Bulletin No. 42. January, 1893.

Agricultural Experiment Station

—OF THE—

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

CO-OPERATIVE SOIL TEST EXPERIMENTS

—FOR 1892.—

A. J. BONDURANT, Agriculturist.
JAMES CLAYTON, Assistant.

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All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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CO-OPERATIVE SOIL-TEST EXPERIMENTS.

FOR 1892.

Results of co operative experiment for 1981 were published in Bulletin No. 34, January, 1892, from this Station, and will be made use of in comparing results obtained from the same line of experiments conducted in 1892.

The fertilizers were carefully analyzed, mixed, weighed, placed in bags and numbered at the Experiment Station, according to the plot on which each was to be used, and then shipped with freight prepaid to the following experimenters:

NAMES.	POST-OFFICE.	COUNTY.
1. Aday, Rev. L. C	Newburgh	Franklin.
2. Beasley, E. J.	Red Level	Covington.
3. Binford, R. E.	Athens	Limestone.
4. Bishop, M. A	Madison	Madison.
5. Bradley, F. W	Walker Springs.	Clarke.
6. Brannon, J. M.	Seale	Russell.
7. Brown, D. L	Randolph	Bibb.
8. Compton, G. W.	Dixon's Mills	Marengo.
9. Cory, A. F.	Mulberry	Autauga.
10. Cross, R. H	Letohatchie	Lowndes.
11. Davis, Maj. E. M.	Prattville	Autauga.
12. Deer, Jno. F	Monroeville	Monroe.
13. Dick, R. M.	Attalla	Etowah.
14. Ellison, J. M.	Creek Stand	Macon.
15. Ewing, R. T	Centre	Cherokee.
16. Gillis, Dan, jr	Abbeville	Henry.
17. Goodwyn, A. T.	Robinson Springs	Elmore.
18. Gordon, Dr. Jno	Healing Springs	Washington.
19. Hobdy, J. M	Louisville	Barbour.
20. Inzer, J. T	Eden	St. Clair.
21. Johnson, Uriah	Trinity Station.	Morgan.
22. Killebrew, J. C.	Newton	Dale.
23. Lane, H. D.	Athens	Limestone.
24. Logan, J A.	Clanton	Chilton.
25. Martin, Wm.	Greensboro	Hale.
26. Mize, J. W.	Remlap	Blount.
27. Newman, W. H.	Uniontown	Perry.
28. Oliver, J. P.	Dadeville	Tallapoosa.
29. Ott, J. C	Florence	Lauderdale.
30. Pitts, J. W.	Cresswell Station.	Shelby.
31. Pruett. S. A	Chesser	Pike.
32. Radney, J H	Roanoke	Randolph.
33. Sellers, W. H	Geneva	Geneva.
34. Snuggs, T. A	Holly Pond	Cullman.
35. Stroud, Z T	Aberfoil	Bullock.
36. White, W L	Hattan	Lawrence.

No reports were received at the date of issuing this Bulletin, from the following co-operative experimenters to whom fertilizers were sent:

NAMES.	POST-OFFICE.	COUNTY.
1. Beasley, E. J.	Red Level............	Covington.
2. Brannon, J. M....	Seale.....	Russell.
3. Ewing, R. T......	Centre..............	Cherokee.
4. Goodwyn, A. T...	Robinson Springs ...	Elmore.
5. Hobdy. J. M	Louisville............	Barbour.
6. Inzer, J. T........	Eden	St. Clair.
7. Lane, H. D.......	Athens..............	Limestone.
8. White, W. L	Hattan...............	Lawrence.
9. Binford, R. E....	Athens	Limestone.

Cost of Fertilizers Applied per Acre.

In order that the experimenters and other farmers may better understand the inquiry made upon the different plots, the cost of the different materials used is given in the statement which follows. The calculations are made upon the cost laid down at Auburn. The local freights upon the packages reshipped to the depots of the experimenters would produce a false impression, since the average local rate of freight charged upon the amount sent to each experimenter from Auburn to their depots exceeds five dollars per ton. Shipped in quantity, the freight to the various depots of the experimenters would average little more than that from the factories to Auburn. Again, in estimating profits resulting from the use of the different fertilizers, it will be more convenient to have a common standard of comparison.

Quantity and Cost per Acre of Fertilizers used by Co-operative Soil Test Experimenters, 1892.

