R. B. Brown Oil Co., St. Louis, Mo	R. B. Brown Oil Co.	St. Louis, Mo	200	2 50	8			2	23 75
Soluble Pacific guano	Pacific Guano Co, Wood Hall, Mass	Pacific Guano Co	Wood Hall, Mass	200	2 15	7	3	2	1	24 38
Baker standard guano	Chemical Co. of Canton, Baltimore, Md	Chem. Co. of Canton	Baltimore, Md	200	1 75	5 80	3 20	3.10	2	22 32
Pure dissolved ammoniated bone	do do	do	do	200	1 75	5 80	3 20	3 10	2	22 32
Resurgam guano	do do	do	do	200	1 25	4 80	3 2	3 10	2	18 87
Pure dissolved South Carolina bone	do do	do	do	200	...	9	5	2	....	21 00
Atlantic soluble guano	Atlantic Phos. Co., Charleston, S. C.	Atlantic Phos Co	Charleston, S. C.	200	1	6	2	1.50	2	17 90
Atlantic acid phosphate	do do	do	do	200	...	10	2	2.50	...	18 00
High grade acid phosphate	do do	do	do	200	..	10	2	2.50	....	18 00
Cherokee dissolved bone	do do	do	do	200	...	9	2	1.50	1	17 50
Atlantic dissolved bone	do do	do	do	200	....	9	2	1.50	1	17 50
Soluble guano	Ashley Phos. Co, Charleston, S. C.	Ashley Phosphate Co.	do	200	2	4	4	2	1	20 80
Cotton and corn combined	do do	do	do	200	1.75	4	4	2	1	19 82
Small grain specific	do do	do	do	200	1 75	4	4	2	1	19 82
Ammoniated dissolved bone	do do	do	do	200	1	4	4	2	1	16 90
Soluble fish guano	do do	do	do	200	2.50	4	4	1	1	22 75

Acid phosphate	do	do	do	do	200	....	6	4	2	1	16 00
Dissolved bone	do	do	do	do	200	...	7	5	2	.....	18 00
Kainit	do	do	do	do	20		....	...		13	13 00
Atlantic ammoniated dissolved bone	Pelzer, Rodgers & Co	Charleston, S.C	Atlantic Phos. Co	do	200	1	8	2	1.50	1	19 90
“ dissolved bone	do	do	do	do	200		10	2	2.50	....	18 00
“ acid phosphate	do	do	do	do	200		9	2	1 50	1	17 50
“ fertilizer	do	do	do	do	200	2	6	2	2	2	21 80
Dissolved bone phosphate So. Car	G. Ober & Sons Co.	Baltimore, Md	G. Ober & Sons Co	Baltimore, Md	200		9	2 50	1 50	....	17 25
Georgia cotton compound	do	do	do	do	200	2	6 75	2 25	1 50	1	23 80
Soluble ammoniated sup. phos. of lime	do	do	do	do	200	2	6 75	2.25	1 50	1	23 80
Farmer standard phosphate	do	do	do	do	200	1.75	6 75	2.25	1 5	1	22 80
Bono fertilizer	Bono Fertililer Co.,	do	Bono Fertilizer Co	do	200	1.65	7	2		1 50	21 43
Bradley's patent	Bradley Fertilizer Co	Boston, Mass.	Bradley Fertilizer Co	Boston, Mass	200	1.85	6 50	2 50	2	1	21 71
B. D. Sea Fowl Guano	do	do	do	do	200	1.85	6 50	2 50	2	1	21 71
Palmetto acid phosphate	do	do	do	do	200	..	9	3	1	...	18 00
Carolina Fertilizer	do	do	do	do	200	1.85	6 50	2 50	2	1	21 71
Eagle Am. sup. phosphate	do	do	do	do	200	1.65	6	2	2	1	19 43
Bradley's Am dissolved bone	do	do	do	do	200	1 65	6	2	2	1	19 43
Eufaula fertilizer	Eufaula Oil and Fert. Co.	Eufaula, Ala.	Eufaula Oil and Ft. Co	Eufaula, Ala	200	1.25	6 50	2.50	1.25	2.50	20 87
Berkley acid phosphate	Berkeley Phos. Co	Charleston, S. C.	Berkeley Phos Co	Charleston, S. C	200		9	1		1.05	16 05
Berkley dissolved bone	do	do	do	do	200		10 50	1.50			18 00
“ soluble guano	do	ho	do	do	200	2 06	7	1	..	1 05	21 08
“ Am. dissolved bone	do	do	do	do	200	1 65	7	1	..	1.05	19 48
Alabama fertilizer	Ala. Fert. Co.	Montgomery, Ala.	Alabama Fert Co	Montgomery	200	2 50	8	2	10	2	26 75
Favorite formula fertilizer	do	do	do	do	200	2 50	6	2	8	1	22 75
Ala. Fertilizer Co acid phosphate	do	do	do	do	200		11	2	13	...	19 50
Kainit	do	do	Imported	Imported.	200					11	11 00
Muriate Potash	do	do	do	do	200				..	80	80 00
Sterling guano	Clarence Angier	Atlanta, Ga	Ga. Chem. Works	Augusta, Ga	200	1 75	6	3		1	21 32
Lockwood Cotton grower	do	do	do	do	200	1.75	6	3	..	1	21 32
Sterling acid phosphate	do	do	do	do	200	....	9	3	..	1	19 00
Lockwood acid phosphate	do	do	do	do	200		9	3	....	1	19 00
Lockwood cotton grower	do	do	do	do	200	1.75	6.75	2 25	1.50	1	22 82
Sterling guano	do	do	do	do	200	1 75	6 76	2 25	1 50	1	22 82
Lockwood acid phosphate	do	do	do	do	200	....	9	3	1	1	19 00
Sterling acid phosphate	do	do	do	do	200	....	9	3	1	1	19 00

Guaranteed Analyses of Commercial Fertilizers, as rendered to the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

Name of Fertilizer or Chemical.	By Whom Reported. Name and Address.	By Whom Manufactured.	Where Manufactured.	Weight of Package.	Nitrogen.	Phosphoric Acid.			Potash.	Commercial Value.
						Water Soluble.	Citrate Soluble	Acid Soluble.		
East Alabama Fertilizer	East Ala. Fert. Co., Clayton, Ala.	East Ala. Fert. Co	Clayton, Ala	200	1.50	8	1 12	1	2	21 53
L. & W. I. X. L. Am. Sup. phosphate	Langston & Woodson, Atlanta, Ga	Langston & Woodson	Charleston, S. C.	200	2	7 50	2.50	1	1	23 80
L. & W. diss. bone with am. and potash	do do	do	do	200	1.70	7.50	2.50	1	1	22 63
L. & W. high grade acid phos.	do do	do	do	200	....	8 50	3.50	1	......	18 00
Trawick's dissolved bone	M. T. Trawick, Opelika, Ala	M. T. Trawick	Opelika, Ala.	200		11	2	2	......	19 50
Lee fertilizer	do do	Lee Fertilizer Works	do	200	2.25	8	1	1	2	24 27
Farmer's club guano	do do	do	do	200	2	8	1	1	1.75	23 05
Trawick's dissolved bone	do do	do	do	200	.	11	2	2	......	19 50
Planter's pride	Marietta Guano Co., Atlanta, Ga.	Marietta Guano Co.	Atlanta, Ga.	200	1.50	6	2	2	1	18 85
Piedmont acid phosphate	do do	do	do	200		10	1	.50	....	16 50
Ga. State standard acid phosphate	Hammond, Hull & Co., Savannah, Ga.	Hammond, Hull & Co.	Savannah, Ga.	200	..	10	2	1	.....	18 00
Crescent bone acid phosphate	do do	do	do	200	...	10	2	1	......	18 00
Forest City acid phosphate	do do	do	do	200		10	2	1	.....	18 00
Ga. State standard dissolved bone phos.	do do	do	do	200	..	10	2	1	......	18 00
Port Royal acid phosphate	do do	do	do	200	...	10	2	1	......	18 00
Port Royal dissolved bone phosphate	do do	do	do	200	...	10	2	1	....	18 00
Oglethorpe acid phosphate	do do	do	do	200		10	2	1	.....	18 00
Hardie's cotton boll acid phosphate.	do do	do	do	200	.	10	2	1	......	18 00
Oglethorpe dissolved bone phosphate	do do	do	do	200	..	10	2	1	......	18 00
Genuine German Kainit	do do	do	do	200	..		...	..	11	11 00
Ga. State Standard Am. sup. phosphate.	do do	do	do	200	1.65	7	1	1	2	20 43
" " "	do do	do	do	167	1 65	7	1	1	2	20 43
Port Royal cotton Fertilizer	do do	do	do	200	1 65	7	1	1	2	20 43
Oglethorpe Am. dissolved bone	do do	do	do	200	1 65	7	1	1	2	20 43
Forest City dissolved bone	do do	do	do	200	1.65	7	1	1	2	20 43
Crescent bone fertilizer	do do	do	do	200	1.65	7	1	1	2	20 43
Farmers am. dissolved bone	do do	do	do	200	1.65	7	1	1	1	19 43

Alliance am. dissolved bone	do	do	do	do	200	1.65	7	1	1	1	19 43
Old Reliable	do	do	do	do	200	1.65	7	1	1	.10	18 53
So. Ca. am. dissolved bone	do	do	do	do	200	1.65	7	1	1	.10	18 53
H. H. & Co. pure animal bone, high grade vegetable fertilizer	do	do	do	do	200	5	7	1	1	5	36 50
Eng. cotton boll acid phosphate	do	do	do	do	200	...	10	2	1	...	18 00
M. H. & Co., am. dissolved bone	do	do	Georgia Fert. Co	do	200	1 65	7	1	1	1	19 43
M. H. & Co , H.G. acid phosphate	do	do	do	do	200	...	10	2	1	.....	15 00
W. O. C	Coweta Fertilizer Co ,	Newnan, Ga	Coweta Fert. Co	Newnan, Ga	200	2	8	2	1	2	24 80
W. G. & Co., manipulated guano	The Wilcox & Gibbs G. Co.	Savan. Ga	Wilcox & Gibbs G. Co.	Savannah, Ga	200	2.10	6	2.75	2	2 50	23 82
Excellent Ga. standard guano	do	do	do	do	200	1.75	6	2 50	2	1	20 57
W. G. & Co., sup. phosphate	do	do	do	do	200	1.75	6	4	2	2.50	24 32
Pure Eng. acid phosphate	do	do	do	do	200	1.75	11	2	1	....	26 32
High grade acid phosphate	do	do	do	do	200	. .	8	5	1	.....	19 50
Standard home mixture	Meridian F. Factory,	Meridian, Miss.	Meridian Fert. Factory	Meridian, Miss	200	2	6	4	2	1	23 80
English acid phosphate	do	do	Imported	England	200	....	10	1	1	....	16 50
Huntsville fertilizer	Huntsville F. & M.Co.,	Huntsville, Ala	Huntsville F. & M. Co	Huntsville, Ala.	200	2 25	6.75	3.25	75	1	24 77
Allen's Truck guano	The Tygert-Allen F. Co ,	Philadel. Pa.	Tygert-Allen Fert. Co.	Philadelphia, Pa	200	8	4	2	..	2 50	42 70
Empire guano	The Rasin Fert. Co.,	Baltimore, Md.	Rasin Fertilizer Co	Baltimore, Md	200	2	4	5	2	1.75	23 05
Sol. Sea Island Guano	do	do	do	do	200	2	4	5	2	1.75	23 05
So. American guano	do	do	do	do	200	2	4	5	2	1.75	23 05
King Guano	do	do	do	do	200	2	4	5	2	1.75	23 05
Giant guano	do	do	do	do	200	2	4	5	2	1 75	23 05
Folmer's guano	Globe Fert. Co ,	Louisville, Ky	Globe Fertilizer Co	Louisville, Ky	200	4	8	. .	2	5	23 00
Boguss phosphate	do	do	do	do	200	1.25	8	.	2	1	17 87
Tinsley's standard fert.* (see note)	Tinsley Fertilizer Co.,	Selma, Ala	Tinsley Fertilizer Co.	Selma, Ala	200	2	8	2	1	1.50	24 30
Tinsley's standard acid phos	do	do	do	do	200	.	11	3	1	. ...	21 00
Eddystone soluble guano	Jno. M. Green,	Atlanta, Ga	Atlanta Guano Co	Atlanta, Ga	200	2	7	2	2	1	22 30
Atlanta am. sup. phosphate	do	do	do	do	200	2	7	2	2	1	22 30
" soluble bone	do	do	do	do	200	...	8	2	2	.....	15 00
Rainbow sol. phosphate	do	do	do	do	200	1	8	2	2	1	19 90
Sunny South acid phosphate	do	do	do	do	200	.. .	8	2	2	......	15 00
Wando soluble guano	F. B. Hacker,	Charleston, S. C	Wando Phosphate Co.	Charleston, S. C.	200	1 65	6.50	2	2	2	19 68
Wando am. dissolved bone	do	do	do	do	200	.75	7	3	2	1	18 92
Wando acid phosphate.	do	do	do	do	200	....	10	1	.50		16 50
Wando dissolved bone	do	do	do	do	200	....	10	1	.50	......	16 50

Guaranteed Analyses of Commercial Fertilizers, as rendered to the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

NAME OF FERTILIZER OR CHEMICAL.	BY WHOM REPORTED. NAME AND ADDRESS.	BY WHOM MANUFACTURED.	WHERE MANUFACTURED.	Weight of Package.	Nitrogen.	PHOSPHORIC ACID.			Potash.	Commercial Value.
						Water Soluble.	Citrate Soluble.	Acid Soluble		
Wando acid phosphate	F. B. Hacker, Charleston, S. C.	Wando Phosphate Co.	Charleston, S. C.	200	....	9	1	1	1	16 00
Etiwan guano	Etiwan Phos. Co., Charleston, S. C.	Etiwan Phosphate Co.	do	200	1.75	5	2	2	1 25	18 50
Etiwan am. sup. phosphate	do do	do	do	200	1 50	5	2	1	1	17 35
Etiwan am. dissolved bone	do do	do	do	200	.87	7	2	1	1	17 89
Etiwan am. dissolved bone	do do	do	do	200	....	10	1	1	...	16 50
Etiwan acid phosphate	do do	do	do	200	...	8	3	1	1	17 50
Southern acid phosphate	Southern Phos. Co., Atlanta, Ga.	Southern Phos. Co.	Atlanta, Ga	200	..	10	4	2	....	21 00
Southern am. dissolved bone	do do	do	do	200	2	7	1.50	2	1 50	21 55
Old Dominion guano	do do	do	do	200	2.25	8	1 50	2	1 50	24 52
Patent Pacific guano	do do	do	do	200	2	8	1 50	1	1.50	23 75
Patapsco am. sol. phosphate	Ga Chemical Works, Augusta, Ga.	Georgia Chem. Works.	Augusta, Ga	200	2	6	3	..	1	22 30
" acid phosphate	do do	do	do	200		9	3	..	1	19 00
" am. dissolved bone	do do	do	do	200	1.75	6	3	..	1	21 32
Mastodon am. sol. phos	do do	do	do	200		10	3		..	19 50
Georgia Formula	do do	do	do	200	2	6	3	3	1	22 30
Acid phosphate	do do	do	do	200	1.75	6	3	3	1	21 32
" "	do do	do	do	200		9	3	2	1	19 00
Mastodon am. sol. phosphate	do do	do	do	200		10	3	2	....	19 50
Georgia Formula	do do	do	do	200	2	6.75	2 25	1.50	1	22 30
Plow brand raw bone sup. phosphate	Walton & Whann Co., Charleston, S.C	Walton & Whann Co.	Charleston, S. C.	200	2	6	2	2	2.25	22 05
Reliance am. sup. phosphate	do do	do	do	200	1 50	5	2	1	1	17 35
W. & W. Co. am. dissolved bone	do do	do	do	200	87	7	2	1	1	17 89
Diamond soluble bone	do do	do	do	200	..	10	1	1	.....	16 50
X X acid phosphate	do do	do	do	200	....	10	1	1	....	16 50
Eng. acid phos. high grade	do do	do	do	200	..	10	1	1	....	16 50
High grade Eng. acid phosphate	do do	do	do	200	..	11.50	1	1	....	18 75
So. States standard am. bone	C. L. Montague & Co., Savannah, Ga.	C. L. Montague & Co.	Savannah, Ga.	200	1 65	6	3	1	1.25	21 18

State Alliance favorite	do do	do	do	200	.82	7	3	1	1	19 22
Alliance standard	Savannah Guano Co., Savannah, Ga.	Savannah Guano Co.	do	200	1.65	6	3	1	1.25	21 18
Our own am. bone	do do	do	do	200	1.65	6	3	1	1.25	21 18
Excelsior am. bone	do do	do	do	200	1.65	6	3	1	1.25	21 18
Diamond cotton food am. bone	do oo	do	do	200	1.65	6	3	1	1.25	21 18
Dissolved bone acid phosphate	do do	do	do	200	..	9	4	1	..	19 50
English dissolved bone acid phosphate	do do	do	do	200	....	9	4	1	.....	19 50
Standard of Alabama	do do	do	do	200	.825	7	3	1	1	19 22
Southern Pacific guano	do do	do	do	200	1	7	3	1	1.25	20 15
Farmer's favorite	do do	do	do	200	825	7	3	1	1	19 22
Acid phosphate	Ga. Chemical Works, Augusta, Ga	Georgia Chem. Works	Augusta, Ga	200		9	3	1	1	19 00
" "	do do	do	do	200		10	3	1	....	19 50
Furman's high grade guano	Adair Bros. & Co., Atlanta, Ga	Furman Farm	Atlanta, Ga	200	2.25	7 50	2 50	2	1.50	25 27
Buffalo bone guano	do do	Improvement Co	do	200	2	7.5	2 50	2	1	23 80
Furman's sol. bone with am and potash	do do	do	do	200	.85	8	3	2	1	20 81
Farish Furman's formula	do do	do	do	200	..	8	3	2	2.50	19 00
Furmans acid phosphate	do do	do	do	200	...	11	2	2		19 50
Golden grain fertilizer	do do	do	do	200	2.25	7	2	2	2 50	24 77
Homestead guano	do do	do	do	200	2	7	2	2	....	21 30
Adair's am. dissolved bone	do do	Adair Bros. & Co	do	200	2	8	2	2	1	23 80
Planter's soluble guano	do do	do	do	200	1 85	7.50	2 50	2	1	23 21
Adair's acid phosphate	do do	do	do	200		11	2	2	...	19 50
King cotton	W. N Reeves, Eufaula, Ala	Chattahoochee Ft Co.	Eufaula, Ala	200	2 31	4 80	3.48	1 99	1.50	22 93
The complete cotton fertilizer	Commercial Guano Co , Savannah, Ga	Commercial Guano Co.	Savannah, Ga.	200	1.65	7	1	1 50	1 75	20 18
Pomona guano	do do	do	do	200	1 65	7	1	1 50	1.75	20 18
Chatham guano	do do	do	do	200	1.65	7	1	1 50	1 75	20 18
Cherokee am bone	do do	do	do	200	1 65	7	1	1.50	1.50	19 93
Old time guano	do do	do	do	200	1.65	6	2	1.50	1	19 43
Am. dissolved bone phos	do do	do	do	200		11	1	1	...	18 00
Pomona acid phosphate	do do	do	do	200		11	1	1	.....	18 00
Chatham acid phosphate	do do	do	do	200		11	1	1		18 00
Georgia bone compound	do do	do	do	200		9	1	1	1 50	16 50
Climax Guano	do do	do	do	200	1 65	6	1	1	1	17 93
Troy Perfect	The Troy Fertilizer Co., Troy, Ala.	Troy Fert. Co	Troy, Ala	200	1 75	7	1	...	1	19 82
Farmers alliance.	do do	do	do	200	1.75	7	1		1	19 82
Pike county.	do do	do	do	200	1.75	7	1	..	1	19 82

Guaranteed Analyses of Commercial Fertilizers, as rendered to the Commi4sioner of Agriculture by Dealers and Manufacturers Continued.

NAME OF FERTILIZER OR CHEMICAL.	BY WHOM REPORTED. NAME AND ADDRESS.	BY WHOM MANUFACTURED.	WHERE MANUFACTURED.	Weight of Package.	Nitrogen.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	Commercial Value.
The Troy acid phosphate	The Troy Fertilizer Co., Troy, Ala	Troy Fert Co	Troy, Ala	200	..	10	2	...	......	18 00
W. W. & B. high grade ammoniated Samson guano	Wight, Weslosky & Brown, Albany, Ga	Wight, Weslosky & Brown	Albany, Ga	200	1.31	7	2	...	2	20 61
Vandiver's high grade acid phosphate	W. F. Vandiver & Co., Montgom'y, Ala.	Wando Phos. Co	Charleston, S. C.	200	..	10	1	.50	......	16 50
Vandiver's am. dissolved bone	do do	do	do	200	75	7	3	2	1	18 92
W. & W. am. dissolved bone	do do	Walton & Whann Co	Wilmington, Del	200	87	7	2	1	1	17 89
Diamond soluble bone	do do	do	do	200		10	1	1	......	16 50
X X acid phosphate	do do	do	do	200	..	10	1	1	......	16 50
Soluble Pacific guano	W. J. Pollard, Augusta, Ga	Pacific Guano Co	Boston, Mass	200	1 85	6.50	2 50	2	1	21 71
Alliance high grade acid posphate	Penn & Co., Opelika, Ala	Berkley Phosphate Co.	Charleston, S. C.	200	..	10	3	2	.....	19 50
Home fertilizer	Boykin, Carmer & Co., Baltimore, Md.	Boykin, Carmer & Co	Baltimore Md	167	2.20	9	3	..	......	20 58
Home fertilizer chemicals	do do	do	do	213	5 75	..	.	..	7	29 42
Stono soluble guano	E. H. Frost & Co., Charleston, S. C	Stono Phos. Works	Charleston, S. C.	200	2	6	2	2	1	20 80
Stono Dissolved bones	do do	do	do	200	..	10	2	2	.....	18 00
Stono acid phosphate	do do	do	do	200		8	2	2	1	16 00
Kainit	do do	do	do	200	...	.....	.		12	12 00
Americus am. bone sup. phosphate	Williams & Clark. New York, N. Y	Williams & Clark Ft. Co	New York, N. Y	200	1.65	6	2	2	1	19 43
Walton guano	Walton Guano Co., Atlanta, Ga	Walton Guano Co	Atlanta, Ga	200	2	7	2	2	1	22 30
Walton acid phosphate	do do	do	do	200	..	10	3	2	....	19 50

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* In Bulletin No. 2, New Series, the commercial value of Tinsley's "Standard" Fertilizer was printed at $21.30, when it should have been $24 30, an unintentional error being made against this brand of of $3.00. The percentage of ingredients was correctly stated; the error occurred in computing the commercial value of the ingredients. This statement is made in justice to said brand, which is manufactured by Tinsley Fertilizer Co., Selma, Ala.

For the imformation of the people of the State, I have thought proper to publish the "Fertilizer Laws," *with a list of the fertilizer dealers to whom license have been issued,* with date of issue.

I find a great many fertilizer dealers and farmers who are ignorant of the law governing this Department, especially that portion of it referring to the sale of fertilizers, and with the hope that all may be educated as to their duties and rights, is my excuse for publishing the fertilizer laws in full.

The list of *licenses* is published that all may know who have complied with the law and who have not. I have announced publicly and privately my intention to enforce the law to the letter so long as I remain at the head of this Department, and to successfully carry out this undertaking I invoke the aid of all law-abiding citizens of the State. The name of this Department implies that it was originated especially for the farmers of the State, and I shall undertake to administer it in their interest.

FERTILIZER LAWS.

Section 139. *Sale or exchange of commercial fertilizers.*—Commercial fertilizers must not be sold or exchanged without a license from the Commissioner authorizing the person making the sale or exchange to deal therein. All sales or exchanges made without such license are void.

Sec. 140. *License.*—On the payment of a fee of one dollar, the Commissioner must issue license to any person or firm, or corporation or association of persons authorizing the sale or exchange of fertilizers during a season, expiring on the thirtieth day of September of each year.

Sec. 141. *Tags to be supplied; licensee.*—The Commissioner must furnish the licensee on application, tags to be attached to fertilizers sold or exchanged, of the kind and description he is required by subdivision 17 of section 137 to prepare, on the payment to him of fifty cents for a number sufficient to tag a ton of fertilizers. *Before selling or exchanging, or offering to sell or exchange fertilizers, the licensee must attach one of the tags to each bag, barrel or package thereof, and a sale or exchange of fertilizers, not so tagged, is* void.

Sec. 142. *Fertilizers to be submitted to Commissioners.*—Before offering a fertilizer for sale or exchange, the person proposing to sell or exchange must submit to the Commissioner a written or printed statement setting forth—

1. The name and brand under which such fertilizer is to be sold or exchanged, the number of pounds contained in the bag, barrel or package, in which it is to be put upon the market, the name or names of the manufacturers, and the place of manufacturing.

2. A statement setting forth the amount of the named ingredients which they are willing to guarantee such fertilizer to contain. First, nitrogen; second, water soluble phosphoric acid; third, citrate soluble phosphoric acid; fourth, acid soluble phosphoric acid; fifth, potash; and such statements shall be held to constitute a guarantee to the purchaser that every package of such fertilizer contains not less than the amount of each ingredient set forth in the statement, and when such statement sets forth the maximum and minimum of any ingredient, the commercial value shall be estimated upon the minimum alone, but this shall not preclude the party from setting forth any other ingredient which the fertilizer may contain, which, as well as the preceding, shall be embraced in the guarantee

Sec 143. *Fertilizers and chemicals for manufacturing to be branded.*—All fertilizers or chemicals for manufacturing or composting the same offered for sale, exchange or distribution, must have branded upon or attached to each bag, barrel or package, *in such manner as the commissioner* may by regulation establish, the true analysis of such fertilizer or chemical as claimed by the manufacturer, showing the percentage of valuable elements or ingredients such fertilizer or chemical contains, *and its commercial value,* calculated upon the standard of value of the principal ingredients as set forth in section 142, *as priced by the commissioner of agriculture* at the beginning of each season, and in every case the brand must specifically set forth the percentage contained in the fertilizer or chemical of the several ingredients specified in section 142 in the terms of that section.

SEC. 144. *Fertilizer; what included in term.*—The term "fertilizer," or "commercial fertilizer," as used in this article, does not include common lime, land plaster, cotton seed, cotton seed meal, ashes or common salt not in combination.

SEC. 145. *Chemist of Department.*—The Professor of Chemistry of the Agricultural and Mechanical College is the official chemist of the Department. On the application of the Commissioner he must analyze and certify the analysis of all fertilizers, samples of which are furnished him, and at the request of the Commissioner, if he can without conflict with his duties as professor, must attend conventions of agricultural chemists, make reports of such matters as he may deem of interest to the Department, and render such other services in the line of his profession as the Commissioner may require.

SEC. 146. *Compensation of Chemist.*—The Chemist is entitled to such compensation as the Commissioner may deem reasonable; not exceeding five hundred dollars annually; and also to his necessary traveling expenses, while on duty assigned to him by the Commissioner; payable from the funds of the Department, on the certificate of the Commissioner.

SEC. 147. *Copy of official analysis; evidence.*—The copy of the official analysis of any fertilizer or chemical, under the seal of the Department of Agriculture, shall be admissible as evidence in any of the courts of this State, on the trial of any issue involving the merits of such fertilizer or chemical.

CRIMINAL LAWS.

SEC. 4153. *Dealing in fertilizers without submitting statement to Commissioner.* Any person who manufactures or exchanges, sells, or offers for sale or exchange, any fertilizer without first submitting the statement required by law to the Commissioner of Agriculture, must, on conviction, be fined not more than five hundred dollars for each offense.

SEC. 4154. *Selling fertilizers without attaching proper tags.*—Any person who sells, exchanges or offers for sale or exchange, any bag, package or barrel of fertilizer which has not been tagged as provided by law, must, on conviction, be fined not less than fifty dollars for each offense.

SEC. 4155. *Using more than once, and counterfeiting tags, etc.*—Any person who counterfeits the tag prepared by the Commissioner of Agriculture, or who knowingly uses a counterfeit of such tag, or who uses a second time a genuine tag, or who uses the tag of a former season, must, on conviction, be fined one hundred dollars.

SEC 4156. *Making false certificate of analysis of fertilizers.* Any chemist, who wilfully makes a false certificate of the analysis, or of the ingredients of any fertilizers intended or offered for sale or exchange, must, on conviction, be imprisoned in the penitentiary for not less than two, nor more than five years.

SEC. 4157. *Dealing in commercial fertilizers without license.*—Any person, who sells or exchanges fertilizers, without having obtained a license from the Commissioner of Agriculture, as provided by law, must, on conviction, be fined not less than one hundred dollars for each offense

SEC. 4158. *Fraud in manufacture, sale or exchange of fertilizers.*—Any person who commits a fraud in the manufacture, sale or exchange of any fertilizer, or any of the ingredients of a fertilizer, must, on conviction, be fined not less than one hundred dollars for each offense.

Dealers and manufacturers will observe from the reading of the foregoing sections of the Code, that *before they can sell fertilizers in this State, they must*—

1. Procure from the Commissioner of Agriculture a license authorizing them to make the sale or exchange. In *all cases* the fee of one dollar *must* accompany the application.
2. Each dealer and manufacturer is *required* to file in this office his *guaranteed analysis* of the several brands of fertilizers he proposes to sell or exchange.
3. *The same guarantee that is filed in this office must appear upon the sacks, bags or barrels.*

LIST OF LICENSES

For Season of 1889-90, With Date of Issue.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Dec. 14 Alabama Fertilizer Co., Montgomery, Montgomery.
24 Alben, J. J. & J. L., Opelika, Lee.
26 Adkison, D. I. B , Martha, Geneva.
30 Armstrong, Thos. L., Balkum, Henry.
30 Arnold, J. H., Liberty, Blount.
Jan. 8 Askew & Harris, Dothen, Henry.
8 Allen & Bro., D. G., Lafayette, Chambers.
10 Andrews & Martin, Clayton, Barbour.
11 Adams & Pearson, Alexander City, Tallapoosa.
11 Acree, O. A. C., Newton, Dale.
15 Akin & Son, J. C., Notasulga, Macon.
17 Askew & Son, Cusseta, Chambers,
18 Atkins & Bowman, Heflin, Cleburne.
21 Auxford & Moseley, Hull, Tuscaloosa.
22 Allen, Sellers & Co., Montgomery, Montgomery.
23 Ashmore, J. W., Scottsboro, Jackson.
28 Agee, W. P., Perdue Hill, Monroe.
30 Andrews, E. L., Lafayette, Chambers.
Feb. 5 Appling, Samuel, Fayette C. H., Fayette.
17 Adair Bros. & Co., Atlanta, Ga.
17 Allen & Co., R. W., Lafayette, Chambers.
March 10 Alberson & Clemmonds, High Falls, Geneva.
17 Ashurst, J. V., Tallassee, Elmore.

Oct. 1 Berkely Phosphate Co., Charleston, S. C.
28 Beavers & Marsh, Collinsville, DeKalb.
Nov. 6 Brantley & Son, F. K., Troy, Pike.
20 Betts, W. H., Burnt Corn, Conecuh.
22 Baker, Joe, Baker, Henry.
23 Boykin, Carmer & Co., Baltimore, Md.
25 Beard, W. F., Troy, Pike.
Dec. 3 Bradley, W. E., Abbeville, Henry.
7 Ballard & Holder, Roanoke, Randolph.
7 Brown & Oakley, Columbia, Henry.
7 Bailey, B. W., Wicksburg, Henry.
9 Boyd, Wm. R., Savannah, Ga.
11 Beach, H. M., Columbia, Henry.
30 Baker, E., Frio, Coffee.
30 Bowdon, Samuel, Gordon, Henry.
Jan. 1 Bowen, J. L., Five Points, Chambers.
6 Black, W. A., Kennedy, Lamar.
6 Brannon & Wright, Troy, Pike.
7 Blackburn & Coggin, Fayette C. H., Fayette.
8 Burdeshaw & Co., P. L., Dothan, Henry.
10 Baxley & Falkner, Sterrett, Shelby.
9 Beeland & Son, J., Greenville, Butler.
14 Beason, F. R., Gurley, Madison.
15 Brown & Co., J. A., Kellyton, Coosa.
18 Baldwin & Co., W. E., Flint, Morgan.
20 Bynum & Sons, J. E., Oneonta, Blount.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Jan	23	Ballard, J., Omaha, Randolph.
	24	Breedlove & Co., J. P., Tuskegee, Macon.
	30	Banks, W. H. & N P., Hurtsboro, Russell.
Feb.	3	Brice & Donehoo, Murphrees Valley, Blount.
	6	Brown & Co., W. D., Gravella, Conecuh.
	8	Brandon & Russell, Sterling, Cherokee.
	10	Brown, J. A., Berry Station, Fayette.
	10	Burgess, J. A., Edwardsville, Cleburne.
	10	Byars & Son, W. G., Blount Springs, Blount.
	15	Burnett & Bro., J. F., Cedar Bluff, Cherokee.
	17	Borders & Co. A. H.. Choccolocco, Calhoun.
	17	Blakeney, L. C., Millport, Lamar.
	21	Brown, W. S., Birmingham, Jefferson.
	25	Brantley & Edmonson, Troy, Pike.
	26	Burns & Wilson. Lincoln, Talladega.
	26	Bloch, Sol. D., Camden, Wilcox.
March	1	Bradley, Philip, Perdue Hill, Monroe.
	3	Bell & Low, Lincoln, Talladega.
	4	Burnett, G. W., Fayette, C. H., Fayette.
	18	Bliss, R. L., Florence, Lauderdale.
	18	Banks, Arnold & Co., Attalla, Etowah.
	20	Brown, A. J , Hillsboro. Lawrence.
	22	Bledsoe, J. W., Three Notch, Bullock.
	26	Brake, J. L., Warrior, Jefferson.
Oct.	1	Columbus Fertilizer Co., Columbus, Ga.
	24	Curtis & Wright, Luverne, Crenshaw.
	28	Chattahoochee Fertilizer Co., Eufaula, Barbour.
Nov.	13	Cheney, J. C , Montgomery, Montgomery.
	15	Crawford, J. W., Lawrenceville, Henry.
	21	Cooke, J. E., Marietta, Walker.
	23	Cleveland, M. L., Randolph, Bibb.
	25	Crim & Borland, Newton, Dale.
	27	Coleman, Walter S., Troy, Pike.
Dec.	9	Chesapeake Guano Co., Baltimore, Md.
	12	Chemical Company of Canton, Baltimore, Md.
	12	Cody, M. & J. M , Columbia, Henry.
	12	Cherry, Robert, Eufaula, Barbour.
	17	Coweta Fertilizer Co., Newnan, Ga.
	27	Casey, W. L., Ozark, Dale.
	28	Cherry & Smith, Opelika, Lee.
Jan.	2	Cassady, J. W., Strickland, Dale.
	3	Carleton, Geo. A., Grove Hill, Clarke.
	14	Crew & Dunnan, Goodwater, Coosa.
	15	Columbus Oil Mills, Columbus, Mississippi.
	18	Carroll, Major, Ozark, Dale.
	20	Crump & Son, J. C., Sand Mountain, DeKalb.
	20	Chambers, J. P. & E. M., Zornville, Henry.
	20	Cooke, Phillips & Walker, Kennedy, Lamar.
	22	Clayton, M. A., Cedar Bluff, Cherokee.
	22	Crew & McElrath, Goodwater, Coosa.
	23	Carlisle & Bro., M. W., La Fayette, Chambers.
	25	Comer & Trapp, Anniston, Calhoun.
	25	Chewacla Lime Works, Chewacla, Lee.
	28	Cox & Barrow, Tuskegee, Macon.
	31	Cameron, J. E., Notasulga, Macon.
Feb.	5	Coons, M. L., Kennedy, Lamar.
	5	Coons, M. L., Millport, Lamar.
	8	Caldwell & Co., J. R., Heflin, Cleburne.
	10	Cooke Bros., Cooke Springs, St. Clair.

		DATE OF ISSUE, POST-OFFICE, AND COUNTY.
Feb.	10	Cooke, J. E. & L., Birmingham, Jefferson.
	13	Cooper & Co., O. W., Oxford, Calhoun.
	14	Clark, White & Co., Guin, Marion.
	15	Clayton, G. A., Petrey, Crenshaw.
	21	Connell & Smith, Falkville, Morgan.
	24	Capps, M. V., Abbeville, Henry.
	24	Campbell & Co., A. E., Eunola, Geneva.
	26	Cole, Phillips & Co., Millport, Lamar.
Mar.	11	Cobb & Poe, Sulligent, Lamar.
	17	Copeland, J. S., Troy, Pike.
	20	Carter & Co., Bradleyton, Crenshaw.
Nov.	22	Davis, John H., Athens, Limestone.
Dec.	1	Davis, John T., Jr., Columbia, Henry.
	4	Dowling & Bro., D. Y., Ozark, Dale.
	12	Davis & Son, Wm. F., Marion, Perry.
	16	Dean & Barnes, Dean's Station, Dale.
	30	Dumas & Co., J. T., Arlington, Wilcox.
	31	Duke & Co., R. J., Burnt Corn, Conecuh.
	31	Dunklin & Son, D. G., Greenville, Butler.
Jan.	3	Dowling, J. W., Ozark, Dale.
	3	Dowling, R. J. & G. P., Ozark, Dale.
	8	Drum & Ezekiel, Greenville, Butler
	10	Davis, Marshall & Co., Mobile, Mobile.
	10	Davidson Bros., Sulligent, Lamar.
	13	Douglass, Duncan & Robinson, Alexander City, Tallapoosa.
	17	Dake, Alex. G., Clanton, Chilton.
	17	Dawson, G. W., Camp Hill, Tallapoosa.
	17	Dean, W. R., Warrior, Jefferson.
	23	Daughtry & Co., R. M., Echo, Dale.
	24	Dickson & Porter, Evergreen, Butler.
	30	Denson & Cross, Pelham, Shelby.
Feb.	1	Davis, E. R., Rock Run Station, Cherokee.
	3	Daniel & Co., J. G., Greenville, Butler.
	5	Dawson & Co., L. G., Ware, Elmore.
	6	Dennis, P. C., Cooper Station, Chilton.
	13	Doster, C. S. G., Prattville, Autauga.
	15	Deans, G. B., Calera, Shelby.
	19	Darr, J. P., Millport, Lamar.
	22	Davis, J. F. M. & T. J., Choccolocco, Calhoun.
Mar.	14	DuBose, J. H., Silas, Choctaw.
	14	Denning & Co., C. P., Evergreen, Conecuh.
	24	Davenport & Co., N. S., Valley Head, DeKalb.
Oct.	1	Etiwan Phosphate Co., Charleston, S. C.
Nov.	18	East Alabama Fertilizer Co., Clayton, Barbour.
	25	Eufaula Oil and Fertilizer Co., Eufaula, Barbour.
Dec.	28	Edmonson & Bro., R. Q., Eufaula, Barbour.
Jan.	6	Earle & Co., P. H., Birmingham, Jefferson.
	21	Edmonds, Wm., York Station, Sumter.
	28	Ehrman, R., Clanton, Chilton.
	30	Emmons, T. J., Monroeville, Monroe.
	31	Elliott & Young, Leeds, Jefferson.
Feb.	10	Easterling & Co., W. S., Berry Station, Fayette.
	20	Ethridge, W. R., Peach Bloom, Conecuh.
	22	Eutaw Mercantile Co., Eutaw, Greene.
Mar.	6	Emmett, L. S., Albertsville, Marshall.
	24	Elliott, A. M., Columbiana, Shelby.
Nov.	4	Folmar & Sons, Troy, Pike.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Nov.	23	Folmar & Co , George A., Luverne, Crenshaw.
	29	Frost & Co., E. H., Charleston, S. C.
Dec.	4	Farley, John C., Opelika, Lee.
Jan.	4	Forrester.. B. A., Cowarts. Henry.
	4	Foast, J. M., Warrior, Jefferson.
	24	Fulmer, Carlisle & Co., Goodwater, Coosa.
	24	French, B. D., Sylacauga, Talladega.
	24	Freeman & Cox, Notasulga, Macon.
	25	Farmer, T. J., Jr., Shorterville, Henry.
	25	Farnham & Co., J. H., Evergreen, Conecuh.
	28	Foster, R. M., Marion, Perry.
	29	Finch & Co., L., Evergreen, Conecuh.
	30	Frohoff, Frank, Hanceville, Blount.
Feb.	1	Formby & Stewart, Spring Garden, Cherokee.
	11	Fleming & Co., Charles P., Vincent, Shelby.
	11	Flinn, R. J., Luverne, Crenshaw.
	20	Fielder, J. B., Loachapoka, Lee.
	26	Fuelner, George, Soapstone, Dallas.
Mar.	1	Farmers Store, Leesburg, Cherokee.
	15	Freeman & Freeman, Walnut Grove, Etowah.

Oct.	28	Goulding, W & H. M., Baltimore, Md.
Nov.	20	Gulledge, F. A., Verbena, Chilton.
	29	Gilder, G. C., Mount Meigs, Montgomery.
Dec.	7	Gilbert, Jno. R., Pinckneyville, Clay.
	11	Griel Bros. & Co., Montgomery, Montgomery.
	11	Goree, L. F., Deatsville, Elmore.
	27	Gibson & Patterson, Tallassee, Elmore.
Jan.	9	Griffin & Co., G. L., Lafayette, Chambers.
	10	Garner, Wm., Ozark, Dale.
	10	Grady & Son, J. D., Stroud, Chambers.
	21	Grant, J. B., Louisville, Barbour.
	23	Greene, Jas. R., Waverly, Lee.
	23	Greene & Sons, R. M., Opelika, Lee.
	25	Gold Hill Alliance Store, Gold Hill, Lee.
	25	Griffith, Asa, Hanceville, Blount.
	29	Gosdin & Co., Goodwater, Coosa.
	30	Griffin & Orr, Oxford, Calhoun.
Feb.	4	Gilmer & Bruister, Butler, Choctaw.
	7	Guin, Perry C., Brockton, Fayette.
	20	Guest, S. W., Seaborn, Etowah.
	27	Gravlee & Co., J. A., Jasper, Walker.

Oct.	1	Hammond, Hull & Co., Savannah, Ga.
Nov.	26	Herring, B. W., Headland, Henry.
	27	Holman, J. C., Ozark, Dale.
	29	Harwell, W. O., Opelika, Lee.
	30	Hooten & Co., Columbia, Henry.
Dec.	10	Henderson Bros. & Co., Troy, Pike.
	12	Hudson, W. J., Mobile, Mobile.
	18	Holmes, N. H., Montgomery, Montgomery.
	19	Howle Bros., Edwardsville, Cleburne.
	19	Hunnicutt & Son, W. R., Heflin, Cleburne.
Dec.	24	Henderson, L & W. J., Troy, Pike.
	27	Hobbie & Teague, Montgomery, Montgomery.
	30	Hutchinson, J. N., Salem, Lee.
	30	Herzberg, H., Gadsden, Etowah.
Jan.	3	Hill, Noles, Jones & Co., Roanoke, Randolph.
	8	Henderson, J. E. & J. C., Ozark, Dale.
	10	Hirsch Bros., Seale, Russell.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Jan. 13 Holley, F. M., Lawrenceville, Henry.
15 Haynie & Co., W. H. Loachapoka, Lee.
15 Henderson, J. M. & Fox, Troy, Pike.
18 Hodge & Co., H. P., Lafayette, Chambers.
18 Hooper & Nolen, New Site, Tallapoosa.
18 Hooper, Jno. F., New Site, Trllapoosa.
20 Hooper & Co., C. W., Selma, Dallas.
21 Holifield & Co., J. A., Auburn, Lee.
21 Hoffman. W. & L., Waverly, Lee.
22 Heard, Geo. P., Georgiana, Butler.
23 Hood, W. T., Oneonta, Blount.
23 Hood, W. T., Murphree's Valley, Blount.
28 Hodo, A. P., Carrollton, Pickens.
29 Hood, David, Wynnville, Blount.
31 Hill, Bell & Cheney, Anniston, Calhoun.
Feb. 1 Hubbard & Hall, Sylacauga, Talladega.
4 Harris, W. H., Troy, Pike.
5 Henderson & Bro., Fullerton, Cherokee.
5 Harkins & Bankhead, Fayette C. H., Fayette.
6 Hansard, M. H., Mumford, Talladega.
7 Henry & Co., Sam, Gadsden, Etowah.
7 Huntsville F. & M. Co., Huntsville, Madison.
7 Holloway & Gilchrist, Geneva, Geneva.
7 Head, T. L., China Grove, Pike.
10 Haynes & Co., D. P., Oxford, Calhoun.
10 Hooper & Co., C. S., Blount Springs, Blount.
10 Hamilton, Wm., Edwardsville, Cleburne.
12 Hoge, Joseph, Portersville, DeKalb.
12 Hamilton Bros., LaPlace, Macon.
14 Henderson, T. J., Mountain Creek, Chilton.
19 Humber, L. P., Fayette C. H., Fayette.
21 Howard & Lamar, Tuskegee, Macon.
26 Hardy, Jr., Miles, Soapstone, Dallas.
March10 Harrell & Fost, Blount Springs, Blount.
11 Henley, T. S., Townley, Walker.
14 Hodges & Cox, Steele's Depot, St. Clair.
20 Hughes, R. F., Piedmont, Calhoun.
25 Hartsell, Bros. & Co., Hartsells, Morgan.
April 2 Hixon Bros., Claiborne, Monroe.
7 Hicks & Co., W. W., Dadeville, Tallapoosa.
8 Hanchey, W. E., Troy, Pike.
10 Haley, C. L., Ark, Winston.

Feb. 3 Ivey, J. W., Petrey, Crenshaw.
April 10 Ingle & Long, Ark, Winston.

Nov. 11 Johnson, Jr., T. M., Augusta, Ga.
Dec. 4 Johnson, J. J., Geneva, Geneva.
6 Jones & Co., Newton, Dale.
Jan. 7 Jordan & Son, Midway, Bullock.
8 Jackson & Mehaffey, Columbus, Miss.
13 Jackson & Co., Talladega, Talladega.
Feb. 7 Jennings, Ben., Seale, Russell.
10 Julian, G. W., Berry Station, Fayette.
March 3 Jordan, Manning & Co., Guntersville, Marshall.
5 Johnston, J. W., Columbiana, Shelby.
13 Jones, H. A., Townley, Walker.

Nov. 27 Kelly & Davis, Newton, Dale.
Dec. 9 Knox, C. J., Troy, Pike.

DATE OF ISSUE, POST-OFFICE, AND COUNTY,

Dec. 27 Klaus & Co., J., Huntsville, Madison.
30 Kennon & Bro., Salem, Lee.
30 Kelly, G. W., Newton, Dale.
Jan. 4 King, Claude, Leighton, Colbert.
10 Kennesaw Guano Co., Atlanta, Ga.
17 Kingry & Co., Gordon, Henry.
20 Koopman & Gerdes, Cullman, Cullman.
23 Kirkpatrick & Co., Howell's X Roads, Cherokee.
23 Kirkpatrick & Co., James D., Kirk's Grove, Cherokee.
29 Keeble Co., H. C., Selma, Dallas.
29 Karter, J. H., Cullman, Cullman.
30 Keener, J. P., Keener, Etowah.
31 Killough, W. M., Mount Pinson, Jefferson.
Feb. 7 Kendrick & Co., A. T., Luverne, Crenshaw.
14 Killian & Burt, Brandon, DeKalb.
17 Kirk & Collins, Guin, Marion.
March 3 Kevell, George, Montevallo, Shelby.
6 King & Co., F. R., Leighton, Colbert.
27 Knobles & Cragin, State Line, Miss., Washington.
31 Keith, W. J., Geneva, Geneva.

Oct. 1 Lowery, A. M., Canoe, Escambia.
Nov. 11 Loeb, Simon, Augusta, Ga.
27 Lockard, A. T., Troy, Pike.
29 Little, Wilkinson & Co., Mobile, Mobile.
Dec. 1 Lewis, D. L. & J. A., Sycamore, Talladega.
14 Lull & Lancaster, Wetumpka, Elmore.
24 Long, N. W. E., Hurtsboro, Russell.
Jan. 2 Long & Co., Granger, Henry.
6 Lorentz & Rittler, Baltimore, Md.
8 Lehman, A., Greenville, Butler.
11 Lewis & Co., D. L., Talladega, Talladega.
11 Lann & Carter, Aberdeen, Miss.
13 Lovejoy & Co., A. B., Sylacauga, Talladega.
21 Lawrence, R., Cedar Bluff, Cherokee.
25 Lemay, S. I., Hartselle, Morgan.
Feb. 3 Little, C. E., Auburn, Lee.
7 Lusk, T. B., Guntersville, Marshall.
7 Lazenby, Reynolds & Co., Forest Home, Butler.
10 Lantznester, J. P., Birmingham, Jefferson.
15 Landerdale & Crew, Goodwater, Coosa.
20 Lee & Co., Robert A., Greenville, Butler.
24 Little & Co., F. M., Littleton, Etowah.
25 Leslie, George, Gordon, Henry.
28 Lawson & Sellers, Bryan Station, Jefferson.
March 1 Lowery & Bro., J. M., Perdue Hill, Monroe.
15 Latimer, S. F., Geneva, Geneva.
15 Laney, H. N., Eden, St. Clair.
April 7 Eden, I. R. W., Eden, St. Clair.