Plot.	Fertilizers.		
1	96 lbs. Nitrate Soda		2.79
2	240 lbs. Acid Phosphate		1.68
3	64 lbs. Muriate Potash		1.62
4	No Manure.		
5	96 lbs. Nitrate Soda	2 79	
	64 lbs. Muriate Potash	1.62—	4.41
6	96 lbs. Nitrate Soda	2.79	
	240 lbs. Acid Phosphate	1.68—	4.47
7	64 lbs. Muriate Potash	1.62	
	240 lbs. Acid Phosphate	1.68—	3.30
8	No Manure.		
9	96 lbs. Nitrate Soda	2.99	
	240 lbs. Acid Phosphate	1.68	
	64 lbs. Muriate Potash	1.62—	6.09
10	240 lbs Floats		1.82
11	240 lbs. Floats	1.82	
	96 lbs. Nitrate Soda	2.99—	4.61
12	No Manure		
13	848 lbs. Green Cotton Seed @ 45c per cwt.		3.81
14	848 lbs. Green Cotton Seed @ 45c per cwt.	3.81	
	240 lbs. Floats	1,82—	5.63
15	4240 lbs. Stable Manure @ $1 per 1,000 lbs.		4.24
16	240 lbs. Acid Phosphate	1 68	
	240 lbs. Cotton Seed Meal.	2 36—	4 04

The following table shows the quantity of potash, phosphoric acid, nitrogen, (and its equivalent of ammonia) contained in the different fertilizers used per acre, as determined by Prof. N. T. Lupton, State Chemist:

Plot No.	FERTILIZERS.	Lbs. of Potash.	Lbs. Phosphoric Acid Available.	Lbs. Phosphoric Acid Total.	Lbs. Nitr'gn.	Lbs. Equivalent to Ammonia.
1	96 lbs. Nitrate Soda	....	..		14.17	17.20
2	240 lbs. Acid Phosphate	....	34 94	38 32	....	......
3	64 lbs. Muriate Potash	31 91		.....	...	......
4	No Manure	...	....	....	......	......
5	96 lbs. Nitrate Soda.	....	....	....	14.17	17 29
	64 lbs. Muriate Potash	31.91	....	....	...	......
6	96 lbs. Nitrate Soda.	....	....	....	14 17	17 20
	240 lbs. Acid Phosphate	....	34 94	38.32	....	......
7	64 lbs. Muriate Potash	31 91	....	.....	.....	......
	240 lbs. Acid Phosphate	.....	34 94	38 32	.....	......
8	No Manure	....	.....	....	....	....
9	96 lbs. Nitrate Soda	.....	.....	....	14.17	17 20
	240 lbs. Acid Phosphate	..	34.94	38 32	.....	......
	64 lbs. Muriate Potash	31 91	.....	.....	.....	......
10	240 lbs. Floats	.....	....	28 50	....	......
11	240 lbs. Floats	....	....	28.50	.....	......
	96 lbs. Nitrate Soda	.....	.....	.....	14 17	17.20
12	No Manure	....	.....	.....	.....	.....
13	848 lbs. Green Cotton Seed	10.6	....	10.17	21.2	25.74
14	848 lbs. Green Cotton Seed	10 6	....	10 17	21.2	.....
	240 lbs. Floats	....	.....	28 50	..	.....
15	240 lbs. Stable Manure	28.40		13 14	26.71	32 43
16	240 lbs. Acid Phosphate	......	34 94	38 32		....
	240 lbs. Cotton Seed Meal	6 55	...	.	15 79	19 17

EXPERIMENT MADE BY REV. L. C. ADAY.

NEWBURGH, FRANKLIN COUNTY.

Soil, Red Cedar Land; Sub-soil, Red Clay.

By examining the following statement of Mr. Aday's work for 1892, and comparing it with the experiments made by him for 1891, it will be seen that the general indications are that his soil is deficient in the three main elements of plant food, as plot No. 9, where a complete fertilizer is used, gives the best results for both years. When floats in combination with nitrate of soda and floats with green cotton seed are compared it is in favor of floats with green cotton seed in 1891, and floats with nitrate of soda in 1892.