Nov. 13 Montague & Co., Savannah, Ga.
Dec. 12 Manley, Handley & Co., Roanoke, Randolph.
14 Marks & Gayle, Montgomery, Montgomery.
17 Mahan, W. H., Randolph, Bibb.
24 Manasses, J., Clayton, Barbour.
27 Mayfield, Pittman & Co., Roanoke, Randolph.
31 Martin, Murdock, Clio, Barbourr.
Jan. 1 Miles, T. B., Union Springs, Bullock,
2 Maas & Schwarz, Selma, Dallas.
2 Moody & Co., W. S., Dothen, Henry,

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Jan.	8	Malone & Collins, Geneva, Geneva.
	18	Merryman & Co., John, Baltimore, Md.
	22	Meadors, T. A., Kempville, Monroe.
	23	Morris, J. C., Day's Gap, Walker.
	23	Maxwell & Groggins, Alexander City, Tallapoosa.
	28	Moreman, J. M., Waverly, Lee.
	30	Martin, T. J., Harpersville, Shelby.
	31	Mathewson & Co., J. O., Augusta, Ga.
	31	Melton & Co., Pine Apple, Wilcox.
Feb.	10	Marietta Guano Co., Atlanta, Ga.
	11	Miller, R. H., Castleberry, Conecuh.
	12	Milner & Hill, Columbiana, Shelby.
	15	Mills & Pouncey, Clayhatchie, Dale.
	20	Moore & King, Fayette C. H., Fayette.
	21	Morris & Bro., D. W., Chepultepec, Blount.
	25	Mayes, R. L., Guerryton, Bullock.
Mar.	10	Martin, W. R., Womack Hill, Choctaw.
April	5	Mills, J. B., Shorterville, Henry.
Oct.	1	McMillan & Harrison, Mobile, Mobile.
Nov.	11	McGriff & Oakley, Columbia, Henry.
Dec.	2	McIver, G. Walter, Charleston, S. C.
	5	McGriff & Sanders, Columbia, Henry.
	11	McRae & Shaw, Clio, Barbour.
	17	McRae, John, L., Louisville, Barbour.
Jan.	6	McMillan & Co., J. B., Talladega, Talladega.
	6	McCollum & Whitley, Winfield, Marion.
	10	McKenzie & Ware, Goodwater, Coosa.
	11	McGehee, Driver & Co., La Fayette, Chambers.
	15	McClesky Bros., Snead, Blount.
	15	McDonald & Co., F. C., Luverne, Crenshaw.
	22	McGhees & Co., Rome, Ga.
	24	McBrown Bros. & Co., Portersville, DeKalb.
	25	McGiffert, David, Knoxville, Greene.
	28	McCleskey, J. H., Attalla, Etowah.
	29	McLendon, E. W., Jernegan, Russell.
Feb.	3	McCravey, Timberlake & Co., Huntsville, Madison.
	10	McClendon & Co., A. R., Springville, St. Clair.
	11	McElhaney, F. G., Auburn, Lee.
	11	McNutt, M. W., Brandon, DeKalb.
	24	McCary & Cothran, Alexis, Cherokee.
March	3	McIntosh, W. C., Dadeville, Tallapoosa.
Oct.	1	Northwestern Fertilizer Co., Chicago, Ill.
Nov.	21	Norwood & Hattimer, Ft. Deposit, Lowndes.
Dec.	4	Norman Bros., Ramer, Montgomery.
Jan.	10	Neece, M. B., Huntsville, Madison.
	16	Noell, R. H., Heflin, Cleburne.
	22	Newton & Son, C. A., Belleville, Conecuh.
	31	Northcutt, Loden & Co., Winfield, Marion.
Feb.	3	Nathan & Co., L. W., Montgomery, Montgomery.
	27	Nuzum, E. B., Tuscaloosa, Tuscaloosa.
Mar.	22	Nix & Co., Deatsville, Elmore.
Jan.	30	Owens, B. W., Blaine, Cherokee.
Feb.	15	Oliver Bros. & Perry, Dadeville, Tallapoosa.
Mar.	22	Ogletree & Jackson, Eastaboga, Talladega.
Nov.	6	Pollard, W. J., Augusta, Ga.
	26	Purcell, H., Columbia, Henry.
	27	Poyner Bros., Newton, Dale.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Dec.	3	Ponder, B. F., Opelika, Lee.
	17	Penn & Co., Opelika, Lee.
	31	Phillips, N. R., Clio, Barbour.
Jan.	1	Pugh, Stone & Co., Dadeville, Tallapoosa.
	8	Preer & Butler, Opelika, Lee.
Jan.	9	Parker, Cowles & Co., Alexander City, Tallapoosa.
	13	Polk, M. S., Alexander City, Tallapoosa.
	14	Porter & King, Town Creek, Lawrence.
	15	Preston, D. B., Opelika, Lee.
	15	Parker, H. C., Georgiana, Butler.
	16	Pearce & Co., J., Guin, Marion.
	17	Porter, Geo. C., Gordon, Henry.
	24	Pickens, J. M., Cullman, Cullman.
	28	Pridgen & Burk, Waverly, Lee.
	29	Prescott, C. M., Roanoke, Randolph.
Feb.	7	Payne, W. H., Dadeville, Tallapoosa.
	10	Pogue Bros , Dadeville, Tallapoosa.
	12	Pippin, J. W., Ozark, Dale.
	13	Phillips, D. T., Elkmont, Limestone.
	14	Perkins, W. W., Jr., Springville, St. Clair.
	20	Perry, Jno. O., Cane, Fayette.
	25	Pope, J. F., Wilsonville, Shelby.
March	5	Pettit & Son, J D., Walnut Grove, Etowah.
	5	Phillips, A. J., Walnut Grove, Etowah.
	7	Porter, Martin & Co., Jacksonville, Calhoun.
	22	Prim & Kimball, Jackson, Clarke.
April	8	Phillips, G. W., Wynnville, Blount.
	16	Patton, W. H., Knoxville, Greene.

Nov.	9	Rainer Bros., Troy, Pike.
Dec.	13	Robertson, Taylor & Williams, Charleston, S. C.
	20	Ruffin & Son, J. L., Helena, Shelby.
	24	Ross & Henderson, Troy, Pike.
Jan.	6	Riley & Son, G. W., Echo, Dale.
	7	Roberts, Frank S., Mobile, Mobile.
	16	Riser, A. V., Alpine, Talladega.
	22	Rumph & Hixon, Perote, Bullock.
	24	Robinson, B. F., Jemison, Chilton.
	28	Rome Oil Mills & Fertilizer Co., Rome, Ga.
	28	Roberts & Webb, Pleasant Gap, Cherokee.
	29	Reynolds, F. L., Geneva, Geneva.
	29	Rhoy, J. C., Bangor, Blount.
	29	Roberts, Locklin & Co., Perdue Hill, Monroe.
	31	Roberts, G. W., Collinsville, DeKalb.
Feb.	5	Russell, E. J., Athens, Limestone.
	5	Rasberry, B. T., Strasburg, Chilton.
	10	Robinson, W. C., Coffeeville, Clarke.
	13	Robertson, W. G., Winfield, Marion.
	15	Roberts, T. A., Carrollton, Pickens.
	21	Raynes, L. W., Farill, Cherokee.
	24	Ray, Miller & Co., Thadeus, Tallapoosa.
March	1	Robertson, F. M., Fayette C. H., Fayette.
	5	Reavis & Son, B. W., Walnut Grove, Etowah.
	5	Rice, Carter H., New Market, Madison.
	7	Rowan, Dean & Co., Jacksonville Calhoun.
	13	Roberson & Jones, Cropwell, St. Clair.
	18	Riley & Levy, Strickland, Dale.
April	3	Reynolds, H. C. & W. B., Montevallo, Shelby.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Oct. 1 Scott & Co., Geo. W., Atlanta, Ga.
2 Simmons, M. R., Union Springs, Bullock.
28 Slingluff & Co., Baltimore, Md.
Nov. 1 Skelton, R. S., Scottsboro, Jackson.
13 Savannah Guano Co., Savannah, Ga.
14 Steiner Bros. & Co., Greenville, Butler.
14 Steiner & Sons, Jos., Greenville, Butler.
25 Sanders, J. G., Sanders, Geneva.
Dec. 12 Smith & Meadows, Opelika, Lee.
27 Schiffman & Co., S., Huntsville, Madison.
Jan. 8 Stephens, B. F., Louisville, Barbour.
9 Sowell, Ellis & Co., Monroeville, Monroe.
13 Schuessler & Co., Roanoke, Randolph.
13 Smothers, Minor C., Kennedy, Lamar.
13 Schuessler Bros., Lafayette, Chambers.
13 Simpson, C. M., Brompton, St. Clair.
15 Snead, J. H., Snead, Blount.
15 Sowell, Ellis & Co., Repton, Conecuh.
16 Steiner & Lobman, Pine Apple, Wilcox.
16 Steinhart, A., Greenville, Butler.
16 Sherrer, J. S., Notasulga, Macon.
17 Street, Merit, Bluff Springs, Clay.
20 Selman, J. B., Kellyton, Coosa.
20 Sorrell & Hickman, Sylacauga, Talladega.
20 Steiner & Frank, Dadeville, Tallapoosa.
21 Sampey, W. L., Clanton, Chilton.
22 Sellars & Co., J. A., Inverness, Bullock.
22 Stewart, Burnett & Co., Spring Garden, Cherokee.
24 Story, A. J., Columbus, Miss.
25 Smith, Jasper, Guntersville, Marshall.
30 Smith, Bros. & Co., Heflin, Cleburne.
30 Stowers, W. F., Keener, Etowah.
30 Savage & Co., L. W., Evergreen, Conecuh.
Feb. 3 Slone Bros., Lebanon, DeKalb.
5 Snead, Jas. E., Wynnville, Blount.
10 Sturdivant Bros., Dadeville, Tallapoosa.
10 Sladghill, Jno. T., Fredonia, Chambers.
17 Shiery, Reuben, Guin, Marion.
19 Simpson & Co., C., Goodwater, Coosa.
19 Smith, E. S., Argo, Jefferson.
22 Scarbrough & Milligan, Chocolocco, Calhoun.
24 Segrest, J. R., Thaddeus, Tallapoosa.
24 Stone & Co., J. A., Alexis, Cherokee.
25 Sims, Jno. M., Dunham, Butler.
March 5 Smith & Bynum, Walnut Grove, Etowah.
6 Smith Bros., Sylacauga, Talladega.
12 Savage, H. J., Walker Springs, Clarke.
13 Smith, Jno. F., Oxford, Calhoun.
17 Smith & Co., F. C., Georgiana, Butler.
20 Sistrunk & Jordan, Tallassee, Elmore.

Oct. 1 Tinsley Fertilizer Co., Selma, Dallas.
Nov. 23 Turner & Rentz, Camden, Wilcox.
30 Trawick, M. T., Opelika, Lee.
Dec. 17 Torbert & Co., C. C., Society Hill, Macon.
30 Tillis & O'Neal, Geneva, Geneva.
Jan. 6 Terry & Payne, New Market, Madison.
8 Thompson, Jno. T., Huntsville, Madison.
13 Tuttle, A. G., Shorter's Depot, Macon.

DATE OF ISSUE, POST-OFFICE, AND COUNTY.

Feb. 8 Talley, Dyer N., Trussville, Jefferson.
10 Thompson & Son, W. P., Tuskegee, Macon.
12 Tucker, Brock & Co., Lafayette, Chambers.
18 Thomasson Bros., Fairfield, Covington.
22 Tolland & Norris, Columbiana, Shelby.
March 5 Turner, P. C., Walnut Grove, Etowah.

Oct. 1 Vandiver & Co., W. F., Montgomery, Montgomery.
Jan. 17 Vinson, U. C., Georgiana, Butler.
Feb. 22 Vaughn & Co., A. L., Cuba Station, Sumter.
Mch. 24 Vansandt & Vansandt, Aurora, Etowah.

Oct. 1 Walton & Whann Co., Charleston, S. C.
1 Waller & Co., N., Selma, Dallas.
9 Webb, John C., Demopolis, Marengo.
19 Winkler, A. G., Greenville, Butler.
Nov. 15 Weld, Jno. D., Savannah, Ga.
Dec. 1 Whiddon, W. W., Dothen, Henry.
2 Walker, Clarence, T., Savannah, Ga.
5 Weedon & Dent, Eufaula, Barbour.
12 Williams, R. G., Opelika, Lee.
14 Williamson, Thomas F., Opelika, Lee.
21 White & Awbrey, Roanoke, Randolph.
26 Wilcox & Gibbs Guano Co., Savannah, Ga.
26 Wood, R., Childersburg, Talladega.
26 Willis, J. J. S., Mount Andrew, Barbour.
30 Wood & Co., J. P., Talladega, Talladega.
31 Wade & Co., A. C., Calera, Shelby.
Jan. 3 Williams, R. S., Wetumpka, Elmore.
6 Webster & Jones, Winfield, Marion.
7 Weathers, J. D., Tuscaloosa, Tuscaloosa.
7 Waters & Russell, Alexander City, Tallapoosa.
8 Walker, J. M., Plevna, Madison.
8 Weil Bros., Opelika, Lee.
11 Walker, Teague & Co , Oxford, Calhoun.
11 Warnock & Son, R. N., Oxford, Calhoun.
13 Windham, A. B., Georgiana, Butler.
17 Woolf, J. P., Piedmont, Calhoun.
21 Whaley & Buckley, Attalla, Etowah.
22 Walden, D., Trinity, Morgan.
23 Walker, W. W., Montgomery, Montgomery.
23 Williams, W. C., Millport, Lamar.
23 Wilson & Bro., W. M., Clanton, Chilton.
28 Wiggins, Sr., W. S., Monroeville, Monroe.
28 Wiggins & Son, L. R., Monroeville, Monroe.
30 Wright, A. R., Farill, Cherokee.
Feb. 3 Watkins, John P., Burnt Corn, Conecuh.
3 Wharton & Co., A. U. R., Summit, Blount.
7 Webb, E. J., Spring Garden, Cherokee.
8 Whitman & Son, J. P., Guntersville, Marshall.
13 Weir & Co., S. E., Kennedy, Lamar.
18 Ward & May, Cuba Station, Sumter.
18 Ward & McGowen, Cuba Station, Sumter.
19 Winfrey, W. N., Woodland Mills, Morgan.
19 Weldon & Co., Weldon, Shelby.
25 Watkins & Co., F., Opelika, Lee.
Mar. 13 Watson, A. G., Cropwell, St. Clair.
17 Wise, G. W. & J. A., Madison, Madison.
20 Wells, K., Verbena, Chilton.

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Mar. 24	Woodall, A. W., Springville, St. Clair.
28	Wimberly, H. T., Greenville, Butler.
April 12	Waite & Co., D. W., Easonville, St. Clair.
Dec. 30	Yeatman & Andrews, Millport, Lamar.
Feb. 16	Yarbrough, John, Ashville, St. Clair.
12	Young, R., Wilson, Escambia.
20	Yeatman, J. D., Kennedy, Lamar.
March 3	Yates, T. C., Whitney, St. Clair.
March 7	Zarn, D. H., Zarnville, Henry.

DEPARTMENT OF AGRICULTURE,
MONTGOMERY, ALA., March 31, 1890.

The attention of farmers and others is called to the following rules adopted by the Commissioner of Agriculture in obedience to Section 137, Subdivision 19, of the Fertilizer Laws, for taking samples :

RULE 1.– All samples must be drawn in the presence of both buyer and seller, or their authorized agents.

RULE 2.—Take a small portion from several sacks or barrels, mix thoroughly and then place in two common quinine bottles, seal tight. Place the signature of both buyer and seller or their authorized agents, with the name of the goods, from whom purchased, and the guaranteed analysis as found on the sacks or barrels, with the date on the bottles; attach one of the tags to the bottle. The farmer will keep one, the merchant the other.

RULE 3.—If the farmer has cause to believe that the goods are not as represented in the guaranteed analysis, let him send the sample kept by him to this Department and the Commissioner will forthwith order the Chemist to analyze it and return the analysis to the sender as early as possible. If the merchant believes that the sample analyzed for the farmer does not correctly represent the goods, then he will send his sample and it will be analyzed in like manner as the first. *These analyses are free to all citizens of the State.*

RULE 4.—How to send samples. Send by express, prepaid, when practical. When there is no express office convenient, place the bottle in a tin can securely packed around with some substance to prevent breakage, and send by mail.

RULE 5.—Parties acting for others in drawing samples must present certificate of appointment, which certificate must accompany the sample when sent to the Department.

Where an alliance, or club, purchases a car load, or other lot of fertilizers, one sample, representative of the whole, should be carefully drawn, before the fertilizer is distrbuted to individuals, and forwarded to the Commissioner for analysis by the State Chemist.

BULLETIN NO. 15. - - - - NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - APRIL, 1890.

INSECTICIDES.

☞The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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KEROSENE EMULSION; HOW TO MAKE AND APPLY IT.

BY GEO. F. ATKINSON.

This Bulletin is published with the special purpose of giving some useful information to those farmers of the State who may not have the opportunity of reading similar publications issued from other sources.

Formulas for the Kerosene Emulsion and methods of its application have been published from time to time in various reports of the U. S. Department of Agriculture, and of the Experiment Stations, but it is hoped that the publication at this season of the year, in connection with some personal experience, will stimulate efforts to destroy many of the enemies of plants, which this simple remedy will do if made and applied properly. This will serve as an apology to our friends in other States who are already flooded by law with similar papers.

The Kerosene Emulsion is one of the cheapest and best insecticides to apply to soft bodied insects which pierce the leaves or stems of plants with their beak and suck the juices. Plant lice (Aphides) are good examples of such insects. Poisons, like Paris Green or London Purple, upon the surface of the leaves, would not injure plant lice, while they are very serviceable in the case of insects like the cotton worm, because this worm bites off portions of the leaves and swallows them.

FORMULA.

The Kerosene Emulsion is made in the following way:

Boil $\frac{1}{2}$ lb. common bar soap in one gallon of water, and while hot add it to two gallons of kerosene oil. This mixture must now be very thoroughly agitated by forcing it, with the aid of a pump, through a nozzle which produces a fine spray, of course directing the spray from the nozzle back into the vessel containing the mixture. This usually requires 10 or 15 minutes. If properly emulsified it will look like white, foamy cream, and will adhere to glass without oiliness.

In this proportion the emulsion is too strong and must be diluted. The proportion of the diluent must in many cases be decided by experiment, but a very good way is to mix one gallon of the strong emulsion with nine gallons of cold water. In diluting the emulsion it is not necessary to churn it again. It will be seen that two gallons of kerosene oil will make thirty gallons of the emulsion. So if a smaller quantity is wanted less oil and soapwater may be used, or the strong emulsion not used may be kept from one week to ten days for use.

TO APPLY THE KEROSENE EMULSION.

If one has never used the Kerosene Emulsion it might be well to try only a small quantity at first and observe the results, whether it injures the foliage ; if not, whether it is strong enough to kill the insects. After a few trials one can discover the exact strength of the emulsion necessary to kill the insects without injury to the plant, and can dilute or strengthen the emulsion accordingly.

In most cases it will be found necessary to apply the emulsion with a force pump which has a nozzle attached to produce a fine spray. The emulsion must come in contact with the bodies of the insects. Where the plants are not very large and the insects are on the upper surface of the leaves or on the stems of the plants, a common watering pot with a nozzle made to produce a fine spray will be found serviceable, or even an old broom can frequently be made quite effective to apply small quantities. But where a great number of plants are to be sprayed it will be cheaper to provide a good force pump suitable for the purpose.

Plant lice are easily killed with the Kerosene Emulsion. The writer used it with success to kill plant lice on cotton at Columbia, S. C., in the summer of 1889. The sprayer used was the "Eureka Sprayer," made by Adam Weaber & Son, Vineland, N. J. As the lice are found on the under surface of the leaves it was necessary to throw the spray upward from near the ground. For this purpose I had constructed a long tube to take the place of the short one attached to the sprayer. A cyclone nozzle was attached on the side at one end so as to throw the spray at a right angle from the tube. The tube was long enough so that standing in an upright position the end with the nozzle could be held close to the ground under the plants. A row could be thoroughly sprayed by walking at a moderate pace. As the lice are usually not evenly distributed over the field, but appear in spots, a portable sprayer for one man would serve the purpose better than heavy machinery with horse power.

The appearance of a few lice on cotton is no cause for alarm, for in a majority of instances they do no appreciable harm. But some seasons they retard and stunt the growth of the plant to such a degree that it would pay to kill them. During the summer of 1889, in some places in Eastern South Carolina, considerable cotton in spots was very badly injured by the lice, so that the plants were said to "turn black and lose their leaves."

Very few plants are exempt from the attacks of one or another of the species of plant lice, and they are sometimes very injurious to garden crops, roses, flowers, fruit trees, etc.

Strong soap suds is sometimes used instead of the Kerosene Emulsion, and I would recommend it instead where a wash is to be applied to the roots of plants to kill those forms of plant lice sometimes found on the roots of such plants as do not extend very far into the ground, or where the lice are confined to the larger roots not far from the stem, as is often the case. I have used it with success to kill the root lice on melons, and I do not doubt that it would be serviceable in the case of the root lice of cabbages and turnips, which I see do some injury in this vicinity. Not only will the soap suds kill the lice, but it will act as a fertilizer.

The chinch bug (*Blissus leucopterus*) is easily killed by the Kerosene Emulsion when it attacks corn. While at the University of North Carolina the writer had the opportunity of carrying out very successfully some experiments in killing the chinch bugs on corn which they attacked after leaving the wheat. The results of these experiments were issued by the State Department of Agriculture as a special Bulletin, which was reprinted in many of the State papers, for the chinch bug was very troublesome in the State that year. One gentleman at Raleigh, before these results were published, had made an application of Paris Green to a forty acre field of corn, and seeing no good results tried London Purple with the same effect. He was just on the point of permitting the bugs to take entire possession when he saw in the papers the results of my experiments. He immediately tried the Kerosene Emulsion and saved his corn.

It can be very easily applied to the chinch bug on corn with a common watering pot, for the bugs collect on the stalk within one or two feet of the ground in great numbers. The gentleman above referred to, not having a force pump at hand to mix the emulsion with and wanting it quickly, used a bundle of twigs with which he "whipped" the mixture until it was emulsified.

There are many other soft bodied injurious insects which do not bite the leaves of plants and therefore can not be killed by applications of arsenical poisons to the leaf that can successfully be controlled with the Kerosene Emulsion.

Many people, in their first attempt to use the Kerosene Emulsion, have been careless in not carefully following the directions for making and applying it. In such cases the oil is not well mixed or the emulsion is too strong and the plants will surely be injured when careless experimenters will condemn the use of a cheap and effective insecticide.

Other Bulletins, with instructions for applying Paris Green, London Purple, etc., will soon follow.

W. M. Shepardson.

BULLETIN NO. 16. - - - NEW SERIES.

Agricultural Experiment Station,

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, ALA., JUNE, 1890.

CORN, COTTON, RYE, CHUFAS.

Conclusions from Six Years of Experiment.

☞ The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

Smith, Allred & Co., Printers, 208 N. Court St., Montgomery, Ala.

SOME CONCLUSIONS FROM EXPERIMENTS WITH FERTILIZERS.

[J. S. NEWMAN, AGRICULTURIST.]

Inquiries as to the needs of the soils of this station and the choice of plants as to sources of their food supplies were commenced in 1884.

A retrospective view of results during five years develops some interesting facts.

The most prominent of these is the effect of phosphoric acid, not consumed by the plants to which it is applied, upon subsequent crops, as shown by the failure of later applications to produce perceptible effects. An application of acid phosphate to corn in 1884 upon land to which none had been previously applied increased the yield seven bushels per acre upon land with clay subsoil. This land, when first taken in charge, produced only 3.7 bushels of corn per acre without manure. Four years later, after continuous cultivation in different crops, all except one of which were fertilized with phosphatic manures, the yield without manure was 13.02 bushels while the application of phosphates gave no increase. The reserve force from previous applications furnished all that the plant needed, or all that it could utilize without additional supply of other elements of plant food.

These and many other facts indicate that, on soil having clay subsoil, the phosphoric acid does not leach to an injurious extent, but remains in an available form in reach of cultivated plants.

On another class of soil having no clay within four feet of the surface different results appear. Here there seems to have been a serious loss of phosphoric acid and a decided response to new applications after seasons in which the rainfall was excessive, causing a rapid descent of the water through the porous subsoil. The last season was exempt from such leaching rains and the corn seems to have received the full benefit of the residue from the application of the previous year as well as that of the current season.

The complaint is often heard, that the phosphates do not produce the effects upon crops that were realized from their early use, and the conclusion that the phosphatic manures have degenerated in quality, is drawn from this assumption of facts. The facts are:

(*a*) That the phosphatic compounds are of higher grade than those sold fifteen years ago.

(*b*) That their effect is equally marked upon lands to which none has been previously applied.

(*c*) Lands, to which repeated liberal applications have been made, contain enough of the unappropriated previous applications to supply the needs of the crops.

This last is true of soils which contain enough clay to prevent injurious leaching.

We infer then that phosphates applied to clay soils, or sandy soils with good clay subsoils, are held until used by plants, or at least the larger part of them. On such soils, therefore, heavy annual applications are not wasteful.

On sandy soils, without clay foundation, however, heavy applications are not advisable, since that not appropriated by the crops to which it is applied may leach beyond the reach of the roots of cultivated plants.

THE THREE FORMS OF PHOSPHORIC ACID.

The results of experiment indicate no difference in the agricultural value of water soluble and citrate soluble phosphoric acid. Repeated, careful comparisons, under identical circumstances have shown no greater variations than would occur either without the use of manure or with equal quantities of the same fertilizer.

Indeed this question of the comparative agricultural value of these two forms may be regarded as definitely settled. Again, the plant seems perfectly indifferent to the source from which *available* phosphoric acid is derived. Formerly a preference was given to animal bone as a source but repeated comparisons indicate that the same quantity of available phosphoric acid from rock is as valuable as its equal weight from bone.

ACID SOLUBLE.

The finely pulverized phosphate rock, known as "Floats," has been subjected to experiment for six years. While the results from its use have not equaled those from the acidulated phosphates when applied alone, when applied with nitrogen, and especially with cotton seed meal, the difference in yield has rarely been sufficient to justify the additional outlay for the acidulated goods. This is especially apparent when we consider the fact that we get nearly twice as much phosphoric acid in a ton of floats as in one of acid phosphate.

The active fermentation which the cotton seed meal undergoes in the soil possibly renders a portion of the phosphoric acid in the floats available.

THOMAS SCORIA OR SLAG.

This is a by-product in the preparation of steel by the "basic process." It has been used in comparison with floats with results closely approximating those from the latter. Its action, like that of floats, is stimulated by association with cotton seed meal.

ALABAMA RAW PHOSPHATES.

Some enterprising parties at Aberdeen Miss., and Selma Ala., have prepared some of the native phosphates, samples of which have been experimented with, but their low grade necessitates the use of such heavy applications as to render the economy of their employment, as substitutes for more costly goods, doubtful.

SOME PRACTICAL SUGGESTIONS ON THE USE OF PHOSPHATES.

Vast sums have been wasted in the cotton states by the injudicious purchase and use of commercial manures. This has resulted,

(*a*) From the absence of a knowledge of the needs of soils, which could be acquired only by experiment.

(*b*) By following the advice and practice of ignorant teachers.

Within the last twenty years the farmers and planters have learned much about the use of fertilizers, but their tuition has involved a severe tax upon their income. Commercial compounds have been purchased and applied without a knowledge either of the composition of the fertilizer or the needs of the soil or the plants. They paid twenty cents per pound for nitrogen while the cotton seed and animal manures were largely robbed of this valuable ingredient by wasteful handling before being applied to the soil.

Phosphates were applied to land already rich in phosphoric acid as are the black prairie lands of Alabama.

Mr. David Dickson made extravagant application of a low grade phosphate to his sixteen acre lot, previously enriched by animal manures, and harvested large crops; others followed his example upon impoverished fields and harvested poor crops and disappointment. This continued until experiment demonstrated that smaller application of concentrated manures gave more profitable results.

Mr. Furman caused a wasteful expenditure for kainit, to be applied to lands already abundantly supplied with potash. Except as a conservator of moisture, during severe drouth, very little benefit has been derived from the use of kainit or other sources of potash. Under a judicious rotation of crops, including those which are humus-supplying little else than phosphates need be purchased by the corn and cotton grower. The lands of this station have been rapidly improved by the following rotation:

Commencing 1st year with cotton.
2nd " corn with peas between rows.
3rd " oats followed by peas same year.
4th " cotton again.

All of these crops except the peas are fertilized. Under this system the soil soon becomes sufficiently supplied with humus to furnish the nitrogen needed for the cotton plant in the cheapest, best possible form, so that an application of acid phosphate is sufficient to secure profitable crops.

Cotton seed and stable manure, supplemented with acid phosphate, furnishing the cheapest and best manure for corn, so that the purchase of nitrogen may be entirely dispensed with, pea vines furnishing it for cotton and cotton seed and stable manure for corn. If lands have been so denuded of vegetable matter as to require the purchase of nitrogen, cotton seed meal affords the cheapest source. This and acid phosphate mixed in equal parts, 100 lbs of each per acre, on sandy and red lands, supply the needs of plants as well as the more costly commercial compounds. They may be easily, thoroughly and cheaply mixed on the farm.

The black prairie lands should be excepted from all rules of treatment of other soils. They respond to sotton seed, stable manure and cotton seed meal but not satisfactorily to phosphates.

If cotton seed, stable manure and phosphates are composted for corn, the following formula, used for many years, has given most satisfactory results; to make one ton of the dry materials use.

500 lbs	Acid phosphate.
750 "	Stable manure.
750 "	Cotton seed.
2000 lbs.	

The cotton seed should be protected from fermentation until used in the compost. The stable manure should remain in the stalls until needed. When the stalls are cleaned out in January, the time for making the compost, a liberal supply of litter should be spread in the stall to furnish a bed for the mules and serve as an absorbent for the first droppings. A small quantity of litter is used during the year, as found necessary, to keep the stall dry. An occasional dusting with land plaster or gypsum will also contribute to this end and prevent loss of ammonia. To those not familiar with this practice it seems at first view untidy, but on the contrary, since the manure is packed down by the tread of the mule from day to day—siloed as it were—no fermentation takes place and no disagreeable odor is emitted, while the animal has a clean, elastic bed throughout the year.

Again, the liquid manure, which contains most of the nitrogen, is absorbed by the solid excrement and no loss of nitrogen takes place. If the manure is removed daily it is almost impossible, in this climate, to prevent injurious fermentation or "fire fanging," while much of the liquid manure is lost.

MANNER OF COMPOSTING.

Take such quantity of the cotton seed and stable manure as can be conveniently mixed with forks and shovels: stir them until thoroughly commingled, wetting them as they are stirred, using enough water to wet them thoroughly without leaching. Spread this mixture, to a depth of about six inches, and pour over it the phosphate, which should be free from lumps, and stir until the particles of phosphate adhere to the manure and seed and the three ingredients are intimately mingled. This process is repeated until all of the material is consumed, each mixed lot being shoveled into the common heap as the mingling is completed. Of course the proper relative proportions must be preserved in these several mixings.

It is important to wet the material of the compost thoroughly to retard the fermentation and prevent fire fanging.

IS AMMONIA LOST DURING FERMENTATION?

It is commonly supposed that when vapor passes off rapidly from the compost heap—when it "smokes"—that a loss of ammonia takes place. Litmus paper placed immediately upon the freshly stirred compost, in the midst of the rising fumes, did not detect the presence of an Alkali, indicating that no free ammonia was present. On the contrary it discovered the presence of acid sufficient to neutralize ammonia should volatilization take place. The acid phosphate prevents loss of ammonia.

WHY IS THIS?

Nearly half of every acid phosphate or super phosphate, as it is sometimes called, is gypsum, or sulphate of lime, which results from treating the pulverized phosphate rock with sulphuric acid. The presence of this sulphate of lime furnishes a safeguard against any loss of ammonia by being volatilized.

If stable manure or stable manure and cotton seed are fermented without the phosphate, or without gypsum added, a perceptible loss of ammonia takes place.

If the compost is to be applied to cotton, we use the following formula, mixing as before.

700 lbs acid phosphate.
650 " Stable manure.
650 " Cotton seed.
———
2000 lbs.

Experiments in the use of kainit in the compost heap indicated that the cotton seed and stable manure supplied enough potash.

If the compost is made for miscellaneous use, 600 lbs of phosphate per ton is used. The compost has proved during twenty years of practical experience and experiment the cheapest manure for the corn and cotton planter.

In making the first experiments with it in 1869 the materials were put up in layers, but this practice has long since been abandoned as unsatisfactory on account of the phosphate hardening into lumps.

COMPOSTING IN THE FURROW.

Some apply the cotton seed in the furrow, over which cotton is to be planted, and sprinkle the phosphate over them early in the season and, covering them with earth, allow the seed to ferment there. If the seasons are favorable in early spring this practice gives good results, but some serious objections stand against it.

(*a*) In order that the seed may not vegetate they must be applied before the soil has been warmed sufficiently to supply the conditions necessary for germination. If heavy, baking rains occur, the soil where the plant is to grow becomes hard. It cannot be rebroken without disturbing the manure, and hence there is difficulty in securing a mellow seed bed.

(*b*) It involves extra labor in distributing the seed and phosphate as they must be distributed separately.

COTTON SEED MEAL IN COMPOST.

Since cotton seed meal is cheaper at twenty dollars per ton, or even at twenty-two dollars per ton, than cotton seed at twelve, the meal has been substituted for the seed in the compost heap with perfectly satisfactory results. The following formula was used:

500	lbs.	cotton seed meal.
500	"	acid phosphate.
1000	"	stable manure.
2000	lbs.	

The stable manure is thoroughly pulverized and moistened and the meal and phosphate stirred into it until they adhere to the moist manure. The fermentation of this compost proceeds much more rapidly than that in which the seed are used and hence must be closely watched to avoid excessive heating. If this occurs, open vertical holes with a crowbar and pour in water, or turn the heap, adding water as it is turned. The plant food in the meal-compost is more promptly available than in that in which the seed are used.

POTASH.

So far as furnishing plant food is concerned, there seems to be little need of applying potash to these soils.

As conservators of moisture in dry seasons the potash salts are useful. During seasons in which there is sufficient rainfall, their influence is not appreciable. Plants seem indifferent as to the source from which they derive their potash. The sulphate, (in Kainit) muriate, and carbonate (in cotton seed hull ashes) have been applied under identical circumstances, using the same number of pounds of potash from each source. Cotton, corn, turnips and potatoes express indifference as to the source from which it is derived. During dry fall seasons cotton to which potash has been applied retains its leaves later than that to which none was applied. This, however, is not usually accompanied by increased production, due to the potash.

NITROGEN.

The following sources of nitrogen have been employed alone and in various combinations, viz: Nitrate of soda, sulphate of ammonia, dried blood, cotton seed meal, cotton seed, stable manure and pea vines.

Of the four commercial sources, cotton seed meal is not only the best suited to this latitude, but is the cheapest source of supply—best, because its nitrogen is not so promptly available as in the others and hence resists the leaching influence of our heavy spring rains better than the others. Nitrate of soda and sulphate of ammonia when applied before or with the seed of spring crops are often leached beyond the reach of the roots of the young plants, on sandy soils, before the seed vegetate. If applied during the growth of the crop, either as a top-dress to small grain, or interculturally, to corn, cotton or vegetables, when the soil is occupied by root-hairs ready to appropriate the nitrates, the effect is very marked.

As remarked of phosphoric acid and potash, plants are indifferent as to the source of supply of their nitrogon, *per se*, but some of the sources carry with them conditions, inseparable from themselves, which render more certain, reliable and continuous their supply of this important factor in plant growth. We need, in our long growing season, a source which will not exhaust itself in the early growth of the plant, but give out a sufficiency for an early and vigorous growth and gradually yield up its supplies, as the season advances, and the demands of the growing plant increase. For this reason, experience and results of experiment point to the vegetable sources as the most desirable in our climate.

The cost of the commercial sources of nitrogen, and the limited supply of the domestic souces—cotton seed and animal manures—render it necessary for us to look for a cheaper and more universally available means through which to permanently improve our wasted soils. This we find in pea vines and other leguminous plants. When lands become exhausted of phosphoric acid, it must be resupplied by purchase; not so with nitrogen. This need not be purchased at all. Peas, clover, melilotus, vetches etc., may be used as factories for its production upon the very soil that needs it. On the stiff clay and calcarious prairie soils, clover, peas or melilotus may be used—on sandy soils, resort must be had to the peas. These furnish the cheapest and most permanent manure available to the cultivator of sandy soils. A crop of pea vines following oat stubble and left to protect, and rot upon the soil, until prepared for corn the following February, proved more than the equivalent of the residue of half a ton of compost and two hundred pounds of cotton seed meal and acid phosphate per acre, applied to cotton the previous year. A rotation of crops for three years, including two crops of pea vines, one cut for hay and the other left to rot upon the land, compared with clean culture in cotton for the same number of years, made a difference of *one hundred and five* per cent. in the yield of rye, following, in favor of the rotation including the peas.

HOW TO USE THE PEA VINES.

In more northern latitudes the practice of summer fallowing prevails as a preparation for winter grain and hence clover is turned in, *while green*, to be followed in August by wheat or barley: Fall plowing is also practiced in climates in which the winter is sufficiently severe to freeze the surface to the depth to which the land is plowed and thus pulverize the soil and prevent decomposition. There are no deleterious effects from thus plowing sod or clover lands, in cold climates, since the low temperature, prevailing through the winter, prevents the decompostion of the vegetable matter, turned into the soil, and consequently there is very little waste possible before the planting season in early spring. The crops therefore in such climate profit both by the meliorating effects of the vegetable matter upon the physical condition of the soil and the supply of plant food resulting from its decomposition.

On the lime lands of Alabama fall plowing is admissible, and even desirable, as a preparation for spring crops, on account of the difficulty of preparing such soils in spring, and the superior physical condition resulting from the fall plowing.

Even on the prairie, lime lands, however, turning in pea vines green, has proved wasteful as demonstrated by experiment, since cutting the vines for hay has left the soil in better condition than turning them green, as shown by subsequent production, while leaving them to rot upon the land gave better results than either.

Many writers have misled farmers by recommending an imitation of northern practice on southern farms, under conditions entirely different. Under no circumstances should the soil be fallowed in this climate during summer unless it is to be covered by another crop immediately. Exposure to our summer suns is injurious even if no green matter is turned in.

If large quanities of green vegetation is turned in, during our warm and long summer, injuriously rapid fermentation takes place and, on sandy soils, every vestige of organized matter soon disappears in consequence of the rapid decomposition.

The soil is benefited in three ways by growing upon it leguminous plants for its improvement.

(*a*). The shade afforded by the growth while it remains upon the surface and the prevention of evaporation and consequent crusting of the surface is important. Land will improve if merely covered with plank but will deteriorate if constantly exposed with a bare surface. During the severest drouth, land covered with pea vines remains porous and friable. The covering of vines also prevents surface washing which has been the most potent agent in the impoverishment of the soils of the cotton states.

(*b*). The presence of the decaying vegetable matter in the soil improves its physical condition and increases its power of absorbing and retaining moisture. In our warm climate, subject to long-continued drouths, this is a most important function.

(*c*). The decomposition of the vegetable matter upon and in the soil improves its chemical properties, directly, by addition of the chemical plant food which the decaying vegetation contains, and indirectly, by the action of the acids and alkalies, generated during and by the decomposition, upon insoluble substances already in the soil. If not turned in too long before planting, it especially supplies nitrogen in a most desirable form and doles it out gradually as the season advances and the growing plant demands it. It also darkens the soil and thus increases its capacity for absorbing heat and thereby hastens the arrival of seed time in spring.

THE TIME TO PLOW IN PEA VINES.

Experiments instituted for the purpose of making this inquiry have invariably indicated that the proper time is in the preparation of the land for the next crop.

If a crop of small grain or grass is to be sown in the early fall, the vines may be turned in some weeks before sowing the seed. If the land is not to be planted until the next spring, then, except with stiff soils, which require fall and winter fallowing, the land should not be broken until a short time before planting. If plowed in green during the summer and the land left bare, as remarked before, injury will result from this exposure and the vegetable matter will have decomposed, and the results of such decomposition leached through the soil, before the spring crop is planted.

Decomposition progresses throughout our mild winters and, unless the land is occupied by some growing crop, loss must ensue.

No one would think of applying manure in August or September for the crop to be planted the following April. The results of experiments have only served to corroborate the current testimony of practical men whose observation and experience have taught them that pea vines *pay best* when left upon the surface until the land is needed for another crop.

CONCLUSIONS FROM SIX YEARS OF EXPERIMENT.

1. Phosphoric acid leaches but little, if any, upon clay soil or those having clay sub-soil, but does leach through sandy soils with sandy subsoils.

2. Citrate soluble phosphoric acid possesses equal agricultural value with water soluble.

3. The phosphoric acid from floats, or phosphate rock ground to an impalpable powder, gradually becomes available in the soil, but produces very little effect upon the first crop.

4. The availability of the phosphoric acid in floats is hastened by use with cotton seed meal.

5. Plants are indifferent as to the sources from which available phosphoric acid is derived.

6. Nitrogen leaches rapidly through sandy soil unless occupied by feeding roots or underlaid by clay subsoil.

7. Plants are indifferent as to the sources from which their supply of nitrogen is derived, but those sources which yield a supply gradually, as needed by the plant, are best suited to our long seasons of growth.

8. Of the commercial sources of nitrogen, cotton seed meal is cheapest and most reliable. It yields its plant food more gradually than either the mineral or animal sources.

9. Pea vines, grown upon the land, and left to protect the surface until preparation is made for the next crop, furnish the cheapest source of nitrogen in the most desirable condition.

10. Pea vines, thus grown and treated, furnish the most reliable and practicable means of improving worn lands.

11. Pea vines cut for hay, leaving the stubble and roots

on and in the land, benefit the soil more than turning them in green during the summer.

12. Potash applied to the soil of this station has not been profitable except during drouth. Its principal benefit seems to result from its affinity for moisture.

13. Plants seem indifferent as to the source of supply from which they derive the potash needed.

14. Following thorough preparation of the soil, shallow cultivation produces larger crops at less cost than deep cultivation.

15. Impoverished soils may be rapidly restored to productiveness by terracing accompanied by a judicious rotation of crops involving a restoration of humus.

16. The best way to utilize the animal manures saved on the farm, and the surplus cotton seed, is in compost with acid phosphate.

17. Contrary to the general opinion, ammonia is not volatilized and lost from such compost during the fermentation.

FRUIT AND STOCK.

18. Grapes, peaches, plums, raspberries, strawberries and the oriental type of pears can be grown profitably under intelligent culture.

19. Growing wool and mutton, intelligently pursued, is more profitable than growing cotton—a profit of fifty per cent upon the value of the sheep and the cost of keeping them can be realized.

20. Pork can be grown here as cheaply as in any state in the union by cultivating our peculiar crops especially for swine.

21. Green crops for soiling cattle may be had in abundant supply, during the entire year, from the cereals, lucerne, corn, sorghum and peas. By means of these and ensilage pasturage may be dispensed with.

SOME FIELD EXPERIMENTS IN 1889.

CORN.

The land upon which this experiment was conducted was embraced in the ten acres planted in cotton in 1888, by order of the Board, to determine the profit of improved cultivation and fertilization, the results of which were reported in Bulletin No. 5, New Series. The liberal application of manure to the cotton the previous season and the absence of the usual leaching rains during the winter of 1888–9 prevented the usual contrast between the fertilized and unfertilized plots, the residue nearly supplying the needs of the corn plant, as shown in the accompanying tabulated statement of results. Attention is invited to the comparison of cotton seed crushed and uncrushed with each other and with an equivalent supply of nitrogen from cotton seed meal. Attention is also directed to the comparison of raw phosphate—a cheap article of Alabama phosphate—with acid phosphate, indicating either that enough phosphoric acid was obtained from the residue of the previous application, or that the raw phosphate possesses valuable fertilizing properties.* The small increased production over the unfertilized plot leaves the question in doubt.

After the crop was gathered, during a protracted drouth in the fall, chemical examination of the soil and subsoil was made, the results of which appear in the accompanying report of the chemist, Dr. N. T. Lupton:

	NITROGEN.	PHOS. ACID.	POTASH.
1. Soil to depth of 6 inches....	0 093	0.06	0 02
2. Subsoil from 6 to 12 inches...	0 093	0 07	0.02
3. " " 12 " 18 " ...	0 074	....	....
4. " " 18 " 24 "	0 046	....	....
5. " " 24 " 30 "	0.065	....	....
6. " " 30 " 36 "	0 031	....	....
7. " " 36 " 42 "	0.056	....	....
8. " " 42 " 48 " .	0 035	......	...

The uniformity in the contents of the soil and subsoil down to twelve inches is worthy of note.

Attention is invited to the fact that the relation between the different parts of the plant seems not to be materially affected by the different manures.

*Possibly part of the effect is due to carbonate of lime in this phosphate.

	Fertilizers per Acre.	Cost of Fertilizers per Acre.	Results. Yield.		Relations of different parts of the plant to the whole.				
			Shelled Corn in Bushels.	Fodder in Pounds	% of Stalk.	% of Shuck.	% of Shelled Corn.	% of Cob.	% of Fodder.
1	105 lbs. Sulphate Ammonia.	$3 86	12 85	300	....	....	.....	....	....
2	131¼ lbs. Nitrate Soda.....	3.57	13.39	280	....	....	.....	....	....
3	378 lbs. Dried Blood..	4.91	18 39	350	23.7	13.2	40 03	9.03	13.6
4	252 lbs. Cotton Seed Meal..	2.36	17 67	394	26	14	36	9	15
5	105 lbs. Acid Phosphate....	1.00	13 48	370	27	11	35	9	17
6	105 lbs. Acid Phosphate ... 52½ lbs. Muriate of Potash..	2.18	14.28	380	30.9	9 8	34.5	8 4	16.4
7	52½ lbs. Muriate of Potash..	1.18	13 39	340	29.8	10	35	9.1	15.8
8	Without Manure...........	....	13.92	340	30.3	10.6	34.3	10.1	15
9	105 lbs. Sulphate Ammonia 105 lbs. Acid Phosphate.... 52½ lbs. Muriate Potash ..	6.04	22.32	405	28.2	8.8	38.4	12.1	12.4
10	131¼ lbs. Nitrate of Soda... 105 lbs. Acid Phosphate..... 52½ lbs. Muriate Potash....	5.75	20 08	510	27.2	10.5	36.5	9 8	16.9
11	378 lbs. Dried Blood .... 105 lbs. Acid Phosphate.... 52½ lbs. Muriate Potash	6.91	22.25	420	26.1	11.2	39 9	9.3	13.4
12	252 lbs Cotton Seed Meal... 105 lbs. Acid Phosphate. ... 52½ lbs. Muriate Potash ..	4.36	22.25	390	26	10.4	41	9.6	13.8
13	670 lbs. Crushed Cotton Seed	3.20	15.89	330	27	9 9	39.2	9 5	14.5
14	670 lbs. Green Cotton Seed .	2 88	16.43	345	26.6	11.2	38.5	9.6	14.4
15	105 lbs. Acid Phosphate... 52½ lbs. Muriate Potash 670 lbs, Crushed Cotton Seed	5.20	18 75	355	26.1	9 9	40	10.3	13 5
16	Without Manure.	.....	17.32	325	26.1	10.1	40.8	9.2	13.7
17	105 lbs. Acid Phosphate. .. 52½ lbs. Muriate Potash 670 lbs. Green Cotton Seed	4 88	20 62	410	26.8	9	38.3	11.7	13.6
18	210 lbs. Raw Phosphate ... 52½ lbs. Muriate Potash. 252 lbs. Cotton Seed Meal..	5.54	23.21	425	25.2	9.3	41.8	9.9	13.5
19	210 lbs. Raw Phosphate.... 52½ lbs. Muriate Potash .... 670 lbs. Crushed Cotton Seed	6.33	24.46	455	27.5	9 1	39.2	11.3	12.8
20	210 lbs. Raw Phosphate... 52½ lbs. Muriate Potash .. 670 lbs. Green Cotton Seed .	6 33	22.85	410	26 1	9	41	9.6	13.1
21	500 lbs. Compost of Stable Manure, Cotton Seed & Acid Phos. mixed and fermented..	2.50	24 10	.....	...	..	......	.....	....
	Average %	....	......	......	27	10 4	39 41	9 8	14 2

EXPERIMENTS WITH VARIETIES OF CORN.

PLANTED APRIL 8; GATHERED SEPT. 26.

Names of Varieties.	From whom Received.	Time Edible.	Time from plant'g to edible in days.	Habit of Growth.	Productiveness.	Yield of 12 Stalks—lbs.
Ea. Southern Sweet	Ferry... ..	June 24	76	Very Small Stalk	Prolific	....
Livingston's Evergreen	Livingston.	July 8	90	Small Stalk.....	Medium ...	....
Livingston's Golden Coin ...	"	" 1	83	" "	"	....
Old Col'ny (early sweet or sug'r	Ferry......	June 26	78	" "	"	....
Clayton's Prolific	Clayton	July 11	93	Medium	Very Prolific	12¾
Flour Corn	"	" 20	102	Small Stalk....	Medium	6
Little's Early	"	" 8	90	Medium	Very Prolific	12¾
Mosby's Prolific	Dept. of Ag	" 16	98	"	Prolific......	10⅞
Naylor's Eight Row.........	" "	" 1	83	Small	Medium	8 9-16
Rice's Early	Clayton ..	" 6	88	Medium	"	9¼
Thornton's Prolific.........	"	" 16	98	Large	"	10 5-16
Webb's Prolific	"	" 6	88	Medium	"	7 7-16
Colquit Corn.	Colquit ...	" 8	90	Large	"	11 5-16
Giant Normandy	Clayton....	" 1	83	Small..........	"	7 9-16
Golden Beauty	"	June 29	81	"	"	5 1-12
Red Cob	McLendon.	July 16	98	Large	"	10¼
Red Field Corn	"	" 6	88	Medium	Prolific	11 2-16
Rice Corn	Bernard ...	" 11	...	Failure.........	... .	.....
Strawberry Corn	Clayton....	" 16	98	Large	Medium	9⅞
Champion White Pearl.....	J.C. Suffern.	June 26	78	Small.	"	6

VARIETIES OF COTTON COMPARED.

Planted 25th April.		Yield per Acre.		
Plat No.	Varieties.	Seed Cotton.	Lint.	% Lint.
1	Allan's Long Staple............	809½	245	30 24
2	Barnett	704½	227½	32 04
3	Cherry's Cluster................	691¼	218¾	31 64
4	Ellsworth	494¼	149	30.09
5	Hawkins' Improved............	665	210	31.57
6	Jones' Improved.	696	232	33.33
7	King's Improved Prolific.........	656½	210	32 20
8	Okra	661	227½	34.43
9	Peerless......................	682½	223½	32 68
10	Rameses.....	678½	227½	33.29
11	Truitt	818½	267	32.64
12	Welborn's Pet................	722	241	33 33
13	Zellner	653⅓	233⅓	35 70
14	Peterkin	1947	735	39 53
15	Southern Hope.	1730	476	27.5

Nos. 14 and 15 were not compared with the other varieties. These were planted 17th June on sandy creek bottom—better soil than that on which the others grew.