Plot No.	POUNDS OF FERTILIZER PER PLOT.	POUNDS OF FERTILIZER PER ACRE.	Lbs. Cotton 1st picking.	Lbs. Cotton 2nd picking.	Lbs. Cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda..	96 lbs. Nitrate Soda.....	39	22	23	84	1344
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate..	27	16	4	47	752
3	4 lbs. Muriate Potash..	64 lbs. Muriate Potash..	26	12	4	42	672
4	No Manure.........	No Manure..	23	11	4	38	608
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash..	32	14	6	52	832
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate.	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate..	36	17	5	58	928
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate.	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	29	15	5	49	784
8	No Manure..........	No Manure..	27	13	5	45	720
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash.	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	46	22	10	78	1240
10	15 lbs. Floats.........	240 lbs. Floats.	27	14	6	47	752
11	6 lbs. Nitrate Soda, 15 lbs. Floats..........	96 lbs. Nitrate Soda, 240 lbs. Floats...........	34	16	6	56	896
12	No Manure..	No Manure...........	34	9	2	45	720
13	53 lbs. Green Cot. Seed	848 lbs. Green Cotton Seed	41	11	2	54	864
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs. Floats, 848 lbs. Green Cotton Seed.	39	11	3	53	848
15	265 lbs. Stable Manure.	4,240 lbs. Stable Manure	31	24	5	60	960
16	15 lbs. Acid Phosphate, 15 lbs. Cot. Seed Meal.	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal.	33	23	7	63	1008

EXPERIMENT MADE BY MR. M. A. BISHOP,

MADISON, MADISON CUUNTY.

Soil, Dark Loam; Sub-soil, Clay.

In Mr. Bishop's experiments for 1891, plots number 6 and 9 give the same yield, and plot number 16 gives 256 lbs. less than either, but the same as plot number 3, while in his experiments for 1892, plot number 6 gives 128 lbs. less than plot number 9, plot number 16 gives 64 lbs. more than plot number 6, and 128 lbs. less than plot number 9, and 192 lbs. more than plot number 3. The results are so conflicting that no conclusion can be drawn. Floats with the nitrate of soda gave best results in 1891, but in 1892 the combination is in favor of floats with green cotton seed.

Plot No.	POUNDS OF FERTILIZER PER ACRE.	POUNDS OF FERTILIZER PER PLOT.	Lbs. Cotton 1st picking	Lbs. Cotton 2nd picking	Lbs. Cotton 3rd picking	Total yield per plot.	Total yield per acre.
1	6 lbs. Nitrate Soda....	96 lbs. Nitrate Soda.....	10	8	4	22	352
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate..	16	14	8	38	608
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash...	14	12	6	32	512
4	No Manure.	No Manure	...	10	8	18	288
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash...	14	12	8	34	544
6	6 lbs. Nitrate Soda, 5 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate	16	14	10	40	640
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	18	14	10	42	672
8	No Manure..	No Manure.	...	9	9	18	288
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	22	18	8	48	768
10	15 lbs. Floats..	240 lbs. Floats	...	14	6	20	320
11	6 lbs. Nitrate Soda, 15 lbs. Floats..........	96 lbs. Nitrate Soda, 240 lbs. Floats..	14	10	6	30	480
12	No Manure....	No Manure	...	11	8	19	304
13	53 lbs. Green Cot. Seed	848 lbs. Green Cotton Seed	14	10	8	32	512
14	15 lbs. Floats, 53 lbs. Green Cot. See	240 lbs. Floats, 848 lbs. Green Cotton Seed	18	12	6	36	576
15	265 lbs. Stable Manure.	4,240 lbs Stable Manure .	22	18	10	50	800
16	15 lbs. Acid Phosphate, 15 lbs. Cot'n Seed Meal	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal	20	16	8	44	704

EXPERIMENT BY MR. F. W. BRADLEY.

WALKER SPRINGS, CLARKE COUNTY.

Soil, Sandy; Sub soil, Red Clay.

The best results obtained by Mr. Bradley in his two years experiments are from the use of cotton seed meal with acid phosphate. In 1891 plot No. 16 gave 276 pounds more than plot No. 9, and 1892 it is 288 pounds more. These results are very decided, and show that it is a waste of money for Mr. Bradley to use potash on his soil. Green cotton seed with floats give better results than nitrate of soda with floats, and for two years give larger yield than complete fertilizer. To purchase a fertilizer which contains potash is a waste of money for Mr. Bradley.

Plot No.	POUNDS FERTILIZER PER PLOT.	POUNDS FERTILIZER PER ACRE.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ..	96 lbs. nitrate soda ..	6	20	8	34	344
2	15 lbs. acid phosphate	240 lbs. acid phosphate	16	25	13	54	864
3	4 lbs. muriate potash.	64 lbs. muriate potash	32	21	10	44	704
4	No manure..........	No manure.	4	16	4	24	384
5	6 lbs. nitrate soda, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash	19	26	15	60	960
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate	28	24	18	70	1120
7	4 lbs. murate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate	33	21	14	68	1088
8	No manure. ...	No manure.....	8	12	6	26	416
9	6 lbs. nitrate soda, 15 lbs acid phosphate, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate.	35	16	21	72	1152
10	15 lbs. floats	240 lbs. floats	16	18	8	42	672
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	33	24	17	74	1184
12	No manure.	No manure.	6	16	2	24	384
13	53 lbs. green cotton seed	848 lbs. green cotton seed	19	23	18	60	960
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	37	29	22	88	1408
15	265 lbs. stable manure..	4240 lbs. stable manure.	37	32	15	78	1248
16	15 lbs. acid phosphate, 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal	37	33	20	90	1440

EXPERIMENT MADE BY D. L. BROWN,

Randolph, Bibb County.

Soil, Sandy; Sub-soil, Clay.

While Mr. Brown's experiments were injured in 1891 by drought and overflow, yet when plot Nos. 6 and 16 are compared with plot No. 9 in 1891, and the same comparison is made in his experiment for 1892, it is cleaaly seen that Mr. Brown's soil does not need potash as his best results are obtained where nitrogen combined with acid phosphate are used and that money can be saved on such soils in buying only cotton feed meal and acid phosphate and mixing them on the farm. In Mr. Brown's experiments, floats with green cotton seed give better results each year than floats with nitrate of soda.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking	Lbs cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ..	96 lbs. nitrate soda ...	16	12	8	36	576
2	15 lbs. acid phosphate.	240 lbs. acid phosphate	20	26	4	50	800
3	4 lbs. muriate potash	64 lbs. muriate potash	16	24	8	48	768
4	No manure.	No manure	6	10	6	22	352
5	6 lbs. nitrate soda, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash.	20	28	12	60	960
6	6 lbs. nitrate soda, 15 lbs. acid phosphate	96 lbs. nitrate soda, 240 lbs. acid phosphate.	48	44	16	108	1728
7	4 lbs. muriate potash. 15 lbs. acid phosphate.	64 lbs. muriate potasc, 240 lbs. acid phosphate.	28	26	12	66	1056
8	No manure.	No manure	8	10	6	24	384
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate	44	36	12	92	1472
10	15 lbs. floats.... ...	240 lbs. floats	24	22	10	56	896
11	6 lbs nitrate soda, 15 lbs. floats.	96 lbs nitrate soda, 240 lbs. floats..........	32	26	6	64	1024
12	No manure.........	No manure..........	16	12	8	36	576
13	53 lbs green cotton seed	848 lbs. green cotton seed	32	28	12	72	1152
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	36	42	14	92	1476
15	265 lbs. stable manure..	4240 lbs. stable manure.	32	44	12	88	1408
16	15 lbs. acid phosphate, 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal	48	46	14	108	1728

EXPERIMENTS WITH FERTILIZERS, G. W. COMPTON,

DIXON'S MILLS, MARENGO COUNTY.

Soil, Dark, Sandy; Sub-soil, Clay.

In Mr. Compton's experiments for two years, results are somewhat conflicting. His soil is most deficient in phosphoric acid, though the increased yield, when combined with nitrogen, is very marked. Floats, with green cotton seed, give best results for the two years, and give only 16 lbs. less than complete fertilizer in 1892.