CLASSIFICATION BY MR. C. E. PORTER, an Expert.

No.	Variety.	Class.	Length of Staple.	REMARKS.
1	Allan's Long Staple.	Strict Good Mid	¾ inch..........	Staple only moderate and irregular.
2	Barnett............	Strict Good Mid	13-16 inch......	Staple very irregular.
3	Cherry's Cluster....	Strict Good Mid	⅞ inch........	St'ple str'ng and regular.
4	Ellsworth...........	Strict Middling	1 inch...........	Extremely fine Staple.
5	Hawkins' Improved.	Good Middling	13-16 inch.......	St'ple str'ng and lint good
6	Jones' Improved.....	Good Middling.	1 inch..........	St'ple str'ng and firm.
7	King's Imp'vd Prolific	Good Middling,	1 to 1&1-32 inch...	Staple extrem'y strong and regular.
8	Okra or forked leaf..	Good Middling.	1 inch...........	Staple unusually strong and excellent mil'ng cotton
9	Peerless............	Good Middling	13-16 inch.......	Staple unusually strong and fine lint.
10	Rameses......	Middling Fair..	1 inch..........	St'ple reg'lr and strong; handsome cotton.
11	Truitt...........	Strict Good Mid	1 inch...........	Staple extremely fine.
12	Overl'ked by classifier	....	....	....
13	Zellner............	Strict Good Mid	⅞ inch..........	Staple strong
14	Peterkin............	Strict Good Mid	⅞ inch..........	Staple moderately str'ng fine lint.
15	Southern hope	Strict Middling.	1 1-8 to 1 3-16 inch	Magnificent mil'ng cotton

As each variety was ginned. a sample was taken and numbered These were sent to Mr. Porter, with numbers, without the names.

EXPERIMENTS WITH COTTON PLANTED AT DIFFERENT DISTANCES—Plots ¼ acre each.

No.	Distance. Feet.	Lbs. Seed Cotton.	Lbs. Lint.	% of Lint.
1	4x4	913	294	32 99
2	4x3	1073	340	31 69
3	4x2	991.2	320	32.24
4	4x1	1001	312	31.16
5	4x5	806	266	33
6	5x5	824	268	32 52
7	3x1	832	267	32 09
8	3½x1	746	242	32.44
9	3½x1 Deep.	856	273	31 88
10	3½x1 Sh'low	739	240	32.47

In the above experiment sufficient care was not employed to preserve a full stand in Nos. 1, 5 and 6, which placed them at a disadvantage. The stands on the remaining plots were quite satisfactory. Plot 9 was cultivated deep at the first plowing only. The experiment in distances are repeated this season under more favorable auspices.

RYE FOR SOIL-FEEDING IN WINTER.

For the purpose of determining definitely the yield of green rye from successive cuttings during the fall, winter and spring, a plot from which summer cabbage had been harvested was sown in drilled rye 25th September, 1889. The land was well fertilized for cabbage but none was applied to the rye. The seed sown were grown upon the station—Northern grown seed will not answer. The rye was sown very thickly in the drills which were two feet apart. The plot was cut four times with the following results:

	Lbs. Green Rye per Acre.
First cutting, Oct. 30th to Nov. 14th, 1889	7,067.05
Second cutting, Nov. 22nd to Dec. 24th, 1889	4,323.65
Third cutting, Jan. 2nd to Feb. 10th, 1890	6,437.10
Fourth cutting, Feb. 20th to Feb. 27th, 1890	3,564.70
Total	21,392.50 lbs.

or 10.69 tons per acre of excellent green food during the months of November, December, January, and February.

The unprecedented freeze of March 1st so seriously injured the roots, exposed by the recent cuttings, that the stubble was plowed in for another crop.

No farm in the cotton states should be without its patches of rye or barley to be cut or pastured during fall, winter and spring.

CHUFAS.

Half an acre of very thin sandy land was planted in chufas in 1889 to be gathered by swine.

A portion of the area was carefully gathered by sections of the class in agriculture, picking by hand the nuts from each hill. These were measured green and showed a yield per acre of 172 bushels. Assuming a shrinkage of one third in drying the yield per acre of dry chufas was 115.24 bushels.

Eight average hills were selected, from which the chufas were carefully gathered and counted. The average number per hill was found to be 568 or a production of 568 nuts from one, planted.

BULLETIN NO. 17, - - - - JULY, 1890.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - - JULY, 1890.

Dry Application of Paris Green and London Purple for the Cotton Worm.

REPORT OF ALABAMA WEATHER SERVICE.

☞The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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THE DRY APPLICATION OF UNDILUTED PARIS GREEN AND LONDON PURPLE FOR THE COTTON WORM.

GEO. F. ATKINSON, Biologist.

In order to obtain an expression of opinion from some of the practical cotton growers of the State, in regard to the value of a recent method of the dry application of Paris green or London purple, for the destruction of the cotton worm (*Aletia xylina*), one hundred circular letters were sent to prominent farmers in the southern portion of the State. Since but few have as yet tried this method the letters were sent "at random," not knowing whether the party addressed had given it a trial.

Up to date of this writing (June 9), twenty-five replies have been received, a very large percentage considering the probable fact that many, not heard from, are unacquainted personally with the method. Of this number four had not applied the poison according to the method described ; of the twenty-one who had, only *one* spoke unfavorably of it ; the twenty who favored this method of application were very emphatic in declaring it to be, all things considered, the very best method yet known.

In view of this remarkable consensus of opinion as to the cheapness, ease of application, and the effectiveness of this method, and the very intelligent character of the replies, it has been deemed wise to publish a bulletin for the farmers of the State based entirely upon the information gained by means of the circular letter.

Following is the letter :

CIRCULAR LETTER.

AGRICULTURAL EXPERIMENT STATION, AUBURN, ALA., May 14, 1890.

Dear Sir—In view of the importance of any improved method in the application of Paris Green or London Purple to cotton for the destruction of the cotton worm, you are respectfully requested to answer the following questions in regard to the dry application of the poison which, according to a recent method, is allowed to dust through osnaburg bags suspended at the end of a pole, the pole being carried by a man mounted on a mule, and the animal trotted across the field. If you have not tried this method will you please hand this circular to one of your intelligent neighbors who has and request him to forward the answers to us. For this purpose a stamped envelope is enclosed.

1. Did you use the Paris green pure, that is, unmixed with any other substance, or did you mix with plaster of Paris, or flour, etc? If so, in what proportion?
2. What was length and size of pole used?
3. Size of bag and material used for bagging?
4. How many rows will be poisoned by one passage across the field?
5. Does the poison float about long enough in the air to poison the under side of the leaves as well as the upper side, or is only the upper side of the leaves poisoned?
6. To what extent does the wind interfere with its application?
7. Will it answer to apply it at any time during the day, or must it be applied when the cotton is wet with either dew or rain?
8. What amount of Paris green is required per acre?
9. How many acres will one man poison in a day?
10 How many applications did you make during the season?
11. Do you consider this method of application so effective in killing the worms as spraying with Paris green water? and will you try it again this year if the worms are troublesome?
12. Do rains wash off the applications?
13. Is the man applying it, or the mule, in any danger of being poisoned? If so, would not a wetted sponge tied over the mouth and nostrils prevent any danger?
14. Is there any danger of poisoning stock which are feeding in adjacent pastures and fields?
15. Did you use Paris green, or London purple, and which do you consider the better poison to use, all things considered?
Why?

Please write the answers to the above questions in the space after each one, and on a separate sheet of paper kindly add any information regarding your trial of this method which you may think of value.

An early reply will be appreciated. Very respectfully,

Geo. F. Atkinson, Biologist.

The names and addresses of those who had tried the method are as follows:

Hon. Jas. G. Gilchrist, Hope Hull, Ala,
C. S. G. Doster, Prattville, Ala.
J. H. Redding, Gallion, Ala.
John P. Streety & Co., Hayneville, Ala.
J. V. Tutt, Belmont, Ala.
Maj. I. F. Culver, Union Springs, Ala.
Hon. H. B. Inge, Greensboro, Ala.

Wm. H. Miller, Union, Ala.
H. A. Stollenwerck, Uniontown, Ala.
W. F. Strudwick, Demopolis, Ala.
W. E. Browning, Pleasant Hill, Ala.
J. W. Edmunds, Faunsdale, Ala.
B. L. Garber, Laneville, Ala.
Hon. G. R. Banks, Tallassee, Ala.
Walter Bros., Woodley, Ala.
Jas. A. Speir, Furman, Ala.
S. M. Cathcart, Alberta, Ala.
Unknown. Letter mailed on Cleveland and Selma R. R.
Hon. A. C. Davidson, Uniontown, Ala.
Hon. Mims Walker, Faunsdala, Ala.
J. Orum, Fitzpatrick, Ala.

The replies have been tabulated and are presented in that form on the closing pages of this article. Instead of repeating the questions the numbers only appear in the table, the answers to each underlying the number in the proper column. I found it necessary to abbreviate a number of the answers in order that they might appear in a tabulated form. Therefore, for an intelligent understanding of the table it will be well to make some remarks upon the nature of the replies and their practical bearing. At the same time an opportunity will be had of quoting more fully some of the more important parts of the replies, as well as some valuable additional information offered by a few, on a separate sheet.

It will be noticed that only one (Mr. Miller) diluted the Paris green, using 5 lbs. flour to one of Paris green. The remarkable thing about the use of the diluent here is that more Paris green was used per acre (3-5 lbs.) than by any one who used it "pure." It will also be noticed that although the pole was seven feet long the number of acres covered per day (column 9) was less than that reported by any one else, even where the pole was only half so long. However, the number of acres per day is not a very good criterion for it is largely dependent upon the rapidity with which the man works, and the aids he has in filling the bags, as well as the time of the day devoted to the work. Mr. Miller prefers to apply it when the plant is damp, and perhaps did not keep the man at work all day. In column 4 we probably have the chief reason for the greater amount of Paris green and the less number of acres covered per day. One passage across the field covered "two middles," which is equivalent to two rows, so that the pole lapped over about one-half of each previous application, whereas a pole three ft.—four ft. long—according to others, covers two rows, while a pole eight feet long covers from 4—10 rows. It may be that when mixed with flour it does not "float" in the air so long, or so far, but falls more quickly to the ground, and hence cannot cover so much ground at one passage as a pole of equal length used with undiluted Paris green. Until the two methods have been compared with a view to settle this question the suggestion given above is all that is warranted.

The favorite length for the pole seems to be about 8 feet. The Hon. H. B. Inge, and the "unknown" gentleman use a narrow board, or "plank," 1 x 4, or 1 x 3, inches. In this case I believe a hole is bored through each end of the "plank," where a stopper can be inserted, and the bag is tacked by the edges around the hole, where it can be easily filled. The former gentleman cuts a place in the middle to fit the hand but not enough to make the "plank" limber.

It will be seen that the size of the bag varies a great deal also. Some of these need explanation. That used by Mr. Redding, for instance, is 30 incheslong, but it is open at each end until slipped on to the end of the pole, and then, when filled, is tied around the pole at each end by a strong cord. Mr. Tutt places the 12 inch side against the pole and tacks it on. Some fasten the bag with a strong draw cord.

Except in two cases the material used is 8 oz. osnaburg. J. P. Streety & Co., use "Brown shirting." It may be that this material is especially adapted to dust the London purple which they now use altogether. The material used by Mr. Browning is a good illustration of what may be done on short notice when the desired material is not at hand. He says, "I used the meal sack that had been washed and ironed. It was folded and sewed up at sides and pinned on end of pole with locust thorns."

For columns 4, 5, 6 and 7 little may be said other than appears in the table. It is worthy of note, however, that a considerable quantity of the poison lodges on the under side of the leaves, a very important feature of the method, for the worms may be killed while very young, when they only feed on the under surface of the leaves.

From column 8 it is evident that in a number of cases there is a great waste of the poison. The Hon. A. C. Davidson says, "it takes too much to be in general use," but with a pole 8 ft. long he counts the rows poisoned at one passage as only two. Compared with what the 8 ft. pole is shown to do in other cases he could reduce the cost so that it would be only about one-fourth that experienced by him. Mr. Tutt says there is more danger of putting on too much than too little. A number of the replies indicate very truly that the amount varies with the size of the cotton.

Nearly all agree that rains wash off the applications more or less, varying with the amount of rain. Mr. Orum states that 24 hours after the application the rain does not wash off the poison. Probably he thought not because the worms were killed. If rain does not come for several hours after application most of the worms are killed, especially when young.

Question 13 is not stated as it should have been, owing to the fact that I had been informed upon this point by questionable rumors. It seems that the danger lies chiefly in the poison coming in contact with some part of the body which is chafed either by clothing or by riding. The replies indicate that it can be prevented by care in covering such parts well, or by moving rapidly enough to keep out of the cloud of dust, and then at night give both man and mule a bath, and the man a change of clothes.

In column 14 the replies show that there only is danger when a heavy wind is blowing towards the pasture.

In reference to the use of Paris green or London purple there will always be some individual preferences for the one or the other. The cheapness of London purple and the fineness of the powder will always recommend it to some, while the more speedy action of the Paris green will cause the latter to be the favorite of others. Paris green is especially desirable when rain is anticipated soon after the application, for, in many such cases if London purple were used a second application would be necessitated after the rain, whereas in many similar cases the more prompt action of Paris green would kill the worms before the rain.

It will be well to carefully read the quotations given below, especially that of J. P. Streety & Co., since they are very large producers of cotton, and are the only ones thus far heard from who prefer to use London purple, which they do successfully. It might be well to keep both the Paris green and London purple on hand, and if there was no indication of rain soon to use the London purple, but if rain is feared soon, to use the Paris green :

The following quotations bear on various questions in the circular, which were too long to incorporate in the table:

FROM HON. JAS. G. GILCHRIST.

"My principal reason for preferring this method to any other is the rapidity and simplicity of application. There is no water to draw and haul, no machine to get out of order at an important time, and nothing to prevent poisoning from beginning the very instant that the young worms appear on the cotton. The bags can be kept ready filled in a dry place, and by keeping a strict watch on the spots where worms first appear they can be effectually checked before they have done any harm.

"In answer to question five, I will state that when the poison is put on at the right time, when the young worms first hatch out, it kills them in the course of one or two hours and this makes me believe that the dust must settle on every part of the plant. When the poison is applied to cotton infested with young worms early in the morning, the worms can be seen by the thousand, in a few hours, hanging dead from the plant by a string of web."

"Since I began using this method, my cotton has suffered but little from the ravages of the boll worm, and I am satisfied that it kills them as well as the cotton worm."

" The poison seems to settle all over the plant, and for this reason, much more poison can be applied without danger of scorching the plant, *enough to kill every one of the worms*. This is a result which I was never able to secure by the old sprinkling method."

" The ease with which the poison can be washed off by showers or shaken off by high winds would seem to be a disadvantage, but its action is so prompt that few hours of suitable weather is all that is necessary to exterminate one crop of worms."

FROM C. S. G. DOSTER.

"Last summer I abandoned the mule and put my *poisoners* on foot, which I found to be slower but much safer and more efficient."

FROM JOHN P. STREETY & CO.

" We have been engaged for many years in making and handling cotton and have tried every method of killing the caterpillars. Our present opinion is that the use of London purple dusted on as described in your circular is, all things considered, much the most satisfactory method we have ever tried. We think it best to poison only two rows at one go; and under fair conditions we have gone over 20 acres a day to the mule. We find it necessary to use a saddle and a folded sack for the protection of the mule and comfort of the rider. Care must be taken to wash, and sometimes grease the mule where the poison may have settled on it. There is we think no danger from inhaling the poison. We have been for many years largely engaged in raising and handling cotton and have of course given the matter our best attention. Last year, (1889-90), we made and handled over two thousand (2000) bales of cotton, and found it very necessary to watch our interest."

FROM HON. H. B. INGE.

"I have been trying to poison the cotton worms for the last 15 to 16 years with Paris green in water applied with various kinds of pumps, but it has always been doubtful whether it paid as it was troublesome, dangerous, uncertain and laborious. But with the pole and bag a man and horse can poison in a day what land the latter can work by keeping him supplied with poison so he would not have to stop to refill. It takes very little poison to do the work, much less than we generally use. If applied when the worms are quite small it takes but a little while to kill them all. The result of my experiment with dry green last year was most satisfactory to me as well as to most of my neighbors. Some claim that it kills the boll worm also, but I doubt that as my crop on one plantation was very materially injured by the boll worm and the army worm did but very little damage."

FROM WM. H. MILLER.

"Must tie up neck and legs well, also must protect shoulders of mule."

FROM H. A. STOLLENWERCK.

"I have poisoned every year since the appearance of the worms. I have used arsenic, London purple and Paris green: have used them with flour and also with water and have abandoned all methods and materials except the Paris green and use this without any mixture. I use it with the bags and pole and also with a distributor that is worked with two mules and driver. With it I poison 60 acres per day. At the proper time, just as the worms are hatching and before they do any damage I start my 'Distributor' which takes only one hand and two mules; also start 6 hands with the poles and bags and go over 120 acres. I poison at least 175 to 200 acres daily and in three days poison my whole crop."

"I wash off my mules at noon and also at night and keep the hands protected and have never had either poisoned. I use double the quantity of Paris green that I did when I mixed with flour. The use of Paris green alone is less expensive than when mixed with flour."

"I do with 6 hands what I formerly did with 30, and do it more quickly and equally as effectively. The worms usually come in fodder pulling time and to save the cotton the fodder had to be abandoned. Now I save both."

"The dry poison kills the worms. If it rains before the second brood hatches I apply the second time. I applied the second time on my bottom lands and the cotton remained green until frost. On the uplands that had matured I did not apply the second time and the worms stripped it."

FROM W. E. BROWNING.

"I could not be induced to use the poison any other way than with the sacks and pole."

FROM J. W. EDMUNDS.

"I poisoned with the 8 oz. osnaburg bags in 1888 and last year, and saved my crop entirely from the ravage of the leaf-worm. I dont expect to use anything else unless something comes along that I am *satisfied* is better."

"If a rain comes up 5 or 6 hours after application I am satisfied fully one half if not two-thirds of the worms are destroyed, and 10 or 12 hours gets them all."

"In 1888 I used 3 lbs. Paris green per acre, but last year I only used 2 lbs. per acre and the effect was the same, killing all the worms."

"The dust of the poison will get all in the animals hair close to the skin and it looks as if it would injure the stock, but it does not. Care must be taken not to let the mules lick one another for a few days."

"The bags should never get the *least* damp or the poison will not come through. I used a strong draw string at the top, or mouth, of the bag. Some persons used as much as 4lbs. per acre in this section, but that is all thrown away. I believe with careful handling 1½ lbs. per acre will be sufficient."

FROM B. L. GARBER.

"We have been using Paris Green since 1873. Have been successful with Paris green, but never so with arsenic or London purple. Have burned up acres with arsenic and scorched more with London purple. Have applied it in all shapes and forms and think the dry application the best. It is a matter of dispute with us as to its being put on while cotton is damp or dry. I think while dry is better as naturally it will be diffused so much more while the atmosphere is dry than while damp. The Roach machine is the best to apply it with. The objection a great many give is cost—$70.00."

(The machine referred to is the "Roach's Cotton Worm Destroyer," Jas. P. Roach Manufacturing Co., Vicksburg, Miss. It is sold by M. Wilkins, Faunsdale, Ala.)

FROM HON. G. R. BANKS.

"Think the dry process is very much less injurious than the water—and is certainly much more rapid. As it requires quick work to rid yourself of the worm before damage, I have concluded it to be the best method and will use it again this year. Have never used the purple to any extent. It may do as well as green—would like to hear from some one who has used it successfully."

FROM JAS. O. SPEIR.

"I prefer to apply with one man walking, putting in sack 1½—2 lbs green and tapping it as he walks along rapidly. The man can also avoid the poison better by shifting the sack so that the dust will not collect or fall on him."

FROM S. M. CATHCART.

"I poisoned my entire cotton crop last year with dry Paris green. It is a great improvement over the old method of poisoning with Paris green water. An expert hand can poison a one mule crop in two days. As soon as get through poisoning every day require the hand to change clothes, and wash the mule off thoroughly. If the proper precaution is taken there is no danger of being poisoned."

FROM HON. A. C. DAVIDSON.

"I shall abandon all methods of using the dry Paris green except through the instrumentality of the machine made at Vicksburg, Miss. In the early part of the season, I will no doubt use Paris green and flour as I have done since 1873, in the proportion of 10 lbs. Paris green to 1 bbl. flour, applied through perforated tin sifter."

(The objection shown in the table seems to be to the use of the "bags and pole.")

FROM JAS. ORUM.

"I used a pole 8 ft. long and about 1¼ inches square, bored a ¾ inch hole in each end, tacked the sacks on the ends of the pole, and after putting in Paris green stopped the holes."

As Prof. J. S. Newman, Director of the Experiment Station, has had an opportunity of testing the use of dry Paris green, and London purple for the cotton worm, on the Station farm, he has prepared, at my request, the following statement of his experience:

"Cotton worms rarely appear in this locality in sufficient numbers to seriously injure the crop. In 1883 they were numerous enough to destroy the leaves from late cotton."

"A rude experiment was made in poisoning them with different liquid preparations. Kerosene emulsion, arsenic, London purple and Paris green were used, each on one-fourth of an acre, and a strip between them left without poison. The Paris green and London purple were each used, one pound to fifty gallons of water, and one pound to one hundred gallons. Having no sprayer the liquid was applied by means of a bunch of "bitter weed" (Helenium tenuefolium), which was dipped into a bucket of the liquid and shaken over the plants."

"The kerosene was churned with milk instead of soap-suds."

"The arsenic was prepared as follows: Five pounds of arsenic were dissolved by being boiled in five gallons of water, to which was added one pound of sal soda. A pint and a half of this solution was diluted with forty gallons of water, and thoroughly stirred before using. All of these preparations destroyed the worms, while the leaves were stripped where no poison was used."

"The arsenic scalded the leaves and the kerosene emulsion injured the tender buds of the cotton. No injury resulted from the use of either the London purple or the Paris green, while the more dilute of each was as effective as the stronger mixture."

Paris Green and London Purple Used Dry.

"In 1887 the worms again appeared in force. As soon as the worms were discovered on the bottom leaves of the plants from ⅛ to ¼ inch in length, the purple and green were each dusted over one-third of the cotton in a half acre lot, the third across the center receiving none. The effect of each was satisfactory in destroying the worms, but the London purple injured the leaves, which received an over-dose. No injury to the plant from the use of the Paris green was observed. A piece of common shirting was tacked loosely to the sides of a six inch plank, four feet long, forming a sack. A hole bored into the plank with a ¾ bit served to admit the poison. The sack covered one-third of the plank—the balance was trimmed so as to be readily handled. A man on foot, holding the plank in one hand over a row of cotton, tapped it gently with the other. The fine powder seemed to be very well distributed to every part of the plant, as every worm was destroyed before perceptible injury was done."

"The eggs of the Aletia are deposited on the lower leaves of the plant and the young caterpillars are not readily discovered until they are several days old and have commenced to feed upon the tender upper leaves."

"They usually make their appearance early in rank cotton where they spend their early existence upon the lower leaves, which are well shaded."

"By walking through such cotton, when their presence is suspected, the small caterpillars adhere to one's pants, and may thus be detected even when they escape a diligent search directed to the plants themselves."

All cotton growers will read the matter presented above with great interest. It is a comparison of the results of a recent method of applying Paris green and London purple obtained by men who live at too great a distance from each other to make these comparisons without the aid of a bulletin on the subject. The details of the results vary, and in this way one man's experience will assist another until by careful attention to all the details the expense can yet be reduced, and the value of the method increased.

It may be well at this point to summarize the chief advantages which this method presents.

The inexpensiveness of the outfit puts it within reach of every cotton grower. Cotton growers in localities rarely visited by the worms are not warranted in keeping on hand machinery even though it cost but a few dollars. The "bags and pole" cost too little to be considered.

The quickness with which the work can be started and the rapidity with which it can be carried on make it possible to kill the worms before they have done any harm.

The poison can be applied without difficulty when the soil is so soft from rains as to make it impossible to go into the field with heavy machinery.

It is as practicable for the man who has only one acre of cotton as for one who has a thousand or more. This is one of the greatest advantages of the method, for, according to former methods, the cost of machinery would nearly equal the value of a small crop.

With proper precautions it is no more dangerous than when the Paris green is applied with water.

Among very large cotton growers, the Roach's machine manufactured at Vicksburg, Miss., may be preferable, since it poisons from 60 to 80 acres per day, with one man and two mules, and can be made very economical in the amount of Paris green or London purple used. The great objection, as stated in one of the letters, seems to be the cost. It distributes the unmixed poison and blows it away from driver and mules.

In conclusion, it may be of service to state very briefly the habits of the parent moth in egg-laying, and of the young larvæ, for it is very important that these points should be well understood in order to make the application of the poison at the earliest moment to insure killing the worms while young.

The moth deposits her eggs at night. She deposits them singly upon the underside of the leaf. Some times three or four eggs are laid upon one leaf, rarely as high a number as thirty or more. She selects the most vigorous or succulent cotton and deposits the eggs on the lower leaves of such plants. When the cotton is older, later in the season, she deposits eggs on the upper leaves also.

In favorable weather the eggs hatch in three to four days to one week. The young worms at first feed only on the underside of the leaves, not biting through the leaf, so that neither they, nor their work, are easily seen until later when they eat entirely through the leaf.

By taking advantage of the habits of the moth and young worms the spots may easily be found where they first attack the cotton. For finding the young worms the reader is referred to the method described by Professor Newman in the article I have quoted from his pen.

I wish here to express my thanks to the gentlemen who have so kindly and promptly responded to the questions in the circular letter, and also to those who have taken the trouble to interest others in the matter when they themselves were unacquainted with the method.

The following are the tabulated answers to the circular letter.

me	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
. G. christ.	Pure.	8 ft. long, 1½ in. in diameter.	6x8 inches, osnaburg.	4–6	Most on upper side.	Calm day better.	Early morning, late evening.	2–4 lbs.	20	2	Yes,	Yes.	Moving rapidly no harm.	Think not.	Have used both, prefer Paris green,
S, G. ɔster.	Pure.	3–4 ft. long, 1 in. in diameter.	To hold ½–¾ gallons, osnaburg.	2	Most on upper side.	Very much.	When wet by dew or rain.	1–4 lbs.	8–12	2	Yes.	Yes.	No.	No.	Paris green more efficient.
. H dding.	Pure.	9 ft. long, 1½ in. diameter.	30 inch. long, osnaburg.	4–6 and 8–12	Both sides.	Benefit if not too strong.	Any time.	No reply.	25	2 generally	Yes.	To some extent.	Move to keep out of dust.	No.	Paris green; London purple blows off leaf too easily.
[. V. Tutt.	Pure.	8 ft. long, 2 in. diameter.	12x6 inches. osnaburg.	6	Both sides.	High wind seriously.	Early morning, late evening.	2 lbs.	10	No reply.	Yes.	Yes.	Causes sores by contact,	Not in calm days.	Paris green, more effective.
[. P. reety.	Pure.	5 ft. long.	To hold 3 lbs. brown shirting.	2	Both sides.	Considerably.	All day; better when damp	1 lb.	15	2–3	Yes.	Yes,	Danger from contact.	No.	London purple; finer and cheaper.
. F. ulver.	Pure.	8½ ft. long.	6x10 inches, osnaburg,	4	Both sides.	High wind seriously.	Early morning, late evening.	½ lb.	40	1	Yes.	Yes.	None with care.	Not unless wi'd blows towards it.	Paris green, never used London purple
I. B nge.	Pure.	8–9 ft. long, 1x4 inches.	10x4 inches, osnaburg,	8–10	Both sides	Prefer a light wind.	Better when dry; bag is ruined if it gets wet.	1–1½ lbs.	25–30	2	Yes.	Heavy rains, etc	Not with care.	Think not.	Paris green, never used London purple
. H. ille .	5 flour to 1 Paris green.	7 ft. long.	8x6 inches, osnaburg.	2 middles	Both sides.	High wind seriously.	When damp.	3–5 lbs.	6–10	2	Yes.	Yes.	Not with care.	Think not.	Paris green, more prompt.
A. Stolwerck.	Pure.	8 ft. long.	To hold 1½ lbs. osnaburg	4	Very little on underside.	Light wind no objection.	Any time, better when damp.	1½–2½ lbs.	20	1–2	Yes.	Yes.	Causes sores.	Think not.	Paris green, more prompt.
V. F. idwick	No reply.	8 ft. long.	Osnaburg.	4–6	Most on upper side.	Seriously.	Any time, better when damp.	No reply.	16–20	No reply.	Yes.	Yes.	No more than with water.	Think not.	Paris green, more effective.
V. E. wning	Pure.	7 ft. long, a large dry cane.	Meal sack folded.	Passed in every 3rd row.	Most on upper side.	Light wind favorable.	Any time.	1½ lbs.	20	1	Yes.	Yes.	To some extent.	Think not.	Paris green.
, W nunds.	Pure.	8 ft. long, 2½ in. diameter.	8x6 inches, osnaburg.	3	Most on upper side.	High wind prevents uniformity.	All day.	2 lbs.	20	2	Yes.	If it rains soon.	No.	Think not.	Paris green, kills quickly and does not scorch cotton.

L. er.	Pure.	8-9 ft. long, 1½ in. diameter.	1 yard for 4 sacks, osnaburg.	4-6	Most on upper side.	None if in right direct'n	Any time, better when dry.	1½-3 lbs.	10-15	2-3	Yes.	To some extent.	Danger of sores.	Not if wind in right direction.	Paris green, more effective.
R ks.	No reply.	No reply.	14x8 inches, osnaburg.	4-6	Both sides probably.	High wind seriously.	Early morning, late evening.	1½-2 lbs.	No calculation.	2 usually.	Yes.	Yes.	If body not protected.	Not if wind in right direction.	Paris green, never used L. purple to any extent.
ter hers	Pure.	5 ft. long, 2 in. in diameter.	6x12 inches, osnaburg.	2	Both sides.	Calm day better.	Any time.	2½-3 lbs.	15	1-2	Yes.	Yes.	Danger wh're rider touches mule.		
A. ir.	Pure.	3 ft, by hand, 4 ft. on mule.	10x12 inches, osnaburg.	1 by hand 2 with mule.	Most on upper side.	High wind seriously.	Any time.	1 lb.	On foot 8-10 with mule 12-15					No.	Paris green, more effective.
										1 usually.	Yes.	Heavy rains do.	Causes sores on body.	No.	Paris green, more effective.
M. art.	No reply.	4 ft. long, 1¼ in. diameter,	8x8 inches, osnaburg.	2	Most on upper side.	High wind seriously,	Any time.	2 lbs.	10	2	Yes.	Yes.	Some,	Think not.	Paris green, never used London purple
wn	Pure.	6 ft. long, 1x3 inches.	To hold 1 qt. osnaburg	4	Both sides.	High wind seriously.	Any time.	No calculation.	15	1	Yes.	No,	Yes,	No.	Paris green, more effective.
son.	Pure.	8 ft. long, size broom handle.	8x4 inches, osnaburg.	Count it 2.	No examination.	Very largely.	All day.	Too large a quantity.	10-12	2-3	For w'rm man and mule.	Yes.	Causes sores.	Do not know.	Paris green, London purple scorches cotton.
s er.	Pure.	8 ft. long, 1½ in, diameter	6x12 inches, osnaburg.	4	No examination.	High wind seriously.	Any time, better when damp.	1-2 lbs.	15-20	1	Yes.	No more than the mixture.	Yes.	never he'rd of any.	Paris green, never used London purple
m.	Pure.	8 ft. long, 1¼ in. diameter.	8x6 inches, osnaburg.	6	Both sides.	High wind seriously.	Any time, better when damp.	Do not know.	15-20	1	Yes.	Not after 24 hours.	Yes.	No.	Paris green, never used London purple

Appendix to Bulletin No. 17, of the Alabama Experiment Station.

REPORT

OF THE

ALABAMA WEATHER SERVICE.

Co-operating with the U. S. Signal Service.

MAY, 1890.

STATE POLYTECHNIC INSTITUTE,
Auburn, Ala., June 15th, 1890.

In North Alabama the frost on the 8th of May damaged young vegetables and slightly retarded the growth of corn. In the middle portions of the State, however, this frost was very slight and hardly perceptible.

The cool nights during the first part of the month were favorable for the multiplication of cutworms and lice, and in some parts of the State farmers have complained about the attacks of these insects. The average temperature was 2.8° dogrees below the normal. The amount of rain over the entire State during the month was large, being about 1.41 inches above the normal. This increase in rain has given a considerable impetus to the growth of cotton and corn, and the pleasant days towards the close of the month have largely aided the cotton plant in recovering the growth lost during the first of the month. The farmers are well up with their work over the State, although the recent rains have caused the grass to grow very rapidly.

J. M. QUARLES,
Assistant.

P. H. MELL,
Director.

STATE SUMMARY.

ATMOSPHERIC PRESSURE (*in inches*).—Monthly mean, 29.992; maximum observed, 30.357, at Chattanooga on the 8th; minimum observed, 29. 628, at Auburn on the 5th; range for the State, 0.729.

TEMPERATURE (*Degrees F.*)—Monthly mean, 69.4; highest monthly mean, 72.7, at Mobile and Union Springs; lowest monthly mean, 64 .9, at Guntersville and Chepultapec; maximum 92, at Gadsden and Citronelle on 31st; minimum, 34 at Double Springs on the 8th; range for the State 61°;

greatest local monthly range 57 at Double Springs; least local monthly range, 35, at Chepultapec.

PRECIPITATION—Including melting snow (*in inches*).—Average for the State, 5.37; greatest, 10.19, at Montgomery; least 1.32 at Guntersville.

WIND.—Prevailing direction, southeast.

AMOUNT OF WIND DURING MONTH (*in miles*),—Auburn, (from 12th to 31st) 1855; Chattanooga, 3206; Mobile, 6055; Montgomery, 3536.

MEAN HUMIDITY.—Auburn 70 3; Montgomery, 69.

NOTES FROM OBSERVERS.

Double Springs (A. M. Weiler). The past month has been favorable for the farmers, and crops have grown off well. The rainfall has been above an average; but no destructive storm has gone over this county.

Greensboro (M. H. Yerby). - Crops of all kinds are doing moderately well, although the nights have been rather cool for cotton. The entire fruit crop is a failure. The melon crop is not very promising at present. More rain is needed for the oat crop.

Jasper (Howard Lamar).—There was lightning in the north at 9 p.m. 7th. Strong west wind all day; quite cool, and fires necessary; heavy frost. 10th, heavy wind and rain storm 7 p. m. to 9 p. m.; constant lightning in South. 19th, thunder storm with a few hail stones about 2 p. m.

Tuscumbia (L. B. Thornton). —May 1st, lightning in southeast at 9 p. m. 6th, hail at 7 p. m., with thunder cloud. 10th, thunder cloud at 5 p. m. and lightning. 12th, lightning in west and east at 9 p m. 18th, continued lightning in northeast at 9 p. m. 19th, thunder cloud with heavy rain at 10 a. m. 24th, rain inappreciable, thunder cloud in west at 3 p. m.

Monthly Summary of Meteorological Reports by Voluntary Observers of the Alabama Weather Service, May, 1890.

STATIONS.	COUNTIES.	Altitude.	Latitude N.	Longitude W.	BAROMETER.					TEMPERATURE.									Total Precipitation	Clear Days.	Fair Days.	Cloudy Days.	Days of Rain.	Prevailing Wind.
					Monthly Mean.	MAX.		MIN.		Monthly Mean.	Mean of Max.	Mean of Min.	MAX.		MIN.		Monthly Range.	Me'n Daily Range						
						Height.	Date.	Height.	Date.				Degrees.	Date.	Degrees.	Date.								
Tuscumbia	Colbert	498	34 42	87.38	....	.....	...	....	....	66.9	77.2	62 1	88	31	45	8	43	15.1	3.71	16	15	0	9	S w
Valley Head	DeKalb	1058	34.30	85.30	....	.....	.	......	...	65 6	79.8	51 4	85	31	41	7	44	28.4	4.78	22	8	1	10	S
Gadsden	Etowah	......	34.02	86 02	....			...	..	68.9	81.3	56 5	92	31	58	8	34	24.8	5.08	...	....	....	7	
Florence	Lauderdale	....	34 48	87.37	....	....	..	......	.	...	...	...	..	......	...	....	....	......	.	....	....	....	....	
Chattanooga	Tennessee	783	35.03	85.14	29.999	30.357	8	29.911	5	68	78	58	89	31	40	8	49	20	3.95	12	13	6	13	S w
Montgomery	Montgomery	219	32 22	86.23	30 022	30 332	8	29.730	5	73	82 6	61.9	89	24	45	8	44	20.6	10.19	8	15	8	15	E & Sw
Tuscaloosa	Tuscaloosa	240	33.12	87.42	......	.	....	......	....			.....		.....		....		......	......	....	..	..	....	
Union Springs	Bullock	516	32.12	85.39	...	..	..	......		72.7	77.7	68 3	85	24	55	8	30	19.4	4.99	8	11	12	7	S
Bermuda	Monroe,	......	31.43	87.12			....	......	....	69.1	79.8	63	85	1,12,24	51	7	34	16.8	7.06		...	...	8	
Mobile	Mobile	30	30.41	88.20	29.995	30 310	8	29.787	4	72.7	81 1	64.3	87	31] 31	53.5	8	33.5	26.7	5 50	9	13	9	11	S
Auburn	Lee	826	32.40	85.30	29.973	30.341	8	29.628	5	71.2	81.2	61.2	88.5	25	42	8	46.5	20	6.18	17	6	8	10	S e
Livingston	Sumter	150	32 34	88.05	30.002	30.027	8	29.770	5	70 8	80.3	61.3	87	2-31	45	8	42	20	4.15	12	7	12	9	S w
Greensboro	Hale	220	32.41	87.36	...	......	....	......	....	70.9	...	..	87	31	48	8	37		4.58	0	19	12	10	
Mt. Willing	Lowndes	......	32 07	87.0	....	......	...			70 5	80.8	62.6	86	22–31	46	8	40	18.2	6.65	...	....	....	6	
Uniontown	Perry,	273	32 28	86.44	29 978	30.33	8	29.72	5	72.4	80.6	62	87	31	48	8	49	18.6	3.10	13	4	11	7	S
Citronelle	Mobile.	352	31.03	87.30	......	....	..	......	....	72 6	82.3	62.9	92	31	46		46	19.4	7.47	19	3	9	11	
Fayette	Fayette	......	33 42	83 12	....	.....	...	....		....	...	....	..	......	...	....	...	....	...	....	...	....	.	
Luverne	Crenshaw.	....	31 45	81 40	....	....	...	......	....	..														
Guntersville	Marshall	..	34 24	86.20	....	......	...	......	...	64 9	81.9	48	87	23	47	11, 14, 23	40	17	1.32	...	....	.	4	S e
	Limestone	....	34.52	86.15	......	...	..	....	....	....	....	....		......	....	... .	....	......	...	...	...	....	....	
Columbiana	Shelby	......	33 15	86.56	...	....	...	....	..	68.1	80.1	56	88	31	38	8	50	14	5.06	...		....	8	
Centre	Cherokee	729	34.10	86.30	....	....	...	...	....	....	...	...		....	.	....	....	..	......	....	...	....	..	
Double Springs	Winston	.....	34 09	85.35	...	...	...	...	...	62 9	81.6	57.9	91	31	34	8	57	23.7	7.39	19	12	0	7	N e
Butler	Choctaw	......	32 05	87.24	.. ..	...	..	...	..	71.7	82.3	61.1	87	22&23	44	8 & 9	43	21.2	7 40	...	....	...	9	
Jasper	Walker	310	33.49	88.12	....	...	...	...	.	67 7	76	59.3	84.5	31	40.5	8	44	16.7	3.55	9	10	12	10	S
Chepultepec	Blount,	....	....		.	....	..	...	...	64 9	66	63.9	76	6	51	8	25	2 1	.....	...		....	...	
Carrollton	Pickens		33 14	88.01	....	....	..	.	....	69 7	77.4	63.5	87	31	46	8	41	13.9	5.24		...	....	9	S e
Means		....	....	....	29 992	...			....	69.4	79.4	60.2	..		...	....	..	...	5.37	13	10.5	7.5	8	S e

BULLETIN NO. 18. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - AUGUST, 1890.

CLIMATOLOGY OF ALABAMA.

☞ The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

THE BROWN PRINTING CO., STATE PRINTERS. MONTGOMERY, ALA.

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CONTENTS.

CLIMATOLOGY OF ALABAMA.

[Compiled from Meteorological Observations taken from 1811 to 1890, including General Phenomena from 1711 to 1890.]

P. H. MELL.

METEOROLOGICAL RECORDS AVAILABLE.

The earliest systematic work of collecting meteorological data in Alabama was under the auspices of the Smithsonian Institute, about forty years ago. Prior to that time a few observers reported at irregular intervals to some of the agricultural journals the reading of thermometers and rain gauges, and in many issues of the papers of that early time frequent references were made concerning the general conditions of the weather and the effects produced on the crops. In the preparation of this bulletin careful examination has been made of the following publications, from which much valuable data have been collected:

Southern Cultivator, Soil of the South, Country Gentleman, Farm and Home, Southern Field and Fireside, Smithsonian Institute publications, Patent Office Reports, Signal Service Reports and Bulletins of the Alabama Weather Service.

HISTORY OF THE WEATHER WORK IN ALABAMA.

Great credit is due Prof. Joseph Henry, late Secretary of the Smithsonian Institute, for the encouragement he extended to meteorological observers before the signal service assumed charge of the system. His earnest pen and liberal use of the means at his disposal for many years, kept up a more or less regular series of observations, compilations of which were published from year to year in the Patent Office Reports and Transactions of the Smithsonian Institute. In 1870 when the entire system was transferred to the chief signal officer he established two stations in the

State, one at Mobile and the other at Montgomery, that were place in charge of signal service men. Until 1880 these two stations were the only regularly organized services that existed in the State. In 1880, however, the chief signal officer placed a set of maximum and minimum thermometers and rain gauges at a number of railroad depots in charge of the agents, who were compensated to keep up regular observations during the crop seasons, and telegraph the same to the central stations at Mobile and Montgomery for the benefit of farming and commercial interests. A number of voluntary observers kept up their work and sent year after year monthly reports to the chief signal officer. In February, 1881, a meteorological station was established at Auburn by the authorities of the Alabama Polytechnic Institute. In 1884, by the solicitation of the chief signal officer, Auburn was made the central station of the Alabama Weather Service; and in March of that year a bulletin was issued containing data from twenty-two voluntary observers. In a few months the number of observers was increased to forty-five. From that date until the present time the State service has been in successful operation, and much valuable material has been collected through the patient and constant service of these earnest observers.

During the first two years there were many difficulties to contend with in placing the service on a firm basis; and doubts were frequently entertained by outside parties whether the service would last very long. There was no money with which to pay the expenses of publication of bulletins and to purchase the necessary instruments for the use of observers. Immediately upon the organization of the service the State Commissioner of Agriculture was urged by the Director to receive the manuscript of the bulletins each month and publish them as part of the transactions of the Department. This he finally consented to do. This trouble having been surmounted the effort was now made to secure first-class and uniform instruments for the stations. This was not successfully accomplished until the chief signal officer in 1888 kindly consented to lend to the State a sufficient number of maximum and minimum thermometers, exposed thermometers and rain gauges to equip one station in each county. Up to this time observers furnished their own instruments.

In February, 1885, the Commissioner of Agriculture withdrew his support, and the publication of the bulletins was transferred to the printing office of the College by the special enactment of the Board of Trustees. At the present time the system is on most excellent footing and is doing most efficient service to the people of the State.

A bulletin is issued at the end of each month and special weekly bulletins, during the crop seasons, on Saturday mornings indicating the effects of the weather on the crops. At irregular periods special bulletins have been issued upon some meteorological subject, written by experts. In the reports that have been sent to the central station during the past five years we find not simply dry figures, but they also include much that is interesting concerning the planting and reaping of crops; the occurrence of frosts and damages resulting from floods; much concerning the health of the people of the State affected by sudden changes of the atmosphere; the passage of cold waves; flight of birds; ravages of insects and great storms.

Alabama has the honor of inventing the present system of signals for indicating the changes of the weather twenty-four to forty-eight hours in advance. This system was first introduced in the State in September, 1884, a year or more before it was finally adopted by the chief signal officer for the entire United States. The cold wave flag did not belong to the Alabama system; it was taken from the system in use by the chief signal officer at the time.

The flags adopted for this purpose are four in number, and are of the form and dimensions indicated on following page, (8):

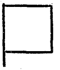
CIRCULAR.

Alabama Weather Service,

AUBURN, ALABAMA.

EXPLANATION OF SIGNALS.

No. 1.
White Flag.

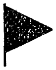


Clear or fair weather.

No. 2.
Blue Flag.

Rain or snow.

No. 3.
Black Triangular Flag.



Temperature signal.

No. 4.
White Flag with black square in centre.

Cold wave.

Number 1, white flag, six feet square, indicates clear or fair weather. Number 2, blue flag, six feet square, indicates rain or snow. Number 3, black, triangular flag, four feet at the base and six feet in length, always refers to temperature; when placed above numbers 1 or 2 it indicates warmer weather; when placed below numbers 1 or 2 it indicates colder weather; when not displayed, the indications are that the temperature will remain stationary, or that the change in temperature will not vary four degrees from the temperature of the same hour of the preceding day. Number 4, white flag, six feet square, with black square in centre, indicates the approach of a *sudden* and *decided* fall in temperature. This signal is not to be displayed unless it is expected that the temperature will fall to forty-five degrees, or lower, and is usually ordered at least twenty-four hours in advance of the cold wave. When Number 4 is displayed, Number 3 is always omitted,

When displayed on poles the signals should be arranged to read downward; when displayed from horizontal supports a small streamer should be attached to indicate the point from which the signals are to be read.

INTERPRETATION OF DISPLAYS.

No. 1, alone, indicates fair weather, stationary temperature.

No, 2, alone, indicates rain or snow, stationary temperature,

No. 1, with No, 3 below it, indicates fair weather, colder.

No, 2, with No, 3 above it, indicates warmer weather, rain or snow,

No, 1, with No. 4 below it, indicates fair weather, cold wave.

No. 3, with Nos. 1 and 2 below it, indicates warmer, fair weather, followed by rain or snow,

☞Communications in reference to the display of signals and symbols should be addressed to

P. H. MELL, Director.
AUBURN, ALA.

Table Exhibiting the History of Meteorological Work in Alabama.

UNTY.	STATION.	Latitude.	Longitude	Elevation.	Date of Opening Station.	Date of Closing Station.	Character of Observations.	Names of Observers, and Authorities Reporting to.
uga	Prattville	32°28'	86° 29'	190	June, 1884	Jan. 1886	rainfall and temperature	Prof T J Lamar, J E Wilkinson, W F Mims, *S W S
lwin	Fish River	30 23	87 51	17	Jan. 1867	Sept. 1868	temperature only, and broken	W. J. VanKirk, Smithsonian Institute.
"	Bon Secour	.....	....	.	1866	1867	temperature	W. J. VanKirk, Smithsonian Institute.
"	Ft. Morgan	.....	.....	..	Jan. 1835	July, 1843	rainfall and temperature; broken	Smithsonian Institute.
our	Eufaula	31 55	85 3	..	Mar. 1884	Aug 1887.	rainfall, maximum & minim. temperature	Capt. R. F. Kolb, Jas. Milton, S. W. S.
ock	Union Springs	32 8	86 36	450	Jan. 186[illegible]	Still open.	rainfall and temperature	J. L. Moultrie, C. H. Franklin, James Grady, S W S
er	Greenville	31 50	86 36	450	April, 1882	Oct. 1887	rainfall, max. and min. temperature	Cotton Belt Station, Judge J. K. Henry, S. W. S.
oun	Jacksonville	33 50	85 42	653	June, 1884	May, 1886	rainfall and temperature	Prof. J. G. Ryals, jr., Prof. J. H. Chapell, S. W. S.
mbers	La Fayette	32 56	85 24	865	July, 1884	April, 1886	rainfall and temperature	Dr. W. B. Trent, Prof. G. O. Willet, S. W. S.
ctaw	Butler	32 5	88 12	..	Jan. 1889	Still open.	rainfall, max and minimum temperature.	B. F Gilder, S. W. S.
ton	Clanton	32 52	86 36	596	Mar. 1884	Sept. 1885	rainfall and temp; (dry-bulb)	W. E. Stewart, S. W. S.
rokee	Centre	34 10	85 37	729	Jan. 1885	Still open	rainfall, max. and min. temp; (dry bulb).	Thos. Bradford, S. W. S.
	Lineville	33 20	85 42	....	Jan. 1886	Aug. 1886	rainfall and temp, (dry bulb)	Prof. G. W. Stevens, Alexander Beck, S. W. S.
urne	Edwardsville	33 44	85 29	.	Jan. 1884	Oct. 1885	rainfall and temp, (dry bulb)	Capt. J. M. K. Guinn, B. B. Bridges, S W S.
ert	Tuscumbia	34 40	87 42	468	April, 1882	Still open.	rainfall and dry bulb	Col. L. B. Thornton, S. W. S.
ecuh	Evergreen	31 25	87 45	....	May, 1884	Still open.	rainfall max. and min. temperature	Cotton Belt Station.
ington	Wiggins	31 15	87 45		Mar. 1889	Still open	rainfall, max. and min. temperature.	M. D. Jones, S. W. S.
nshaw	Luverne	31 45	86 20	..	June, 1889	Still open.	rainfall, max. and min. temparature	J. O. Sentell. W. I. Fundaburk, S. W. S.
ee	Clintonville	31 26	85 54		June, 1884	April, 1886	rainfall, temperature, (dry bulb)	R. A. Clements, S. W. S.
e.	Newton	31 21	85 35	..	Mar. 1884	May, 1888	rainfall, max and min temperature	T F Mangum, jr., C L McCartha, C P Atkinson, O D
las	Carlowville	32 10	87 15	400	June, 1856	Dec. 1874	rainfall and temperature, (dry bulb).	H. L. Allison, M. D., S. Inst. [Killebrew, S W S.
......	Selma	32 25	87 0*	236	Jan. 1858	Still open.	rainfall and temperature, broken	S K Jennings, C F Fahs, B H Riggs, Miss S V A Hunt,
......	Cahaba	32 22	87 10	..	3 months	in 1859	temperature and direction of wind.	Dr. Mathew Troy, S. Inst. [W D Dunlap, S W S.
......	Orrville	32 24	87 6	200	5 months	in 1859-60	rainfall and temperature.	Dr. S K Jennings, T A Huston, J A Coleman, S I.
Kalb	Valley Head	34 30	85 30	1058	June, 1885	Still open.	rainfall, max and min, dry bulb temp	Dr. E. P. Nicholson, S. W. S.
wah	Gadsden	34 2	86 2	...	May, 1884	Still open.	rainfall, max and min temperature	D. P. Goodhue, S. W. S.
ore	Wetumpka	32 33	86 2	....	June, 1884	Nov. 1885	rainfall, max and min temperature	M. E. Reese, S. W. S.
ette	Fayette C. H	32 42	87 48	. .	July, 1884	Still open.	rainfall max and min temp	T. P. McConnell, Daniel Collier, S. W. S.
ene	Boligee	32 46	88 10	....	1860	....	rainfall and temperature, (dry bulb)	Col. Horace Harding, S. I.
ene	Eutaw	32 46	87 54	....	1851	1852	rainfall and temperature, (dry bulb)	Prof. A. Winchell, S. I.
eene	Knoxville	33 2	87 52	....	....	....	observations made on direction of wind	Smithsonian Institute.

e	Erie	32 48	87 31	....	May, 1824	June, 1825	rainfall and temperature from dry bulb	Dr. S. K. Jennings, Dr. T. C. Osborne, S. I.
	Greensboro	32 42	87 35	220	Jan. 1855	Still open.	rainfall and dry bulb thermometer	R B Waller, N T Lupton, J W A Wright, M H Yerby
	Green Springs	32 47	87 46	250	Jan. 1854	July, 1885	rainfall, max & min tem, bar. humidity	Dr. Henry Tutwiler, J. W A. Wright, S I & S W S.
	Havana	32 52	87 36	300	1853	Dec. 1869	rainfall and dry bulb temperature	Dr. Henry Tutwiler, Dr. S. K. Jennings, S. I.
	Newbern.	32 41	87 35	..	....	....	direction of the wind and cast of the sky.	Smithsonian Institute.
son	Scottsboro	34 45	85 58	..	April, 1882	Aug. 1889	rainfall max and min temperature	Cotton Belt Station.
erson	Birmingham	33 32	86 37	600	Sept. 1884	Still open.	rainfall and dry bulb temperature	J. E. Waller, W. B. Summerville, C B S and S W S.
lerdale	Florence.	34 48	87 45	563	Jan. 1849	Still open.	rainfall dry bulb temperature	Prof. J K Powers, J W Milner, C W Ashcroft, S W S
rence	Moulton	34 27	87 25	643	1859	1868	rainfall, dry bulb, barom. relative humidity	Prof J Shackelford, A J Harris, T J Peters, A D Hunt
	Auburn	32 40	85 30	826	Jan. 1854	Still open.	r'f. soil tem. m & m tem, bar. ter. & solar rad	Prof Darby, P H Mell, H Lamar, W D Dunlap, A C
	Opelika	32 38	85 25	..	Jan. 1867	Still open,	rainfall, max and min, dry bulb tem	J. H. Shields, Miss Shields, G. Lyons. [Dunstan.
estone	Elkmont	34 52	86 56	...	Feb. 1889	Still open.	rainfall, max and min temperature	D. J. Moore, S. W. S.
ndes	Benton.	......	......	....	1849	1851	rainfall and temperature (dry bulb)	Smithsonian Institute, Dr. C. F. Percival.
"	Ft. Deposit	31 59	86 36	...	May, 1884	Still open.	rainfall, max and min temperatures	Cotton Belt Station.
"	Mt. Willing.	32 7	86 44	..	Sept. 1884	Still open.	rainfall, max and min temperature	W. M. Garrett, S. W. S.
ison	Huntsville	32 45	86 40	690	Jan. 1831	Aug. 1877	rainfall and temperature	U. S. Post Hospital Reports.
"	New Market	34 54	86 27	809	Jan. 1888	Aug. 1889	rainfall, max and min temperature.	Dr Geo. D. Morris, S. W. S.
ngo	Demopolis	32 31	87 52	....	April, 1882	Oct. 1883	rainfall, max and min temperatures	Cotton Belt Station.
hall	Guntersville	34 24	86 15	....	July, 1889	Still open	rainfall, max and min temperatures	A. J. Baker, S. W. S.
le	Citronelle	31 7	88 12	150	July, 1888	Still open	rainfall, max and min temperatures	Dr. J. G. Michael, S. W. S.
	Mobile.	30 41	88 2	35	Jan. 1840	Still open	rainfall, dry bulb, max and min, bar.	Dr. S. B. North, J. J. Nicholson, L. B. Taylor, Sgt. S.S.
	Mt. V. Barracks.	31 12	88 2	.	Aug. 1840	Still open	rainfall, max and min temperatures	U. S. Post Hospital reports.
	Spr. Hill College.	30 42	81 1	..	1866	....	rainfall, dry bulb temperuture	Rev. A. Carnette, S. Inst.
oe	Monroeville	31 32	87 28	150	Mar. 1849	Nov. 1855	rainfall, temperature, (dry bulb)	S. J. Cumming, S. Inst.
	Bermuda	31 43	87 12	...	Feb. 1886	Still open	rainfall, max and min dry bulb temp	Wm. Fowler, S. W. S.
gomery	Montgomery	32 23	86 18	219	Mar. 1849	Still open	rainfall, max and min dry bulb, baro	Rev. J. A. Shepherd, Foster and Sgts. of S. S.
an,	Trinity.	34 38	87 3	875	Mar. 1884	April 1887	rainfall, temp from dry bulb	Prof. Joseph Shackelford, S. W. S
	Marion.	32 38	87 26	430	Oct. 1873	Still open	rainfall, max and min, dry bulb temp	Prof. A. D. Smith, D. Thos. Dill, S. W. S., C. B, S
	Uniontown	32 28	87 30	....	April, 1882	Still open	rainfall, max and min, bar , soil temp	W. H. Newman, S. W. S.
ns.	Carrollton	33 14	88 3	..	July, 1884	Still open	rainfall, max and min dry bulb temp	Judge M. L. Stansel, S. W. S. [douer, S. W. S.
	Troy	31 50	85 54	450	April, 1872	Dec. 1889	rainfall, dry bulb, max and min temp	H. C Bailey, J. W. Morgan, J. M. Dill, Jos. Wal-
olph	Roanoke	32 12	85 23	..	Aug. 1884	Mar. 1886	rainfall and dry bulb temp	G. W. Stevens, J. P. Shaffer, S. W. S.
ll	Ft. Mitchell	32 30	85	..	July, 1836	Sept. 1837	rainfall	Smithsonian Institute.
	Oswichee	32 15	85	...	Jan. 1886	Dec. 1887	rainfall and (dry bulb) temp,	Dr. W. C. Whitaker, S. W. S.
lair	Ashville	33 52	86 20	..	Jan. 1857	Dec. 1857	temperature	Thos. M. Baker, S. Inst.
y	Calera	33 6	86 31	502	April, 1882	July 1887	rainfall, max and min temp	C. L. Candler, Cotton Belt station.
	Columbiana	33 15	86 36	...	April, 1873	Still open	rainfall, max and min temp	Smithsonian Institute, W. D. Lovette, S. W. S.
er	Coatopa	......	......	...	......	......	rainfall and temperature	Smithsonian Institute, Dr. S. K. Jennings.

NOTE.—S. W. S. stands for State Weather Service; S. I. stands for Smithsonian Institute; C. B. S. stands for Cotton Belt Station.

Before entering into a discussion of the climatic features of Alabama it is thought best to cull and mention in this place some of the most interesting data from the large mass of material collected by the observers mentioned in the preceding list. The following classification has been made as a matter of convenience:

1. Temperature data from some stations furnishing several years continuous observations.
2. Rainfall data from stations giving several years observations.
3. Years of drought and wet years.
4. Destructive storms.
5. Remarkably cold winters and warm summers.
6. Years of good crops and years producing poor crops.
7. The winds of Alabama.

1. Temperature data from some stations furnishing several years continuous observations.

AUBURN.

TEMPERATURE.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.
1855..															
1856.	42.98	49.5	53.0	64.4	71.4	77.7	80.1	79.1	76.5	62.9	56.7	48.96	63.6	....	....
1857..															
1881....	.....	49.2	50.6	61.7	72.8	79.1	80.7	78	76.3	69.3	53.4	50	..	100	19
1882....	51.9	53	58	65 2	67	77.5	74.7	75.9	71.7	61.6	50.5	41.4	62.4	93	14
1883....	48.1	56.6	50.9	64.2	69.5	75 8	..		..	67 9	54 8	50 2	....	..	19
1884....	38.4	54	56.3	59.7	72	72.4	76	77	75.9	69.3	54	48.8	62.8	94	3
1885....	43.4	42	49 4	63 3	68	75	78	77.5	74	60	53	45.5	60.8	92	12
1886....	39.8	47.1	53.7	62.4	70.2	76	77.8	78 9	76	64.3	52.3	42 9	61.8	97	4
1887....	42 9	57	55.2	64.6	74	*	83	77.7	71.7	61.7	55	46.3	....	96	9
1888....	47.2	52.8	54 2	67.1	71	76	80	78 4	72.1	62.2	54.7	46.1	63.6	93	17
1889....	46 9	46.3	54.7	62.5	70.1	76.1	80.7	77.6	74.8	62 3	53.1	57.8	62.7	98	16.5
Means	44.6	50.7	53 6	61 2	70.5	76	79	78.9	74.3	64.2	53.8	47.8	62 8	....	....

* The records were destroyed by fire June 27th, 1887.

CARLOWVILLE.

TEMPERATURE.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.
1856			...		..	78.93	83.38	82.06	74 60	66.76	56.28	45.46	..	98	10
1857	38.86	59.31	53 20	58 11	69.74	78 98	77.93	79.24	75.05	61.64	52.40	55.19	63.30	96	8
1858	57.72	47.62	59.28	66.04	70.39	76.30	81.70	79.14	72.62	70 57	45.63	48.31	64.36	96	25
1859	42.96	56.25	64.74	61.48	74 14	78 96	87.08	81.51	74.33	63.69	62.63	49.65	66.03	96	15
1860	....	...	...	....		...	87.00	....				..	....	103	..
1867	45.65	56.63	57 10	65.50	70 93	80.63	81.03	80.50	77.38	67.32	57.80	55.75	65.35	95	24
1868	45.03	50.48	62 30	66.45	72.43	80.98	80.93	79.00	75.55	65.00	52.28	44.83	64.61	100	14
1869	51.28	50.28	57.50	65 28	72.00	78.60	82 53	81 90	73.65	60 35	53.38	47.40	64.51	98	27
1870	50.98	50.25	52.95	62.65	75.18	77 65	82.23	82.00	75.13	66 63	54.98	44.28	64.58	98	12
1871	49.15	55.68	59.78	66 55	70.63	79 95	83.23	82.63	72.88	67.90	55.42	49 92	66.14	98	19
1872	42.07	49.10	53.92	68.00	75.55	79.25	80.90	81 05	76.78	64.58	51.75	45.97	64.08	96	18
1873	43.15	52.61	54.32	64.59	74.11	78.89	81.57	80.28	74.70	62.48	53.75	50.17	64.22	96	15
1874	50.4	54.7	61.90	63 20	74.50	81.80	83.40	82.20	78.20	68 50	59.40	51.30	67.47	...	..
1875	47.2	52.4	56.30	62.20	75.20	81.20	84.30	77 40	73.20	59.10	60.60	57.10	65.50	...	..
1876	56.8	52.5	54.40	68 90	71.70	79.40	81.70	80.70	75.80	65.50	53.60	40.30	65.10	...	..
1877	48.5	49.2	54.60	61.40	71.20	83.50	83.90	81.40	75.90	....	....	....	....	...	..
Me's	47.8°	52.7	57.3	64.3	72.7	74 3	88 2	80.7	75 1	65 7	55.0	48.9	65.2	...	..

GREENSBORO.

TEMPERATURE.

Year.	January.	Febr'y.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Annual.	Max.	Minim.
1855	....	....	....	....	....	...	....	....	...		....	...	....	..	..
1856	.	.	.	....	....	79.9	82.6	81.6	...	66.3	54.3	43.7	...	94	..
1857	37.3	57.5	52.7	56.0	67.6	75.6	74.6	76.6	72.4	59.7	52 3	50.5	61.1	91	8
1858	50.6	45.5	57.3	64.0	70.9	75.6	80.0	77.7	70.7	64 9	44.8	55.0	63.1	93	22
1859	44.8	54.2	56.3	62.4	72.4	76.8	78.5	77.6	73.2	60.8	57.1	42.5	63.0	93	14
1860	....	....	..	....			..	...		...		...	. .	..	..
1861	45.5	50.3	56.2	62.8	68.7	78.6	79 2	77 2	74.5	63 9	63 8	54 0	64 6	..	..
1862	53.3	50.5	....	....	78.2	77.9	83.2	80 0	....	. .	....	47 0	...	98	23
1863	...	....	....	....	....	....	....	...	...	...	....	...	....	..	..
1864	....	...	....	..	....	....	....	...	....	....	....	..	....	..	..
1$65	....	....	...	...	....	...	...	....	...	....	...	....	....	..	..
1866	....	...	....	....	....	....	...	...	....	....	....		....	..	..
1867	...	....	...	...	....	....	....	....	....	...	...	...	....	..	..
1868	....	....	....	....	....	....	...	...	....	....	....	...	....	..	..
1869	....	....	...	....	..	...		...	....		52.8	46 4	...	..	..
1870	50.0	...	...	....	....	....	....	...	....	...	..			..	..
1876	45.39	50.47	56.16	61.90	70.31	76 92	79.31	78 28	72.22	61.97	52 60	47.21	62.7	..	..
1884	....	...	....	64.0	76.0	76 0	80.6	78 8	76 7	68.5		49.7			..
1885	44	44.9	51.0	65.7	69.0	79.0	78.9	80 2	75.0	61.5	55.0	47 0	62 8	..	..
1886	39.4	48.0	57.2	63.6	71.0	76.1	77.3	77 5	77.7	70.0	54.4	45.9	63.2	..	.
1887	45	59.4	58.0	66 3	72.0	...	...	..	...	...	..	...	..	..	.
1888	46	53 1	54.6	66.3	71.6	78.0	82.0	79.4	71.6	61.9	57	57 9	65.0	..	..
1889	47.1	45.2	55.5	66	70.7	76.9	81.7	77 9	74.8	64.7	53	60.3	64.5	..	..
Me's	45.7	50 8	55 5	63 3	71.6	77.3	79.8	78 6	73 9	64.0	54.3	48.9	63.6	..	..

GREENE SPRINGS.

TEMPERATURE.

Year.	January	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Novem.	Decem.	Annual.	Maxim.	Minim.
1854	43.94	....	63.20	60.11	....	....			. .		. .	43.83	...	...	..
1855	47.63	43 43	56 30	72.57	80.23	80.16	79.19	82 17	75 00	61.80	61.60	47.72	65.65	103	16
1856	35.30	47.00	56.48	67.79	73 37	79.70	81.19	78.87	73.67	64.83	53 39	42,88	62.87	102	8
1857	35.83	61.27	50.57	55.28	69.54	76.17	76.24	78.28	72.42	59.43	57 32	50.18	61.21	92	4
1858	50.11	43.74	56.37	63 19	70.50	76.50	79.32	78 08	73.90	66.23	44 14	51.69	62.81	95	22
1859	47.91	53.46	57.97	61.71	73.30	77.17	78.70	77.80	77.41	60.21	57 09	42.92	63.47	..	..
1860	....	....	....	....	....	....	83.70	78.15	73.78	61.53	49 70	42.75	....	100	..
1861	43.35	49 23	...	....	....	...	...	.		. .	...	...	....	..	..
1866	...	...	.	..	...	76.17	....	78.03	63 03	61.95	51.93	44.02	...	97	20
1867	42.66	54.16	53 98	62.59	66.88	76.30	79.10	78.68	76.84	63.69	55.30	53.65	63.65	94	19
1868	42.76	48 13	60.68	64.78	68 43	77 55	79.45	77.31	73.20	61.37	46 83	42.86	61.93	97	10
1869	47.92	47.84	52.65	60.50	68.15	75.78	80 45	80.63	71.23	56.06	49.38	44.08	61.14	98	20
1870	47.60	47.53	57.10	59.36	68.85	75.44	79.48	80.21	73 86	63.65	52.12	42.38	61.76	95	9
1871	46.43	51 68	58 00	64.00	68 66	78.61	83.00	83.55	74 05	66.15	53.50	48.20	64.44	94	16
1872	39.39	49.12	50.38	68.25	71 16	79.20	82.43	83.21	77.00	62.30	49.28	10.73	62.70	..	..
1873	41.00	51 00	54 00	62 30	71.32	72.12	79.00	76.80	71.63	57 48	48.92	44.12	60.81	..	..
1874	44.33	50.20	57.56	58.07	70.91	72.93	80.58	83.05	76 61	62.18	55.02	18.79	63.35	..	..
1875	43.18	44 72	55.80	59.30	71.92	76.25	84.33	76.17	74.28	56.43	56.82	53.10	62.69	..	..
1876	50.05	50.81	51.25	63 03	69.86	76.22	80.84	78 35	74.55	60.61	49.08	37.18	61.82	..	..
1877	43.66	48.67	51.80	61 69	68.52	77.64	80.35	78.04	73.10	62.11	48 93	48.18	61 89	..	..
1878	41.30	45.53	60 00	64 71	78.23	77.00	83.91	81 26	74 90	64.00	54 72	41.50	63.92	..	..
1879	42.89	13.78	56.60	59.96	69.35	73 94	79 33	74.00	70.70	64.70	54.28	49.94	61.62	..	..
1880	53 80	49 03	55.90	63 56	71 50	74 20	79.78	78 65	74.00	62.70	48.36	42.75	62.85	..	..
1881	42.10	48.80	51 90	62 39	73.26	79 50	81.17	81 06	76 35	69 50	54 30	52.48	64.40	..	..
1882	53.16	56.63	60.81	65 38	68.58	79 03	77 03	71 86	72 50	68.50	52 44	42.50	64.03	..	..
1883	46.13	54.22	53.50	64 23	68.28	78.22	82 85	79.77	75 10	70 00	55.37	50.10	64.81	..	..
1884	37.66	52.18	57.00	61.00	71.30	73.52	80.00	77.32	76.50	68.35	49 83	48.69	62.78	..	..
Mns	44.40	49.67	55.82	62.73	70.87	76.63	80.47	78 85	73 82	65.41	52.77	46.04	63.12	...	..

HUNTSVILLE.

TEMPERATURE.

Year.	January	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Annual.
1829	42.1	42 6	51.3	61.3	67.2	74.2	76.4	76.2	70.1	59.5	49.7	41.8	59.7
1830													
1831													
1832													
1833													
1834													
1835													
1836													
1837													
1838													
1839													
1840													
1841													
1842													

MOBILE.

TEMPERATURE.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.
1840	56.1	57.4	65.6	70.7	78	82.7	83.8	85.3	79.3	73.	59.2	54.5	70.5	93	34
1841	54.3	56.9	61.8	69.9	74.8	81.3	83 2	81.8	74.6	67.8	63.6	56	68.8	94	31
1842	57 9	57.8	69.5	69.4	76.4	82.5	80.3	81.2	78	69.1	61.7	56	70.0	93	33
1871	50.5	58.3	61.1	67.9	72.7	80.6	82.3	83	74.9	68.7	57.9	51.6	67.5	....	. .
1872	44.6	51.7	55.1	68.9	76	80.8	80.7	81.3	77.7	75.5	54	47.9	65.4	....	....
1873	46.3	56.1	57.1	65.7	74.3	79,3	82.1	79.6	76.2	64.8	56.9	53.6	66.0	98	19
1874	52.8	56.6	63.1	64.3	73.4	79.8	80.6	83.7	77.9	68.6	60.1	53.9	67.9	100	31
1875	49.9	50.9	60	63.1	75.8	80.7	84.1	78.3	74.9	62.7	62.2	57.5	66.7	99	25
1876	56.7	55.3	55.9	66.4	74.6	80.9	83.2	79.2	76.5	63.7	55.1	43.8	66.0	....	....
1877	49.7	52.9	57.2	65.8	72.9	82.4	85	81.5	77.4	67.8	55 8	53.8	66.8	100	...
1878	47.8	51.9	64.3	69.8	75.7	81.3	84.4	82.5	77.2	68	57.6	47.2	67.3	98	26
1879	48.7	51.8	61.8	66.1	74.8	80.2	81.4	78.2	75.8	69.1	60.6	55.8	67.0	100	15
1880	59.4	56 3	64.4	69.3	75.2	80.1	80.5	80.4	75.1	66.7	*	49.1	..	98	14
1881	47.6	53 2	56.7	65.4	76.6	82.9	83.3	81.4	79.3	73.7	59.1	56.6	68 0	100.8	28
1882	58.3	51.1	65.1	70.5	72.5	81.3	78.6	79.4	75.7	71.4	58.5	48.5	68 2	100	24
1883	52.7	59.6	57.7	68.8	72.9	81 3	83.6	82	77.9	73.3	60.5	56.4	68 9	101	28.5
1884	43.5	51.3	62.2	66.2	74.6	77.8	80.1	78.7	78.6	72.2	55.5	53.9	66.2	96	13.9
1885	41.2	48.3	53.5	66.2	71.7	78.8	79.4	79	76.6	72.9	56.2	47.5	64.3	94	20
1886	44.1	49.7	56.7	63.9	72.2	77.9	78.6	79.9	77.6	67.4	56.1	48.9	64.4	97	11
1887	47.6	62.5	58.9	66.3	73.9	77.7	80 4	79.9	77	66.4	58.6	50.8	66.7	98	16
1888	52.4	56 3	57.5	68	72.1	77.5	80.5	78.2	72.8	65.2	56.9	49	65.5	97	23
1889	49.8	49.4	56.2	66	70.2	76.7	81.2	79.3	76.7	66	56.3	61	65.8	95	29
Means	50.7	50.2	60 7	66.7	74.2	80.2	81.7	80 7	76.	68 6	55.6	47.4	66 2		...

* Records of office were destroyed in December, 1880.

MONTGOMERY.

TEMPERATURE.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.
1849 } 1861 }	52.73	60.88	63.80	75.49	77.62	...	...	..	73.40	61.40	50.19	50.18	....	.....	....
														.....	....
1873..	43.4	53.4	54.2	63.9	73.8	77.7	83.2	80 1	74.9	62.6	53.7	49.2	63.8	97	14
1874..	50.8	54.3	60.9	62.2	73.1	79.6	79 9	82 3	76	64.9	57.8	51.2	66.3	103	27
1875..	47.7	49.3	56.9	62.1	74.5	80.7	85.3	78.3	74.3	60.4	58 9	54.4	65.5	102	18
1876..	54.4	53.9	54	65	73.1	79.8	82.8	80.4	74.8	62.4	52.6	41.4	64 9	.....	....
1877..	49.2	57.8	54.7	64.2	71.9	80.7	83.7	81.4	75.3	65.3	53.5	52.1	65.6	102.5	....
1878..	46.2	49.8	62.6	67.3	74.9	79.3	84.3	83 6	76.7	64.7	55.8	44.4	65 9	100	22
1879..	48 9	48.9	60.4	63.3	73.8	79	82.5	77.1	73.5	67.9	58.4	53.8	66.0	101	14
1880..	57.6	53.8	61.5	66 9	73.8	79.3	81	79.8	73.2	65	51.1	46 2	66.6	100	8
1881..	44.5	50.5	53.4	63.5	75.2	81.9	84 1	81.1	77.8	71.2	56.4	54	66.2	106.9	24
1882..	55.2	57.4	62.2	68	70.4	79 6	78.1	78.6	74	69.6	54	44.9	66	97.6	19.2
1883..	49.8	58.2	54.8	65.9	70.6	79.2	82.4	80.3	76	71.2	58	53.6	66.7	98.6	25
1884..	40.5	55.4	59.9	63.4	74.6	75.6	81	78.4	79	71.5	54	51.2	65.4	97.1	8
1885..	46.2	45.4	51.7	65.8	70.1	79.8	80.2	79.7	75.2	60.9	54.3	46.6	62 9	98	15
1886..	41.8	47.2	55.6	63.8	72.7	77.5	79 6	80	77.3	66	54	44.8	63 4	98	5
1887..	45.2	59.3	57.6	66	75.7	79.9	79.7	79 3	75.7	63.5	56	47.8	65.5	102	13
1888..	51.1	54.5	56.6	68.7	72.4	78.6	82.7	78.6	71.6	62.3	54.8	46.6	64.9	98	18
1889..	47.4	46.9	54.8	64.4	70.6	76.2	79.5	78.5	75.4	63.9	54.6	59.2	64.3	99	21
M'ans	48.2	52.8	57.1	64.9	73	79	81.8	79 9	75.3	65.5	55.4	49.5	65 3	.....	....

MOULTON.

TEMPERATURE.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.
1859...	.....	.....	55.82	60.67	73.52	....	.....	.....	.....	....	.....	....	....	..	..
1861...	45.00	48.00	51.00	61.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	..
1866...	.....	.....	....	64.67	....	72.23	80.5	.....	.....	.....	.....	.....	.....	..	..
1867...	38.9	57.94	48.93	60.95	67.33	75.45	76.73	75.55	73.35	59.62	51.03	48.20	60.66	87	17
1868...	38.1	45.46	57.68	60.55	66.99	75.60	78.53	74.94	69.28	59.02	46.81	38.91	59.32	92	12
1869..	44.63	44.48	49.62	60.98	66.22	73.40	76.35	78.95	67.94	52.22	47.15	41.67	58.63	91	20
1871...	44.82	51.15	57.17	64.53	68.03	76.75	78.33	78.50	69.92	62.30	50.25	44.30	62.17	90	16
1872...	34.45	46.10	48.80	64.78	69.65	75.72	78.47	79.45	72.30	59.28	45.20	37.38	59.30	90	12
1873...	37.00	45.85	50.10	61.18	69.75	75.69	78.72	77.15	71.32	56.75	49.67	46.75	59.99	90	11
1874..	.....	....	.....	.....	....	.....	.....	.....	.....	.....	.....	....	.....	..	..
1875...	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	..
1876...	41.66	47.47	52.63	61.46	68.49	74.17	77.20	76 48	70.19	56.95	48.35	42.93	.....	..	..
Means.	40.6	48.3	52.4	61.6	68.4	74.9	78.1	77.3	70.6	58.0	48.4	42.9	60.1	..	..

MOUNT VERNON BARRACKS.

TEMPERATURE.

Year.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	An'ual	Max.	Min.
1840..	....	....	....	....	...	....	....	78.83	74.12	67.65	55.92	50.53	...	...	..
1841..	50.50	53.00	58.00	67.00	72.25	77.00	....	....	....	....				...	..
1842..	50.38	54.70	66.50	67.12	73.00	78.50	76.70	75.50	74.60	65.82	55.03	49.05	65.57	...	..
1843..	52.50	50.70	47.70	69.50	75.30	76.66	82.35	78.21	78.86	63.61	59.56	49.61	65.38	94	24
1844..	..	..	...	.	77.51	78.42	81.17	78.16	73.97	62.65	57.07	47.40		98	24
1845..	51.30	53.14	55.73	70.49	73.59	80.08	81.36	81.04	74.30	62.62	53.03	42.53	64.93	99	16
1846..	48.93	50.63	61.57	64.18	72.72	76.52	77.43	78.19	77.60	65.17	58 87	57.23	65.75	94	26
1847..	47.40	55.02	57.09	69.99	70.53	77.90	77.08	77.33	71.45	66.30	57.84	47.11	54.58	94	21
1848..	52.98	56.61	60.44	64.50	73.95	74.89	78.22	77.82	72.76	65.59	51.19	57.98	65.58	92	26
1849..	53.00	49.86	65.14	64.75	72.50	76 90	76.27	79.05	74.50	64.21	58.90	54.22	65.77	95	18
1850..	56.30	51.66	61.55	66.61	73.18	76.90	79.89	81.61	78.33	66.96	55.57	52.04	66.72	95	26
1851 .	51.26	57.04	59.12	67.52	74.89	79.83	81.82	79.22	75.53	66.83	54.79	49.82	66.47	98	18
1852..	42.15	59.55	64.17	64.42	76.43	79.60	82.29	82.14	79.01	70.58	56.87	59.51	68.06	98	9
1853..	47.48	53.84	61.22	70.96	74.31	79.86	78.55	80.41	75.70	65.88	61.10	47.31	66.39	95	28
1854..	51.52	53.18	65.24	62.30	74.64	79.17	78.90	81.17	79.58	69.17	54.76	49.22	66.57	98	24
1855..	53.19	48.39	57.85	72.34	78.48	78 98	78.84	79.78	78.35	63.93	62.99	51.12	67.02	102	21.
1856..	39.50	56.46	57.19	68.63	74.18	78.60	81.71	81.33	74.64	66.97	58.68	49.29	65.59	95	13
1857..	43.73	61.48	56.48	59.07	71.08	79.36	79.86	78.65	76.58	60.86	56.99	55.73	64.99	95	10
1858..	56.24	50.69	60.35	66.34	73.73	78.36	81.36	80.17	76.04	70.90	49.97	56.65	66.73	96	27
1859..	48.95	57.67	62.42	65.01	75.33	78.65	80.98	79.63	76.34	65.23	60.98	48.39	66.63	96	14
1860..	50.53	53.36	60.27	71.14	78.01	86.21	89.79	87.71	81.76	69.96	55.69	51.49	69.66	104	17
1873..	.....	.....	.....	.....	.....	.....	.....	....	....	63.0	57.1	56.9	....	...	..
1874..	53.9	56.3	65.2	64.6	75.3	80.9	81.6	84.3	78.4	69.0	60.7	55.9	68.8	..	..
1875..	50.2	52.3	61.4	64.7	76.1	80.1	84.8	78.2	76.5	65.7	65.2	59.3	67.9	102	..
1876..	58.5	57.5	58.2	68.2	74.9	80.7	83.0	80.0	78.6	66.3	56.5	51.3	67.8	102	..
1882..	...	...	66.1	70.5	72.4	79.7	77.6	78.6	75.2	71.9	57.7	49.5	....	102	20
1883..	52.9	61.5	59.3	67.9	71.9	80.1	82.4	82.3	78.8	74.6	60.8	56.8	69.1	...	23
1884..	43.7	59.4	63.9	67.1	74.5	76.6	81.6	80.6	80.3	74.1	57.2	54.7	67.8	101	10
1885..	49.9	49.7	55 5	69.2	73.5	81.2	81.6	80 9	77.6	64.7	57.4	50.5	66.0	99	15
1886..	44.4	50.5	58.5	65.4	74.1	78.8	80.4	82.2	78.8	69.2	57.3	49.3	65.7	...	..
1887..	48.1	63.6	60.2	68.3	75.4	79.6	81.6	82.3	78.5	66.5	58.8	50.3	67.8	...	..
1888..	52.7	57.1	60.1	70.2	71.5	79.3	83.1	79.9	75 0	66.5	58.5	49.8	67.0	...	..
1889..	50.5	50.0	58.5	66.8	71.0	77.7	81.0	79.0	75.2	65.6	55.2	60.0	65.8	..	..
M'ans	52.2	56.8	62.0	67.1	74.1	78.9	80.8	82.9	76.7	66.8	55.6	52.8	67.2	...	..

MEAN TEMPERATURE AT STATIONS IN ALABAMA.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.	Max.	Min.	No. of years.
Auburn	44.6	50.7	53.6	61 2	70.5	76	79	78.9	74.3	64 2	53.8	47.8	62.8	100	4	11 years, 3 months.
Bermuda	48.3	53.4	55.2	66	71.3	76.6	78.6	78.5	74.8	63.5	57.7	47	64.2	96	15	4 years.
Birmingham	39.1	41.7	50.1	61.7	69	75.8	79.4	79.2	78.1	68	49	49	61.7	103	0	3 years.
Bolling	44	44	49.7	64	70	....	80	80	78	64.5	47	48	...	100	17	2 years.
Carlowville	47 8	52.9	57.3	64.9	72.7	74.3	88.2	80.7	75 1	65.7	55	48.9	65.2	103	8	15 years, 5 months.
Carrollton	39.7	48.3	52 2	63.9	71.3	77.3	79.8	76.8	73.8	63.8	52.4	42.9	61.9	96	0	5 years.
Centre	39	40	48.6	60.9	62.4	74.5	78.5	76.1	73.3	60.1	50.8	46.9	59.2	96	14	3 years.
Clanton	44	...	52.9	63.8	72.6	71.5	78.4	79.9	....	68	49	47	....	96	20	2 years.
Clintonville	49	51	55	68.2	72.4	74.2	77.7	..	77	73	56	....	....	90	22	1 year.
Coatopa	47.3	52.3	56.4	62.8	70.2	77.2	80.6	82	73.4	66.2	52.4	43.8	61.7	98	11	2 years.
Decatur	35.5	41.3	50	61	73	78	81.9	83	....	....	....	41.4	....	102	14	1 year.
Edwardsville	38	37	43.5	60.7	66	76	80.7	79.3	78	62.7	52.3	42	59.7	97	8	3 years.
Erie	48.9	54.5	62.4	65.3	75	78.5	82.8	82.1	76.1	65.9	54.2	50.7	66.4	....	..	5 years.
Eufaula	41.2	51 6	56.8	64.4	73.7	77.2	79.4	79	75.6	69.4	54.4	48.2	64.2	98	8	4 years.
Eutaw	41.3	52.2	58	65.7	73.6	79.9	82.4	80.7	73.7	61.8	50.5	45.2	63.5	.....	.	2 years, 2 months.
Evergreen	46	43.1	56	66.6	74	76 3	82.2	85	77.8	66	54.9	49.5	64 8	99	15	2 years.
Fayette	35.4	41.9	53	61.3	72	79.5	83.2	75	75.9	64.9	50.6	41	61.1	104	0	4 years.
Florence	37.7	40.2	49	61.9	68.6	74.5	79 4	78.6	89	60 3	49.9	41.5	60.9	96	16	5 years.
Fort Morgan	55.3	50.3	56.2	65.1	75	80	82.2	81.4	77	70.9	60.9	56.8	67.6	....	.	2 years, 10 months
Gadsden	38.3	43.2	47 9	58.7	67.3	73.6	79.4	76.2	71.5	58.4	49	37.9	58.4	102	.	6 years.
Greensboro	45.7	50.8	55.5	63.3	71.6	77.3	79.8	78.6	73.9	64	54 3	48.9	63.6	93	2	11 years, 2 months,
Green Springs	44.4	49.7	55.8	62.7	70.9	76 6	80.5	78.9	73.8	65.4	52.8	46.1	63.1	103	4	24 years, 6 months.
Greenville	47	58	52 9	66.2	73.6	77.7	80 9	79.8	77.2	71	53.8	47.8	65.5	94	11	3 years.
Huntsville	42.1	42.6	51.3	61.3	67.2	74.2	76.4	76.2	70.1	59 5	49.7	41.8	59.7	94	..	14 years.
Jacksonville	40.9	45	49	59.2	68 3	75.8	83.3	76.5	74	63.8	50.3	44.8	60.9	100	13	2 years.
LaFayette	38.1	...	43.2	57.9	69	78	83.5	79	76.5	64	53.3	....	....	92	0	2 years.
Livingston	45.8	52.6	54.4	65.3	70.1	76.9	81.5	79.7	74.8	62	52.8	45.5	63.4	100	10	3 years.
Marion	40.9	47.9	54.2	63.6	72	78.3	80.1	74.5	75.8	66	51.5	44.2	61.6	98	11	4 years.
Mobile	50.7	50.2	60.7	66.7	74.2	80.2	81.7	80.7	76.9	68.6	56.6	47.6	66.2	101	11	22 years.
Monroeville	47.9	56.4	62.8	65.6	73.5	78.3	80	80.2	76.1	69.5	56.4	52.7	66.6	.....	..	4 years.

Montgomery	48.2	52.8	57 1	64.9	73	79	81.8	79.9	75.3	65.5	55.4	49.5	65.3	106.9	5	18 years, 5 months.
Moulton	40.4	48.4	52.4	62.2	68.8	75	77.9	77.4	70.7	59.2	48.4	42.9	60	92	11	7 years, 10 months.
Mount Vernon	52.2	56.8	62	67.1	74.1	78.9	80.8	82.9	76.7	66.8	55.6	52.8	67.2	104	-9	30 years, 8 months.
Mount Willing	45.3	52.4	54.1	63.3	71.8	78	77	79.5	74.9	66.8	54.9	48.2	63.8	102	10	4 years.
Newton	50	51.9	57.4	65.5	54.7	79.9	-0.5	79.6	78	70.8	55.9	52 1	64.7	99	12	3 years.
New Market	41 1	40.8	51.8	63.5	65.5	81	78.9	76	....	59.4	47.7	45.9	...	90	10	2 years.
Opelika	45 8	50 7	56.9	62.8	68.9	77.7	80.2	78.4	74.8	62.3	52.1	46.9	63.2	105	11	2 years, 7 months.
Oswichee	41.7	52.6	55.2	61.2	74.4	77.3	79 2	77.4	77 3	66	56.9	46.3	63.8	97	8	3 years.
Prattville	40.9	43.3	49	62.3	69.7	73 6	80.7	77	77	64	50.2	46.1	61.2	96	6	2 years.
Selma	49.3	52	55.8	64	73.5	79	82	81	74.4	66 6	55.7	49.3	65.7	98	14	5 years.
Talladega	46	48.7	55.3	65 2	72.3	77.7	82 2	79 9	72	63.5	55	46 5	63.7	100	15	2 years.
Trinity	37.3	44.5	50.9	59.9	70.5	74.9	79.2	78	75	63.4	51.7	41.5	60.6	96	16	4 years.
Troy	46.9	51.3	58.3	65.2	74.4	-0.5	82.2	80.4	76.6	65.5	57.1	52.3	65 9	104	14	5 years.
Tuscaloosa	45.1	48.6	56 6	63.8	72 7	78.6	82.4	78	76.3	64.3	53.5	50.4	64.2	97	4	6 years.
Tuscumbia	38 3	43.9	48.6	61.8	67.7	73.6	78.3	74.9	70.9	57 5	49.2	40.7	58 7	99	14	6 years.
Union Springs	48.6	53.6	58	66.6	75.4	80.6	82.5	80.6	76 8	67.4	56.7	50.9	66.5	98	8	19 years.
Valley Head	36.1	43.3	48.5	59.9	66	75 3	76	75.2	68.8	55.6	47.3	38.6	57.7	98	16	5 years.
Wetumpka	46	45	52	70	...	78.5	80.9	79.5	76.5	70.5	52	49	....	94	20	2 years.
Mean	42 9	49.2	54.1	63.5	73.3	77 8	83.9	78 9	79.9	64.8	52.9	46 6	63.1			

2. Rainfall data from Stations giving several years observations.

AUBURN.

PRECIPITATION.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1855.....	0.25	0.99	1.85	2.28	1.72	1.89	3.85	5.86	1.64	2.47	5.38	9.34	37.52
1856.....	5.53	1.90	6.83	0.88	0.83	6.47	2.38	4.86	0.58	0.46	10.92	4.00	45.64
1857.....	5.39	1.10	3.68	.....	6.79	....,	4.34	3.73	1.07	.....	.....	5.76	....
1881.....	3.72	4.11	7.57	4.87	0.73	4.25	2.50	6.03	4.11	4.91	5.12	6.30	54.22
1882.....	4.47	11.31	9.28	4.34	2.45	2.93	9.18	3.42	7.92	2.14	2.48	5.09	65.01
1883	8.79	2.46	2.58	12.82	2.05	6.22	....	.....	.....	3.01	1.85	5.47	....
1884.....	5.38	4.20	10.07	2.97	0.61	11.52	5.38	2.31	0.21	0.57	2.52	4.78	50.52
1885.....	9.25	3.59	3.41	2.03	7.44	3.30	6.92	3.45	4.77	5.08	4.70	2.98	56.92
1886.....	7.92	4.31	8.03	4.02	3.69	8.15	4.40	5.24	0.40	0.00	5.04	3.92	55.12
1887.....	4.05	6.79	2.27	1.59	3.73	*	21.09	4.32	7.16	2.74	0.08	13.84	....
1888.....	3.13	7.34	11.24	2.47	6.50	5.31	3.25	4.52	4.90	4.39	4.96	2.94	60.95
1889.....	9.48	5.72	2.81	3.73	1.52	2.71	3.75	3.73	3.42	1.52	6.26	0.68	45.13
Means...	5.61	4.49	5.80	3.82	3.17	5.28	4.37	4.20	3.29	2.48	4.49	5.43	52.42

*The records were destroyed by fire June 27th, 1887.

CARLOWVILLE.

PRECIPITATION.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.
1856	....	....	....	....	....	9.14	1.39	4.85	1.10	0.30	15.60	6.28	....
1857	4.97	2.10	4.87	4.88	6.75	2.05	4.96	6.92	1.32	0.85	3.90	3.87	47.44
1858	6.80	3.99	9.09	7.68	1.25	5.01	3.10	4.02	1.90	7.75	2.12	6.50	59.21
1859	....	....	....	....	....	....	....	....	....	....	....	....	59.17
1867	1.88	3.39	7.80	6.37	4.41	4.52	2.26	3.72	4.50	2.87	3.87	8.80	49.39
1868	8.63	6.79	3.50	10.46	0.80	2.70	5.60	3.13	6.51	6.40	3.44	6.90	64.86
1869	8.30	10.82	5.70	10.05	1.54	3.54	5.67	6.63	1.95	2.40	5.93	6.71	69.24
1870	5.05	6.75	7.87	2.84	0.75	8.01	3.50	8.21	2.97	0.57	8.66	7.70	62.88
1871	5.24	6.73	13.00	9-21	6.04	9.39	1.48	4.69	2.24	1.65	9.37	3.61	72.65
1872	4.95	12.14	11.42	4.92	8.04	2.17	18.55	2.84	0.48	1.23	6.90	5.08	78.72
1873	6.05	11.39	6.10	2.51	10.28	4.71	3.90	3.72	5.84	1.85	2.52	2.63	67.50
1874	4.90	7.46	12.81	11.17	1.15	9.46	5.70	1.49	0.10	1.24	2.75	7.14	65.37
1875	8.07	9.63	20.50	4.08	1.02	1.88	3.31	1.97	12.65	1.88	8.72	5.63	79.34
1876	6.19	7.61	10.95	12.52	4.57	1.76	5.41	2.80	2.05	1.38	3.30	7.33	65.77
1877	5.84	2.36	7.35	15.10	2.15	5.76	2.56	1.56	12.43	....	....	....	....
Means ..	5.91	7.01	7.77	7.83	3.77	5.01	4.81	4.04	4.00	2.33	5.93	5.63	65.19

DECATUR.

PRECIPITATION.

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1879........	....	3.30	8.10	....	..	....	1.40	1.60	1.90	2 70	3.80	2.80	.....
1880.........	....	2.45	13.85	8.85	3.75	0.85	....	....	....	....	.. .	4.60	.....
1881.........	1.70	4.35	5.75	5.30	3.95	1.30	1.00	1.90	3.20	3.55	5.55	5.65	44.20
1882.........	13.70	6 90	5.21	4.85	2.95	2 00	6.19	4.81	1.00	2.30	5.15	1.95	57.01
1883.........	7.10	4.60 *	4.30	5.67	3.42	4.04	....	...	....	....	....	....	.....
1884.........	7.28	8.90	6.55	5.35	0.85	4.25	6.95	2.25	0.80	1.70	2.10	3.70	50.68
1885.........	7.65	4.10	2.40	3 45	5.90	5.10	2.90	2.85	2.75	2.90	5.55	1.25	46.80
1886.........	6.70	3.55	8.40	3.40	3.95	5.74	1.43	1.54	3.25	0.05	8.75	2.50	49.26
1887.........	6.80	6.85	2.80	3.15	2.49	4.31	5.20	1.99	2.03	3.95	0.80	4.00	44.37
Means.....	7.27	5.00	6.37	5.00	3.40	3.45	3.58	2.42	2.13	2.45	4.53	3.31	48.91

*25 days.

GREENSBORO.

PRECIPITATION.

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1855......	1.33	1.44	1.64	0.59	1.79	3.99	1.68	6.41	6.29	1.45	5.24	5.75	37.60
1856......	3.52	2.60	6.16	3.95	5 23	6.37	1.91	2.75	0.58	0.44	12.99	5.73	52.23
1857......	5.17	2.21	3.34	3.43	8.55	1.71	4.73	2.46	0.84	1.49	6.04	7.99	47.96
1858......	9.29	3.58	3.15	4.55	3.26	1.11	0.91	3.88	0.14	2.67	3.19	7.87	43.60
1859	4.29	6.33	7.00	6.27	1.96	2.65	7.20	3.93	5.52	1.56	1.95	4.79	53.45
1860......	2.16	6.13	0.91	2.63	1.41	3.35	4.06	11.61	3.90	4.52	7.77	6.36	54.81
1861......	4.85	6.21	3.02	2.88	2.32	2.51	4.41	13.18	1.79	2.31	3.87	2.58	49.93
1862	8.39	9.76	5.12	7.16	1.29	1.74	0.36	1.00	4.14	0.58	0.53	3.09	43.16
1863......	7.50	9.51	6 13	3.70	1.93	4.61	1.83	5.84	0.48	2.85	2.85	7.39	54.62
1864......	2.45	1.75	9.15	2.74	1.32	7.73	2.04	3.84	6.79	4.30	6.31	5.20	53.62
1865......	4.85	13.09	6.11	5.90	1.02	1.37	2.14	5.22	2.74	2.08	2.94	8.44	55.90
1866......	3.05	7.05	2.73	7.38	7.36	6.31	3.06	5.22	2.74	2.13	4.41	3.78	55.22
1867......	1.86	1.67	9.55	5.67	3.85	4.52	3.06	5.22	2.74	1.92	2.77	5.11	47.94
1868	9.80	3.74	3.05	6.70	....	....	....	....	....	....	....	....	.....
1869......	....	....	....	....	....	....	....	....	...	....	4.50	5.90	.....
1870......	6.50	....	....	....	....	....	....	....	....	....	....	....	.....
1884......	....	....	....	....	.. .	....	....	....	....	....	....	6.09	.....
1885	8.94	3.33	2.92	3.17	5.88	4.00	2.51	2.23	1.84	1.37	7.32	5.33	48.84
1886......	10.15	5.34	11.72	6.97	2.86	6.73	5.95	7.31	0.54	1.50	4.53	2.11	65.61
1887......	3.36	4.90	1.04	2.58	3.37	4.29	3.09	3.45	....	....	....	....	.....
1888......	4.38	4.38	11.20	2.16	2.35	4.14	3.37	9.29	7.93	4.40	3.13	2.15	49.00
1889......	5.40	2.00	1.52	6.62	0.61	3.37	4.52	2.98	1.91	0.37	4.13	2.19	39.68
Means..	5.36	5.00	5.02	4.48	3.13	3.92	3.16	5.27	2.99	2.18	4.81	5.52	50.84

GREENE SPRINGS.

PRECIPITATION.

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept	October	Nov.	Dec.	Annual.
1854	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.87	.....
1855......	1.09	1.20	1.19	0.40	1.30	4.61	3.13	6.62	2.79	1.64	7.11	4.93	36.01
1856......	2.91	2 65	5.87	4 41	6 12	6.94	1.20	4.57	2.20	4.50	9.52	4.68	55.57
1857	4.12	3.64	2.74	3.45	5.64	2.29	4.98	5.56	1.08	1.35	6.39	8.95	50.19
1858.....	8.69	6.48	3.59	3.22	2.77	3 60	4.41	3 88	0.00	4.29	2 16	7.50	50.59
1859......	4.17	7 87	8.00	3.18	2.28	3.13	6 16	6.30	5.45	1.25	2.66	4.93	55.40
1860......	.....	.....	.....	.....	.....	.....	1.80	8.85	2.67	2.82	8.70	5.19	.....
1861......	2.12	4.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1866......	.....	.....	.....	.....	.....	5.97	3 02	.....	4.79	1.75	4.37	4.99	.....
1867	1.70	1.38	8.77	4.01	5.29	2.84	5.00	2.10	1.77	1.38	3.83	2.41	40.48
1868	11.04	3.03	3.51	7.27	4.40	5.88	5 33	3.72	3.66	7.17	4.17	4.19	58.37
1869......	5.96	9.16	3.25	8.22	0.97	1.73	1.38	2.32	1 67	2.50	4.30	5.90	47.36
1870......	4.77	4.74	5.65	2.76	0 50	3.75	7 38	2 55	0.40	0.30	7.35	5.13	45.28
1871......	5.95	7 90	8.35	13.30	5.80	4.43	2.95	4.70	1.10	5.05	5 05	2.35	66.93
1872......	3.45	4.80	7.06	4.28	4.10	7.70	10.00	0.10	3.50	0.05	2 30	6.70	54.34
1873......	4.87	7.78	4.85	2.57	5.58	5.65	2 90	1.86	4.11	1.00	1.19	1.25	43.70
1874......	4.55	6.02	8.79	14.59	2.31	5.18	2.65	1.48	2.67	0.79	1.06	3.42	53.51
1875......	4.92	5.50	8.85	4.19	2.19	4.72	3.13	3.15	4.36	1.00	3.59	7.13	52.73
1876......	3.89	5.09	5.25	10 25	7.18	4.28	7.60	4.22	2.15	2.15	0.52	3.18	55.76
1877......	6.21	5.66	5.50	9.63	2.31	3.13	4.89	2.31	14.11	4.85	5.05	4 75	68.40
1878......	2 82	2.52	5.20	5.70	4.09	8 36	2 50	8.32	2.55	2.32	2 81	7.11	54.30
1879......	5.56	4.68	1.22	5 90	5.86	6 84	4.50	5.08	0.98	9 85	4.09	5.55	60.11
1880......	0.95	4.03	10.76	10.15	4 59	4 21	2.00	5.45	5 00	5.12	10.54	8.28	71.08
1881......	6.45	5.10	10.00	5 03	1.96	3 87	1.73	11 00	2.98	3 90	5 43	4.75	62.20
1882......	7.36	5.35	7.15	8.18	2.01	2.45	7.02	7 08	2.26	3.80	3.55	4.30	60.51
1883.....	10.47	5.00	3 56	5.13	1.62	4.10	2.57	6 95	0.68	2 20	4 53	5.99	52.80
1884......	7.76	6.48	9.17	5.18	1.18	7.57	12 02	1 04	1.25	2.41	2.02	5.39	61.47
Means..	5 07	5.04	6 01	6.13	3.48	4 75	4.41	4 55	2 97	2.94	4.49	4 99	54.83

NOTE.—Capt. J. W. A. Wright, of Livingston, makes the following comments in regard to the tables of rainfall and temperature for Greene Springs.