Plot No.	Pounds of Fertilize per Plot.	Pounds of Fertilizer Per Acre.	Lbs. Cotton 1st Picking.	Lbs. Cotton 2nd Picking.	Lbs. Cotton 3rd Picking.	Lbs. Cotton 4th Picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda ...	96 lbs. Nitrate Soda. ..	2	6	7	2	17	272
2	15 lbs. Acid Phosphate.	240 lbs. Acid Phosphate.	13	11	5	1½	30½	488
3	4 lbs. Muriate Potash...	64 lbs. Muriate Potash..	1½	5	4½	2½	13½	216
4	No Manure.	No Manure	½	3½	3½	2	9½	152
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash...	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash..	½	3	3	4	10½	168
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate..	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate..	22	9	3	½	34½	552
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate .	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	8	10½	4	1	23½	376
8	No Manure.	No Manure.	3	6	4	1½	14½	232
9	6 lbs. Nitrate Soda, 15 lbs Acid Phosphate, 4 lbs. Muriate Potash...	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	22	15	4	2	43	688
10	15 lbs. Floats	240 lbs. Floats	8½	13	6	3½	31	496
11	6 lbs. Nitrate Soda, 15 lbs. Floats...........	96 lbs. Nitrate Soda, 240 lbs. Floats..	11	11½	4	2	28½	456
12	No Manure......... ..	No Manure.....	2	6½	4½	2½	15½	248
13	53 lbs. Green CottonSeed	848 lbs. Green CottonSeed	10	12	5	2	29	464
14	15 lbs Floats, 53 lbs. Green CottonSeed	240 lbs. Floats, 848 lbs. Green CottonSeed	18	15½	4½	4	42	672
15	265 lbs. Stable Manure	4,240 lbs. Stable Manure.	15	13½	4½	1½	34½	552
16	15 lbs. Acid Phosphate, 15 lbs. Cotton Seed Meal.	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal.	24	12½	3½	1	41	656

EXPERIMENT BY MR. A. F. CORY

MULBERRY, AUTAUGA COUNTY.

Soil, Red. Sub-soil, Red Clay.

It is clearly shown from Mr. Cory's experiment that his soil does not need potash. Plot 6, nitrate of soda with acid phosphate, gave **111** lbs. more than plot No. 9, complete fertilizer, while plot No. 16 gave an increase of 32 lbs. over plot No. 9.

Floats with green cotton seed give better results than floats with nitrate of soda, and both give larger yields than complete fertilizer.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ..	96 lbs. nitrate soda ...	12	22	..	34	544
2	15 lbs. acid phosphate..	240 lbs. acid phosphate..	13	14	....	27	432
3	4 lbs. muriate potash. .	64 lbs. muriate potash .	9	19	..	28	448
4	No manure.	No manure	11	17	..	28	448
5	{ 6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda .... 64 lbs. muriate potash .	14	20	..	34	544
6	{ 6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate .	30	14	...	44	704
7	{ 4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 250 lbs. acid phosphate .	15	9	....	24	384
8	No manure	No manure.	8	12	...	20	320
9	{ 6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate .	27	10	....	37	592
10	15 lbs. floats	240 lbs. floats	15	12	...	27	432
11	{ 6 lbs. nitrate soda, 15 lbs. floats..........	96 lbs. nitrate soda, 240 lbs. floats	20	20	...	40	640
12	No manure.	No manure	9	16	...	25	400
13	53 lbs. green cotton seed	848 lbs. green cotton seed	16	22	...	38	608
14	{ 15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	25	23	...	48	768
15	265 lbs. stable manure..	4240 lbs. stable manure	26	11	..	37	592
16	{ 15 lbs. acid phosphate, 15 lbs cotton seed meal.	240 lbs, acid phosphate, 240 lbs. cotton seed meal	30	9	...	39	624

EXPERIMENT MADE BY R. H. CROSS,

Letohatchie, Lowndes County.

Soil, Sandy Loam; Sub-soil, Yellow Clay.