GENERAL RESULTS.—The temperature table shows the average temperature of our three winter months is 47 deg.; spring, 63 deg.; summer, 79 deg., and autumn, 63 deg. The rather curious and interesting fact follows, that our average temperature for April and October, as well as for spring and autumn, is the same as the annual average of our climate, as obtained in these observations in twenty years (21,900 observations)—that is 63 deg., and this 63 deg. would be the number on a map with Isothermal lines for our part of Alabama. The range between our average for winter and summer (79 deg.—47 deg.) is only 32 deg., and this is the very important element by which climates are compared.

The range of temperature between the coldest monthly average, 45 deg. (January), and the warmest monthly average, 81 deg. (July), is 36 deg. The greatest range between the coldest month here recorded, 37 deg. (December, '76), and the warmest month, 84 deg. (July, '75, '78, and '88), is 47 deg. The extreme range of temperature in this part of Alabama, from the warmest to the coldest hour ever properly observed and recorded since 1854, with standard thermometers properly protected from direct and reflected rays of the sun, is a little more than 100 deg. That is, positively the highest ever so observed—and that was before the war—was 104 deg. in the shade, observed by Prof. Tutwiler and myself very carefully at Greene Springs. Only twice, since 1854, has the mercury, in properly placed thermometers, ever been observed lower than 4 deg. (that is, 4 deg. above zero). In January, '84 and '85, the mercury stood on our coldest days, in different localities, from zero to 2 deg. below zero. This shows the extreme range of our climate in Central Alabama, during the last thirty-five (35) years, to be 106 deg. Never, at any time for thirty years past, have I seen the thermometer, when properly shaded, as high as 100 deg. in our part of Alabama, nor do I believe it has been seen so high by any one else, with a standard thermometer properly placed. I wish to place my testimony on record here, that the mercury very rarely, even on our hottest days in July and August, stands above 96 deg. in the shade, and that any record up to or above 100 deg. for our part of Alabama, as a normal temperature for the last twenty-five years, is merely an error. Heat accumulated by roofs and walls and streets in cities may show a higher temperature, but can this be properly called normal? For the last three winters, our coldest temperature has been 20 deg. in December and January, and the mercury with us very rarely falls below 20 deg.

The rain table proves that March and April are our most rainy months, while May, September and October are our dryest—the least average rainfall occurring in October, while the averages for May and September are nearly the same. It shows that our heaviest rainfall, any one year, has been a little more than 71 inches (in '80); and the least, 43.7 inches (in '73). It gives the most rain in one month, more than 14 inches (April, '74 and September, '77); while the least rainfall, during any one month, was one-twentieth of an inch (0.05), in October, '72. It is worthy of remark, that the average rainfall of each of the three summer months, is between four and five inches, and of each winter month between five and six inches. There was no month entirely without rain.

The unusually small rainfall recently for six months, from December, '88 to May, '89, inclusive, furnishes a very interesting confirmation of the theory of Herschel and other eminent astronomers, that our years of maximum and minimum rainfall correspond with years of maximum and minimum sun-spots—periods of ten or eleven years from maximum to maximum and minimum to minimum.

During the six months named, we had only about half the rainfall of our wettest years—the latter amounting to thirty-five or thirty-six inches, as in '83-'84 and '73-'74, as can be seen from the rain table. From Prof. Charles A. Young, of Princeton, who has made the sun and its spots a life study, I learn there were scarcely any sun spots in the six months from last December to May inclusive. Another period of minimum rain and sun spots was the winter of '77-'78.

It seems very reasonable, that the fewer the sun spots, the more light and heat we receive from the sun; the dryer the earth's surface and atmosphere becomes and consequently the less rain falls, and vice versa.

N. B.—All annual and monthly averages in these tables of temperature and rain correspond so nearly with those at the important Signal Station, Montgomery, that they may be safely used for Central Alabama, in general.

HUNTSVILLE.

PRECIPITATION.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October	Nov.	Dec.	Annual.
1831.......	6 71	2.34	4.26	4 16	4.30	4.66	4 16	4 57	0 83	1.65	3.60	2.22	43.46
1832.......	2 77	3.46	1 93	5 54	3 60	2.15	5.46	6 65	2.22	4.71	2.27	5.57	46.33
1833.......	6 87	11.45	10 80	4 90	5.91	8 00	3 8	2.49	2 04	3.82	2 90	4.61	67.67
1834.......	10.41	8.24	2.91	3.32	4.15	1.66	4.84	7.06	4 03	5.85	3.05	7.62	63.14
1835.......	4 86	3.19	6 10	12 30	3 18	6 37	3.74	10.26	2.14	1.67	4.96	1.52	60.29
1836.......	4 85	3 05	5.82	5.16	6.53	3.60	8.40	6.13	1.25	2.22	1.38	6.36	54.75
1837.......	1.52	4.02	5.32	3 32	2.49	7.03	1 66	5.55	4.01	5.23	3.05	3.88	47.08
1838.......	5.53	2.87	3.18	2.77	4.02	6.08	3.95	0.69	3.19	1.80	9.12	5.12	48.32
1839.......	2.63	2.08	4.00	3.74	1.94	5.54	2.64	1 80	2.22	0.00	0.28	2.21	29.08
1871.......	....	....	.....	.	..	5 40	2.00	6.00	0.38	4.40	1.10	...	.....
1872.......	....	..	5 50	1.90	..	.	10.50	2.45	2.40	0.85	....	7.50	.....
1873.......	6 60	8.50	3.50	1.40	4.10	8.30	3 80	3.40	4.30	5.05	1.60	4 71	54.76
1874.......	5.47	4.55	9.03	17.39	2.00	6 03	6 71	10.15	7.85	3.47	5.18	3.19	81.02
1875.......	5.94	6.05	10.46	2.83	1 61	3.20	4 84	5.93	1.83	1.22	6.22	8.12	58.25
1876.......	5.93	2.61	6.40	9 90	9.60	3.71	5 90	6.76	1 00	1.95	1 20	3.30	58.26
1877.......	6.50	1 31	5.40	8.15	2.35	5 66	5.50	2.08	....	..	...	....	.....
Means.....	5.42	4.55	5 64	5 79	3.98	5.16	4.88	5.12	2.64	2.93	3.28	4.71	54.10

MOBILE.

PRECIPITATION.

Year.	January	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Novem.	Decem.	Annual.
1840...													
1841...													
1842...	5.59	3.87	6.54	5.43	4.65	6.40	8.21	6.60	4.41	2.46	4.55	3.94	62.65
1852...													
1869...													
1871.....	6.50	5.13	9.76	2.93	6.18	6.17	4.24	3.70	3.95	5.33	6.68	1.01	61.58
1872....	3 69	8.00	12.76	4.35	3.78	6 33	13 37	1.67	2.11	2.77	5.65	3.70	68.18
1873.....	4 16	3.15	3.86	0.88	11.47	9.87	8.75	10 35	8.07	1.85	3.23	2.97	68.61
1874.....	2.48	2.72	10.57	10.92	1.23	5 69	10.21	3.79	2 54	0 00	2.04	4.17	56.36
1875....	5.79	7.15	8.32	7.51	1 46	2.45	4 00	7.07	8.52	2 32	3 06	3.01	62.66
1876.....	3.14	4.32	8.01	3 88	4.32	3.35	5.38	11.53	1.76	0.37	5.36	7.18	58.60
1877.....	6.30	1.40	5.94	8.40	1 68	7.07	3 74	4.69	12.68	6.15	4.70	5.99	68.74
1878.....	4.57	3.40	4 33	4.09	4.90	6.60	2.98	9.95	3.86	4.84	6.31	7.64	63.47
1879....	0 78	1.99	5 94	6.42	3.56	2.35	11.17	10.54	1.33	5.15	4.72	3.38	57.33
1880.....	1.18	5.73	9 41	2.99	5 62	5.08	4.92	4.75	7.04	7.32	*	3.71	.....
1881.....	7.62	8.00	10.41	9 21	1.44	4.85	2.77	15.22	11.71	3.23	7.36	9.15	90.97
1882.....	6.77	4 54	5.13	9.92	6.78	2.40	9.52	8.96	4.05	8.29	2.67	5.84	74.67
1883.....	8.80	3.63	4 21	7.25	8.51	9.42	3 31	5.88	0.96	0.84	2.57	3.11	58.50
1884.....	7 40	5.01	11.53	5.54	8.48	7.01	4.98	1.26	1 78	5 36	4.12	5 10	67.57
1885.....	11.95	2.85	6.36	5.24	3 27	4 18	3.81	6.07	3 23	1.19	4.83	5.00	54 98
1886.....	6.12	4.10	14 62	5.86	1.27	5.94	6 59	3.55	2.69	0.13	3 36	1.97	56.18
1887.....	2.90	6.62	3.65	1 93	2.84	8 91	4.31	4.31	6 21	2 45	0.44	7.02	51.59
1888.....	3.20	10.33	7 24	3.39	7.30	13.56	5.36	14.35	3.04	2.48	.2 46	...	.....
1889.....	5.07	4.64	3.48	1.65	2.78	5.35	9.55	2.80	6.97	0 08	6.78	).52	49.67
Means...	5.39	4.38	7.10	5 40	4.61	6 24	7.24	6.73	4 64	2.82	4 2	4.15	62.99

*Office, instruments and records destroyed by fire November 17, 1880.

MONTGOMERY.

PRECIPITATION.

Year.	January.	Febr'y.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Annual.
Oct. 1858 to Dec. 1874.........	6.04	7.48	7.29	5.75	4.79	7.28	3.23	1.91	1.12	2.10	4 65	5.26	56.90
1872.............	..	....	....	....	...		....	....	3.38	0.53	5.73	4.08	....
1873.............	4.97	9.97	4.51	5.57	10.25	11.08	5 17	2.56	3.06	0.68	4.58	2.61	64.00
1874.............	3.69	6 57	10.66	9.45	2.03	4.31	3.87	1.25	0.39	1.97	2.60	5.14	51.93
1875.............	6.71	7.86	11.56	3.54	1.67	1.94	0.99	2.14	8 13	1.68	5.90	6.04	58.16
1876.............	3.70	5.07	7.33	10.99	6 55	4.85	6.24	3.05	1.61	0.96	3.42	5.97	59.74
1877.............	6.67	2.68	7.17	10.36	0.82	2.94	3.43	1.07	4.07	2 51	3.75	4.79	50.26
1878.............	5.39	2.59	2.64	5.91	4.06	5.85	4.59	7.67	2.55	3.49	3.92	6.74	55.40
1879.............	2.06	2 14	2.68	4.50	3.90	3.22	5.21	4.54	1.12	10.20	1.47	7.42	48.46
1880.............	1.65	6.11	9.26	6.42	7.07	0.90	3.17	4.41	2.83	2.66	4.06	5.68	54.22
1881.............	3.58	7.05	5.45	4.52	1.41	3.04	2.18	5.06	4.49	2.72	4.56	9.75	53.81
1882.............	4.54	9.27	6.92	5.03	2.94	3.98	6.29	3.41	4.18	2.40	1.91	3.88	54.75
1883.............	7.20	2.00	3.61	8.16	2.62	5.02	0.87	2.08	0.22	2.00	1.70	4.23	39.71
1884.............	4.82	4.80	9.50	3.08	1,18	10.26	2.80	3.05	0.58	1.87	2.67	4.00	48.61
1885.............	9.72	3.68	2.93	3 92	8.92	4.32	1.54	3.93	4.83	2.38	3.59	3.13	58.89
1886.............	6.69	4.10	6.86	7.38	2.95	8.61	3.37	5.37	1.12	0.03	6.72	3.05	56.25
1887.............	5.08	7.47	0.72	1.18	2.84	3.31	8.56	2.04	2.03	2.47	0.79	8.25	44.74
1888.............	4.12	7.67	11.51	1.08	5.19	4.82	3 86	6.51	5.73	5.39	3.38	2.13	61.39
1889.............	6.70	3.49	2.95	3.13	1.28	4.02	5.70	6 33	4.35	0.01	6.17	0.49	44.62
Means...........	5.59	6 46	6.77	5.64	4.33	6.06	3.58	2 58	2.08	2.27	4.19	5.06	54.61

MOULTON.

PRECIPITATION.

YEAR.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1867.........	....	....	..	...	..	...	...	..	....	....	....	....	44.01
1868.........	....	..			...	....	..	...	....	....	..	...	44.23
1869.........	..	...	....	....	...	...	.	...	.	...	....	....	46.30
1870.........	...	...		..	...	...	...	...	....	....	..	....	.....
1871.	...	...	...	..	..	..	....	...	....	....	....	..	44.78
1872.........	...	..	...		..	...	..	...	....	..	...	...	44.24
1873.........	...	...	...	....	....	..	..	...	....	....	...	...	42.65
1874.........		...	...	...	..	.	..	...	...	...	...	...	36.57
Means....	3 66	4.10	5.57	6.41	3 48	3 84	3.25	2.10	3.29	2.55	2 69	2 93	43.87

MOUNT VERNON BARRACK8.

PRECIPITATION.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1840.......	....	....	....	....	...	....	. .	.....	....	5.73	1.70	2.26	......
1841.......	12.84	4.86	9.28	4 65	7.23	4.60	. .		...	.....	.....	.....	......
1842.......	.....	.....	.	..	..	.	.	.. .	..	....	.....	.....	......
1843.......	3.81	5.90	9.22	5.17	0.72	16.67	6.11	2.18	3.49	5.04	6.27	11.80	76 38
1844.......	.....	.....	....	....	5 92	9.38	5.03	8 29	0.98	2.90	10.57	2.54	.....
1845.......	11.30	8.37	4.52	1.79	2.54	2.19	2.73	6 48	5.40	11.87	4.99	6.34	68.52
1846.......	6.82	5.31	5.63	11.51	5.49	5.57	9.42	4.74	2.12	0.40	3.75	4.60	65.36
1847.......	6.83	7.70	6 45	3.77	3 94	4.05	11.92	7.39	5.85	0.42	4.10	9.01	71.43
1848.......	3.90	5.17	3.50	2 78	2.15	6 35	3.10	4.39	2.99	1.54	7.94	5.74	49.55
1849.......	2.89	2.44	1.36	3.06	6.11	9 25	14.56	11.15	0.65	13.00	10.54	4.22	79.23
1850.......	9.59	4.81	2 09	4.22	6.72	2.01	6.44	5 13	0.15	0.85	2.32	5.22	49.55
1851.......	3 89	7.26	0.77	1.14	3.44	5.35	1.84	8.69	4.42	2.07	6.99	2.91	48.77
1852.......	1.92	1.95	1.52	6.24	6.75	1.56	1.92	9.64	0 70	2.40	9 74	7.15	51.49
1853.......	11.18	8.10	16.45	6.59	5.34	2.00	12.64	8.95	11.09	8.44	2.70	13.09	106.57
1854.......	11.01	12.83	6.22	1.96	4.45	6.72	6.13	2.29	6.82	0.81	2.34	0.73	62.31
1855.......	0.45	1.16	1.17	1.52	0.20	2.22	9.85	12.59	10.03	2.17	10.78	7.62	59.76
1856... ...	5.46	3.16	5.33	3.53	3.41	9.26	3.19	5.74	1.25	0.70	11.25	5.87	58.15
1857.......	2.65	2.00	4.50	4.78	0.17	2 60	3.85	9.33	0.17	3.33	10 05	6.39	49.82
1858.	10.62	3.12	5.21	2.02	1.42	4.80	7.31	5.89	4.38	7.73	3.98	7.87	64.35
1859.......	6.07	8.49	10.82	6.42	2.97	6.47	5.57	4.53	6.48	2.41	1.80	2.91	64.94
1860.......	2.38	10.80	1.68	1.58	2.56	3.45	1.25	6.98	5.10	6.93	4.40	3.50	50.61
1873.......	.	.....	.....	.....	....	....	....	....	.....	3.25	4.40	3.50	.....
1874.......	7.85	12.75	12.95	12.95	1.80	13.05	8.80	4 05	3.25	0.15	2.04	5.95	85.59
1875.......	6 00	10.81	12 45	3.89	2.00	3.37	2.46	3 85	7.81	4.90	3.70	3.28	64 52
1876.......	4.75	5.13	8.32	5.79	3.25	7.48	8.94	2.51	1.94	0.50	5.80	5.33	59.74
1882.......	6.51	5.88	8.41	4.98	8.57	3.79	14.54	11.26	1.79	2.26	0.68	5.88	74.55
1883.......	10.30	3.22	4.19	11.18	8.23	14.24	3.27	1.67	0.07	0.57	2.64	3.31	62.89
1884.......	5.45	4.76	14.68	5.61	5 79	7.75	5.61	4.98	1.15	5.76	4.73	3.10	69.37
1885.......	9.58	3.52	7.89	8.15	4.19	6.79	4.07	4.20	5.05	1.35	4.32	2.77	61.88
1886.......	7.12	2.37	7.59	7.11	2.53	7.41	6.50	6.90	0.76	0.00	7.03	1.43	56.75
1887.......	4.49	6.93	0.93	0,67	1.12	6.17	6.01	3.37	4.84	4.06	1.18	9.92	49.69
1888	2.39	10.37	11.67	1.50	5.78	7.86	2.67	8.66	2.64	5.10	2.92	3.77	65.33
1889.......	7.09	2 62	3.14	2.47	2 62	1.98	7.91	1.13	6.36	0.23	6.89	1.63	44.07
Means ..	6.00	5 92	6 48	4 73	3.91	6.14	6.33	6.10	3.72	3.45	5 24	5.12	63 14

THREE MILES NORTH OF UNION SPRINGS.

PRECIPITATION.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1867	...		....	....	....	....	...		...	7.30	3.60	2.30	.....
1868	5 80	4.90	3.00	5.40	3.35	0.25	6.50	2.22	1.16	8.38	1.55	4.00	46.51
1869	5.70	4.93	2 59	7.78	1.25	3.79	2.77	2.88	0.53	0 45	4.47	4.65	41.79
1870	3.18	2.61	6.35	2 20	0.38	2.42	1.34	1.50	2.27	0.00	5.64	6.38	34.27
1871	3.87	6.35	6.82	6.47	5.51	9.76	0 34	5.91	1.94	1.58	4.61	1.55	54.71
1872	1 57	5 95	6.20	2.97	3 43	1.26	5.96	1.63	0.97	0.86	3.20	2.38	36.38
1873	1.37	5 13	2.85	3.46	6 38	5.83	2 39	4.01	1.30	1.63	2.09	1.10	37.56
1874	1.97	5.03	10 91	10 48	1.12	6 76	5.15	1.25	2.37	0.92	3.08	4 67	53.71
1875	5.69	4.34	12.32	3 06	1.75	2.47	2.92	2.90	4.96	1.24	4.31	3.47	49.43
1876	1 90	2.37	4.71	5.11	5 83	1.10	3.79	2.43	0.43	1.74	2.27	5.84	37.52
1877	4.75	2.42	6.76	7.83	1 07	3.55	1.83	1.44	3.80	2 22	4 87	2.66	43.20
1878	3.46	1.87	2.99	3.88	4.41	3.77	3.28	5.32	1.67	1.92	7.32	4.23	44.32
1879	1.54	1.21	2.94	5.74	1.83	0.74	3.17	3.01	0.75	7.62	0.55	5.30	34.40
1880	1 02	3.87	5.91	3.54	2 64	1.63	1.45	5.25	2.35	3.60	2.92	3.95	38.13
1881	2.17	8 32	7.05	5.02	0.47	4.63	0.80	3.64	2.03	4.00	3.63	6.00	47.76
1882	3.67	6.09	4.66	5.13	2.86	4.26	6.43	6.61	4.37	1.85	1.75	4.33	53.01
1883	7 22	3.03	4.00	8 75	4.43	3.44	1.23	4.07	1.65	1.03	1.37	3.05	43.27
1884	0.67	2.82	10.52	3.67	2.83	8.43	3.71	3 74	0.00	0 00	2.53	3.08	41.40
1885	7.18	3 15	3.19	2.78	7 58	3.27	4.64	2.70	5.67	4.22	3.13	3.10	50.66
1886	6 72	3.97	6.59	4.95	1.02	8.73	3.95	3.66	0 95	0 00	5.19	2.77	48.50
1887	3.63	4.85	0.58	1.99	2.66	5.09	15.77	3.07	5 03	3.12	1.87	7.83	55.49
1888	3.45	6.57	13.48	2.08	3.37	5 87	1 33	4.15	6.98	8 53	4.08	2.31	62.60
Means	3.64	4.27	5.92	4.87	3 06	4.15	3 75	3 40	2.44	2.83	3.37	3.86	45.56

PRECIPITATION, IN INCHES, AT STATIONS IN ALABAMA.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual.	Period of Observation.
Auburn	5.61	4.48	5.80	3.82	3.17	5.28	4.37	4.20	3.29	2.48	4.49	5.43	52.42	12 years.
Bermuda	3.80	3.31	5.40	3.82	1.77	4.79	2.45	5.15	4.39	3.41	3 58	3 03	44.90	4 years.
Birmingham	7.07	2.59	11.51	7.76	3.06	4.28	3.07	3.84	3.40	1.72	...	3.40	.....	5 years.
*Calera	....	...	. .	4.45	2.91	6.09	2.76	2.58	1.87	0.49	....	....	....	6 years.
Carlowville	5.91	7.01	7 77	7.83	3.77	5.01	4.81	4.04	4.00	2.33	5.93	5.63	65.19	13 years, 4 months.
Coatopa	5.40	4.90	6.60	3.00	4.05	5.80	3.70	1.35	2.25	2.80	7.00	5.80	52.65	2 years.
Carrollton	5.55	3.98	2.25	5.35	4.99	3.21	3.44	3.55	2.65	2.30	2.76	5.42	45.45	4 years.
Decatur	7.27	5.00	6.37	5.00	3.40	3.45	3.58	2.42	2.13	2.45	4.53	3.32	48.91	7 years, 8 months.
Demopolis	..	....	.....	6.20	1.81	7.60	4.44	5.36	1.76	2.66	..	...	....	2 years.
Edwardsville	7 33	5.48	4.76	1.90	6.78	5 19	4.34	3.74	2.68	1.70	2.25	4.52	49.67	2 years.
Elyton	3.94	4.40	8.28	1.12	1.87	4.00	3 87	4.44	3.43	3.75	3.25	4.00	46.32	2 years.
Eufaula	5.94	4.64	3.15	2.46	2.13	3.27	6.97	4.34	3.25	1.88	5.08	2.12	44.23	4 years.
*Evergreen	2.22	3.83	8.58	3 55	1.88	5.72	7.37	3.38	4.94	1.77	7.72	2.43	50.43	4 years.
*Fish River	3.49	2.00	4.28	...	1.00	3 05	5.69	7.52	5.23	0.89	2.33	3.32	.....	5 years.
Florence	6.06	4.34	3.95	2.39	4.57	4.20	5.83	2.78	2.88	5.96	2.58	4.66	46.20	5 years.
*Fort Deposit	..	..	...	9.96	4.68	3.87	3 31	2.32	2.18	1.50	...	...	.....	4 years.
Fort Mitchell	2.29	5.52	4.61	6.70	6.30	7.08	1.75	4.28	1.22	0.11	3.86	1.48	45.20	1 year, 3 months.
Gadsden	5.77	3.77	3.47	1.80	5.84	5.22	3.76	3.52	2.48	2.40	3.51	6.44	47.9	4 years.
Greensboro	5.36	5.00	5.02	4.48	3.13	3.92	3 16	5.27	2.99	2.18	4.81	5.52	50.84	18 years, 8 months.
*Greenville	7.55	4.22	3.63	7.83	4.64	8.89	4.66	3 30	2.33	1 51	7.39	2.35	58.10	6 years.
Green Springs	5.17	5 04	6.01	6.13	3.48	4.75	4.41	4.55	2.97	2.94	4.49	4.99	54.83	28 years.
Havana	8 66	6.54	3.76	8 53	2.90	0.66	3.16	3.24	4.59	6 35	3.45	5.08	56.92	2 years.
Huntsville	5.42	4.55	5.64	5.79	3.98	5.16	4.88	5.12	2.64	2.93	3.28	4.71	54.10	16 years.
Jacksonville	5 69	3.00	7.19	3.18	6.03	5.83	4.19	2.16	....	1.69	2.68	3.03	....	3 years.
†Livingston	3.22	4.25	1.54	5.06	7.87	3.71	3.62	3.15	1.81	5.73	2.06	6 06	48.08	4 years,
Marion	2.50	5.00	5.50	8.92	3.48	2.56	4.81	4.24	2.74	3.37	2.00	2.60	47.72	6 years.
Mobile	5.39	4.38	7.10	5.40	4.61	6.24	7.24	6.73	4.24	2.82	4.29	4.15	62.99	24 years.

Monroeville	3.68	6 69	4.65	5.52	7.04	4.95	6.89	7.30	2.74	1.56	5.72	4.15	60.89	5 years, 5 months.
Montgomery	5.59	6.46	6.77	5.64	4.33	6.06	3.58	2.58	2.08	2.27	4.19	5.06	54.61	22 years.
Mount Vernon Barracks	6.00	5.92	6.48	4.73	3.91	6.14	6.33	6.10	3.72	3.45	5.24	5.12	63.14	32 years.
Mount Willing	8.59	6.28	1.47	4.87	5.26	2.50	....	2.92	2.28	1.42	3.30	6.86	.....	4 years.
Moulton	3.66	4.10	5.57	6.41	3.48	3.84	3.25	2.10	3.29	2.55	2.69	2.93	43.87	10 years.
Newton	7.03	4.98	3.57	4.45	4.39	2.45	3.82	8.08	2.61	1.60	3.49	5.26	51.53	4 years.
Oswichee	5.76	4.21	7.43	2.16	2.35	8.36	5.08	6.55	1.21	3.80	2.90	5.45	54.26	2 years.
*Opelika	...	....	....	6.48	9.08	5.20	6.97	3.93	2.52	3.30	3.14	4.44	.....	8 years.
*Pine Apple	....	....	....	6.13	2.67	3.46	3.86	2.44	1.24	1.33	....	....	.....	6 years.
Prattville	9.17	3.69	1.87	2.44	7.25	6.50	3.99	3.06	0.00	2.44	3.15	6.73	50.29	2 years.
Selma	4.31	6.43	8.74	6.55	2.16	4.18	4.16	3.78	2.20	2.50	4.97	5.93	55.91	13 years.
*Scottsboro	....	....	....	5.73	3.63	4.60	5.59	3.57	2.41	2.91	.	....	.....	6 years.
Talladega	5.70	5.13	7.52	2.17	1.92	4.09	2.31	3.82	5.57	2.33	2.08	7.20	49.84	2 years.
Trinity	7.28	5.98	3.99	5.38	4.60	7.02	4.37	1.99	0.95	1.68	2.06	5.78	51.08	4 years.
Troy	4.77	5.68	11.14	6.36	3.5	4.95	6.35	4.80	3.55	1.81	4.19	4.68	61.85	5 years.
Tuscaloosa	3.27	1.73	6.99	9.71	2.70	3 33	2.71	2 06	2.05	2.61	2 34	1.36	41.75	6 years.
Tuscumbia	6.02	4.84	2.74	2.31	5.45	5.78	5.07	2.52	3.77	2.46	3.25	5.16	49.37	4 years, 1887 incomplete
*Uniontown	....	. . .	.	7.73	1.97	3.93	4.80	4.50	1.16	1.38	...	....	.....	2 years.
Union Springs	3.64	4.27	5.92	4.87	3.06	4.15	3.75	3.40	2.44	2.83	3.37	3 86	45.56	21 years, 3 months.
Valley Head	5.33	6.44	12.78	3.72	4 04	10.55	2.57	6.42	2.22	2.42	3.52	5.39	64.40	5 years.
Wilsonville	4.08	3.36	6.38	4.87	2.79	4 56	3.85	3.91	2.64	3.20	3.48	3.50	48.62	6 years.
Means	5.36	4.67	5.76	5.12	3.95	4 80	4.40	4.01	2.74	2.47	3.84	4.49	51.89	

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† Two years' observations at this Station were made by Captain J. W. A. Wright, and two years by Observer of Cotton Belt Station.

* Stations of the Cotton Belt Series.—The Observers at these Stations report only during the crop season, viz: From April 1st until November 1st.

The chart on the opposite page shows in an interesting manner how regularly the mean maximum and the mean minimum temperatures follow the averagc temperature of the State. The extremes are not great. The high maximum shown on the chart occurred only once during the period covered by the diagram, and was recorded at the signal office in Montgomery in July of 1881. The reader must understand that this does not represent an average for the State, but is an abnormal temperature observed only once during the period of twenty-one yerrs.

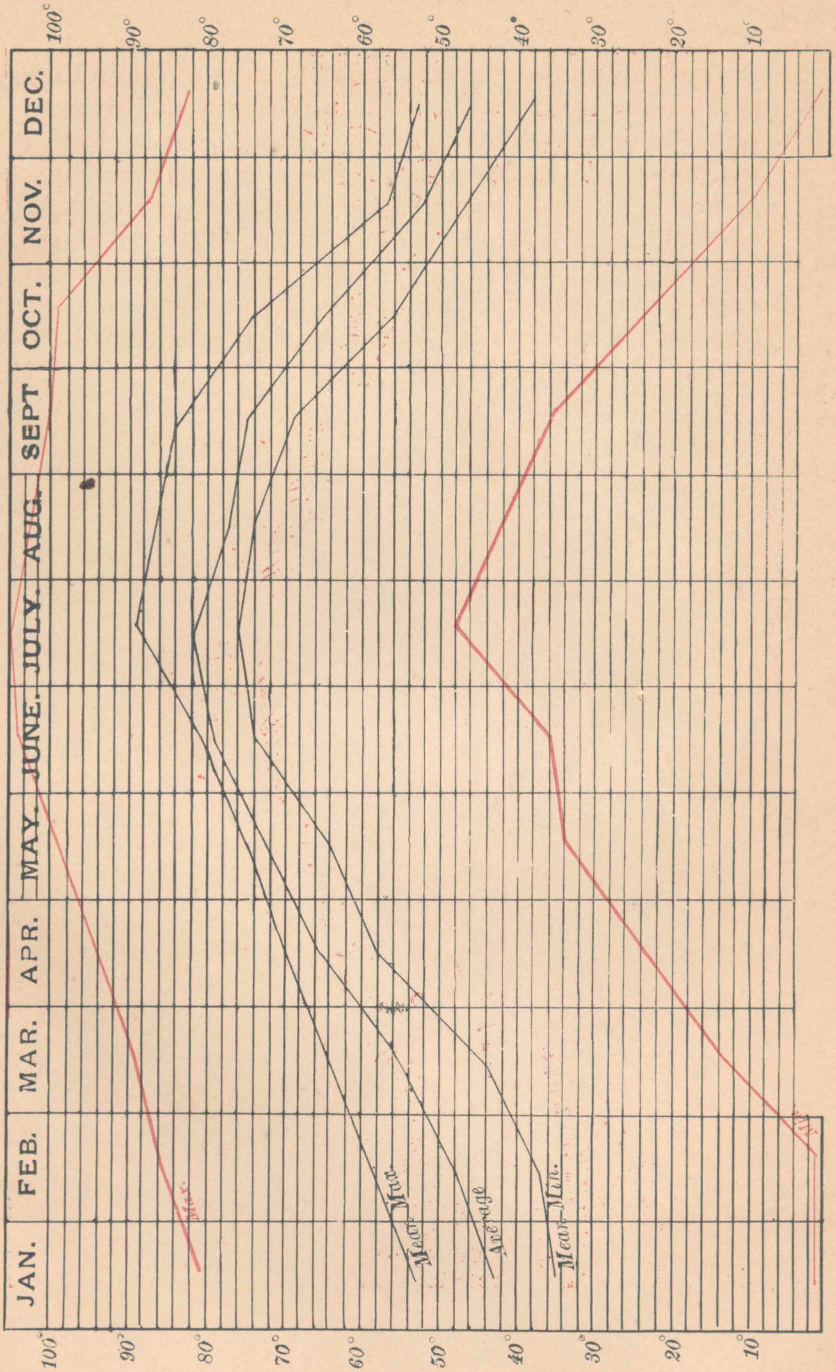


Diagram showing for the entire State of Alabama, the Maximum, Minimum, Mean Maximum, Mean Minimum and Average Temperatures of the Air. Compiled from reports of the StateWeatherService. extending over periods of 2 to 21 years.

3. YEARS OF DROUGHT AND WET YEARS.

From special Bulletin No. 1, issued by the Alabama Weather service and compiled by Capt. W. H. Gardner of Mobile, the following extracts are taken concerning the condition of the weather prior to 1830. From 1830 to the year 1890 the data mentioned in this bulletin, came from the Reports of the Smithsonian Institute; Reports of the Department of Agriculture; Reports of the Signal Service; Patent Office Reports, and reliable agricultural and scientific journals:

1711. There was a severe storm and high flood in March on Mobile Bay which overflowed the newly organized town and caused its removal to its present site.

1746. A destructive cyclone visited the Gulf coast, which laid waste the plantations and totally destroyed the rice crop. This article was used in most families as a substitute for bread.

1807. The spring was wet and the water courses were high.

1817. A year of constant rains in Alabama, Georgia and South Carolina.

1825. A dry summer.

1829. A year of continuous rains in Alabama and Mississippi, and poor crops.

1832. A winter of heavy rains and extraordinary floods.

1833. A winter of heavy rains and great floods in the rivers of Alabama. The Tombigbee, above Gainesville, was higher than ever known prior to this time.

1840. The spring was dry and cool. The fields early in June presented a bleak and barren aspect. Famine seemed imminent. The summer was also dry and the farms were thoroughly cultivated. The Warrior at Tuscaloosa was very nearly dried up, resulting in the death of a great many fish. At Montgomery there was a slight rain early in August, and no more until late in October. The Alabama river was too low for navigation. An immense cotton crop was made, perhaps the largest yield per acre ever known in the State up to this time. There was no bad weather to prevent picking from August to the following spring. The total rainfall for the year at Huntsville was only 29.08 inches, and at Savannah, Georgia, 25.98 inches.

1843. The spring was late, with continued rains in July and August, throughout the cotton region. This wet weather acted so injuriously on the cotton that a most favorable fall failed to produce as large a crop as that obtained in 1842.

1844. The summer was dry and the season generally excellent for the growth of cotton. The crop opened very early and was large. Cotton picking was general August 1st.

1845. The spring and summer were exceedingly dry.

1846. A memorable year in Alabama. The cotton caterpillar made its appearance for the first time in the clay lands north of the Black Belt or the Cretaceous formation. The damage in central and south Alabama was fearful. Boll worms were also abundant. The rapid multiplication of these insects was caused by the unusually wet summer. The cotton crop was 25 per cent. less than that produced in 1844.

1847. A wet summer, and insects were very numerous. Scarcely any cotton opened on August 27th. All the southern rivers were very high from the heavy rains in December. Rainfall for the year at Mobile was 71.43 inches. The season was unpropitious and backward. The spring opened late and the frequent occurrence of destructive hail storms and the prevalence of northeast winds, accompanied with chilling rains, until late in May, exercised an unhappy influence on the growing crop, placing it back three or four weeks.

1850. The winter and spring were so wet and the land was in such bad order it could not be well prepared for the crop. Much of the soil was ploughed up in wet clods that had not pulverized when the season for planting had arrived. Cotton insects were numerous.

1851. Excessive rains and very high water in April. The summer was dry and hot and there was but little rain from May 4th until August 10th; resulting in the poorest corn and cotton crops on the sandy and clay lands ever made. The drouth of seven weeks parched up the gardens in east Alabama. It also cut off the oats, except the autumn crop. About the middle of August, after an exceedingly dry year throughout the cotton regions it rained generally over the country. The fall continued warm and dry until unusually late and afforded to planters double the crops they expected in August.

1852. There was a frequency of rain in July and August that produced a too rapid development of weed in the cotton plant, and multiplied the injurious insects, that resulted in considerable damage to the crop.

1853. The March rains were heavy, while in April there was no rain of consequence. In May it continued excessively dry in the same districts affected in April and the drought was very severe. In July the rains became abundant and even excessive where the drought had been severe. These rains began early in the month and continued and were profuse, giving at the end of July 7.00 to 11.00 inches of rainfall, or nearly twice the mean depth. During September the rains were heavy, as much as 15.00 inches falling at Pensacola. Some damage was done by these rains in retarding the development of cotton bolls, and by flooding bottoms. The annual rainfall at Mount Vernon Arsenal, near Mobile, was 106 57 inches; the largest ever recorded in Alabama. The rains of September and the generally wet character of the latter parts of the season, together with the early drought, that lasted about three months, seriously reduced the yield of cotton.

1854. The weather of spring cold and dry and the wheat and oat crops were cut off. The severity of the drought was unprecedented, affecting more or less the entire country. Even the low lands, that heretofore gave large yields during dry years, materially failed in 1854. In the month of September the rains were abundant and damaged to a great extent the opening cotton. The grain crop was also seriously injured.

1855. A mild winter with considerable dry weather. Rivers were not navigable. Cotton that was planted in April and May did not germinate for want of moisture. Late in May there was sufficient rain to bring up cotton and late planted cereals. The summer was dry but cultivation was perfect and the cotton crop was very large. The yield per acre was the largest ever realized except possibly in 1839. Total rainfall for the year at Green Springs was 39.27 inches; at Greensboro it was 37.60 inches, and at Auburn, 37.85 inches, or a deficiency of nearly 20 inches. The summer rainfall was well distributed and the deficiency was not so severe on the growing crops.

1857. No rain fell in East Alabama during the months of June and July. The year was distinguished by abnormal conditions of both temperature and rainfall. The deficiency in precipitation was fully 16 inches.

1858. During this year occurred great spring floods. August was hot and dry, except in East Alabama where the rains were continuous. The fruit crop was abundant and cotton and grain crops excellent. During the months of August, September and October little rain fell, and the cotton opened rapidly and early and the season was most excellent for gathering it. A large crop was saved. Oats were destroyed by rust. The corn crop was fair and there was an abundance of fruit.

1859. Another spring of heavy rains and destructive floods. The summer was seasonable, and the fall was like that of 1875 and 1876, and like those years an immense cotton crop was gathered in very bad condition. Picking was continued until March, 1860.

1860. The planters of Alabama made enough corn to do them. In a few localities of the State such was the length of the drought, and the intensity of the heat the crop was cut a little short, but in other sections more favorable there was enough corn made to spare. No rain fell in East Alabama from June 5th to July 27th. In this part of the State the effects of the drought were exhibited by the dried up creeks, stunted cotton bare of fruit and the forest shrubbery dying for want of moisture in the earth. There were two equinoctial storms—one August 11th and the other September 15th.

1865. The rivers were all high in April and May, but the summer was dry and fair crops were made.

1867. Continuous spring rains and the rivers over the State very high. The crops were replanted early in June, and by September promised a fine yield, but the cotton caterpillars appearing in large numbers, and no fruit having developed by that time, the crop was seriously damaged.

1868, The summer was moderately favorable, and the cotton plant was well fruited by July 10th. Continuous rains from August 20th until September 10th developed both boll worms and caterpillars which inflicted great damage, reducing the cotton crop on the black lands fully one half.

1870, A dry spring, particularly during May, The weather during June and July was favorable for cultivation, There was a late frost and the cotton crop was very large,

1871, March and April were very wet, May cool, with frequent rains, and June was showery, July was dry and favorable for farming operations, but August produced heavy rains. September, October and November were favorable for gathering the crop but the yield was light. Caterpillars did great damage in central Alabama.

1872, A year of moderate temperature and favorable distribution of moisture, The cotton crop was very forward. July and August were very warm with light rainfall. Cotton opened very rapidly, the fields being white by August 24th. The yield was large,

1874. January and February were pleasant months. April was wet and May was dry. Heavy rains in June. [Caterpillars did considerable damage in central Alabama.

1875. April and May dry. Poor stand of cotton, There were general rains about the middle of June which gave healthy, vigorous growth to the plants, the lands having been placed in fine condition during the dry weather of April and May. July and August were very dry in middle and southern alabama. The fall and winter months were continuously wet and the very large crop of cotton was gathered in very bad condition. There was no frost of consequence until December 8th.

1876. March 19th a very heavy snow storm swept over west Alabama, resulting in a heavy rainfall at Mobile. Caterpillars were more generally prevalent than ever known, but coming late did no material damage.

1877, An equinoctial storm swept over the State on September 18 and 19, in which the wind was not high, but the rain fell on the north west limits of the storm in torrents. At Tuscaloosa 14,00 inches fell in two days, The Warrior river was 63.6 feet above low water and destroyed all the corn and cotton crops on the rich bottom lands between Tuscaloosa and Eutaw. The rain fell without intermission.

1879. The season up to May 20th was very favorable for planting and farm operations. From this date until June 5th there were continuous rains and but little plantation work was done and crops became grassy. July and August were showery. The autumn was mild and comparatively dry. Picking season was generally excellent and the crop was large.

1881. During March rains were very heavy and the rivers were higher than in 1865. The months of April, May, June and July were quite dry. The corn crop was cut down to save fodder, as the protracted drought prevented the formation of corn.

1883. Prolonged and unprecedented drought continued during August and October. The weather during October was hot, dry and unhealthy. Crops suffered for rain, and in some localities, wells dried up.

1884. The remarkable features for the year were the unusually heavy rains of June and July, followed immediately by a prolonged drought, that lasted nearly four months. The rainfall was about four inches below the average.

1885. The summer opened moderately cool and slight damage was done to the cotton, but by the beginning of July the weather turned off very favorably and the outlook for a fine crop was encouraging. The abundant rains that occurred during July and August developed the cotton insects and rust, and the cotton plant was retarded in its growth, During the autumn the weather was so wet the cotton sprouted in the fields, and this trouble, together with the numerous insects and rapid increase of the rust cut off the crop considerably.

1886. The spring opened with extensive and damaging floods. The rise in the rivers was greater than was ever known to occur before. During May the rains were so frequent the crops became badly choked with grass and weeds. The rains continued throughout June, damaging cotton very much. During July the days were fair and the farmers cultivated the lands so well the crops recuperated wonderfully. The fair weather of August and the dry, sunshiny days of September opened the cotton so raipidly a very fair crop was gathered. The weather continued dry until the close of October.

1887. The spring was dry until May, when rains occurred so often as to place the young crop in good condition. On the 24th of June the Central Office of the State Weather Service, with all its records, was destroyed by the fire that burned the main building of the Alabama Polytechnic Institute, and no bulletins were issued until September, The fall was remarkable for a continued drought and high temperature. In some portions of north Alabama the thermometer ranged as high as 100° in September, and before the close of the month there was a fall of 50°. Crops of all kinds suffered on account of drought and hot weather,

1888. The spring opened wet and cool. The rains were continuous throughout August. The autumn was unusually mild and roses were in bloom at Auburn on December 10th.

1889. The spring was quite dry and farmers complained very much about the dry condition of the atmosphere producing withering effects on the crops. The rains were frequent in north and west Alabama during June, but in eastern and southern portions of the State the farms still suffered for want of rain until the close of the month when copious showers fell. The weather generally during the summer months was favorable for the crops. A good cotton crop was gathered and the staple was in excellent condition because of the fine dry weather during the autumn months,

HEAVY RAINFALLS PER DAY.

1880. Green Springs, April 19 and 20, 3.82 in 9 hours.
1881. Mobile, August 3rd, 6.20; 4th, 3.10; 5th, 3.56.
Mobile, November 6th, 4.50 in 10 hours.
Montgomery, December 14th, 2.93; 21st, 3.45.
1882. Montgomery, February 8th, 3.01.
Auburn, February 8th, 3.56 in 14 hours.
Auburn, February 28th, 2.33 in 9 hours.
Mount Vernon, March 26th, 4.81, from 7.15 a. m. to 9.30 p. m.
Auburn, March 26th, 1.58 in 1 hour and 30 minutes.
1883. Auburn, October 22nd, 2.15.
1884. Birmingham, April 15th, 3.50.
Auburn June 28th, 4.00.
Carrollton, July 28th, 3.10.
Wetumpka, July 28th, 3.50.
Prattville, December 14th, 3.50.
1885. Clintonville, January 23rd, 4.07.
Tuscaloosa, April 30th, 5.25 in 3 hours.
Pine Apple, May 30th, 5.30.
Trinity, June 12th, 4.90.
Tuscumbia, September 29th, 6.33.
Marion, November 6th, 6.00.
1886. Greensboro, January 3rd, 4.57.
Russellville, March 29th, 9.75.

Tuscumbia, September 14th, 5.16.
1887. Fayette, January 23rd, 5.00.
Auburn, July 27th, 7.37.

WET MONTHS.

1867. August, 13.55 at Fish River.
1881. March, 11.74 at Tuscaloosa.
March, 7.57 at Auburn.
August, 15.22 at Mobile.
1882. January, 13.70 at Decatur.
February, 11.31 at Auburn.
June, 14.41 at Birmingham.
July, 16.37 at State Line.
July, 14.54 at Mount Vernon Arsenal.
August, 11.26 at Mount Vernon Arsenal.
September, 10.25 at Troy.
1883. January, 10.47 at Greene Springs.
January, 10.30 at Mount Vernon Arsenal.
April, 12.83 at Auburn.
April, 11.22 at Birmingham.
April, 11.18 at Mount Vernon Arsenal.
April, 10.65 at Opelika.
June, 14.24 at Mount Vernon Arsenal.
June, 10.28 at Greenville.
1884. January, 12.94 at Clanton.
January, 11.52 at Auburn in 15 days.
July, 12.02 at Greene Springs. Thunder storms occurred almost daily.
June, only 3 days without rain in some parts of the the State.
1885. May, 12.96 at Bolling.
1886. January, 11.00 at Newton.
March, 18.25 at Newton.
June, 12.41 at Lineville, 18 days rain.
November, 11.55 at Mount Willing.
1887. July, 21.09 at Auburn.
December, 15.95 at Mount Willing.
1888. January, 11.50 at Selma.
March, 13.48 at Union Springs.
June, 13.56 at Mobile.
August, 14.35 at Mobile.

DRY MONTHS.

1882. June, 0.10; September, 0.31, Talladega.
June, 0.13; September, 0.32, Calera.
October, 0.29; Talladega, 0.37, Calera.
1883. September, 0.07, Mount Willing; 0.16, State Line; 0.22, Montgomery; 0.25, Uniontown; 0.48, Pine Apple.

1884. September, 0.00, Prattville; 0.00, Wetumpka; 0.00 Troy; 0.00, Tuscaloosa; 0.00, Evergreen; 0.00, Selma; 0.00, Fort Deposit; 0.00, Calera. This was the dryest month on record. From 33 reports only 5 gave 1.00 inch and over. The average for the State was 0.40 of an inch.

October. The following stations reported a fall of rain less than 1.00 inch: Eufaula, Union Springs, Jacksonville, Edwardsville, Summerville, Auburn, Opelika, Fort Deposit, Calera. The mean depth of rainfall for the State was 1.48 inches.

1886. September. The following stations reported a fall of rainfall of less than 1.00 inch: Centre, Selma, Greensboro, Birmingham, Auburn, Marion, Carrollton, Tuscaloosa, Livingston, Fort Deposit, Mount Willing, Oswichee.

October. Tuscumbia, Fayette, Florence, Trinity, Selma, Auburn, Montgomery, Marion, Livingston, Eufaula, Union Springs, Newton, Fort Deposit, Mount Willing, Mobile, Bermuda, Oswichee. The average for the State was 0.58 inch.

1887. March. Less than 1.00 inch. Bermuda, Marion, Montgomery, Union Springs, Mount Willing, Tuscaloosa, Troy.

1889. May. Less than 1.00 inch: Bermuda, Livingston, Greensboro, Columbiana, Uniontown, Centre.

October. Tuscumbia, Union Springs, Mobile, Livingston, Greensboro, Pine Apple, Uniontown, Selma. Average for the State 0.98 of an inch.

4. Destructive Storms.

1740. September 11th a most destructive hurricane swept the Gulf coast from the Mississippi to Pensacola. It began about 1 A. M. and lasted until 12 M. It blew down several houses in Mobile. Half of Dauphin Island was carried away and more than three hundred head of cattle were drowned on the island. On the 18th another violent storm visited the coast of Alabama. It came from the N. N. E., and was accompanied by heavy rains that caused an overflow of all the rivers by which were laid waste all the plantations of the Indians from Carolina to Mobile. Much suffering resulted from these storms in and around Mobile.

1772. From August 31st to September 3rd a storm visited the country around Mobile much more destructive than any before experienced. Vessels were driven into the heart of the town and the violence of the wind forced the salt water over the ground, destroying all vegetation. All the houses were filled with water several feet deep. The sea was driven over the islands along the coast of the Gulf in mountainous waves. The wind ranged from S. S. E., but further west the storm was more violent and the wind come from N. N. W. It is stated that during this storm the mulberry rees in Mobile lost all their leaves by the force of the winds, and afterwards put forth a second crop of leaves, blossomed and produced fruit within the brief space of four weeks,

1794. A destructive tornado in August, The locality visited was not mentioned in the record. Such a small area of the territory between latitudes 21° and 41°, in Alabama, was occupied prior to 1815, we have no record of the tornadoes and violent storms which generally produce such terrible havoc in the months of March, April and May,

1819. August 25th to 28th a destructive cylone prevailed on the Gulf coast, A large brig was stranded on Dauphin street in Mobile,

1852. August 25th produced an equinoctial storm of great violence, causing the highest flood ever known in Mobile, except that of 1772.

1878. March 27th a tornado passed through Hale county, prostrating trees and small houses.

1880. March 18th a tornado passed across the southern portion of Pike county, during the evening, causing great damage to timber and fencing. The storm passed about three miles west of Smilie's bridge on Conecuh river in an easterly direction, and in a distance of ten miles greatly damaged fourteen plantations.