Mr. Cross gains nothing by the use of potash on his land. In 1891 complete fertilizer gave a slight increase over plot 6, nitrate soda and acid phosphate, but yields 160 lbs. less than plot 16, cotton seed meal and acid phosphate. In 1892, plots 6 and 9 gave the same. Plot 16 gave 304 lbs. more than either. The indications for the two years are that potash is not needed in this soil. Floats, with green cotton seed, gave better results for the two years than floats with nitrate soda.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer Per Acre.	Lbs. Cotton 1st Picking	Lbs. Cotton 2nd Picking	Lbs. Cotton 3rd Picking	Lbs. Cotton 4th Picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda .	96 lbs. Nitrate Soda	12	16	14	9	51	816
2	15 lbs. Acid Phos . .	240 lbs. Acid Phosphate	16	20	21	11	68	1088
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash.	8	10	14	9	41	656
4	No Manure. . . .	No Manure	5	7	12	4	28	448
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash	18	22	16	8	64	1024
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate.	26	29	22	12	89	1424
7	4 lbs. Muriate Potash 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	21	25	20	16	80	1280
8	No Manure.	No Manure.	7	9	11	5	32	512
9	6 lbs. Nitrate Soda, . 15 lbs. Acid Phosphate 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	30	24	19	16	89	1424
10	15 lbs. Floats	240 lbs. Floats.	12	21	26	18	77	1232
11	6 lbs. Nitrate Soda, 15 lbs. Floats.	96 lbs. Nitrate Soda, 240 lbs. Floats	16	12	18	20	66	1056
12	No Manure	No Manure.	6	9	13	7	35	560
13	53 lbs. Green Cot. Seed	848 lbs. Green Cot. Seed	30	26	21	6	84	1344
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs. Floats, 848 lbs. Green Cot. Seed	33	24	20	8	85	1360
15	265 lbs. Stable Manure	4240 lbs. Stable Manure.	40	34	21	7	102	1632
16	15 lbs. Acid Phosphate 15 lbs. Cot. Seed Meal,	240 lbs. Acid Phosphate, 240 lbs. Cot. Seed Meal.	41	41	20	6	108	1728

EXPERIMENT MADE BY MAJ. E. M. DAVIS,

PRATTVILLE, AUTAUGA COUNTY.

Soil, Sandy Loam; Subsoil, Red Clay.

In Maj. Davis's experiments results are conflicting. In 1891 the complete fertilizer gave the best results, while in 1892 nothing is gained by the use of potash as in plot No. 9. Floats with green cotton seed give the best results in 1891, while floats with nitrate of soda gave best results in 1892. Further experiment is necessary to determine anything for this soil.

Plot No.	Pounds Fertilizers per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking.	Lbs. cotton 2nd picking.	Lbs. cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ...	96 lbs. nitrate soda ..	21	18	3	42	672
2	15 lbs. acid phosphate.	240 lbs. acid phosphate.	17½	9	½	27	432
3	4 lbs. muriate potash	64 lbs. muriate potash.	17	13	½	31	496
4	No manure	No manure	17	12	2	31	496
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash.	19	22	3½	44½	722
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate.	26	20	1	47	752
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate	18	24	2	44	704
8	No manure	No manure.	15	18	4	35	560
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate.	20	24	2½	46½	744
10	15 lbs. floats	240 lbs. floats	15	16½	2	33½	536
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	19	19	4	42	672
12	No manure.	No manure....	17½	13	3	33½	536
13	53 lbs. green cotton seed	848 lbs. green cotton seed	22	16	3	41	656
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs green cotton seed	22	4	3	38	608
15	265 lbs. stable manure	4240 lbs. stable manure	27½	14	1	42½	680
16	15 lbs. acid phosphate, 15 lbs cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal	28	10	1	38	608

EXPERIMENT MADE BY J. F. DEER,

Monroeville, Monroe County.

Soil, Gray Sandy; Sub-soil, Clay.

Mr. Deer failed to make a report last year, 1891, so we have only this year's work to compare. It is evident from this experiment for one year that it is a waste of money to apply potash as in plot 9 on land like Mr. Deer's. Floats with green cotton seed give better results for the one year than floats with nitrate of soda.

Plot No.	Lbs. Fertilizer Per Plot.	Lbs. Fertilizer Per Acre.	Lbs. Cotton 1st picking	Lbs. Cotton 2nd picking.	Lbs. Cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ..	96 lbs. nitrate soda	½	6	15	21½	344
2	15 lbs. acid phosphate	240 lbs. acid phosphate...	16	26	8	50	800
3	4 lbs. muriate potash.	64 lbs. muriate potash..	3½	13	7	23½	376
4	No manure. ...	No manure.....	1½	8	6	15½	248
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash.	1½	10	14	25½	408
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate.	10	20	10	40	640
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate.	8	17	8	33	528
8	No manure.	No manure.	3	11	5	19	304
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs muriate potash, 240 lbs. acid phosphate. .	9	20	6	35	560
10	15 lbs. floats	240 lbs. floats	5	14	3	22	352
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	5	16	5	26	416
12	No manure.........	No manure	2	11	4	17	272
13	53 lbs. green cotton seed	848 lbs. green cotton seed.	9	18	5	32	512
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed.	12½	20	5	37½	600
15	265 lbs. stable manure.	4240 lbs. stable manure...	16	19	4	39	624
16	15 lbs acid phosphate 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal.	16	18	1	35	560

EXPERIMENT MADE BY R. M. DICK.