1881, On February 18th a tornado passed through Tuscaloosa county. Its direction was northeast and extended a distance of fifteen miles, Another storm passed a little north of Sumterville in Sumter county, at 5 P. M. on the 23rd of March, that was very violent in its effects. This storm was also northeast, and its track was about forty yards wide.

1882. September 9th a destructive gale visited Marvin on Saturday night. Another began in Alabama on the 10th, and passed across Georgia and South Carolina. This storm swept over the section around and in Auburn, prostrating trees and small houses. The gale continued with unabated force for five or six hours.

1883. On April 22nd a violent tornado occurred in Alabama and passed through Talladega county, killing one person and destroying considerable property. Another storm passed to the north and west of Headland, Henry county, on the evening of May 20th, that destroyed some farm buildings. On October 16th a heavy storm passed near Williams' Station, but no material damage was done in the immediate section,

1884. February 19th tornadoes of great violence passed through Montgomery county on the afternoon. At Montgomery the wind blew at the rate of 32 miles per hour, The wind veered from S. to Nw. during the storm and the temperature fell from 80°.9 to 47°, Storms also passed through the following counties doing considerable damage: Calhoun (8 persons killed); Cherokee; Coosa; Elmore; Jefferson (destroyed most of the town of Leeds and killed 11 persons, wounding 31. The storm was accompanied by hail with stones of unusal size); Perry.

1884, March 11th tornadoes passed through the counties of Greene and Pickens. And on the 24th at 2 A. M., another swept through Barbour county that was accompanied by unusual electric displays and torrents of rain. Its track was about one-quarter of a mile wide. Several persons were badly injured, and one man was killed. On the 25th a tornado passed through northeast Alabama continuing on into Georgia, doing great damage in its track to property. Another on the same day swept through beat one in Chambers county, five miles north of Fredonia. It destroyed everything in its path.

April 2nd a tornado passed through Springville during the night. This storm swept in a northeast direction into Tennessee, and about 60 miles southwest of Chattanooga seven persons were killed. The track of the storm was one hundred yards wide. Eleven miles east of Huntsville a strong wind demolished a farm and killed three persons, wounding four others. At 4 P. M. on the 14th considerable damage was done by a storm at Frankfort in Franklin county. Another tornado passed through Cullman county on the 15th, and also one swept through Elmore county on the 16th in a northeast direction. Another on the 15th through Henry county, and also through Morgan county. Three miles south of Auburn a tornado committed considerable havoc over a distance of eight miles or more, This storm originated four miles southwest of Auburn and passed over into Georgia. In that State a number of persons were killed and thousands of dollars worth of property destroyed.

December 12th a violent storm of wind and rain passed through Mr. J. W. Harris' plantation ten miles north of Auburn, sweeping everything in its track; eight houses were demolished. The width of the track was about 100 feet, and the course of the storm was northeast. The initial point was supposed to be near Mount Meigs.

1885. January 11th tornadoes passed through the following counties: Lamar, Fayette, Cullman, Blount, Marshall, DeKalb, Greene, Hale, Bibb, Chilton, Coosa, Clay, Randolph, Macon. These storms carried death and destruction in their paths, The general direction was northeast, Immense tracks of forests were seriously damaged, and the largest and best timbers in the course of the storms were prostrated and piled together in tangled masses, The storms were most violent between 5 and 7 P. M.

April 30th a storm of considerable violence passed over Summerfield, Dallas county, The tornado came from northwest and was accompanied with rain and small hail stones.

May 6th a severe storm passed over the section of the State in the neighborhood of the towns of Plantersville, Dixie and Randotph at 4:30 P. M. Newspaper accounts fix the loss at $10,000.

November 6th—The storms of this date swept across the State about 11 A. M. The following places were more or less damaged: Fort Payne, Decatur, Florence, Greensboro, Livingston, Marion, Mobile, Montgomery, Opelika, Selma, Orrville Station, Coatopa Station, Plantersville, Tuscumbia. The damage resulting to crops and property over the State was very great, and in some localities persons were killed by the violent winds. The rivers rose very rapidly and soon overflowed their banks.

1886. March 27th a tornado did considerable damage near Grove Hill. The track was a quarter of a mile wide and came from the west. On the 29th a storm passed through Smith's Station from the southwest, doing considerable damage to timber and other property. On the 30th, between 11 A. M. and 12 M., the northeast portion of Bullock county was visited by a tornado, The track was about one hundred yards wide, and its direction was N. N. E.

1888. March—Heavy precipitations occurred on the 26th and 27th that damaged property over the State to a considerable degree. All railroads were more or less injured and trains were stopped for several days. The local wind storms accompanying this rain were quite severe in some localities—unroofing houses and prostrating fences and trees. This cyclone lasted for two days, and the temperature was high during the entire period.

From the above notes, it will be seen that the heavy floods and strong winds occur most frequently in Alabama during the months of March, April and May,

TORNADOES IN ALABAMA.

The following interesting account of tornadoes in Alabama was taken from the *American Meteorological Journal*, and was prepared for that journal by Lieut. John P. Finley of the United States Signal Service. The map shows only approximately the directions and locations of these storms. For a more detailed and accurate account, refer to the tables accompanying Lieut. Finley's article:

Period of observation, 67 years, 1822-1888.

Total number of storms, 112.

Year of greatest frequency, 1884—19 storms.

Average yearly frequency—1.6 storms.

Year in past (10) ten years no report of storms—none.

Month of greatest frequency, March—28 storms.

Day of greatest frequency, January 11th—7 storms.

Hours of greatest frequency, 6 to 7 P. M. and 7 to 8 P. M.

Months without storms, July, August, September and October.

Prevailing direction of storm movement—Ne.

Region of maximum storm frequency, north central portion.

Table II.—A Chronological Table, showing the location, date and time of occurrence, and general character of formation and movement of Tornadoes in the State of Alabama for a period of sixty-seven years, from 1822 to 1888.

County.	Month and Day.	Year.	Time.	Direction.	Form of Cloud.	Width of Path in Feet.
Morgan	April 16	1822	5 p m	NE.	Funnel	2640
Chilton		1823		E 10° N.		2640
Morgan	April 6	1823	9 p m	NE	Funnel	3960
Tuscaloosa	April 25	1829				
Calhoun	May 1	1830				
Morgan	June 16	1834	4:30 p m	NE	Funnel	1237
Blount		1840		E 20° N		
Etowah		1840		E 20° N		
Blount	March 10	1840	6 p m	E.	Funnel	2640
Jefferson	March 16	1840	About 6 p m	NE		1320
Mobile	March 24	1840	7 p m	S 80° E		165 to 660
Tuscaloosa	March 4	1842	6 a m	NE		
Tuscaloosa		1843		E 45° N	Inverted Cone.	600
Lee	March 7	1854	1 p m	NE		900
Pickens	March 12	1855		SE		
Cherokee	May 24.	1857		NE		
Lee		1858		NE		1320
Cleburne	November 30.	1861	10 p m	NE		600 to 900
Cleburne	March 4	1863	11 p m	NE		600 to 900
Lee	December 25	1864	Midnight	NE		
Cherokee		1866		E 40° N		
Cleburne	April 16	1866	11 p m	NE.		600 to 900
Talladega	May 6	1866	8 p m	E 10° N		1320
Calhoun	February 15	1867		E 10° N		
Tuscaloosa	April 29	1867	10 a m	E 20° N	Funnel	
Cleburne	May 4	1867	Midnight	NE		600 to 900
Cleburne	May 26	1867	8 p m	ENE	Funnel	600 to 900
Cleburne	February 12	1868	3 p m	NE		600 to 900

TABLE II.—A Chronological Table, showing the location, date and time of occurrence, and general character of formation and movement of Tornadoes in the State of Alabama for a period of sixty-seven years, from 1822 to 1888.—Continued.

COUNTY.	Month and Day.	Year	Time.	Direction.	Form of Cloud.	Width of Path in Feet.
Tuscalooaa	May 8	1868				
Clay	January 29	1869	8:30 a m	E	Funnel	1320
Talladega	April —	1869		NE		
Pickens	May 6	1869	6 p m	E		450
Calhoun	January —	1870	8 a m			
Marshall	April 23	1870		NE		
Calhoun	December 24	1870			Funnel	
Cleburne	November 16	1873	12 p m	NE		600 to 900
Jackson and Calhoun		1874				
Hale	November 22	1874	Afternoon	SE		
Colbert	November 22	1874	6 p m	NE	Funnel	900
Shelby	November 22	1874	Midnight	E 10 S		300 to 1320
Dallas	November 27	1874			Funnel	
Cherokee		1875		E 30 N		1320
Lamar	February 24	1875	6:30 p m	NE		450
Lee	March 20	1875	2 p m	NE	Funnel	300 to 900
Pike	March 20	1875				
Coosa and Tallapoosa	May 1	1871	about 10 a m	E		1320
DeKalb	April 23	1876		NNE		
Etowah	December 25	1876		E 20 N		
Hale	April 23	1878	5 p m	NE		2640
Chilton	Febrnary —	1879				360 to 600
Chilton	February 13	1880		ENE		1320
Barbour	March 15	1880	Evening			
Pike	March 18	1880	Evening	NE		
Jackson	April 25	1880	Afternoon	NE	Funnel	1000 to 3500
Blount	December —	1880		SE		
Cherokee		1881		ENE		

Tuscaloosa	February 18	1881	Afternoon	NE	Funnel	Narrow.
Perry	February 26	1881	Midnight	NE		300
Randolph	March 22	1881	1 a m	NE	Funnel	
Sumter	March 23	1881	5 p m	NE	Funnel	80 to 120
Madison	February 28	1882	11:45 a m	NE	Funnel	900
Barbour	March 27	1882	night			5280
Dallas	March 27	1882	night			
Henry	March 27	1882	9:30 p m	E		
Lee	March 27	1882	night			
Washington	March 27	1882	2:30 p m	E		1320
Etowah	April 2	1882		NE		
Choctaw	April 22	1882	4 p m	NE		1200
Jefferson	January 16	1883		NE	Funnel	
Blount	April 2	1883		SE		
Jefferson	April 22	1883		NE		600
Cherokee	April 22	1883	10:30 p m			900
Cherokee	April 23	1883	4:30 p m	NE		1320
Fayette	January 11	1884	6 p m	E	Funnel	1200
Pickens	February 19	1884	12 m	NE		
Pickens	February 19	1884	11 a m	NE		
Talladega and Calhoun	February 19	1884	2 p m	NE	Balloon	1320 to 3960
Marshall	February 19	1884	9 p m			1320
Jefferson and St. Clair	February 19	1884	1:20 p m	NE	Funnel	600 to 2640
Cherokee	March 6	1884	4 p m			450
Tuscaloosa	March 11	1884	10:30 p m	NE		1320
Pickens	March 11	1884	7 p m	NE	Funnel	300 to 900
Marshall	March 11	1884	7:30 p m			900 to 1200
Greene	March 11	1884	8 p m	NE	Funnel	300
Jefferson	March 25	1884	2 p m	NE	Funnel	300
Cherokee	March 25	1884	8 p m	NE	Funnel	
Lawrence and Jackson	April 1	1884	6 p m	NE	Funnel	900 to 1320
St. Clair	April 1	1884	Midnight	NE	Funnel	
Blount and DeKalb	April 1	1884		NE		
Lawrence	April 12	1884	2:30 p m			
Lee	December 12	1884	night	NE		100

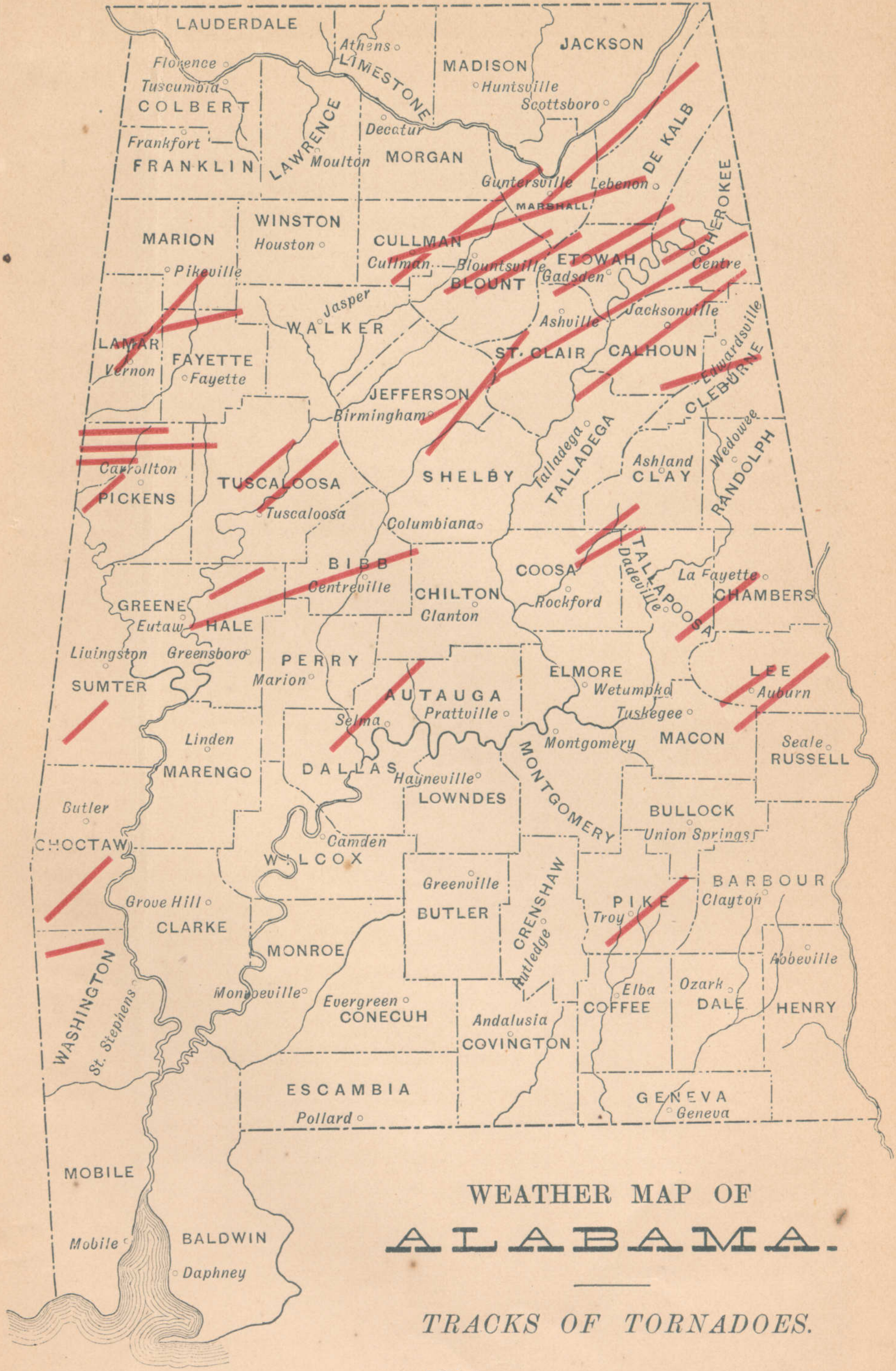
TABLE II—A Chronological Table, showing the location, date and time of occurrence, and general character of formation and movement of Tornadoes in the State of Alabama for a period of sixty-seven years, from 1822 to 1888.—Continued.

COUNTY.	Month and Day.	Year.	Time.	Direction.	Form of Cloud.	Width of Path in feet.
Randolph	January 11	1885				
Macon	January 11	1885	11 p m	E 20° N		2640
Coosa and Clay	January 11	1885	9 p m	E 10° N	Funnel	1320 to 2640
Lamar, Fayette and Walker	January 11	1885	5 p m	E 15° N		1320 to 2640
Greene, Hale, Bibb and Chilton	January 11	1885	6:20 p m	E 30° N	Funnel	900 to 1320
Cullman, Blount, Marshall and DeKalb	January 11	1885	7 p m	E 20° N		600 to 3960
Coosa	February 20	1885	5:30 p m	NE	Funnel	250
Marshall	March 28	1885	Afternoon			300
Madison	May 6	1885	6:30 p m	N 45° E	Funnel	Narrow
Sumter	November 6	1885	8 p m	NE		1320
Lamar	November 6	1885	10 p m	NE		300 to 2700
Dallas	November 6	1885	3:30 p m	NE	Funnel	300 to 2640
Hale	April 25	1886	Afternoon	NE		
Elmore	March 29	1886	Morning	NE	Funnel	450
Washington	January 13	1887	Morning	NE	Funnel	1320
Jefferson	April 18	1887	3 a m	NE	Funnel	Narrow
Lamar	April 22	1887	6 p m	NE	Funnel	900
Pike	June 26	1888	Afternoon	Easterly	Funnel	Narrow
Talladega	June 26	1888	Afternoon	Easterly	Funnel	Narrow

TABLE 3.—Relative frequency of Tornadoes by Months and Days, for Alabama.

The *italic* figures to the right of the dates show how many times Tornadoes occurred on that day of the month. The blank (—) signifies date missing.

MONTH.	DAY OF MONTH.	No. of days.	Total No. of tornadoes per month.
January	(11)*7*, 13, 16, 29 and (—)	5	11
February	12, 13, 15, 18, (19)*5*, 20, 24, 26, 28 and (—)	10	14
March	(4)*2*, 6, 7, 10, (11)*4*, 12, 15, 16, 18, (20)*2*, 22, 23, 24, (25)*2*, (27)*5*, 28, 29 and (—)	18	28
April	(1)*3*, (2)*2*, 6, (12)*2*, (16)*2*, 18, (22)*4*, (23)*4*, (25)*3*, 29 and (—)	11	24
May	(1)*2*, 4, (6)*3*, 8, 24 and 26	6	9
June	16, (26)*2*	2	3
November	(6)*3*, 16, (22)*3*, 27 and 30	5	9
December	12, 24, (25)*2*, and (—)	4	5
Blank	(1)*9*	1	9
Total		62	112



WEATHER MAP OF

ALABAMA.

TRACKS OF TORNADOES.

5. REMARKABLE COLD WINTERS AND WARM SUMMERS.

1748. The winter was so severe that the Mississippi river at New Orleans was frozen thirty to forty feet from the banks.

1768. Another cold winter that froze the Mississippi River at New Orleans some distance from the banks and killed all the orange trees.

1772. A winter like those of 1746 and 1768, followed by a summer of tropical intensity.

1779-80. The winter was exceedingly cold over the South. The extreme cold began about November 15th, with the forest foliage still green in many places because the autumn was very mild and gentle, and some trees and shrubs were putting forth new growth. Through the winter until the middle of February there was not sufficient warmth to cause even a temporary thaw, but there was a constant succession of snow storms, which so obstructed the usual methods of travel that the ice on rivers and large creeks was used in the place of the ordinary roads. The winds were so piercing that wild turkeys were frozen in the woods and domestic fowls fell from their roosts. The deer sought shelter from the blasts around the cabins of the settlers, and all kinds of animals perished in the forests for want of food, which was buried beneath the snow.

1783. July and August were so cold the colonists had to resort to winter clothing. White frosts made their appearance in the beginning of September. On the 15th of November the cold became intense. There was a constant succession of spualls and the wind blew with great violence from the north and northeast, and from the south. The variations of the weather were such that several times in six hours Reaumur's thermometer fell from 20° above freezing to 3° below in a closed room where fire was kept.

1793, 1794, 1796 and 1799 were very severe winters.

1807. February 7th was very cold and was called the "Cold Friday." On the evening of the 15th the weather was mild with light rain about night. In a few hours the rain was turned into snow that covered the ground about six inches, The snow was immediately followed by a northwest wind storm of great violence. The cold became more intense as the night advanced, and on the morning of the 16th the frozen sap expanding caused the bark of trees to explode.

1816. This is known in history as the year without a summer. January, February and March were mild; April and May were quite cold. It is stated by a traveller on a boat from Mobile to New Orleans, he saw on April 16th the spray that was blown from the waves freeze on the rigging. June 8th there was a killing frost in latitude 33°. August and September were quite cool; October and November stormy and disagreeable; but December was mild and comparatively genial. There was frost every month as far south as latitude 34°.

1823. This year marks the lowest temperature recorded in Mobile. At midnight on the 16th of February the thermometer was down to 5° above zero.

1825. This year should be known as the year without a winter. About September the cotton crop was supposed to have been irreparably damaged, and large speculative purchases were made in Charleston for shipment to Liverpool. During September there were showers which revived and invigorated the plant, causing new growth and fruitage, which, in the absence of cold and frost matured a large crop, resulting in a ruinous decline for the speculators.

1827. A killing frost on the 27th of May throughout the cotton States, greatly damaging the cotton crop. Early in December the weather became intensely cold. The ground was hard frozen in Alabama until March, 1828.

1832. A winter of great severity. At Huntsville the thermometer registered in January—9°. There were destructive hail storms throughout the State; but fair crops were made.

1833. A cold winter. This year is remarkable for the magnificent meteoric display that occurred on the night of November 13th—and that is now so well known in history. Many rustic hamlets and log cabins became extemporized confessionals; and "old citizens" yet hold to the opinion that more vows of reformation, more promises of amendment were made that night than ever before in the same space of time.

1834 and 1835 were cold winters; and February 6th and 7th, 1835, were exceedingly cold, the temperature at Mobile was 6° at sunrise. The cotton crop for 1835 was very large.

1846-47. The winter was unequaled in severity by any since 1835. In middle Alabama the thermometer registered 10° to 22° above zero.

1849. *Fabruary and March were mild and spring-like. Vegetation was more advanced than ever noticed before. Wheat was ripening, and cotton had four to six leaves; corn was waist high and the leaves of the forest trees about grown by April 15th. On the 16th ice formed on all still water and the ground was frozen half-inch deep and everything green was killed. It became necessary to replant both corn and cotton.

1852. Thermometer registered 8° at Mobile on January 20th. Marking ink froze as rapidly as the brush was withdrawn from the marking pots, causing the suspension of work in the cotton yards. The spring was cool, inclement and late; but the summer was seasonable and crops of corn and cotton were large.

1855-56. The winter was the coldest since 1852. Standing water near Mobile was frozen hard enough to permit of skating, a most unusual sight for that latitude.

1857. The spring was unprecedentedly cold and backward. Nearly all the fruit and advanced vegetables were cut off. There was no cotton up on the 20th of April; and the wheat that was jointing in central Alabama was killed by a frost on the 5th of April. On April 13th it began snowing and was the largest for 15 years, but the ground not being frozen the snow did not accumulate more than three or four inches in depth. May 6th a severe hail storm swept through central Alabama. The summer was cool. The corn and cotton crops were poor. While the winter was not unusually cold, the low spring and summer temperatures reduced the mean for the year about 2° below the average, while some stations showed a mean lower than those for 1823 and 1835. The peaches, although few in number, were very large and unusually fine.

1874-5. The winter was mild and there was no frost of consequence until December 8th, 1875.

1876. March 19th, a very heavy snow storm over West Alabama. April 20th and 21st, a frost occurred in latitude 33° which killed all young leaves;

and on June 8th the temperature was near the frost point in Central Alabama. December 30th, a snow storm began that proved to be the fiercest ever known in Alabama. The cotton crop was very poor.

1877. The Bigbee River was frozen over at Columbus, Mississippi, the first week in January. The ice was thick enough to support a boy's weight. This is the only time in this generation where such a freeze occurred. The temperature at Columbus was 0°.

1884-5. Five cold waves passed over the State during the month of January, 1885. Comparatively few days were mild and the temperature was 5° below the normal. The month of February was decidedly colder than the same period of time for a number of years. The average temperature was about 6° below the normal. But little farm work was accomplished because of the frozen condition of the ground. The fall oats were all killed, and the farmers were compelled to replough the fields and sow them in spring grains. The average temperature for the winter was 5° below the normal.

1886. The severe weather of the month has rendered January the most remarkable season recorded in many years. The oats that were growing finely at the opening of the month were totally destroyed by the cold wave that began on the 8th. Considerable stock were killed where proper protection was not given. The temperature in north Alabama was as low as 7° below zero. On December 3rd to 5th, throughout north Alabama a snow storm occurred that covered the ground with snow to the depth of 20 inches; in middle Alabama it reached a depth of 16 inches; and as much as 12 inches in some portions of south Alabama. This fall of snow was unusually heavy for this climate, and in some sections was the cause of marked comment, because such a sight had never been witnessed before, especially in the extreme southern part of the State.

1887. The month of January was very cold. The average temperature for the State was 6° below the normal.

1889-90. Mild spring-like weather continued throughout the winter, and vegetation came forth with well developed leaves before the 1st of March.

6. Years of Good Crops and Years of Poor Crops.

The following years produced good crops and in abundance: 1823, 1825, 1835, 1837, 1839, 1840, 1842, 1844, 1855, 1858, 1859, 1870, 1872, 1875, 1878, 1879, 1885, 1886, 1889.

The following years produced inferior crops: 1817, 1827, 1838, 1843, 1846, 1847, 1849, 1850, 1851, 1852, 1853, 1854, 1857, 1867, 1868, 1871, 1876, 1884.

7. The Winds of Alabama.

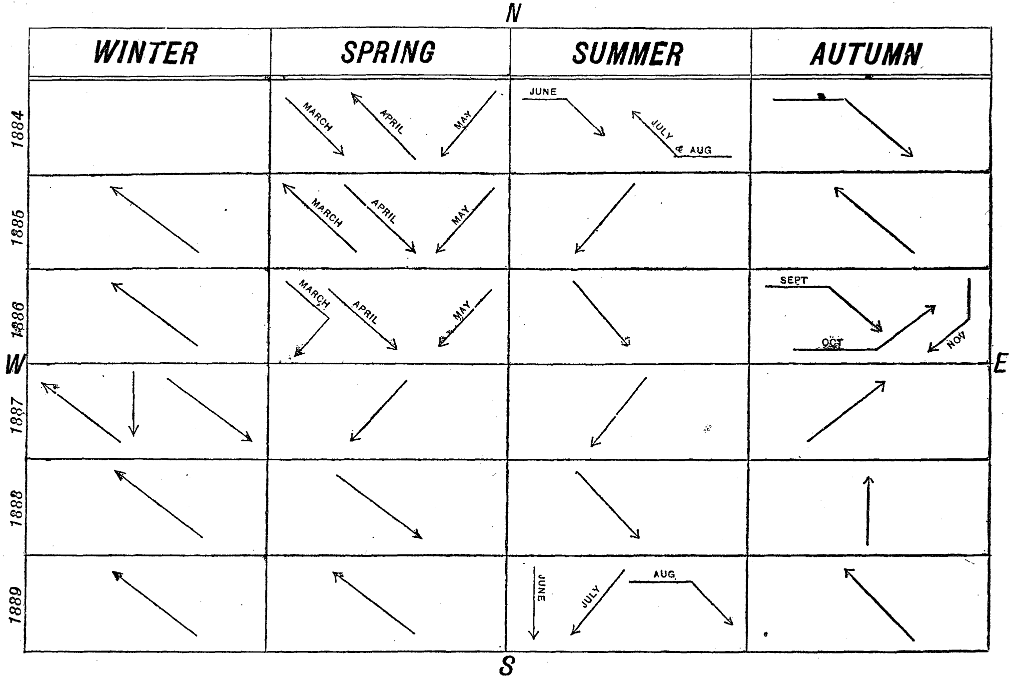
It is a fact well known in meteorology that the circulation of the air, or what is commonly called wind, controls the conditions of the climate of the country over which it moves. It is an old saying that the winds are variable, but a number of years of observations, carefully taken, will furnish data from which average conclusions may be drawn. Dry air in passing over a surface of water or moist object will absorb a large amount of vapor, that it will hold so long as the temperature of the air remains the same it was when the water was absorbed. But in sweeping across the country it must come in contact with currents varying in temperature to its own. Air from more northern climes and cooler coming in contact with the warm, moist atmosphere, the vapor will be condensed and rain will result. The question may be naturally asked, can the conditions of the weather be foretold by observing the directions of the wind? This is possible with considerable degree of accuracy. Whenever there is a low pressure in Alabama, the air from the surrounding territory will rush in to fill in the partial vacuum. The particles coming from the south and south west and east and south east are generally accompanied with vapor caught up while passing over the Gulf and Atlantic; the air from the west and north west is generally cool and largely emptied of moisture in sweeping across such a wide stretch of land. These currents striving to reach the centre of the depression will cause a whirl around the trough and rain will result on the outer rim of this whirl pool. It is also generally true that in impinging on each other the northern and southern currents will cause minor eddies that will frequently result in violent local storms—electrical and sometime tornadic also. By a careful observation of barometers, well located in different portions of the country, the unequal expansions of the air may be accurately noted. If a low pressure passes across the State rain or cloudy weather may be expected, and fair weather will almost certainly accompany a high pressure.

After many years of observations made under the auspicies of the Smithsonian Institute and the Signal Service the following table has been prepared by the chief signal officer concerning the circulation of air and its influence on rain and clear weather:

MONTHS.	WINDS MOST LIKELY FOLLOWED BY RAINS.	WINDS LEAST LIKELY FOLLOWED BY RAINS.
January	South or East.	Northwest or Southwest.
February	" " "	" " "
March	Southwest or Southeast.	North or West.
April	Southwest or Southeast.	North, Northwest or West, Southwest.
May	Southwest or Southeast.	North or West.
June	Southwest or Southeast.	Northeast or Northwest.
July	Southwest or Southeast.	Northeast or Northwest.
August	South or East.	Northeast or Northwest.
September	South or East.	Northwest or Southwest.
October	South or East.	Northwest or Southwest.
November	South or East.	Northwest or Southwest.
December	South or East.	Northwest or Southwest.

The following chart has been prepared from data supplied by the observers of the State weather service and indicates by a diagram the average directions of the wind for each season of the year. The service began operations March 1st, 1884, and hence the winter of 1883-4 is left blank. The arrows fly with the wind. The diagram shows that the average direction of wind in winter is from the south east; in the spring it blows from the south east and south west; in summer from the south east and south west, and in autumn from the west and south west:

Diagram Showing the Annual Average Direction of wind in Alabama from 1884 to 1889



NOTE.—The arrows fly with the wind.

SOME GENERAL CONCLUSIONS.

In studying the mass of material given in the preceding pages, much that is valuable can be obtained concerning the climate of the State. At some stations the observations were conducted so long, satisfactory conclusions may be drawn concerning local climatic conditions.

Alabama is so situated in relation to the parallels of latitude and the difference in elevation between the southern and northern portions that many of the plants necessary for man's sustenance and pleasure may be successfully grown within her borders. Her climate is so varied, without great extremes, that most of the plants peculiar to tropical regions, are grown in the belt bordering the Gulf; and the cereals and forage plants common in the north and west are successfully cultivated in her mountains and upper valleys. The health of the people of Alabama can compare favorably with any other country on the globe. Violent epidemics are very rarely found within her borders, and whenever, after long years, yellow fever or cholera find lodgment on her soil it is due entirely to immigration and the disease soon spends itself in the locality where it it first finds foothold. The thermometer seldom goes above 100°, and only now and then in years does it range a degree or so below zero. It is considered to be extremely cold when the temperature reaches 10°, and intensely hot when the thermometer records 100° in the shade. Not more than two or three days in the year give such high temperature, and only a few localities in the State. The atmosphere is moist enough to produce a cooling sensation on the skin when the breeze passes across the heated person as it sweeps in from the west and north west. The average rainfall for the entire State is only 52.12 inches, and at no place does the normal precipitation run above 65.00 inches. By a glance at the table of normal precipitations found on another page of this Bulletin, it will be noticed that the least annual rainfall is 41.75 inches, and the greatest is 64.96 inches. It is thus seen that the atmosphere is neither too dry nor too moist for the most luxuriant production of vegetation and for the best condition for the health of the inhabitants of the State.

The highest normal average temperature is 82.°2 in July and the lowest is 43.°1 in January, giving a range of 39.°1. The winters are seldom very cold and the summers are not excessively warm. The last frost in spring occurs on April 15th, and the first frost in autumn comes on November 15th, so that the farmer is blessed with seven months in which no cold occurs sufficiently severe to even nip the most tender bud, except at rare intervals already indicated in the previous page of this bulletin. It is a fact well known that because of this long season for growing and maturing plants sometimes several crops are gathered on the same body of land in the same year.

The cold weather does not begin until December, and only one month in the winter is really disagreeably cold, viz: January. The winter is usually mild and snow seldoms falls heavy enough to cover the ground more than two or three inches.

As a matter of interest in this connection the following tables are given of maxima and minuma temperatures to show that the climate of Alabama is not extreme either in heat or cold. The stations selected are those that have furnished records for a series of years:

Montgomery—Maximum ; Series extends from 1872 to 1890—

J	F	M	A	M	J	J	A	S	O	N	D
78.5	81.2	86.3	90.	99.	105.5	106.9	103.	98.	96.1	83.	79
73.3	76.9	80.8	86.8	93.5	97.1	98.9	96 3	93.2	86.3	79.	72.7

The year of extreme heat was 1881.

Minimum—

J	F	M	A	M	J	J	A	S	O	N	D
5.	14	25	30	44	48	60.8	59	40	31	21	8
19.3	24 5	33.2	40.5	50.7	61.1	69	65.5	52.7	40.8	29.1	22.8

The year of extreme cold was 1886.

Huntsville—Minimum; Series extends from January, 1831, to December, 1839—

J	F	M	A	M	J	J	A	S	O	N	D
9	7	8	13	31	36	51	54	39	29	13	—7
11.4	12.2	19.5	34.8	45.8	51.9	59	58	45.2	34-6	21	15 4

The years of extreme cold were January, 1832, and 1836.

Maximum—Series extend from January, 1831, to December, 1839.

J	F	M	A	M	J	J	A	S	O	N	D
75	75	84	86	90	92	95	96	91	86	78	68
68	70	80	82	86	90	92	90	86	81	72	67

The year of extreme heat was 1838.

Mobile—Minimum temperature; Series extend from April, 1840, to December, 1889 -

J	F	M	A	M	J	J	A	S	O	N	D
19	33	31	44	55	51	68	70	60	42	36	27
24.3	30.8	37.1	43.6	52.9	63.4	63.1	68.4	53.6	44	31.5	26.2

The year of extreme cold was in 1873.

Maximum—Series extend from April, 1840, to December, 1889—

J	F	M	A	M	J	J	A	S	O	N	D
78	79	80	85	92	96	98	96	96	94	85	76
71.8	74.8	79 8	81.9	87.7	89.8	97.4	95.3	92.8	91	78.1	72.8

The year of greatest heat was in 1873.

Mount Vernon Arsenal—Series extend from August, 1840, to December, 1889 ; Minimum—

J	F	M	A	M	J	J	A	S	O	N	D
9	13	23	33	48	58	61	57	46	32	24	14

The year of greatest cold was 1852.

Maximum—Series extend from August, 1840, to December, 1889—

J	F	M	A	M	J	J	A	S	O	N	D
80	84	90	95	102	100	100	104	98	96	88	84

The year of greatest heat was 1860.

Auburn—Minimum ; Series extend from February, 1881, to December, 1889—

J	F	M	A	M	J	J	A	S	O	N	D
4	11	24	27	45	46	60	61	46.5	32	18	14
13.6	19.7	28.9	37.4	50.6	58	64.2	62.3	52.2	38.2	24.7	20

The year of greatest cold was 1886.

Maximum—

J	F	M	A	M	J	J	A	S	O	N	D
76	76	81	86	93	97	100	97.5	95	94	81	74
69.6	73.2	75.9	83.5	88,6	92	95,7	93,2	91.3	81.8	77.2	69,3

The year of greatest heat was 1881.

Carlowville—Minimum ; Series June, 1856, to September, 1877—

J	F	M	A	M	J	J	A	S	O	N	D
8	24	29	40	48	70	74	70	52	32	30	28

Maximum—

J	F	M	A	M	J	J	A	S	O	N	D
75	80	84	85	95	94	103	98	90	88	76	78

The first figures in the above series represents the maxima and minima temperatures at the stations named. The second series of figures represents the average of all the maxima and average of all the minima. These latter figures are more important in studying the question of effects of heat on plant economy. These averages will be reached each year while the first series of figures may not be reached by the thermometer during several years. For instance, at Huntsville the minimum temperature during nine years was —9°, and the thermometer registered this degree only twice within that period. At Auburn the maximum temperature was 100° in nine years, and this record was made only once during those nine years. It is not an unusual occurrence for the thermometer to register at Huntsville 11.°4 in winter and a maximum of 92° in summer. And at Auburn 13.°6 may be often reached in ten or twenty years, or 95.°7 in summer. These average maxima and minima may therefore be properly termed plant temperatures

METEOROLOGICAL SUMMARY FOR THE STATE OF ALABAMA.

Compiled from material furnished by Observers of the State Weather Service.

	1884.		1885.		1886.	
		DATE.		DATE.		DATE.
Mean barometer	29 979		30.089		30.087	
Highest barometer and date	30.504	December 19	30 64	January 3	30.702	February 5
Lowest barometer and date	29 53	March 1	29.386	February 17	28.955	January 3
Mean temperature	67 3		61 3		61 4	
Maximum temperature and date	104	July	105	June	103	August
Minimum temperature and date	6	December	1	February	0	December
Greatest monthly range	66	October	66	Jan. and Feb.	72	February
Least monthly range	14	July	13	July	19	June and July
Mean temperature, spring	65 2		61.2		62.1	
" " summer	76 9		79 3		77.9	
" " autumn	66.3		61 9		64.4	
" " winter			44 5		41.9	
Coldest day spring, mean minimum	29.3	March 1	24.9	March 23	27	March 11
Warmest day spring, average for State	92.7	May 22-23	86 7	May 25	90.5	May 28-29
Coldest day summer	57.1	June 1-11	63	July 1	62.4	June 19
Warmest day summer	95.4	August 29	96.3	August 1	97.7	August 16
Coldest day autumn	30	November 25	28.7	November 26	28	November 19
Warmest day autumn	94 4	October 7	89.7	September 15	91.9	September 17
Coldest day winter	13.6	December 19	3.7	January 9, 1886	10.5	Jan. 3, 1887
Warmest day winter	74.7	December 22	65.9	Feb. 23, 1886	78	Feb. 18, 1887
Rainfall in inches	40 35		51.49		54 63	
No. cloudy days	100		130.3		126	
No. clear days	87		117.8		122	
No. fair days	118		116 9		117	
No. days of rain	81		109		94 7	
Average direction of wind	S. E.		N. W.		S E.	
No. months wind from north and northeast	0		0		1	
" " " " south and southeast	8		3		5	
" " " " south and southwest	1		3		3	
" " " " west and northwest	3		6		3	

METEOROLOGICAL SUMMARY FOR THE STATE OF ALABAMA.

Compiled from material furnished by Observers of the State Weather Service.

	1887.		1888.		1889.	
		DATE.		DATE.		DATE.
Mean barometer	30 135		30 126		30.102	
Highest barometer and date	30.800	January 3	30.72	April 26	30.68	December 1
Lowest barometer and date	29.26	October 19	29 00	August 11	29.43	Jan. 27, Mar. 18.
Mean temperature	63 6		63.1		62 8	
Maximum temperature and date	102	June, July, Aug.	100	July	101	June
Minimum temperature and date	1	January	9	February	7	February
Greatest monthly range	69	November	62	January	63	October
Least monthly range	6	July	19	June and July	16	August
Mean temperature, spring	64.1		63.6		62 2	
" " summer	79 3		78.6		77.2	
" " autumn	62 9		62 5		62 3	
" " winter	47 4		47.9		45.5	
Coldest day spring, mean minimum	31	March 29	28.8	March 23	29 7	March 10.
Warmest day spring, average for State	90 6	May 17	91.2	May 27	89 8	May 17
Coldest day summer	59.3	June 14	55 6	June 4	43.8	June 1
Warmest day summer	97	July 19	95	August 2	94.8	July 24
Coldest day autumn	20	November 21	28 8	November 28	23	November 30
Warmest day autumn	95.9	September 15	88.5	September 11-12.	93	September 15
Coldest day winter	17.9	January 19, 1889	17.9	Feb. 7, 1889	26 6	December 1
Warmest day winter	74.5	January 6, 1888.	75 6	Feb. 17, 1889	77 4	December 15
Rainfall in inches	47 83		58.83		45.58	
No. cloudy days	110		122		108	
No. clear days	139		115		137.4	
No. fair days	116		128		119.6	
No. days of rain	74.6		96 5		79.9	
Average direction of wind	S. W.		S. E.		N. W.	
No. months wind from north and northeast	3		3		1	
" " " " south and southeast	3		4		1	
" " " " south and southwest	5		2		3	
" " " " west and northwest	1		3		7	

WEATHER MAP OF

ALABAMA.

NORMAL TEMPERATURES.

[Prepared for Bulletin on Climatology of Alabama,
by P. H. MELL.]

WEATHER MAP OF
ALABAMA.

NORMAL PRECIPITATIONS.

[Prepared for Bulletin on Climatology of Alabama,
by P. H. Mell.]

APPENDIX.

Soil Temperatures.—Observations taken at Auburn during the years 1888 and 1889:

The set of thermometers belonging to the soil series range in length from 1 to 96 inches. There are three groups of instruments so arranged as to give the temperature of moist soil and as near as possible an average dry, sandy soil. The first set consists of nine thermometers, viz: 1, 3, 6, 9, 12, 24, 36, 48, 60 inches respectively, that are buried on the banks of a running stream of water in bottom, sandy land. The other two sets—one, consisting of the same number of thermometers as above, and the other the same number with three additional, viz., 72, 84 and 96 inches—are buried on the top of a hill in sandy soil that is often stirred during the crop season. The smaller set on the hill was originally placed in a grass plat with the intention to leave the grass growing around the instruments as a means of comparison with those in cultivated ground, but by mistake the grass was removed by the workmen on the farm and some time elapsed before the grass recovered, so that results were vitiated.

The first of the following tables give average results of soil temperatures for the year 1889, obtained from readings made three times each day at the hours of 7 a. m., 2 p. m. and 7 p. m., and compared with average temperature of air and terrestrial radiation.

The second table shows by comparison with the maximum and minimum temperatures of the air and terrestrial radiation the fluctuation of maxima and minima temperatures as depth in soil is reached.

Table showing by comparison the maxima and minima temperature of terrestrial radiators, air and soil thermometers.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Max. Terrestial Thermometer	**51°**	**66°5**	**54°**	**62°**	**63°**	**74°**	**73.°5**	**72°5**	**78**	**60**	**60**	**59.5**
Max. Air	**67°**	**75°**	**76**	**82**	**89**	**91.5**	**98.**	**92.5**	**93**	**82**	**76**	**74**
On hill.												
Maxima 3 inches....	63.5	69	73 5	82.5	92.5	96	101.5	95	96 5	84.5	69.5	69
Maxima 6 inches ..	61	76 5	68 5	79 5	89	92	98	92.5	92 5	82.5	68 5	65
Maxima 24 inches....	52.5	57	58.5	67	76.5	80	86	82	89 5	74	65 5	60
Maxima 48 inches ..	53.5	53	56.5	63	71.5	75	79.5	79	84.5	74.5	69	60.5
Maxima 96 inches ..	59 5	56.5	56	60.5	62 5	69	73	73 5	76.5	74 5	70	65
In bottom.												
Maxima 3 inches....	60.5	67	69	80 5	92.5	95	101	96	96	84.5	71.5	69.5
Maxima 6 inches....	58.5	65	66 5	79.5	88	91	97.5	93	92	82	69	65
Maxima 24 inches ..	54	57.5	58	67.5	76	80	85.5	82	82.5	74.5	66	60
Maxima 48 inches ...	54.5	54	57	64	71	75	79.5	79	79	75	68	61
Min. Terrestial Ther.	**21**	**24**	**32**	**37**	**43**	**43**	**60**	**62**	**48**	**36**	**22**	**30.5**
Minimum Air......	**23**	**16.5**	**30**	**38**	**45**	**46**	**67.5**	**63**	**48**	**38**	**24**	**29**
On hill.												
Minima 3 inches ...	33.5	32	37	48.5	52	52	71.5	69.5	54 5	45	35	35
Minima 6 inches....	35 5	34.5	39	50	55	55	73 5	70.5	57 5	48	37	37.5
Minima 24 inches....	46 5	44	49	58	64.5	68.5	77	78	72	62 5	52	50
Minima 48 inches ..	51 5	48	50.5	56.5	63	69.5	74.5	77	75	67	58	56.5
Minima 96 inches ...	56.5	54.5	54 5	54	60	65.5	69	73	73 5	70.5	64	62
In bottom.												
Minima 3 inches ...	35 5	35	41.5	47.5	55	55	74	70 5	56 5	45	34	34
Minima 6 inches...	39	38	44	52	59	58	76	73	60	49	37	36
Minima 24 inches ...	48.5	46	51	58 5	65	69.5	77	78.5	72.5	63	52.5	50
Minima 48 inches	52.5	50 5	51 5	57	63.5	69 5	74.5	77	75	67.5	59	57

Average soil temperatures, at Auburn, Alabama, during the year 1889.

	Terrestial.	Air.	1	3	6	9	12	24	36	48	60	72	84	96	
		°	°	°	°	°	°	°	°	°	°	°	°	°	
January	39.7	46 9	47.4	47.3	47.3	46.8	46.7	49.2	50.8	52.5	53.6	54.7	55.9	57.5	Thermometers on hill.
			47.5	47	48.2	47.9	48.2	50.8	52	53.4	54.6				Thermometers in bottom.
February	36.8	46.3	47	46.8	46.7	46	45.8	47.7	48.9	50.3	51.6	52.4	53.4	55	" on hill.
			46.2	46.1	46 7	46.3	46.7	49.4	50.2	51.6	52.6				" in bottom.
March	43.2	54.7	56.7	56.4	55.8	54.7	53.5	53.4	53.1	53.2	53.3	53.3	54	54.8	" on hill.
			55.2	54 1	54.6	53.8	53.8	54.4	53.9	54.3	54.2				" in bottom.
April	55.6	62.5	67.2	67.1	66.5	65.5	63.9	62.6	61.1	60.9	59	58 3	58.2	58	" on hill.
			67.9	66.8	66.6	64.5	63.8	62.6	60.9	60.6	59.3				" in bottom.
May	57.2	70.1	76.1	76.7	76.1	75.3	73.9	71.6	69.3	66.7	65.4	64.2	63.3	62.4	" on hill.
			77.4	77	75.5	74.6	73.7	71.1	67.4	66.3	65.3				" in bottom.
June	65.8	76 1	82.1	81.9	81.3	80.1	78.3	76.1	74	72.5	70.6	69.3	68.5	67.2	" on hill.
			82.3	82	81.5	79.5	78.7	76.2	73.8	72.4	70.2				" in bottom.
July	70.0	80 7	86.2	86.6	86.3	85	83.3	80.9	78.7	77.2	74.7	73.3	72.5	70.8	" on hill.
			86.4	86.7	86.6	84.5	80.4	80.9	78.1	76.6	74.2				" in bottom.
August	67.5	77.6	81	81.6	81.4	80.7	79.3	79.1	78.3	77.5	76.4	75.6	75	73 3	" on hill.
			82	82	82.5	81.1	80.5	79.7	79.2	77.7	76.1				" in bottom.
September	65.2	74 8	78.3	78.4	78.4	80.8	77	77.8	77.2	77.1	77.8	75.6	75.1	73.8	" on hill.
			79.1	78.7	79.2	78.2	77.6	78.1	75.4	76.2	75				" in bottom.
October	49.5	62 3	68.9	68.5	68.1	67.2	67.1	69	68.3	71.2	72.3	72.3	72.2	72.2	" on hill.
			69.1	68.7	68.8	67.6	67.8	69.5	70.7	71.9	72.2				" in bottom.
November	42.9	53.1	56.6	56.2	56.3	56	56.2	59.6	61.6	63.5	64.7	65.7	66.6	67	" on hill.
			56.7	55.9	56.4	56.2	56.3	60.2	63.1	64.4	65.9				" in bottom.
December	45.5	57.8	59	57.9	57.3	56	55.2	56.7	57.5	58.7	60	60.5	61.5	62.9	" on hill.
			58.9	57.7	57.1	55.8	55	56.9	57.7	58.9	60.1				" in bottom.

The observations of soil temperatures have not been taken long enough to produce normal results, but it is interesting to note some features in the accompanying tables.

1. The average temperature of the soil in the bottom within two feet of the surface is about one degree higher in January than it is on the hill. The two places in February produce practically the same results within a depth of two feet. In March the bottom is slightly cooler. In April, May, June and July the results are practically the same. In August and September the bottom is again nearly one degree warmer, while in November and December the hill soil is slightly warmer than the bottom soil.

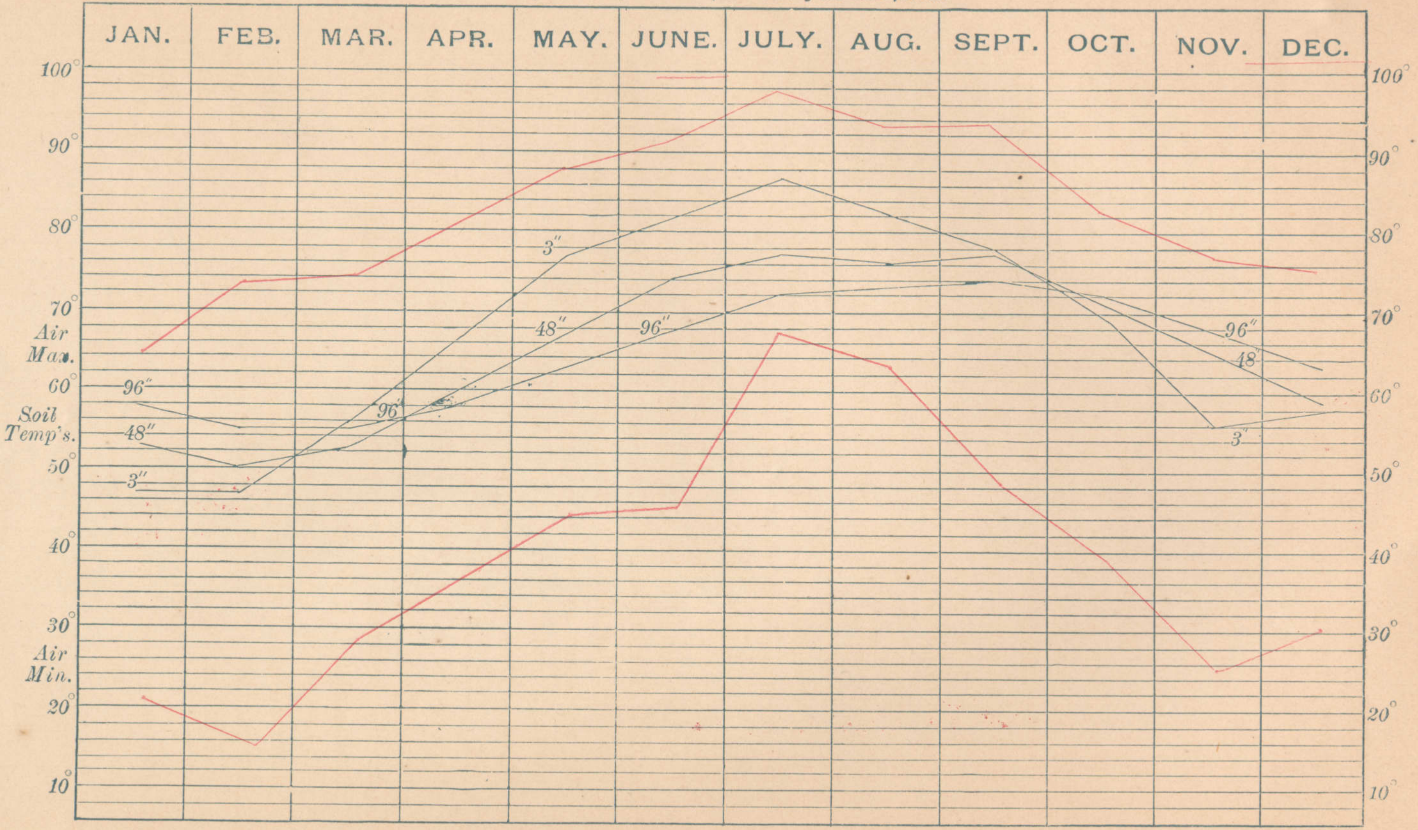
2. There is a gradual increase of temperature in the winter months from the surface to the depth of eight feet, averaging 7.°3, greater in January (10.°1) and least in December (3.°9). In the spring months there is a decrease in temperature to eight feet, averaging 8.°3, least in March (1.°9) and greatest in May (13.°7). In the summer months the stratum of earth at eight feet depth is 12.°7 cooler than that of one inch below the surface. It is 15.°4 cooler in July and only 7.°7 cooler in August. In September the eight feet stratum is only 4.°5 cooler, while in October it is 3.°3, and in November 10.°4 warmer than the one inch stratum.

3. In the middle of summer the eight feet soil thermometer registers an average temperature 9.°9 cooler than the average temperature of the air, while in January it is 10.°6 warmer than the atmosphere.

4. The difference between the average January temperature of the eight feet soil thermometer and the July temperature of the same thermometer is 13.°3, while the difference between the January and July average atmospheric temperatures is 33.°8.

The chart on next page represents graphically the fluctuations of three soil thermometers 3, 48 and 96 inches during the year, and the comparison with the maximum and minimum temperatures of the air during 1889 at Auburn. It is interesting to note how closely the three soil thermometers register in March and October, and how wide asunder they are in January, July and December.

Diagram showing Average Temperatures of the Soil for each Month in 1889, at Depths of 3 - 48 and 96 inches. Also Maximum and Minimum Temperatures of the Atmosphere during the same period.



BULLETIN NO. 19. NEW SERIES.

Agricultural Experiment Station,

OF THE

Agricultural and Mechanical College,

AUBURN, ALA. - - - - - - - OCTOBER, 1890.

ROADS AND ROAD MAKING.

METEOROLOGY.

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ROADS AND ROAD-MAKIN

JAMES H. LANE, C. E., M. A., LL. D.,

Professor of Civil Engineering and Drawing.

At the request of the Board of Direction of the Experiment Station this paper was prepared by the Professor of Civil Engineering, and is issued as a bulletin conveying useful and practical information.

THE BEST METHODS OF CONSTRUCTING FARM ROADS, TURNPIKE ROADS, ETC.

Some of the advantages of good common roads in England are thus summed up in a report of a committee of the House of Commons: By the improvement of our roads, every branch of our agricultural, commercial and manufacturing industry would be materially benefitted. Every article brought to market would be diminished in price, and the number of horses would be so much reduced that, by these and other retrenchments, the expense of five millions (pounds sterling) would be annually saved to the public. The expense of repairing roads, and the wear and tear of carriages and horses would be essentially diminished; and thousands of acres, the produce of which is now wasted in feeding unnecessary horses, would be devoted to the production of food for man. In short, the public and private advantages which would result from effecting that great object, the improvement of our highways and turnpike roads, are incalculable; though, from their being spread over a wide surface, and available in various ways, such advantages will not be so apparent as those derived from other sources of improvement of a more restricted and a less general nature.

I have also seen it stated that the roads in Scotland, under the direction of Telford, produced a change in the state of the people which is probably unparalleled in the history of the country for the same space of time. Telford, himself, testifies that in the Highlands they greatly changed for the better the habits of the great working classes.

If good common roads have done so much for England and Scotland, surely they are worthy of our most thoughtful consideration.

A model road is one that will enable passengers, goods, farm products and other burdens to be transported over it in the least possible time, with the least possible labor, and with the least possible expense. Though the topography of the country and other circumstances may prevent our uniting and reconciling all three of these factors in any one combination, yet, in building a road we should endeavor to approximate this model as near as possible. To enable us to make this approximation, we must consider the direction, the grade, the cross section and the surface of the road.

As an unnecessarily long road would increase the cost of construction, the cost of repairs, and the cost of time and labor in travelling over it, it should, other things being equal, be perfectly straight, but straightness should always be sacrificed to obtain a level or to make the road less steep. This is one of the most important principles to be observed, and yet it is most often violated. I use the word straight here in its mathematical sense, and not as ordinarily applied to roads. We commonly call a road straight when it continues in a vertical plane, regardless of its deviations from a horizontal plane. Let us turn our planes through an angle of 90° and we will find that our straight road has become what we ordinarily call crooked. To illustrate further, if we place a hemisphere so as to rest on its base, the halves of great circles which join the two opposite points of this base are all equal, whether they pass horizontally or vertically—our vertical semi-circle is our so-called straight road, and our horizontal one is our crooked road. From this it will be readily seen that a road around a hill may not be longer than one over it. Even should it be longer within proper limits and be practically level, it would be better to go around than across; for on it a horse will draw a full load at his usual rate of speed, while on the road over the hill, the load must be diminished, or the horse must reduce his speed.

Roads should also be made to curve sometimes for economy in construction, such as to avoid swampy or bad ground, or to avoid large excavations, or to reach points on streams better suited for the approach of bridges.

Besides its substantial advantages, the gently curving road is much more pleasant to the traveller, for he is not fatigued by the tedious prospect of a long straight stretch to be traversed, but is met at each curve by a constantly varied view.

I have seen it stated that one of the reasons for this passion for so-called straightness of roads in some of the older States, is that the houses of the first settlers were usually built on hill tops to escape the poisonous miasmata and the scalping knives of hostile savages, and that the first roads—which were only trails or tracks for men and pack-horses—very properly followed the shortest though steepest routes. Wheel carriages were next used upon these steep tracks, and before sufficient attention was paid to the subject, the lands had been fenced off and appropriated, and these random tracks became the legal highways. And now, the evil is perpetuated by the unwillingness of farmers to allow a road to run through their farms in a winding line. They attach more importance to the squareness of their fields than to the improvement of their roads—not being aware how much more labor is wasted by them in travelling over the steep roads than there would be in cultivating an awkward corner of a field. I am informed that in some of the new Western States, the farmers have this squareness of fields on the brain to such an extent, that they have run their roads along the section and sub-section lines, so that if one of them wishes to pay his neighbor a social or business visit, he has often to travel in rectangular zigzags, after the manner of a sailing vessel when making a point against an adverse wind.

When a wagon rests on a horizontal road, its whole weight, or as we say in Natural Philosophy, its gravity, is supported by the road, and a horse in moving this wagon has only to exert a force sufficient to overcome the friction. But, if the road be tilted in the least, that is given a grade, the line along which gravity acts is no longer perpendicular to the surface of the road, and a part of the weight tends to roll the wagon down grade, so that a horse in going up grade will have to exert an extra force to overcome this downward tendency. In other words, he will have to exert an extra effort to overcome a weight which is such a part of the whole weight, as the height of the road is of its length. For example, if a road rises one foot in every thirty of its length, a horse drawing up it a load of one ton, is compelled to lift up one thirtieth of the whole weight, besides overcoming the friction.

The question now naturally arises, how steep can the slope up the side of a hill be most advantageously laid out. Engineers generally agree, from experiments made, that the maximum ascending grade on a broken stone road ought to be from one in thirty to one in thirty-five, though on some of our rough American roads it is much greater.

In descending a grade, gravity should not overcome the friction so far as to permit the wagon to press upon the horse. This limiting slope corresponds to the angle of repose in mechanical science, that is, the angle with the horizon at which that part of the gravity or weight which tends to pull the wagon down grade and its friction just balance. This angle has also been determined by experiment to be 1 in 35 on good broken stone roads, the same as the maximum ascending grade. Of course it must be remembered that the angle of repose varies with the smoothness of the road.

Although theoretically the road should be level, in practice it is not desirable that it should be so, on account of the difficulty of keeping the surface free from water. A moderate inclination is therefore to be selected as a minimum slope, and this slope is taken at 1 in 125; and in a level country it is recommended to form the road by artificial means into gentle undulations approaching this minimum.

We have then this rule, that the longitudinal grades of a road should be kept, if possible, between 1 in 35, and 1 in 125, never steeper than the former, nor nearer level than the latter.

There is a popular belief that a gently undulating road is less fatiguing to horses than one which is perfectly level. It is said that the alterations of ascent and descent call into play different muscles, allowing some to rest while others are exerted, and thus relieving each in turn. The distinguished Prof. Mahan inclined to this belief, while Gen'l. Wheeler, his successor at West Point, says it has no foundation in fact. Mr. Stevenson, another distinguished engineer, submitted this question to Dr. Jno. Barclay, of Edinburgh, an eminent and successful teacher of comparative anatomy, and he declares that it is demonstrably false that muscles can alternately rest and come into motion in cases of this kind. Where such distinguished gentlemen disagree, I think it unfortunate that the poor horse, which has had so much practical experience, can not speak for himself upon this vital point.

The proper width for a road depends, of course, upon its importance and the amount of travel upon it. The least width to enable two vehicles to pass with ease is assumed at 16½ feet. In England, the width of turnpikes approaching large towns is 60 feet. Ordinary turnpikes are 35 feet wide, and ordinary carriage roads across the country are given a width of 25 feet. In France, the roads vary in width from 66 feet to 26 feet; and all have the middle portion ballasted with stone. In New York, all public roads are laid out by the commissioners of highways and are not less than three rods wide between fences, and no more of them need be worked or formed into a surface for travelling upon than is deemed necessary.

When a road ascends a steep hill by zigzags, it should be wider on the curves connecting the tangents or straight portions—this increase of width being one-fourth when the angle between the straight portions is from 120° to 90°, and one half when the angle is between 90° and 60°.

All of the works on roads which I have read, agree that the best form for the uppper surface of the roadway—its cross section—is that of two inclined planes meeting in the centre of the road, and having their angles slightly rounded by a curve. The inclinations of the planes should be greatest where the surface is rough, and least where it is smoothest and hardest. A slope of 1-24, or half an inch to a foot, is given a road with a broken stone surface. The transverse slope should always exceed the longitudinal slope, so as to prevent the water from running too far in the direction of the length of the road.

Though engineers agree that the above is the best shape, the usual shape givèn to the cross-section is that of a convex curve, approaching in form a segment of a circle or an ellipse. Some of the objections to this form are that the water stands on the middle of the road; the road wears unequally and is apt to wear in holes and ruts in the middle; that vehicles have a slinding tendency when forced to travel on the sides; and that they have to ascend a considerable slope when obliged to cross the road.

Where the surface is made flat, it soon becomes concave from the wear of travel over it, and forms a receptacle for water, making a puddle, if on level ground, and a gully if the ground is inclined.

On a steep hill-side the surface should be a single slope, inclining inwards to the face of the hill. A ditch on the side next to the hill receives the surface water, which should be carried, at proper intervals, under the road to its outside. This form is also advantageous when the road curves rapidly around the hill, as it counteracts the dangerous centrifugal force of the vehicle.

Near large cities, roads have foot-paths on both sides for the convenience of pedestrians. They should be from 5 to 6 feet wide and raised about 6 inches above the roadway. The upper surface should have an inclination towards the side channels to allow the water to flow into them and thence into the ditches.

The drainage of a road by suitable ditches is one of the most important elements. All attempts at improvement are useless till the water is thoroughly got rid of. These ditches are sunk to a depth of about three feet below the roadway, so as to thoroughly drain off the water which may pass through the surface of the roadway. They should lead to the natural water courses of the country, and have a slope corresponding to the minimum longitudinal slope of the road. Their size will depend upon circumstances, being greater when they are required to carry off the water from side hills or where they are made in wet ground. A width of one foot at the bottom will generally be found sufficient. There should be a ditch on each side of the road on level ground and in cuttings. One is sufficient where the road is on a hillside.

The most common and almost the only kind of roads in this country have their surfaces covered with the natural soil, which makes them deficient in hardness and smoothness. In wet weather and under much travel, they become almost impassable. The principal means of improvement for these roads, are to reduce the grades, thoroughly drain the roadway and freely expose the same to the action of the sun and wind. In a flat country it is advisable to raise the roadway above the general level of the ground.

If the soil be a loose sand, a coating of 6 inches of clay carted upon it, will be the most effective and cheapest way of improving it, if the clay can be obtained within a moderate distance. Only one half of the width need be covered with clay, thus forming a road for the summer travel, leaving the other sandy portion untouched, to serve for the travel in the rainy season. If the soil be an adhesive clay, the application of sand in a similar manner will produce equally beneficial results. On a steep hill these improvements will be particularly valuable.

In repairing these roads the earth used should be as gravelly as posssible and free from vegetable earth. Sod or turf, though at first tough, soon decays and forms the softest mud in wet weather. Stones of considerable size should not be used, as they will not wear uniformly with the rest of the road, and will produce hard bumps and ridges.

When a dirt road passes over a soft, swampy ground which can not be drained without too much expense, a corduroy road is often used. This road is made by laying straight logs of timber either round or split, side by side across the road at right angles to its length. Those of

Gen'l Lee's veterans who were so unfortunate as to be wounded in the battles near Fredericksburg, know something of the pleasures? of travelling over such roads as they doubtless have vivid recollections of their rides in springless army wagons to the railway stations, where box-cars took them to some of the many hospitals in Richmond, and elsewhere.

To diminish the resistance or friction on earth roads, it is necessary to cover their surface with some material such as gravel, stone, slag, shells, wood, &c., which will not only make them hard and smooth, but protect the ground beneath from the action of the rain water, which by penetrating to it and remaining upon it, would not only impede the progress of vehicles, but render the road too weak to bear their weight.

In Michigan and Wisconsin good roads have been made through swampy forests, by felling and burning the timber and covering the surface with the charcoal thus prepared. The timber is cut and piled up lengthwise in the centre of the road, and then covered with straw and earth in the manner of coal kilns. The earth required to cover the piles, taken from each side, leaves two good sized ditches. When the timber is charred, the earth is removed to the sides of the ditches, and the coal is raked down to a width of fifteen feet, leaving it two feet thick at the center and one at the sides.

In districts where lumber is cheap, road coverings of plank have been used. The method most generally adopted in constructing a road of this kind, consists in laying a flooring or track, eight feet wide, of boards fron nine to twelve inches in width and three inches thick. The planks rest upon two parallel rows of sleepers or sills laid lengthwise of the road and having their centre lines about four feet apart, or two feet from the axis of the road. The sleepers are embedded in the earth, and the planks are laid perpendicular to the axis of the road, as this position is as favorable to their durability as any other, and is also most economical. Deep ditches are dug on the sides of these roads to ensure perfect drainage.

In making a gravel road, the roadway is first prepared by removing the soft and loose earth, and thoroughly draining the road. The bed is sometimes of the shape of the upper surface and sometimes level. On this a layer of gravel about four inches in thickness is laid, and when compacted by the travel over it, or better still, with a heavy iron roller, another layer is laid, and so on until a thickness of sixteen inches at the centre has been reached. It is sometimes advisable to compress the bed by rolling it well with a heavy iron roller before beginning to lay the gravel. In some cases a bed of broken stone has been used. Gravel from river shores is generally too clean, there not being enough clayey material mixed with it to bind the grains together. That from pits is apt to be too dirty and requires partial cleansing. The gravel used should be sifted through screens and all pebbles over two inches in diameter should be broken into small pieces or rejected. It is an erroneous practice to put the larger gravel at the bottom and the smaller at the surface.

A gravel road carefully made, with good side ditches to thoroughly drain the road bed, forms an excellent road. Some gravel roads are very poor, caused in a great measure by using dirty gravel, which is carelessly thrown on the road in spots, which causes the road to soon wear into deep ruts and hard ridges.

There are excellent but expensive roads in this country and in Europe, whose covering is composed of stone broken into small angular fragments. The road beds are prepared as in gravel roads, and these fragments are placed on these natural beds, or on rough pavements of irregular blocks of stone. The former are called McAdam and the latter are known as Telford roads. These two kinds of roads have been the subject of violent partisanship on several disputed points, the most important one being the necessity of a paved foundation beneath the coverings of stones.

In the McAdam road, the roadway after having received its proper shape and been thoroughly drained, and rolled if necessary, is covered with a layer of broken stones from three to four inches thick. This layer is thoroughly compacted by allowing the travel to go over it, or by rolling it with heavy iron rollers. Successive layers of broken stone are then spread over the road and treated in the same way, until a thickness of from eight to twelve inches is obtained. Should the layers be too thick, it will be difficult if not impossible to compact the stones sufficiently well.

In the Telford road the bed is prepared as in gravel and McAdam roads, and on it is laid a pavement of blocks of stone of an irregular pyramidal shape; the base of each block being not more than five inches and the top not less than four inches. These blocks are set by hand as closely together as possible—the largest blocks being in the centre and the smaller ones on the sides so as to give the surface a slightly convex shape. The spaces between the blocks are filled with chippings of stone compactly set with a small hammer. Layers of broken stone are then laid over this pavement and treated as in the McAdam road. The stone for the pavement of this road may be of an inferior quality, as it is but little exposed to the wear and tear occasioned by travelling; but the stone used for the small angular fragments of both these roads should be selected from those which absorb the least water and are hard and tough. There is a diversity of opinion as to the size of the stones used. Some say 2½ inches in longest direction—they should be as cubical in shape as possible—and others only an inch and a half through. The French engineers value uniformity of size much less than McAdam, and call it rather an evil than a good. They, therefore, use equally all sizes from an inch and a half to dust.

It is recommended by some that when fresh material is added in repairing these roads, the surface on which it is spread should be broken with a pick to the depth of half an inch, and the fresh material be well settled by ramming, a small quantity of clean sand being added to make the stone pack better. If practicable, the road surface should at all times be kept free from an accumulation of mud and dust, and uniformly even by the daily addition of fresh material whenever the wear is sufficient to call for it. When not daily repaired by persons whose sole business is to keep the road in good order, general repairs should be made in the Spring and Autumn by removing all accumulations of mud, cleaning out the side channels and other drains and adding fresh material when requisite. Without constant supervision, the best constructed road will, in a short time, be unfit for travel.

Those of us who followed General Lee in his brilliant campaigns through the Valley of Virginia into Maryland and Pennsylvania, frequently marched on some of these broken stone roads, and in dry weather we always kicked up such a dust that we each eat our peck of dirt in much less than the allotted time.

Shells, slag and other hard and tough substances may be used for road coverings. They are applied like gravel and broken stones.

This paper "on the best methods of constructing farm roads, turnpike roads, &c"—written at the request of the Board of Direction—is compiled largely from standard works, with which all professional engineers are doubtless familiar.

Appendix to Bulletin No. 19, of the Alabama Experiment Station.

REPORT

OF THE

ALABAMA WEATHER SERVICE.

Co-operating with the U. S. Signal Service.

SEPTEMBER, 1890.

STATE POLYTECHNIC INSTITUTE,
Auburn, Ala., October 15th, 1890.

The rainfall was unusually large during the month, and complaints have come from all parts of the State that the cotton crop has been greatly damaged by the continued wet weather. In many places the bolls are rotting and the staple is much stained. The average precipitation for the entire State was 3 28 inches above the normal.

The nights during September were cool and pleasant, but in South Alabama some of the days were warm; the observers at Pine Apple and Union Springs reported temperatures as high as 97°. There were only two or three days of such weather, and the temperature for the State was below the normal 5.°8.

Some small grain was sown during the month and is doing well, although the season generally was unfavorable to all other farming interests.

J. M. QUARLES,
Assistant.

P. H. MELL,
Director.

MONTHLY SUMMARY.

Atmospheric pressure (in inches).—Monthly mean, 30.049; maximum observed, 30.291 at Auburn on 1st; minimum observed, 29.860 at Union town on 23rd; range, .431.

Temperature (Degrees F.)—Monthly mean, 74.1; highest monthly mean, 78.8 at Goodwater; lowest monthly mean, 69.60 at Valley Head; maximum, 97 at Pine Apple on 10th, and at Union Springs 19th, 20th and 21st; minimum, 50 at Florence on 28th, and at Valley Head on 17th and 18th; range for the State, 47; greatest local monthly range, 45 at Union Springs.

Precipitation, including melting snow (in inches).—Average for the State, 6.02; greatest, 10.07, at Valley Head; least, 3.08, at Goodwater.

Mean relative humidity, 87.7, at Auburn; 83.1, at Uniontown; 83, at Montgomery, and 89.7 at Valley Head.

Wind—Prevailing direction, E. Miles traveled, 2,678, at Chattanooga; 4,323, at Mobile; 3,259, at Montgomery; 2,826, at Auburn.

TABLE OF SOIL TEMPERATURES—September, 1890.

(The observations for this table were taken at Auburn, Ala.)

A. M. LLOYD, Observer.

NOTE—There are three sets of thermometers—Nos. 1 and 2 are situated on a hill in sandy soil, and No. 3 is placed near a small stream in bottom land. The depth of instruments range from 1 inch to 96 inches below the surface, and the observations are made three times each day—morning, noon, and evening.

Depth in Inches.	Set No. 1, on hill.	Set No. 2, on hill.	Set No. 3, in bottom.
1	77.1	76.8	77.8
3	77.0	77.1	78.4
6	76.9	77.4	78.0
9	76.5	77.3	77.1
12	76.3	76.3	76.6
24	77.0	76.8	77.0
36	76.7	76.5	76.5
48	76.4	76 3	76.4
60	75 9	76.0	75.5
72	....	75 4	....
84	....	75.1	....
96	....	78.2	....

Monthly Summary of Meteorological Reports of the Alabama Weather Service, September, 1890.

STATIONS.	COUNTIES.	Altitude.	Latitude N.	Longitude N.	BAROMETER.					TEMPERATURE.									Total Precipitation.	Clear Days.	Fair Days.	Cloudy Days.	Days of Rain.	Prevailing Wind.	OBSERVERS.
					Monthly Mean.	MAX.		MIN.		Monthly Mean.	Mean of Max.	Mean of Min.	MAX.		MIN.		Monthly Range.	Me'n Daily Range							
						Height.	Date.	Height.	Date.				Degrees.	Date.	Degrees.	Date.									
Selma	Dallas									76.3	85.5	67 1	93	10	56	29	37	18.4	5 37						†
Valley Head	DeKalb	1058	34.30	85.30						69.6	78.8	60 4	90	8	50	17–18	40	18.4	10 07	13	8	16	9	E..	E. P. Nicholson.
Pine Apple										75 6	84.8	66 4	97	10	53	28	44	18 4	6.26						†
Florence.			34 48	87.37						72 5	80.5	64.5	92	6	50	28	42	16	7.87				9		C. W. Ashcraft.
Chattanooga	Tennessee	783	35.03	85.14	30.097	30.283	2	29.963	12	71.5	78 9	64	90	8	55	18	35	14.9	7 10	6	14	10	16	N e	L. M. Pindell.
Montgomery	Montgomery	219	32.22	86.23	30.044	30.169	5	29.923	23	75.9	84.2	67.6	91	6	57	28	34	16.6	6 03	5	8	17	18	E..	*L. Dunne.
Marion	Perry,									73 2	84.3	62.1	92	10	50	29	42	22 2	6 54						†
Union Springs.	Bullock	516	32.12	85.39						75.4			97	28–29–30]	52	28, 29,30	45		6.13	9	6	15	8	E..	R J. Grady.
Bermuda	Monroe.		31.43	87.12						73.1			89	10	56	29	33		6.01				13		Wm. Fowler.
bile	Mobile	30	30.41	88.20	30.028	30.142	8	29.922	23	76.6	84.2	69	90	9-17	54	29	36	15 2	3.61	4	19	7	15	N..	*A. Pritchard.
rollton	Pickens		33.14	88.01						73.7			84	9–19	56	28–29	28		4 93				14	S e	M. L Stansel.
Auburn	Lee	826	32.40	85.30	30.053	30.291	1	29.867	28	73 7	80.6	66.9	88	20	56	30	32	13.7	5.53	7	8	15	8	E..	J. M. Quarles.
Livingston	Sumter	150	32.34	88.05	30.070	30.170	8	29.940	24	72			87		51		36		5.93				17	N w	J. W. A Wright.
Greensboro.	Hale	220	32.41	87.36						73.5			90	9	54	28	36		8 98		10	20	14	N w	M. H. Yerby.
Mt. Willing	Lowndes		32.07	87.00						76	85	67.3	89	7–8	60	29	29	17.7	6 65				11		Wm. M. Garrett.
Uniontown	Perry	273	32 28	86.44	30.002	30.160	8	29.860	23	74 5	83	66	90	6	51	27–28	39	17	6 84	8	6	16	14	E..	W. H. Newman.
Citronelle.	Mobile.	352	31.03	87.30						77.4	87 6	67.2	95	19	53	29	42	20.4	3.33	11	2	17	12		J. G. Michael.
Fayette	Fayette		33.42	83 12																					Dan Collier
Opelika	Lee									72 6	81.7	63.7	93	8	52	29	41	18	4.79						†
Guntersville	Marshall		34.24	86.20																					A. J. Baker.
Chepultepec	Blount,																								W. B. Allgood.
Columbiana	Shelby		33 15	86.56						72.2	81.4	63 1	91	9	54	28	37	18 3	6.90				16		W. D. Lovett.
Centre	Cherokee	729	34.10	86.30																					Thos. Bradford.
D'ble Springs	Winston		34.09	85.35																					A. M. Weiler.
Butler	Choctaw		32.05	87.24															4.90				10		B. F. Gilder.
asper	Walker	310	33.49	88.12						72.3	79.4	65.2	86	8–9	55	28–29	31	14.2	6.59	5	11	14	11	S...	Howard Lamar.
Wiggins	Covington																								M D. Jones.
oodwater	Coosa									78.8	83 7	73.9	91	9	62	30	29	9.8	3.08				8		J. W. Batson.
Eufaula	Barbour									73	85	61	90	6	54	8, 26, 27	36	24	5.14						†
amden																									S. D. Bloch.
Means				30.049						74.1	82	65.7					36.6	17.4	6.02	7	9	14		E..	

NOTE.—*Sergeants Signal Service. †Cotton Belt Stations.

BULLETIN NO. 20. NOV. 1890.

OF

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA.

SMALL FRUITS, MELONS AND VEGETABLES.

Report of Alabama Weather Service.

☞ The Bulletins of this Station will be sent Free to any citizen of the State, on application to the Director.

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W. B. FRAZER	Clerk and Accountant

Notes on Small Fruits, Melons and Vegetables.

J. S. NEWMAN,
Agriculturist.

JAS. CLAYTON,
Assistant Agriculturist.

STRAWBERRIES.

The following notes on Strawberries were made in 1889, and owing to the quantity of other matter presented for bulletins and the smallness of the printing fund, laid aside to be combined with similar notes in 1890.

As most of the varieties were in full fruitage first of last March, the date of the memorable freeze, reliable notes could not be made. A moderate crop was produced later, but a just comparison could not be instituted between the varieties.

Early Canada and *Parry* are still the earliest varieties tested, and both have improved in quality and productiveness since their introduction to these grounds five years since.

Of the newer kinds, Belmont, Buback, Haverland, Gandy, Hoffman and 1001 or "Eureka," are very promising.

The Henderson still leads the list in its quality and its vines are becoming more vigorous and prolific as it becomes acclimated.

Wilson, Agriculturist and Sharpless still hold their places as standards.

NOTES ON

Number.	VARIETIES.	Growth of Plants.	Productiveness.	Time of first ripe berry.	Size of Fruit.	Color of Fruit.	Color of Flesh.
1	Agriculturist......	Vigorous. ..	Prolific....	April 20	Medium....	Deep red	Light red
2	Belmont..........	“	“	“ 26	Large......	Red	“ “
3	Bidwell..........	“	“	“ 26	“	Deep red	“ “
4	Big Bob..........	“	Not Prolific	“ 27	Medium....	“ “	“ “
5	Boyden's No. 30..	Not vigorous	“ “	“ 13	“	“ “	“ “
6	Champion........	Vigorous....	“ “	“ 29	“	“ “	“ “
7	Champion of Ky..	“	Prolific....	“ 20	“	“ “	“ “
8	Charles Downing.	Not vigorous	Not Prolific	“ 24	“	“ “	“ “
9	Crescent.	Vigorous. ..	Prolific...	“ 24	“	Red	“ “
10	Cumbrl'd Triumph	“	Not Prolific	“ 24	“	“	White....
11	Daniel Boone.....	Not vigorous	Prolific	“ 24	“	Deep red	Red.......
12	Early Canada.....	Vigorous. ..	“	“ 10	“	“ “	“ ......
13	Finch's Seedling..	Not vigorous	Not prolific	“ 26	“	“ “	Light red.
14	Galceran.........	“ “	“ “	“ 24	“	“ “	“ “
15	Golden Defiance..	“ “	“ “	“ 26	“	“ “	“ “
16	Harris' Mammoth.	Vigorous. ..	“ “	“ 24	“	“ “	“ “
17	Haverland........	“	Prolific....	“ 24	Large obl'ng	“ “	“ “
18	Henderson.	Not vigorous	Not prolific	“ 26	Medium...	“ “	Red.......
19	James Vick.......	Vigorous. ..	“ “	“ 26	Small......	Red.....	Light Red
20	Jewell............	“	“ “	“ 24	Medium....	Deep red	Red,......
21	Jucunda..........	Not vigorous	Prolific....	“ 20	“	“ “	Light red.
22	Jumbo............	“ “	Not prolific	“ 30	Large......	“ “	Pink. .....
23	Longfellow.......	“ “	“ “	“ 20	Obl'g and med.	Lig't red	W.& r. c'tr
24	Manchester.......	Vigorous. ..	Prolific....	“ 24	Medium....	Red.....	Light red.
25	May King........	“	Not prolific	“ 27	Large.....	“	“ “
26	Miners...........	Not vigorous	Prolific....	“ 26	“	Deep red	White ....
27	Monmouth.	....	....	“ 27	“	Red.....	Light red.
28	Mount Vernon...	“ “	Prolific ...	“ 24	Medium....	Deep red	White ....
29	Mrs. Cleveland...	“ “	Not prolific	“ 26	Small.	Red. ..	Light red..
30	Nig's Superb.	Vigorous. ..	“ “	“ 26	Large	“	“ “
31	No. 1001 (Eureka)	“	Prolific....	“ 27	Medium....	“	“ “
32	Parry.	“	Not prolific	“ 10	“	“	Pink .....
33	President Lincoln.	“	“ “	“ 20	“	“	White ...
34	Primo	“	“ “	“ 24	Large	“	Light red.
35	Prince of Berries..	“	“ “	“ 24	Medium....	Deep red	“ “
36	Sharpless.........	“	Prolific....	“ 24	Very large	Red.....	“ “
37	Wilson...........	“	“	“ 24	Medium....	Deep red	“ “
38	Windsor Chief....	“	Not prolific	“ 27	“	Red.....	“ “
39	Wonderful.	“	“ “	“ 24	“	Red.....	Red. .....

STRAWBERRIES.

	Texture of Fruit.	Cavity or Core.	Free Acid.	Flavor or quality of Fruits.	REMARKS.
1	Firm	Neither.........	None.....	Best......	Amateur and market.
2	"	Core and cavity.	Slight ..	Very good	Fine market berry.
3	"	Neither.........	"	Good....	
4	"	Large Core	"	Very good	Very firm.
5	Soft	Cavity	None.....	" "	
6	"	....	Very Acid	Barely g'd	
7	Firm	Neither	None.....	Very good	
8	Soft.....	....	"	Best......	For amateur culture only.
9	Firm	Large Core	Slight	Good	Sho'd be plant'd by a large vig. variety
10	Soft	Slight Cavity ...	....	" ..	
11	"	Neither........	None.....	Very good	
12	"	Cavity..........	"	Good.....	Earliest every season for five years.
13	"	None	Slight	" ...	
14	Firm.....	None	None....	Very good	
15	"	Neither.........	Slight ..	" "	
16	Soft	"	" ...	" "	
17	Firm.....	"	None....	Best.	Berry v'y obl'g—resembl's Henderson
18	Soft	"	"	" ...	
19	"	Slight Core....	"	Barely g'd	
20	"	" "	Slight	Good ..	
21	Firm.....	Neither	None	Best.	
22	"	Cavity....	Slight ..	Very good	
23	Soft	Cavity	None....	" "	Ripens on top while green underside.
24	Firm.....	Neither.......	....	....	
25	"	"	None.....	Best......	Dies out badly in summer.
26	"	Cavity..........	"	Good....	
27	Firm	Neither........	" ...	Very good	
28	Soft......	Cavity	"	" "	
29	Firm	Neither	Slight	Good.....	
30	"	Large Core.....	"	Barely g'd	
31	"	Neither.........	None.....	Good.....	A promising new variety.
32	"	Slight Core.....	"	"	Ripens either with early Canada or a [few days later.
33	Firm.	Cavity	None.....	" ...	
34	Soft	"	"	Very good	
35	Firm.	Neither.........	"	Best. ...	
36	"	Cavity.........	"	Very good	Standard for home and market.
37	"	Neither.........	Slight	Very good	Standard for home and market.
38	"	"	"	Good	
39	"	"	Very Acid	Barely g'd	

NOTES ON RASPBERRIES.

VARIETIES.	Growth of Plant.	Productiveness.	Hardiness.	Date of Ripening.	Type.	Color of Fruit.	Size of Fruit.	Size of Receptacle.	Texture.	Quality of Fruit.	REMARKS.
Brandywine	Not vig'us	Prolific	Not hardy	May 13	Red cap.	Red	Large	Large	Firm	Good	
Caroline	Vigorous	Prolific	Medium.	May 13	Black cap	Black	Medium.	Medium	Firm	Best	
Crimson Beauty	Not vig'us	Not prolific	Not hardy	May 29	Red cap.	Red	Medium.	Large	Soft	Good	Die out badly.
Davidson's Thornless.	Not vig'us	Not prolific	Not hardy	May 20	Black cap	Black	Small	Large	Firm	Good	Dies badly.
Doolittle	Medium	Prolific	Hardy	May 13	Black cap	Black	Small	Small	Soft	Very g'd	Same as Tyler.
Early Prolific	Vigorous	Not prolific.	Not hardy	May 24	Red cap.	Purplish red	Large	Large	Firm	Good	Dies badly.
Florence	Vigorous.	Prolific	Hardy	May 13	Black cap	Dark yellow	Medium	Large	Firm	Good	Hybrid. Canes sunscald badly.
Golden Queen	Vigorous.	Not prolific.	Not hardy	May 24	Red cap.	Bright yell'w	Large	Large	Firm	Best	Hyb'd. be'f'l f't. vin's die b'dly
Gregg	Medinm.	Medium	Not hardy	May 24	Black cap	Black	Large	Small.	Firm	Good	Musky.
Hansell	Not vig'us	Not prolific	Not hardy	May 20	Red cap.	Dark red	Large	Medium.	Firm	Good	
Hopkins	Vigorous	Medium	Medium.	May 20	Black cap	Black	Small	Large	Firm	Very g'd	Dies badly.
Marlboro	Medium.	Medium	Not hardy	May 24	Red cap.	Red	Large	Large	Firm	Best	
New Rochelle	Medium.	Prolific	Medium.	May 20	Black cap	Dark purple	Large	Medium	Soft	Good	Dies badly—some acid.
Ohio	Medium.	Not prolific.	Not hardy	May 24	Black cap	Black	Small	Medium	Firm	Good	Dies badly.
Rancocas	Not vig'us	Not prolific	Not hardy	May 29	Red cap.	Dark red	Large.	Very l'ge	Soft	Very g'd	Dies badly.
Reliance	Not vig'us	Not prolific.	Not hardy	May 20	Red cap.	Dark red	Very l'ge	Very l'ge	Soft	Good	Dies badly.
Souhegan	Medium	Prolific	Medium.	May 13	Black cap	Black	Large	Small	Firm	Best	Dies badly—similar to Tyler.
Superb	Medium.	Prolific	Hardy	May 20	Red cap.	Dark red	Medium.	Large	Firm	Best	Dies back.
Thompson's E. Pride.	Medium.	Prolific	Hardy	May 29	Red cap.	Red	Large	Medium.	Firm	Best	A promising new variety.
Thompson's E. Prolific	Medium.	Prolific	Hardy	May 29	Red cap.	Red.	Large	Medium	Firm	Best	A promising new variety.
Turner.	Very vig's	Very prolific	Very h'dy	May 20	Red cap.	Purplish red	Medium.	Small	Firm	Best	The most reliable variety.
Tyler.	Medium.	Prolific	Medium.	May 13	Black cap	Black	Small	Small	Firm	Very g'd	Same as doolittle.
Welch	Not vig'us	Not prolific.	Not hardy	May 24	Red cap.	Dark red	Very l'ge	Large	Firm	Very g'd	Dies badly.

Out of more than thirty varieties tested, during the last five years, the Turner is the most hardy and reliable. It fruits abundantly and continues long in bearing. The only objection found, so far, is its profuse multiplication of plants.

The canes are self-supporting when pruned back to two feet in length. It stands the sun of our summers in open field culture and has never been injured by freezing.

The black cap varieties sun-scald midway the canes where they bend over. Another objection to this type is that they fail to propagate under clean culture during dry seasons.

Experiments with Canteloupes planted March 22d, 1889.

NAMES OF VARIETIES	Seedsman.	Time of Ripening.	Av'ge weight in lbs.	Netting.	Form	Lengt. in inches	Diam. in inches	Cavity.	Thi'k-ness of rind.	Thi'k-ness of flesh.	Color of flesh.	Texture.	Flav'r or quality of fruit.
Acme	Landreth	July 10	2.72	Perfect	Oblong	6.16	5.16	Small	.33	.88	Green	Firm&coarse	Very g'd
Baltimore	Ferry	July 9	2.12	Perfect	Oblong	5.12	4.08	Small	.29	.87	Green	Soft & coarse	Very g'd
Baltimore	Thorburn	July 5	2.77	Perfect	Oblo'g&point'd	6 77	5.75	V'y sm'll	.33	.91	Green	Soft & coarse	Best
Bird's New Canteloupe	"	July 22	5	Perfect	Flat	5.50	7	Small	.37	1.25	Pale g'n.	Soft & coarse	Good
California	Landreth	July 15	4.48	Imperf't	Roundish	5.08	6 33	Medium	.37	1.	Yellow	Soft & coarse	Good
Cassaba	U. S. Dep't Agr.	July 15	4 43	Medium	Oblong	8.50	8.54	Medium	29	.87	Pale g'n.	Fine and soft	Good
Chicago	Thorburn	July 1	3.12	Medium	Round	5.26	4 70	Large	.29	.79	Green	Fine and firm	Good
Champion Market	U. S. Dep't Agr.	July 20	2.16	Imperf't	Round	5.16	4.87	Large	.25	.75	Green	Soft and fine	Good
Early White Japan	Thorburn	July 4	2.88	V'ry sli't	Round	5 35	5 37	Medium	.36	.61	Green	Soft and fine	Good
Extra Early Hackensack.	"	June 28	2 48	Medium	Round	4.58	5 43	Medium	.34	63	Green	Fine and firm	Good
Emerald Gem	"	July 8	1.57	None	Roundish flat	4 26	5 26	V'y sm'll	.26	.72	Yellow	Soft and fine	Good
Emerald Gem	Dreer.	July 11	1	None	Roundish flat	3.88	4 27	V'y sm'll	.25	.82	Yellow	Soft and fine	Good
Fine Nutmeg	Thorburn	June 28	2 50	Medium	Roundish	4.75	5 12	Small.	37	.87	Pale g'n	Soft & coarse	Very g'd
Golden Perfection	"	July 6.	3 06	Medium	Round	3.25	3 63	Medium	.11	.51	Yellow	Soft & coarse	Very g'd
Golden Netted Gem	"	July 5	1.22	Perfect	Slightly oblong	3 16	3 97	V'y sm'll	25	.72	Green	Fine and firm	Best
Golden Perfection	U. S. Dep't Agr.	July 5	2 25	Perfect	Round	4.95	5.69	Small	30	.80	Pale g'n.	Soft & coarse	Very g'd
Green Citron Nutmeg	"	July 12	4 45	Medium	Oblong	7.06	5.98	Medium	31	.98	Pale g'n.	Soft & coarse	Very g'd
Green Montreal	Thorburn	July 9	3.87	Imperf't	Roundish	5 96	5 23	Large	.25	70	Pale g'n.	Fine and firm	Good
Hybrid Bay View	"	July 10	5 22	Perfect	Long	10 42	5 03	Medium	.25	.96	Pale g'n.	Fine and firm	Very g'd
Hackensack	"	July 4	4	Perfect	Roundish	4 72	5 86	Medium	.26	91	Green	Soft & coarse	Good
Jenny Lind	"	July 4	1.22	Medium	Flat	2 98	4.45	Medium	24	.61	Green	F'm & coarse	Very g'd
Miller Cream	Dreer	July 14	2 98	Imperf't	Roundish	5 88	5 22	Large	.25	.75	Yellow	Fine and firm	Good
Montreal	Landreth	....	....	... Fail	ure				..	..	......	....	......
New Surprise	Thorburn	July 8	4.16	Imperf't	Roundish	5 98	6 27	Medium	.42	96	Yellow	Firm and fine	Good.
New Early Hackensack	Henderson	July 13	3.81	Medium	Round	5 37	5 33	Small	25	1 06	Pale g'n.	Firm and fine	Very g'd
Nixon	Alexander	July 20	4.16	Perfect	Oblong	7 37	5.18	Small	.31	1.18	Yellow	Soft and fine	Good
Orange Christina	Thornburn	July 9	3.27	Perfect	Round	5 45	5 41	Medium	35	.60	Yellow	Firm&coarse	Good
Prolific Nutmeg	U. S. Dep't Agr.	July 18	2 35	Medium	Round	5 75	5.75	Medium	25	.75	Pale g'n.	Soft and fine	Good
Skillman's Netted Gem	Thorburn	July 12	2.77	Perfect	Flat	4.69	5 37	Medium	36	69	Pale g'n.	Soft & coarse	Good
The Delmonico	Henderson	July 13	8.50	Perfect	Round	6 87	6 37	Medium	.28	.96	Yellow	Soft and fine	Good
Ward's Nectar	Thorburn	July 12	2.03	Imperf't	Round	4 55	4.76	Medium	.41	75	Pale g'n.	Soft & coarse	Good

The above notes of comparison were made in 1889. The list embraces a large number of varieties not well suited to this soil and climate. The cantaloupe to succeed in this latitude must be well covered with rough nettings to prevent sun-scalding. The Persian or Cassaba, so highly prized at the North fails here on account of scalding under our suns. A melon with yellow flesh rarely ranks higher than "good." Those varieties which rank "best" usually have deep green flesh. The Delmonico is the best yellow fleshed variety yet tested. The Washington Market grown here for the first time this year is a very superior variety. After previously comparing all of the varieties advertised in the principal seed catalogues, all except a few of the best old varieties have been discarded. These few best are planted from year to year as standards of comparison for the new candidates for popular favor. The following table shows results of such comparison the present season.

CANTELOUPES PLANTED APRIL 3rd, 1890.

NAMES OF VARIETIES.	Seedsman.	Time of ripening.	Productiveness.	Form.	Netting.	Average weig't in lbs.	Length in inches.	Diameter in inches.	Thickness of flesh in inches.	Thickness of rind in inches.	Color of flesh.	Cavity.	Flavor.	Texture.	Remarks.
Atlantic City	Landreth	July 4	V'ry g'd	Oblong	Perfect	4½	8	5	1 3-16	3-16	Green	Medium	V'y good	Soft & coarse	
Baltimore	Thorburn	J'ne 28	Good	Oblong	V'ry sli't	5¼	8	6	1⅜	⅛	Yellow	Medium	Good	Fine and firm	
Champion Market	Thorburn	July 2	Good	Roundish	Perfect	3½	6½	5¼	1⅛	⅛	Green	Medium	Good	Fine and firm	
Delmonico	Henderson	J'ly 28	Good	Roundish	Perfect.	5	7⅛	5¼	7-16	⅛	Yellow	Medium	Good	Fine and firm	
Extra Early Cape May	Landreth	July 1	V'ry g'd	Roundish	Imperf't	4¾	7	5⅛	1	⅛	Lig't green	Large	Good	Fine and firm	
Extra E'ly Hackensack	Landreth	J'ne 25	V'ry g'd	Flat	Perfect	3⅞	5	5⅝	1 1-16	3-16	Green	Large	Good	Fine and firm	
Extra Early June	Landreth	July 2	V'ry g'd	Flat	Perfect	3	3⅞	5⅝	1	3-16	Green	Large	Good	Fine and firm	
Golden Netted Gem	Thorburn	J'ne 28	Best	Oblong	Perfect	1¼	4¼	3	1 1-16	⅛	Green	Small	Best	Fine and firm	
New Orleans Market	Buist	July 2	V'ry g'd	Round	Very g'd	3½	5⅞	5¾	1½	⅛	Green	V'y sm'l	V'y good	Fine and firm	
Osage	Hallock & Son.	....	......	....	....	..	..	..	....	..	....	......	....	....	Worthless.
Picaninny	Northrop B. & G. Co	....	......	....	....	..	..	..	....	..	....	......	....	....	Worthless.
Pine Apple	Buist.	J'ne 30	Best	Oblong	Perfect	2¾	7¼	4½	1 3-16	⅛	Green	Small	Best	Soft & coarse	
The Princess	Hallock & Son.	July 1	V'ry g'd	Round	Perfect	3¾	5¼	5¾	1⅛	3-16	Yellow	Medium	Good	Fine and firm	
Versailles Prize	Buist	....	......	....	....	..	..	..	....	..	....	......	....	....	Worthless.
Washington Market	Buist.	July 1	V'ry g'd	Roundish	Perfect	4½	6⅛	5½	1⅞	⅛	Green	Small	Best	Soft & coarse	

EXPERIMENTS WITH WATERMELONS, PLANTED MARCH 19, 1889.

NAMES OF VARIETIES.	SEEDSMAN.	Time of Ripening.	Av'ge weig't in lbs.	FORM.	Color of Rind.	Corrugations	Lengt' in Inches	Diam in Inches	Thi'k of Rind.	Cavity	Color of Seed.	Color of Flesh	Quality.
Boss	Ferry	July 12	19 20	Oblong	Dark Green	Distinct.	14.43	9.87	1.	Slight.	Black.	Red	v'y g'd
Cuba	Home Grown	" 15	19.66	Long.	D'k Gr'n St'p'd	None	17.66	7.41	.58	None	Wh. with br' tips	d'k red	Best
Cuban Queen	Thorburn	" 12	29.70	Slig'ly Ob'lg	Rattle Snake	Slight	14.66	9 75	.68	Slight	White	Red	Best
Florida Favorite	Thorburn	" 10	17.03	Oblong	D'k Rat. Sn'ke	Slight.	14.31	7 69	.75	Slight		d'p red	Best
Goodwin's Imperial	Thorburn	" 10	14.40	Roundish	Pea Green	Distinct.	9.61	8.80	.75	Slight	Br. with bl'k tips	p'le r'd	Good.
Green and Gold	Dreer	" 10	17.83	Oblong	Ming. Green	Distinct.	13 87	9 56	.75	None.	Wh. with br' tips	Or'ng'	Good
Green and Gold	Henderson	" 13	16.	Slig'ly Ob'lg	Ming. Green	Slight	11.09	8 50	.53	None	Wh. with br' tips	Lemo'	Good.
Ice Cream	Thorburn	" 15	16.60	Long	Green	Distinct.	14.37	8.37	.87	None.	Black.	p'le r'd	Good.
Icing	Thorburn	" 13	19.42	Roundish	Green	Slight.	11.	9.06	.87	Slight.	White	Red	Good.
Kolb Gem	Dreer	" 12	27.62	Round	Green Striped	None	11.50	9.50	.87	None.	Black	Red	v'y g'd
Kolb Gem	Exp't Station	" 12	28.25	Round	Green Striped	None.	11.37	10 12	1.06	Large	Black	Red	Good
Light Icing	U S Dep. Agr.	" 13	22.50	Round	Gray	None	13.50	10.50	.75	None	White	Li' r'd	v'y g'd
Oemlers	U S Dep. Agr.	Failed											
Peerless	Ferry	" 12	20.64	Long.	Mingled Green	Slight.	16.78	8.06	.96	Slight	White	Red	v'y g'd
Perfection	U S Dep. Agr.	" 12	14.	Round	Dark Green.	Slight.	11.	10.	1.	None	Black	p'le r'd	Good.
Round Light Icing	Ferry.	" 12	21.90	Oblong	Gray	None	13.78	8.75	1.25	Med.	White	Red	Good.
Scaly Bark	U S Dep. Agr	" 13	17.	Oblong	Mottled Green	Slight	13.25	8.33	.93	Slight.	Wh. with br' tips	d'k red	Good.
*Seminole	Thorburn	" 13	21.20	Long	Gray	None	17 01	6.92	.86	Slight	Brown	d'k r'd	v'y g'd
*Seminole	Dreer	" 13	20.50	Long.	Gray	Slight.	17.50	8.50	.75	Slight	Brown	d'k r'd	v'y g'd
†Seminole	Ely	" 18	16.	R'nd & L'ng	G'y & Sc'y B'k	Slight	11.	8.29	.70	Slight	Wh. with br' tips	l'm'r'd	Good.
Sugar Loaf	Clayton	" 13	29.50	Long.	Gray	None	19.	9 30	.75	None	Brown	d'k r'e	Best
Spanish Queen	U S Dep. Agr.	" 12	16.50	Round	Dark Green	Distinct.	9.75	9 18	.75	None	Black	p'le r'd	Good
W'te Seed'd Ice Cr'm	Thorburn	" 12	20 94	Roundish	Dark Green	Distinct.	11 96	7.64	.96	V'y l'g	White	Red	v'y g'd
Pride of Georgia	Thorburn	" 10	23 50	Round.	D'k Gr'n St'p'd	Slight	12.	10 50	1.	Slight	Wh' with br' tips	Red	Best

*Same as sugar-loaf. †Badly mixed.

Comparison of varieties discovers many old acquaintances under new names. The "sugar loaf" melon has been growing in Georgia and Alabama for nearly half a century, and has continuously sustained a high character for productiveness and excellent quality. It came to us from a seedsman three years ago, as "Jordan's Gray Monarch." Last year it was extensively advertised under the attractive name of "Seminole," which was not only identical, in every respect, with the old sugar loaf, but produced the same sport—a melon of the same form, but of a darker gray. In 1888 the Kob Gem came to us as "New Round Excelsior." The same year almost a fac-simile of the rattlesnake came under the name of "Mammoth Ironclad." This year the old rattlesnake comes as "The Wild."

For shipping, no other variety compares with the Kolb Gem. For home use, there are several varieties superior to it, being of finer flavor and having more tenderflesh. Among these are the Cuba, Sugar Loaf, Florida Favorite and Pride of Georgia. The Cuba is known in Georgia under the local names of "Tinker," "Simpson," and "Kirkpatrick." It is the sweetest melon grown, but is too small for market. The Georgia rattlesnake possesses fine qualities when fully developed, but has a tendency to grow in irregular shapes. The sugar loaf is probably the most prolific variety yet tested. Watermelons cross so readily that a patch of *thoroughbreds* is rarely seen on our farms. This station will distribute, during the winter, a few pure Cuba and sugar.loaf melon seed; and some Nixon cantaloupe seed, for trial in different parts of the State.

WATERMELONS PLANTED MAY 3d, 1890.

VARIETIES.	Form.	Color of Rind.	Color of Flesh.	Quality.	Seedsman.	REMARKS.
Birdsong	Round	Mixed	Yellow	Good		Presented by Chancellor Foster.
Crawford*	Oblong	Dark rattle-snake	Bright red	Very good		Presented by Mr. Cox.
Kentucky Wonder	Oblong	Green	Red	Good	N. B. G. Co	
Pearson*	Oblong	Dark rattle-snake	Bright red	Very good		Presented by Mr. Averett.
Ruby Gold	Oblong	Green	Orange red	Very good	Henderson	
The Wild	Oblong				Henderson	Same as Georgia Rattle-snake.

* Local names for an old variety—known in Florida as "Florida Favorite"—known in Burke county, Ga., thirty years ago as the "Lawson Melon"—supposed to be the parent of the Georgia Rattlesnake.

BEANS--BUSH OR DWARF VARIETY. PLANTED APRIL 15, 1890.

NAME.	SEEDSMAN.	Time Edible.	Color.	Form.	Productivness.	Growth of Vine.	Affected with Authracnose.	REMARKS.
Bismark	Buist	June 5	Wax	Round.	Very Good	Vigorous	Slight	
Black-Eyed Wax	Thorburn	June 9	Wax	Round	Good	Poor	Slight	
California Tree	N B & G Co		Green	Roundish	Very Good	Vigorous	Free	
Canadian Wonder	Thorburn	June 9	Green	Flat	Very Good	Very Vigorous	Slight	
Crystal Wax	Thorburn		Wax	Flat	Very Good	Very Vigorous		
Cylinder Black Wax	Henderson	June 5	Wax	Round	Best	Vigorous	Badly	
Dun Colored Bush	Thorburn	June 7	Green	Flat	Good	Vigorous	Slight	
Dwarf Black Wax	Thorburn	June 5	Wax	Round	Good	Poor	Free	
Dwarf Ivory Pod Wax	Thorburn	June 5	White	Flat	Very Good	Poor	Free	
Dwarf Mexican Tree	Thorburn		Green	Roundish	Very Good	Vigorous	Free	
Dwarf White Wax	Thorburn	June 7	Wax	Short & Flat	Very Good	Poor	Very Slight	
Early China	Thorburn	June 9	Green	Short & Flat	Good	Poor	Very Slight	
Early Mohawk	Thorburn	June 9	Green	Long & Flat	Very Good	Very Vigorous	Free	
Early Round Six Weeks	Thorburn	June 9	Green	Flat	Very Good	Very Vigorous	Very Slight	
Early Valentine	Thorburn	June 10	Green	Round	Very Good	Very Vigorous	Free	
Ely's Prolific Dwarf Wax	Ely	June 5	Wax	Round	Very Good	Vigorous	Badly	
Extra Early Maine	Thorburn	June 8	Green	Flat	Very Good	Very Vigorous	Free	
Golden Butter Wax	Thorburn	June 2	Wax	Round	Good	Poor	Free	
Golden Refugee	Thorburn	June 12	Pea Gr'n	Round	Very Good	Vigorous	Medium	
Golden Wax Bush	Thorburn	June 5	Wax	L'g & Round	Best	Vigorous	Slight	
King of the Green's Flagoelet	Thorburn	June 10	Green	Flat	Best	Vigorous	Free	Woody.
Large White Kidney	Thorburn	June 10	Green	Flat	Good	Very Vigorous	Free	
Lemon Pod Wax	Thorburn							Failed to Vegetate.
Low's New Champion	Thorburn	June 9	Pea Gr'n	Very Flat	Best	Very Vigorous	Free	Woody.
Marble Head Dwarf Horticultural	Thorburn		Green	Flat	Good	Poor	Very Slight	
Ne Plus Ultra	Thorburn	June 10	Green	Roun'ish flat	Best	Vigorous	Free	
New Date Wax	Thorburn	June 7	Wax	Flat	Best	Vigorous	Very Slight	
New White Valentine	Thorburn	June 10	Pea Gr'n	Flat	Best	Vigorous	Very Slight	
Red Kidney	Thorburn	June 7	Green	Very Flat	Very Good	Vigorous	Very Slight	Woody.
Refugee, or 1000 to 1	Thorburn	June 9	Pea Gr'n	Round	Best	Vigorous	Free	
Saddle Wax	Landreth	June 10	Wax	Round	Good	Poor	Badly	
Scimeter	Thorburn	June 10	D'k Gr'n	Flat	Best	Vigorous	Very Slight	Woody.
Thorburn's Ex. Early Refugee	Thorburn	June 9	Pea Gr'n	Round	Best	Vigorous	Free	
Wardwell's New Dwarf	Thorburn	June 7	Wax	Flat & Long	Best	Vigorous	Free	
White Marrow	Thorburn	June	Green	Flat	Best	Very Vigorous	Very Slight	Woody.
Wonder of France	Thorburn	June 10	D'k Gr'n	Flat	Best	Very Vigorous	Free	Woody.
Yosemite	Henderson	June 10	Wax	Round	Good	Poor	Very Slight	

TOMATOES--Seeds sown March 21st. Transplanted May 5th, 1890.

NAME OF VARIETIES.	Seedsman.	Time of ripening.	Av'age w't in ounces.	Form.	Color.	Corrugations.	Length in inches.	Diameter in inches.	Cavity around s'd.	Average waste in ounces.	Core.	Flavor	Remarks.
Chernin	Burpee	July20	3⅓	Round	Light red	None	2⅛	2⅛	None	1-6	Slight	Good	
Dwarf Champion	Thorburn	July20	3⅔	Roundish flat	Pinkish	None	1¾	2¾	None	¼	V'y "	v'y g'd	
Early Ruby	Henderson	....	....	....	....	....	..	..	....	.	....	....	No test. Plants all d'd
Earliest of All	Northrop,B.& G.Co	....	....	....	....			..	....			....	No test. Plants all d'd
Golden Queen	Landreth	July17	4⅔	Irregular	Light yellow	Decid'd	1½	2¾	None	⅓	Dcid'd	Best.	Standard.
Haines' No. 64	Hallock.	July17	5½	Roundish	Red	Slight	1⅞	2⅞	None	⅓	V'y sl	v'y g'd	
Horsford's Prelude	Thorburn	July17	½	Round	Pinkish	None.	1⅜	⅜	None	None.	Dcid'd	Good	Small but very prolific
Ignotum	"	July22	6¾	Roundish flat	Red	None.	2	3¼	None	1-6	Slight	Best	A very super'r variety.
Livingston's Beauty	"	July17	5⅓	" "	Red	None	1⅞	3	None	1-6	Slight	Best.	Standard.
Livingston's Favorite	"	July22	5½	" "	Light red	None	1¾	3	None	1-12	None	Good	Standard.
Matchless	Hallock	July22	4⅓	" "	Light red	None.	3⅞	2⅝	None	1-12	V'y sl.	Good	
New Paragon	Thorburn	July20	4 1-6	" "	Red	None.	1½	2⅞	None	1-6	V'y sl.	v'y g'd	[tle red cherry.
New Zealand Fig	Hallock	July17	....	....	Yellow	....	..	.	....	....	....	....	Size and shape of lit-
Optimus	Thorburn	July20	2⅔	Roundish.	Red	None	1½	2¼	None	1-12	None.	Good.	
Station Upright Tree	"	July22	....	....	....	....			....	....		....	Sam' as Dw'f Ch'mp'n
Thorburn's New Jersey	"	July22	4 5-6	Roundish flat	Light red	None.	1¾	2½	None	¼	V'y sl.	v'y g'd	
Volunteer	"	July17	4⅔	" "	Light red	None.	1⅝	3⅛	None	1-6	Dcid'd	Good	

The same plan was adopted with tomatoes as with melons—a few standard varieties only were used with which to compare the new candidates.

By length is meant the diameter which is a continuation of the axis of the stem.

By diameter is meant the length of the axis at right angles to this.

The "waste" is the difference between the weight of the whole tomato and that after cutting away the thicker part around the stem cavity.

ONIONS.

Seeds furnished by the U. S. Department of Agriculture, sown April 5th, and produced sets which were planted September 25th, 1889.

Varieties.	Time ripe 1890.	Diam. in inches	Form.	Color.	Remarks.
Danvers Yellow	J'ne 14	2½	Round ...	Yell'w	Standard varietv.
Early Garden Queen ..	M'y 30	2¾	Roundish.	Whi 'e	Earlv and desirable.
Early White Norcera..	M'y 30	3¼	Roundish..	Whi 'e	Early and desirable.
Early White Queen ...	M'y 9	3¼	Flat	Whi 'e	Very early and fine.
Extra Early Red	M'y 30	3¼	Flat	Yell'w	Yellow instead of red.
Flat Madeira	J'ne 10	3	Flat	Yell'w	
Giant Red Rocca	J'ne 10	3¼	Roundish..	Red ..	Large and fine,
Giant Yel. Globe Rocca	J'ne 10	3⅜	Roundish .	Yell'w	
Giant White Italian ...	M y 30	4	Flat ...	Yell'w	Superior.
Mammoth Pompeii....	J'ne 10	3¾	Roundish..	Yell'w	Large and fine.
Mam'oth R'd Garganus	M y 30	3¼	Flat	Red ..	Large and fine.
Mammoth Red Pompeii	J'ne 10	3¾	Round ...	Yell'w	Large and fine.
Mammoth Silver King.	M y 30	4¼	Flat	Whi 'e	Superior.
New Adriatic Barletta.	M y 9	2¾	Flat	Whi 'e	Extra early & desirable
Round Madeira.......	J'ne 16	4	Round ...	Yell w	
White Maggiajola.....	M y 9	3¼	Flat	Whi 'e	Extra early & desirable

ACKNOWLEDGMENTS

OF

SEEDS, PLANTS, ETC., PRESENTED TO THE STATION, 1890.

D. H. Tolbot, Sioux City, Iowa	Black Barley
Jacob C. Bauer, Judsonia, Ark	Van Deman, Mitchell's Early, Doubravas, No. 3, Strawberry Plants
Peter Henderson & Co., New York	Vegetable and Flower Seeds
G. H. Miller & Son, Rome, Ga	Raspberry Plants
Geo. D. Norris, New Market, Ala	Vegetable Seeds
S. W. Hatcher, Ceres, Ga	Plow Stock and Attachments
J. R. Hawkins, Mountainville, N. Y	Banquet Strawberry Plants
W. E. Alexander, Leighton, Ala	Venango Grape Cuttings
Judge J. B. Jones, Herndon, Ga	Bertram Grape Cuttings
G. R. Banks, Tallassee, Ala	Wafford Grape Cuttings
B. F. Ingram, Marvyn, Ala	Wafford Grape Cuttings
Heller, Hirsh & Co., New York	One Sack Evaporated Tankage
Geo. F. Watson, Chicago, Ill	White's Northern Muscat Grape Vines
Stephen Hoyt's Sons, New Canaan, Conn	Green Mountain Grape Vines
W. J. Smilie, Baileyville, Texas	Storm Proof Cotton Seed
W. Altee Burpee	Vegetable Seeds
Prof. S. M. Tracy, Agricultural College. Miss	Lespedza Cyrtobotrya Seed
Virgil Wilson, Huntsville, Ala	Red Blackberry
Jas. B. Olcott, South Manchester, Conn	Grass Seeds and Sets Festuca No 1
Vernon Rhodes, Memphis, Tenn	Cultivator Hoe
A. B. Stroud, Haines City, Fla	Casava Roots and Canes
Smiths, Powell & Lamb, New York	2 Group Pictures, Holstein Cattle
U. S. Dep't. Agr. Washington, D. C	Peach and Plum Seeds
" " " "	Osier Willow Cuttings, 13 Varieties
" " " "	Fig Cuttings, from Smyrna, 12 "
" " " "	Cotton Seed, 2 Varieties
" " " "	Sorghum Seed, 13 Varieties
" " " "	Wheat for Fall Planting, 2 Varieties

Appendix to Bulletin No. 20, of the Alabama Experiment Station.

REPORT

OF THE

ALABAMA WEATHER SERVICE.

Co-operating with the U. S. Signal Service.

October, 1890.

STATE POLYTECHNIC INSTITUTE,
Auburn, Ala., November 15th, 1890.

The rainfall for October was rather large. and the most of it fell during the first two weeks of the month. So much moisture falling on the cotton fibre in such a short period produced damaging results The last part of the month, however, was clear and very favorable for rapidly gathering the cotton that quickly opened under the warming influence of the sun's rays. The average precipitation for the month was 1.54 inches above the normal.

The last of October was cool, that reduced the average temperature 2.°5 below the normal. The first frost occurred on the 15th, throughout North Alabama. It was light, however, and not much damage was done. The first killing frost that occurred, throughout the State, was on the 28th. That was accompanied by thin ice. On the 31st there was another heavy frost with ice.

MONTHLY SUMMARY.

Atmospheric pressure (in inches) —Monthly mean, 30.043; maximum observed, 30.420, at Livingston on 31st; minimum observed, 29.615, at Chattanooga on 29th; range, .805.

Temperature (degrees F.)—Monthly mean, 62.3; highest monthly mean, 68.5, at Citronelle; lowest monthly mean, 56.1, at Valley Head; maximum, 93, at Citronelle, on 4th and 5th; minimum, 28, at Valley Head on 31st; range for State, 65; greatest local monthly range, 57, at Valley Head.

Precipitation, including melting snow, (in inches).—Average for the State, 4.01; greatest, 7.33, at Opelika; least, 1.90, at Fort Deposit.

Mean relative humidity, 82, at Auburn; 77, at Montgomery; 90.4, at Valley Head; at Uniontown, 77.3

Wind—Prevailing direction, N. W; miles traveled, at Chattanooga, 4,036; at Montgomery, 3,333; at Mobile, 5,185; at Auburn, 3,940.

J. M. QUARLES,
Assistant.

P. H. MELL,
Director.

NOTES FROM OBSERVERS.

Greensboro, (M. H. Yerby)—The first three weeks of the month the weather was very unpropitious and retarded the gathering of cotton very materially—but the last ten days of the month were beautiful, with continuous sunshine, so that cotton picking has progressed finely and the crop will be gathered without great damage. Killing frost and thin ice occurred in this locality on the 30th and 31st, which is a month earlier than for the past two years.

Livingston, (J. W. A. Wright).—Our rainfall for October (2.82 inches) was less than the normal which is 2.90. Of this amount, only 0.39 fell in the first 14 days; 0.95 fell during the storm of 15th and 16th, and 1.48 during the storm of 21st and 22d. No precipitation on the last 9 days of the month. So, altogether, October was true to its record, as, in the long run, October, September and May are our months of the least rainfall. On the 15th, 20th and 24th the minimum temperature was 41° each day, and there were light frosts. Minimum on the 27th, 28th and 31st, respectively, was 39°, 38° and 34° each, with a little heavier frost. The average here of 60° for the month, is 3° cooler than the normal for October.

Valley Head, (Dr. E. P. Nicholson).—The first frost of the month, and of the autumn, occurred on the 14th; first severe frost on the 19th, with very thin ice crystals; on the 28th and 31st, killing frost, with ice The minimum thermometer registered 24°. This is the lowest I have seen recorded anywhere South.

Jasper, (Howard Lamar).—The latter part of the month has been clear and cool. Frost occurred 9 days during latter half of month, and ice twice. All vegetables have been killed by recent frosts and forest trees are shedding their leaves very rapidly.

TABLE OF SOIL TEMPERATURES—OCTOBER, 1890.

(The observations for this table were taken at Auburn, Ala.

A. M. LLOYD, Observer.

NOTE—There are three sets of thermometers—Nos. 1 and 2 are situated on a hill in sandy soil, and No. 3 is placed near a small stream in bottom land. The depth of instruments range from 1 inch to 96 inches below the surface, and the observations are made three times each day—morning, noon, and evening.

Depth in Inches.	Set No. 1, on Hill.	Set No. 2, on Hill.	Set No. 3, in Bottom.
1	66.0°	65.5°	67.0°
3	66.0	65.7	66.6
6	65.2	65.7	66.4
9	64 6	65.2	65.7
12	64.9	64.9	65.5
24	68.0	67.7	68.2
36	69 4	69.7	69.5
48	71.2	70.9	70.7
60	72.3	71.6	71.5
72		71.8	
84		72.2	
96		72.3	

Monthly Summary of Meteorological Reports of the Alabama Weather Service, October, 1890.

STATIONS.	COUNTIES.	Altitude.	Latitude.	Longitude N.	BAROMETER.					TEMPERATURE.									Total precipitat'n	Clear Days.	Fair Days.	Cloudy Days.	Days of Rain.	Prevailing Wind.	OBSERVERS.
					Monthly Mean	Max.		Min.		Monthly mean.	Mean of Max.	Mean of Min.	Max.		Min.		Monthly R'nge	Me'n d'ly r'nge							
						Height.	Date.	Height.	Date.				Degrees.	Date.	Degrees.	Date.									
Selma	Dallas	...	32.28	87 00	.....	....		....	..	63 8	76.4	51 3	89	13	34	31	55	25.1	2.66	..		..	..	...	†
Valley Head	DeKalb	1031	34.34	85 37	.....	......	..	.....	..	56.1	67.7	44.6	85	12	28	31	57	23.1	3.44	18	3	10	7	S e	E. P. Nicholson.
Pine Apple	....	...	31 35	87.00	....	.....	..	.....	..	63.5	74.7	52.3	86	6	33	27–31	52	22.4	5.53	..	..	..	..	....	†
Florence ...	Lauderdale .	...	34.48	87.37	.....					61.6	72.8	50.4	85	10–12	30	30	55	22 4	2.04		..	..	..	..	C. W. Ashcraft.
Chattano'ga	Tennessee ..	783	35 03	85 30	30.060	30 304	31	29.615	29	59.5	68 3	50.7	84	12	33	28	51	17 6	4.13	14	11	6	12	N w	*L. M. Pindell.
Montgomery	Montgomery	219	32 22	86 23	30.044	30.272	31	29 756	22	65.0	74.3	55.8	88	5	37	31	51	18.8	5.87	19	4	8	10	W	*L. Dunne.
Marion	Perry	...	.. ..	.	.....	....	.	....	.	.	....	..	.	...				..	..	..		..			†
Union Spr'gs	Bullock	516	32 12	85 39	.....	....	..	.....		65.6	..	...	86	5	43	31	43	..	6.55	7	16	8	5	N e	R. J. Grady.
Bermuda ...	Monroe	...	31.43	87 12			..			60.8		..	85	5	36	28	49	...	2 90				8	...	Wm. Fowler.
Mobile. ...	Mobile	30	30.41	88 20	30 054	30.292	31	29.695	22	66.8	75.2	58.3	86	4–10	41	27	45	16.9	5.58	13	12	6	10	N	*A. Pritchard.
Carrollton. .	Pickens	...	....	....			..							..		..	...								M. L. Stansel.
Auburn	Lee	826	32 40	85.30	30 050	30 303	31	29 787	22	63.6	71 1	56.0	83.5	5	36	31	47.5	15.1	7.21	23	2	6	8	N w	J. M. Quarles.
Livingston..	Sumter	150	32 34	88 08	30 018	30.420	31	29.970	29	60.0	...	..	84	5,6,12	38	28	46	...	2.82	20	2	9	7	N w	J. W. A. Wright
Greensboro.	Hale	220	32 41	87.36	..	....	.	....	.	62.8	....	..	86	5, 11	36	g1	50	...	3.15	..	22	9	8	N w	M. H. Yerby.
Mt. Willing	Lowndes ...	...	32 07	86.45	.....	......	..	....	.	63.5	..	..	84	5–7	31	31	53	...	6.50	..		..	6	...	Wm. M. Garrett
Uniontown.	Perry	273	32 28	86 44	30.030	30.300	31	29 680	22	64.1	74.1	54.1	87	5	36	31	51	20.	3.21	20	3	8	5	E	W. H. Newman.
Citronelle ..	Mobile	352	31 03	87 30	.. .	....	..	....	.	68.5	80.7	56.2	93	4, 5	37	31	56	25.5	4.08	23	3	5	5	...	J. G. Michael.
Fayette	Fayette	...	33.42	83 12	.....	....	.	......	..	...				...		...		...	..	..	..			...	Hon. D. Collier.
Opelika	Lee	..	32.45	85.28	.....	.....	.	....		60.8	70.9	50.8	83	5	30	31	53	20.1	7.33	..		..	.	....	†
Guntersville.	Marshall . ..	655	34 24	86 18	.....	....	.	.....	..	..	..	..	..	....	..	....	..	....	.	..	..	.		...	A. J. Baker.
Chepultepec	Blount. ...	890	33 58	86 20	.....	....	.	.....	..	...				...		...	...							...	W. B. Allgood.
Columbiana	Shelby	560	33 15	86 38	.....	....	.	.....	.	60.3	71.1	49.5	84	12	29	31	55	21.6	5.56	..	..		7	...	W. D. Lovett.
Centre.	Cherokee. ..	728	34 10	85 42	.....	....	.	....	..	...	...			...	..	...	...						..	...	Thos. Bradford.
Double Sp'gs	Winston ...	...	34.08	85 35	.....	.....	..	......	.	57.1	.	51.6	79	7	30	31	49	...	3.53	..		..	4	...	A. M. Weiler.
Butler	Choctaw ...	...	32.05	87.24	.....	....	.	......	..	...				...										....	B. F. Gilder.
Jasper......	Walker ..	310	33 49	88.12	.....	....	.	......	.	61.3	71.3	51.3	83	12	31	31	52	20.	3.16	16	8	7	6	.	Howard Lamar.
Tuscumbia .	Colbert	468	34.42	87.38	....	....	.	......	.	57.9	..	..	85	12	34	31	51	.	3.15	..	..	..	..	S w	L. B. Thornton.
Fort Deposit	Lowndes ...	...	34.42	86 36	..	....		......	.	64.9	74.8	55.0	89	5	38	30	51	19.8	1.90	.	..	..	..	..	†
Means..	....	..	....		30 043	....	..	......	..	62.3	73.1	52.5	.	..	..	...	51.1	20.6	4.01	15	8	7	..	N w	

NOTE.—*Sergeants of the Signal Service. †Cotton Belt Stations.

BULLETIN NO. 21. DEC. 1890.

OF

AGRICULTURAL EXPERIMENT STATION,

Agricultural and Mechanical College,

AUBURN, ALA.

A New Root Rot Disease of Cotton.

Report of Alabama Weather Service.

☞The Bulletins of this Station will be sent Free to any citizen of the State on application to the Director.

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A New Root Rot Disease of Cotton.

GEO. F. ATKINSON.

In response to a circular letter issued from the Alabama Agricultural Experiment Station during the early part of the summer of 1890, requesting specimens of cotton affected with the so-called "black rust," "red rust," "root rot," etc., I received specimens of rotted roots of cotton from Saville, Ala. The specimens were sent by Mr. G. W. Rhodes of that place on whose farm they were collected.

The disease was called by him "root rot." and the roots were certainly in quite an advanced stage of decay. The two roots sent were tap roots and were probably pulled up so that the decayed lateral roots were broken away.

I expected to find the *Ozonium* described by L. H. Pammel as being the cause of a root rot disease of cotton in Texas (Bulletins Nos. 4 and 7, Tex. Ag. Ex. St.). There were no external signs of the mycelium of a fungus visible to the unaided eye, and examination was made by taking cross-sections. In all the preparations fungus threads were present, having penetrated the dead tissue. I supposed these were probably connected with the *Ozonium*, though we would expect to find various saprophytic fungi attacking such tissues. In one preparation, however, peculiar fat globules were present in quanity in enlarged cavities. Upon close examination I found also peices of a thin membrane marked with irregular rugosities and striæ.

This at once suggested to me the presence of the female cysts of *Heterodera radicicola* (Greef) Müll., a root-gall nematode, which was made the subject of a special study* by myself one year ago, and is known to be very injurious to many plants.

The subject now possessed a new interest and I made a special trip to Saville the early part of September to thoroughly investigate the disease and to make careful collections of plants in various stages. Although I possessed the faint suggestions of the presence of *Heterodera* in the material sent me, I was quite surprised to find that this worm was the cause of the disease.

There were perhaps two or three acres in the field that were more or less affected. In some places there were spots several square rods in extent on which the cotton was entirely dead.

These spots were often connected by areas more or less affected, and in some places an apparently healthy plant was surrounded by dead ones. The plants I examined were carefully dug up with a shovel. At first I selected those entirely dead. Only a portion of the tap root remained attached to the stem, the lower portion having rotted away. To the plants which had recently died portions of the lateral roots remained in connection, the majority, however, easily breaking away.

In a few cases, even though the roots were well rotted, the characteristic galls could be seen on some of the lateral roots, being oval and somewhat one-sided enlargements. On the decayed tap roots no galls could be found since the tissues were well broken down. A few plants which had been badly diseased showed evidence of partial recovery, young branches growing from the lower part of the stem. Such plants yielded unmistakable evidence of the work of *Heterodera*. While the lower end of the tap root had rotted away, the plant had succeeded in putting out a number of roots near the surface of the ground which had given it the fresh impetus for growth. These lateral roots possessed an abundance of the galls, and the peculiar cracked

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* Science Contrbutions from the Agricultural Experiment Station, Alabama Polytechnic Institute, Vol. I. No. I., Dec. 1890. An abstract prepared by the author was published in the March and April (1890) numbers of the Southern Cultivator, Atlanta, Ga., uuder the title, "Nematode Root-Galls."

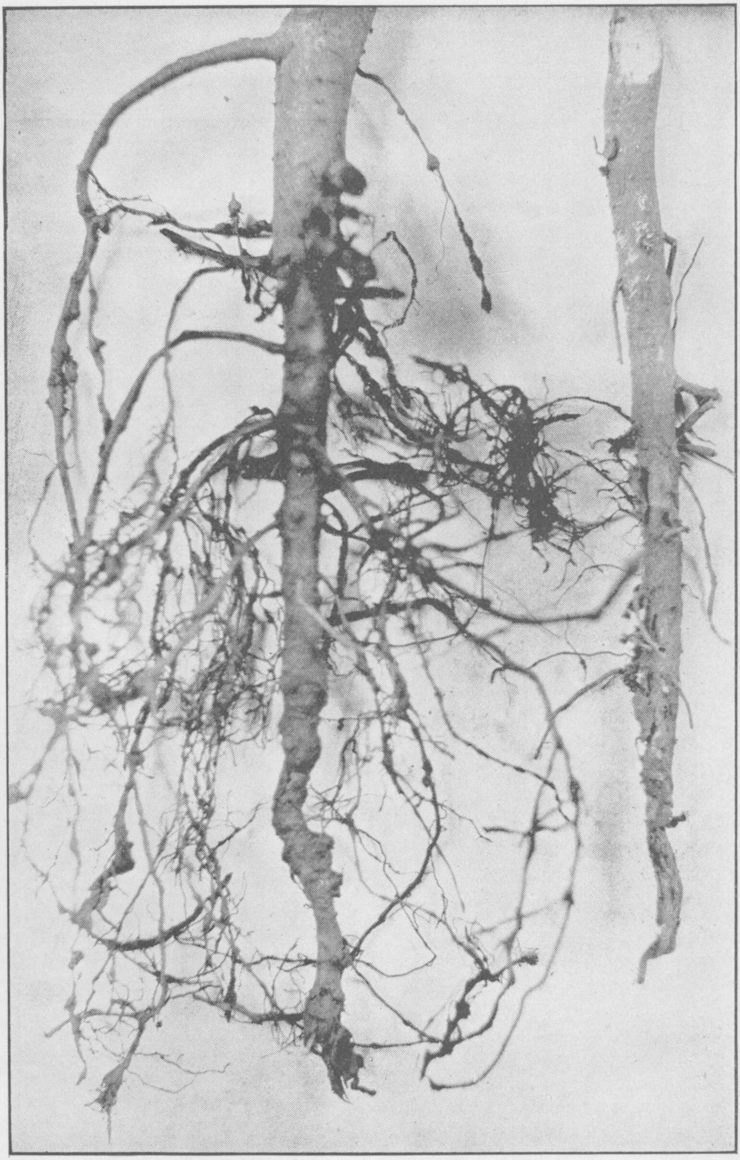

PLATE I.—ATKINSON, A NEW ROOT ROT DISEASE OF COTTON.

and scabby lateral galls on the upper portion of the tap root showed how thoroughly infected the plant had been.

But the richest specimens were found in plants which showed the first external signs of the disease. In these specimens not only was there a profuse development of the galls on the lateral roots, but nearly the entire lower portion of the tap root was affected, having large lateral galls, which from age were cracked and scabby in appearance. Plate I. is from a photograph of specimens collected by myself. This is the appearance of the old larger galls on all plants, and lays these parts under contribution to various putrefactive bacteria and saprophytic fungi so that the roots of many plants literally rot off. The presence of the worm has this effect in the case of the tomato plants that are badly diseased. The tap root is always very freely attacked and rots off below. Tomato plants seldom die outright as a result of the decay of the lower part of the tap root, for they are capable of quickly sending out numerous lateral roots above the point of injury and thus tide the plant along. Cotton plants do not have the power of sending out lateral roots so readily near the surface of the ground when the stem becomes rather old and are therefore more liable to serious injury when badly diseased.

Mr. Rhodes was not acquainted with the characteristics of nematode root-galls and was not aware that any plants in his neighborhood were affected by such a disease. I noticed one old peach tree still in the cotton field, and was informed that a peach orchard occupied the grounds about twenty years ago. At my request we visited the garden and upon pulling up tomato and okra plants found them very badly diseased. This was sufficient evidence that portions of the grounds there were very badly infected.

The external manifestations of the disease in cotton are strikingly similar to those of the root rot disease caused by *Ozonium* as described by Pammel; the irregular distribution of the spots as well as the tendency to increase in extent and sometimes the changing of the spots. Also as in the case of *Ozonium* the first external sign of the disease is the sudden wilting of a plant on a hot sunshiny day, especially after rain. This similarity in external appearance is easily accounted for from the nature of the disease, since the condition of the roots prevents the absorption of water in quantities equal to that transpired by the leaves, though there may be an abundance of water in the soil. From this time the plant rapidly declines.

The diseased plants begin to die about the time of "chopping out" the cotton in May, when the plants are quite small, and the disease continues throughout the season.

In my studies last autumn I found cotton affected at Auburn, but not seriously. Some cotton planted in September of the present year for experimental purposes was, in some cases, seriously attacked while yet only one or two leaves above the cotyledons were developed.

The worms are able to live and develop in the roots of a great variety of plants, though some plants are more subject to serious attack. There are indications that they may become somewhat provincialized in their tastes, in some localities attacking more seriously plants which in other localities are not much injured. If deprived for some time of the food plant they prefer they will affect more seriously the ones which formerly nearly escaped their injuries.

That the worm can produce a serious disease of cotton, and is more widely and thoroughly distributed than is generally known, increases the gravity of an already serious question.

It may be of interest for the readers of this article to have a short account of this worm. *

Other examples of nematode worms are found in the *trichina* of pork, which produces in man the disease known as *trichinosis*; in the "*vinegar eel*" or "*paste worm*;" and in the so-called "*hair worm*," one of the *Gordidæ*, popularly supposed to be a metamorphosed horse hair.

The eggs are bean-shaped, and 250 of them placed end to end would make a line one inch long. The young worm, or larva, hatches from the egg in about a week's time in favorable weather.

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* This account of the worm is quoted from an article by myself in the *Agricultural Journal*, Montgomery, Ala., Nov. 1890, entitled "Danger from the continued Distribution of the Root-Gall Nematode."

It is "thread like" or "eel like," from which the family of worms to which this one belongs gets its name of *Anguillulidæ.* It is blunt at the head end and narrowly pointed at the tail. The mouth is in the center of the blunt head. In the œsophagus is a short, slender spear which the worm can thrust forward partly out of the mouth and then draw it back. By thrusting this spear forward the worms puncture holes in the roots which enables them to enter. Once in the root the worm moves around, sucks the juice, and, by its presence, stimulates the tissues of the root to abnormal growth, and thus the galls are formed. The worm now becomes stationary in the tissues of the gall, moults its skin the second time, having moulted once just about the time of hatching; it distends by growth into a vesicular body resembling a small gourd. Before it is fully grown important differences appear in the males and females. The males instead of distending farther shrink away from their skin, leaving it as an "empty shell," exactly the shape of their body when they resembled a small gourd. As they shrink in diameter they increase in length until when fully developed they are coiled three or four times inside their distended cast off skin. The distended cast off skin makes the third moult. While they are elongating they moult again, which makes four times for the males. The males have returned to the eel form of the worm. but are much longer than the larva and have blunt tails instead of narrowly pointed ones. They now break through their cystic wall (the distended cast off skin) and seek the female to fertilize her. Twenty or twenty-five males placed end to end would make a line one inch long.

The female continues to distend so that she closely resembles a stout gourd, the head being at the small end. Of course she is not so large as a gourd, since it takes about five millions of the females to make a mass so large as a common sized gourd. Each female contains from 200 to 300 eggs. The larvæ hatch while yet within her body because she is imprisoned in the roots, unless some accident happens to the gall which breaks it.

In favorable weather the worm will develop from the egg to the mature female, to eggs again in about one month. So it will be seen that they develop very rapidly.

REMEDIES.

There are many nurseries, market gardens, propagating houses and less pretentious places for growing such plants as the peach, grape, cabbage, tomato, Irish potato, etc., for sale, or even to give away, to be transplanted, that are infected with this worm. When soil is once infected it is very difficult to get rid of the worm. The most important action is to prevent the farther distribution. Irish potatos are one of the most prolific sources of infection and the only way to tell certainly when they are infected is to know whether or not the soil where they were grown is free from the worm, and the seed potatos from which the crop was raised were also free.

The purpose of this bulletin is to warn farmers and horticulturists to be very cautious as to the source from which they get rooted plants or tubers for planting in their fields or gardens.

Where land is already infested, though no remedy is known, there are some practical suggestions to be made, which if followed will keep the worms somewhat in check.

ROTATION OF CROPS.—By growing for a few years on badly infected soil, plants which are known to be insusceptible to the attacks of the worm, the numbers can be greatly reduced. It should be some crop that can be cultivated, or else weeds should be pulled from the ground. If a crop susceptible to the attacks of the worm were grown every third year probably it would suffer much less harm.

*CLEAN CULTIVATION.—The absence of clean cultivation is one of the most fruitful scources of the thorough impregnation of the soil with the worms. It was of course impossible to make an application of this principle to the enemy in question before that enemy was known, and especially before the time required for its complete development from the egg had been determined. Now that these facts are known and since we know many of the plants subject to the disease it is to be hoped this method will be employed by those desirous of subduing the worms. Not

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* The remaining suggestions are taken from my article in Science Contributions from the Agricultural Experiment Station, Alabama Polytechnic Institute, Dec. 1889, pp. 47-50, Vol. I., No. I.

only should an effort be made to prevent the growth on arable land of all plants growing wild which are liable to serious infection, but so soon as a crop has been gathered, or it is found that the crop will not be worth gathering, from any cultivated plant liable to serious infection the farther growth of the plants should be stopped, or what is better the roots of the plants should be gathered and burned when possible. In gardens this would not be a serious task compared with the benefit to be derived. I have noticed cabbages, tomatoes and potatoes, all of which are seriously susceptible to the disease, growing in an abandoned condition for two months in the latter part of the season, all the while providing for the rapid development and multiplication of the parasites. During this time two successive generations of the worms are developed. Each female egg would on the average, making no allowance for fatalities, produce in the first generation 200 young. Allowing 50 per cent. of these for males there would be 100 to start the second generation for every one at the beginning of the first. These would then on the basis of a similar computation produce 20,000 young or 10,000 females to be the producers of the third generation. Then during the time of the abandoned growth of these diseased plants every productive parasite has produced 10,000 productive parasites.

TREATMENT OF PERENNIALS.—The greatest care should be exercised in the cultivation of perennials like the grape, peach, fig, etc. The young plants should be obtained from sources where it is known they have been grown in non-infected soil. The orchard or grapery should be selected and by a system of cultivation of insusceptible plants be rendered sterile by starving out the worms. Then the practice of cultivating either for forage or as a fertilizer plants liable to the disease in the orchard should be discontinued. Where orchards or graperies are so seriously injured as to interfere with the productiveness of the trees or vines, they might be preserved for a few years while the orchard is renewed in soil freed from the worms, when they should be destroyed.

The peach trees and grape vines which I have examined in the vicinity of Auburn, while slightly affected do not appear yet to suffer any serious consequences. Young trees and seedlings are more seriously affected. The most badly diseased grape cuttings I have seen were those grown very near diseased cabbages and tomatoes. Care should also be used in the cultivation of seed potatoes which are not infected.

TRAPPING THE WORMS.—In Germany cultivators of the sugar beet have resorted with a degree of success to trapping the worms of a related species (*H. Schachtii*)* from badly infected soils by the cultivation of plants very susceptible to the disease, and then gathering the roots before the worms are fully developed and destroying them. Such plants they call "catch plants" ("Fangpflanzen").

COMPOSTS.—If roots are ever used in the making of composts great caution should be used since there is danger of infecting soils hitherto free from the worms by fertilizing such land with compost material containing diseased roots. Kühn‡ has shown that such infection does take place in the case of a related species, *Heterodera Schachtii* Schmidt, and also states that the material may be rendered innocuous by placing unslacked lime in layers with the infected refuse of plants which may be used in compost.

PLANTS AFFECTED.—The following list of plants affected with the Nematode root-galls is by no means complete. It comprises only such as with limited time I have been able to determine thus far in the vicinity of Auburn:

1 Amygdalus Persica (peach).
2 Ficus Carica (fig).
3 Vitis vinifera (grape, several varieties).
4 †Solanum tuberosum (potato).
5 Solanum esculentum (egg plant).
6 †Lycoperscium esculentum (tomato).
7 Physalis sp.
8 †Abutilon sp.
9 †Gossypium herbaceum (cotton).
10 Hibiscus esculentus (okra).
11 Sida spinosa.
12 Modiola multifida.

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*Sorauer, Pflanzenkrankheiten, Vol. II p. 851.

‡Die Rüben Nematode. Zeitschrift des landwirthschaftlichen Central-Vereins der Provinz Sachsen. No. 12. pp. 332-335. 1870.

†Badly affected.

13 Cassia obtusifolia (coffee weed).
14 Dolichos catiang (cow pea),
15 Phaseolus.
16 Lespedeza striata (Japan clover).
17 Lotus corniculatus (bird's foot clover).
18 Melilotus alba.
19 Ipomœa tamnifolia.
20 Ipomœa lacunosa.
21 Clematis sp.
22 Phytolacca decandra.
23 †Helianthus annuus (sunflower)
24 †Citrullus vulgaris (watermelon).
25 †Cucumis melo ("nutmeg melon," "citron").
26 Beta vulgaris (beet).
27 Amarantus retroflexus (spineless careless weed).
28 Chenopodium Anthelminticum (worm seed)-
29 Zea mays (corn).
30 †Brassica oleracea (cabbage).
31 Brassica Rapa (turnip).
32 †Brassica campestris rutabaga (rutabaga).
33 Marrubium vulgare (horehound),
34 †Pastinaca sativa (parsnip).
35 Lactuca sativa (lettuce).
36 †Tragopogon porrifolius (salsify).

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†Badly affected.

REPORT

—OF THE—

ALABAMA WEATHER SERVICE,

Co-operating with the U. S. Signal Service.

November, 1890.

STATE POLYTECHNIC INSTITUTE,
Auburn, Ala., Dec. 15th, 1890.

The month of November was remarkable for the fine weather prevalent during the entire period, the rather high temperature and the very small precipitation. Two observers reported a total absence of rain, and the average for the State was 3 .25 inches below the normal. The small amount of moisture thus indicated is singular this season of the year.

The first few days of the month were cool and so was the last week, but the temperature generally was high and the weather delightfully mild and pleasant. The season was exceedingly favorable for harvesting and the farmers have been able to save their crops in excellent condition. Roses, delicate geranium and wild flowers were in bloom up to the close of the month, and in fact no frost was heavy enough to destroy the buds of the tender plants exposed to the free circulating night air. The average temperature was 4 °.4 above the normal.

J. M. QUARLES,
Assistant.

P. H. MELL,
Director.

MOTHLY SUMMARY.

ATMOSPHERIC PRESSURE (*in inches*)—Monthly mean, 30 .179; maximum observed, 30 .565, at Auburn on the 21; minimum observed, 29 .910, at Chattanooga on the 30; range for the State, .655.

TEMPERATURE (*Degrees F.*)—Monthly mean, 57 .3; highest monthly mean, 63 .6, at Citronelle; lowest monthly mean, 46 .7, at Double Springs; maximum observed, 85, at Citronelle on the 11 and 12; mimimum observed, 23, at Valley Head on the 1 and 4; range for the State, 62; greatest local monthly range, 59, at ValleyHead; least local monthly range, 39, at Union Springs.

PRECIPITATION—INCLUDING MELTING SNOW (*in inches*)—Average for the State, .59; greatest, 1 .79, at Uniontown; least, 0 .00, at Bermuda and Columbiana; mean relative humidity, 66 at Auburn, 65 at Uniontown, 83 .4 at Valley Head.

WIND.—Prevailing rirection, N. W. Miles travelled at Chattanooga, 3,140; at Montgomery, 2,077; at Mobile, 4,886; at Auburn, 2,167.

NOTES FROM OBSERVERS.

Tuscumbia (L. B. Thornton)—At 7 P. M. on the 23 a faint halo; on the 28 smoky looking a little like Indian summer.

Livingston (J. W. A. Wright).—Heavy frost and ice ond the 1st, 4th, 21st 27th, and 29th. Only five years out of the last twenty have brought us less than two inches of rain during November. Our average rainfall here for November 3 .90, while in 1870 and 1875 we had over 7 inches, and in 1880 over 10 inches, in 1873 we had 1 .19 inches' in 1874, 1 .06 inches, but in 1876 only .52 inches; tn 1887 only .35, and in this November .67 of an inch. The average temperature for October was 3° cooler than normal for that month. The average temperature for November was 3° warmer than normal as shown by our observations for more than 23 years in western Alabama.

Greensborough (M. H. Yerby) —No unusual phenonena this month, with the exception of the very small amount of precipitation, it having rained but one day during the entire month. Better weather for harvesting a crop could not have been desired. The cotton crop has been gathered and the yield was considerably better than last year.

TABLE OF SOIL TEMPERATURES—NOVEMBER, 1890.

(The observations for this table were taken at Aubnrn, Ala.)

A. M. **Lloyd**, Observer.

Note.—There are three sets of themometers—Nos. 1 and 2 are situated on a hill in sandy soil, and No. 3 is placed near a small stream in bottom land. The depth of instruments range from 1 inch to 96 inches below tne surface, and observations are made three times each day—morning, noon, and evning.

Depth in Inches.	Set No. 1, on Hill.	Set No. 2, on Hill.	Set No. 3, in Bottom.
1	61.2	62.2	61.1o
3	60.7	61.4	61.8
6	59.3	60.6	59.I
9	58.1	59.2	58.3
12	58.0	58.4	57.7
24	60.2	60.1	59.3
36	61.2	60.1	60.7
48	64.5	62.6	61.7
60	65.4	63.8	65.8
72		64.0	
84		64.6	
96		67.7	

Monthly Summary of Meteorological Reports of the Alabama Weather Service, November, 1890.

Stations.	Counties,	Altitudes	Latitude N	Longitude W.	BAROMETER.					TEMPERATURE.															Names of Observers.
						MAX.		MIN.					MAX.		MIN.										
					Monthly Mean	Height	Date	Height	Date	Monthly Mean	Mean of Max,	Mean of Min.	Degrees	Date	Degrees	Date	Monthly Range	Me'nDaily R'nge	TotalPreci'tation	Clear days	Fair days	Cloudy days	Days of Rain	Prevailing wind	
Selma	Dallas ,,.......	....	32 28	87 00	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	
Valley Head..	DeKalb.......	1031	34 34	85 37	......	.....	...	......	..	53	68 6	37 4	82	11	23	1-4	59	31 2	35	21	6	3	1	Sw	E.P.Nicholson
Pine Apple .	....	....	31 35	87 00	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	†
Florence......	Lauderdale...	....	34 48	87 37	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	C. W. Ashcraft
Chattanooga..	Tennessee....	783	35 03	85 30	30 188	30 413	21	29 910	30	55 8	67	44 6	79	11	28	23	51	22 4	0.16	22	5	3	3	Nw	* L. M. Pindell
Montgomery..	Montgomery .	219	32 22	86 23	30 168	80 390	21	29 950	2	60 1	72 4	47 8	82	12–13	33	1	49	24 6	26	20	7	3	3	Nw	* L. Dunne
Marion	Perry	....	33 12	87 42	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	†
Union Spr'gs	Bullock	516	32 12	85 39	......	.....	......	......	..	62 5	....	....	78	11	39	4	39	....	60	3	22	5	1	N	R. J. Grady
Bermuda	Monroe,......	....	31 43	87 12	......	.....	......	......	..	54 8	....	....	81	18	30	1	51	....	0 00	....	....	....	0	....	Wm. Fowler
Mobile	Mobile	30	30 41	88 20	30 164	30 375	21	30 030	2	61 1	71 2	51	81	11–12–13	36	1	45	....	32	13	13	4	3	N	* A. Pritchard
Carrollton	Pickens.......	....	.....	88 03	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	M. L.Stansel.
Auburn	Lee...........	826	32 40	85 30	30 224	30 565	21	29 970	2	60 8	67 7	51 8	78	11–12–16	38	1	45	18	16	24	6	0	2	E	J. M. Quarles
Livingston, ...	Sumter	150	32 34	88 08	30 190	30 370	20-22	30 090	..	57 6	70 8	44 4	81	15	29	1	52	26 4	0.67	16	8	6	1	Nw	J.W.A,Wright
Greensboro...	Hale	220	32 41	87 36	......	.....	......	......	..	59 1	....	....	80	9–10	32	1–4	48	....	0.91	....	....	....	1	N	M. H. Yerby
Mt. Willing ..	Lowndes......	....	32 07	86 45	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	W. M. Garrett
Uniontown ...	Perry	273	32 28	86 44	30 140	30 380	20	29 960	2	59 4	69 8	46	81	17	31	4	50	23 8	1.79	....	....	....	1	Nw	W. H. Newman
Citronelle	Mobile	352	31 03	87 30	......	.....	......	......	..	63 6	76 5	50 7	85	11-12	32	4	53	25 8	1.40	....	....	....	3	....	J G Michael
Fayette C H..	Fayette	....	33 42	83 12	......	.....	......	......	..	...	....	....	..	....	..	....	....	....	....	....	....	....	....	....	Daniel Collier
Opelika	Lee..........	....	32 45	85 28	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	†
Gunetersville..	Marshall.....	655	34 24	86 18	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	A. J. Baker
Chepultepec ..	Blount........	890	33 53	86 20	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	W. B. Allgood
Columbiana ..	Shelby.	560	33 15	86 38	......	.....	......	......	..	55	70	39 9	80	16	25	1	55	30 1	0 00	....	....	....	0	....	W. D,Lovett
Centre	Cherokee,....	728	34 10	85 42	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	Thos. Bradford
Double Spr'gs	Winston	....	34 08	85 35	......	.....	......	......	..	46 7	....	33 8	68	8	28	27	40	....	1.10	....	....	....	3	....	A, M. Weiler
Butler	Choctaw	....	32 05	87 24	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	B. F. Gilder
Jasper	Walker	310	33 49	83 12	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	Howard Lamar
Tuscumbia....	Colbert.......	....	34 42	87 33	......	.....	......	......	..	53 7	....	....	74	7-9	29	28	46	....	0 58	23	....	7	2	Sw	L. B. Thornton
Fort Deposit..	Lownde....	....	34 42	86 39	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	†
Piedmont	....	468	....	.....	......	.....	......	......	..	....	....	....	..	....	..	....	....	....	....	....	....	....	....	....	
	Averages				30 179	......	......	......	..	57 3	70 5	44 7	..	....	..	....	....	25 3	59	18	8	4	2	....	

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*Sergeants of the United States Signal Corps. †Cotton Belt Station