Attalla, Etowah County.

Soil, Red Loam; Sub-soil, Red Clay.

In Mr. Dick's experiments for 1891 nitrate of soda with acid phosphate, as in plot No. 6, gives 48 lbs. more than complete fertilizers as in plot No. 9, while in 1892 the results are in favor of the complete fertilizer which gives 376 lbs. more than plot No. 6. The Floats with green cotton seed give better results for the two years than floats with nitrate of soda.

Plot No.	Pounds of Fertilizer per Acre.	Pounds of Fertilizer per Plot.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking.	Lbs. cotton 3rd picking.	Total yield per Plot.	Total yield per Acre
1	6 lbs. Nitrate Soda	96 lbs. Nitrate Soda ...	8½	13	11	32½	520
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate	22	24	13	59	944
3	4 lbs. MuriateP otash.	64 lbs. Muriate Potash.	12	15	14	41	656
4	No Manure	No Manure . . .	9	13	11	33	528
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash.	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash..	10	19	13	42	672
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs Acid Phosphate	23	25	14½	62½	1000
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	24	26	14	34	1024
8	No Manure	No Manure	8	13½	11	32½	520
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	29	33	24	86	1376
40	15 lbs. Floats	240 lbs. Floats.	17	19	15	51	816
11	6 lbs. Nitrate Soda, 15 lbs. Floats	96 lbs. Nitrate Soda, 240 lbs. Floats	16	22	13	51	816
12	No Manure	No Manure	10	14	12½	30½	584
13	53 lbs. Green Cot. Seed	848 lbs. Green Cot. Seed	16	21½	17	54½	872
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs Floats, 848 lbs. Green Cot. Seed	22	26	16½	64½	1032
15	265 lbs. Stable Manure..	4240 lbs. Stable Manure.	26	26	18	70	1120
16	15 lbs. Acid Phosphate, 15 lbs. Cot. Seed Meal..	240 lbs. Acid Phosphate, 240 lbs. Cot. Seed Meal...	27	23½	12½	63	1008

EXPERIMENT MADE BY J. M. ELLISON,

Creekstand, Macon County.

Soil, Sandy; Sub-soil, Sandy.

Results are conflicting in the experiments made by Mr. Ellison. In 1891 nothing was gained by the use of potash as in plot No. 9, while in 1892 plot No. 9 gives an increase over plot No. 6 of 224 pounds. Floats, with sodium nitrate, gives better results for the two years than floats with green cotton seed.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer Per Acre.	Lbs. Cotton 1st Picking.	Lbs. Cotton 2nd Picking.	Lbs. Cotton 3rd Picking.	Lbs. Cotton 4th Picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda..	96 lbs. Nitrate Soda ..	5	17	12	7	41	656
2	15 lbs. Acid Phos	240 lbs. Acid Phosphate	5	9	18	7	39	624
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash.	6	21	20	14	61	976
4	No Manure..... ...	No Manure.	6	12	20	13	51	816
5	6 lbs. Nitrate Soda,.. 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash	19	17	10	16	62	992
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate.	13	18	20	21	72	1152
7	4 lbs. Muriate Potash 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	13	22	13	19	67	1072
8	No Manure..........	No Manure.........	9	15	10	17	51	816
9	6 lbs. Nitrate Soda, . 15 lbs. Acid Phosphate 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	14	22	18	27	81	1296
10	15 lbs. Floats.........	240 lbs. Floats....	9	14	18	33	74	1184
11	6 lbs. Nitrate Soda, 15 lbs. Floats.........	96 lbs. Nitrate Soda, 240 lbs. Floats	14	20	16	28	78	1248
12	No Manure	No Manure........	11	12	12	16	51	816
13	53 lbs. Green Cot. Seed	848 lbs. Green Cot. Seed	12	12	14	18	56	896
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs. Floats, 848 lbs. Green Cot. Seed	10	12	13	15	50	800
15	265 lbs. Stable Manure.	4240 lbs. Stable Manure.	17	13	10	10	50	800
16	15 lbs. Acid Phosphate 15 lbs. Cot. Seed Meal,	240 lbs. Acid Phosphate. 240 lbs. Cot. Seed Meal.	18	10	6	8	42	672

EXPERIMENT MADE BY MR. DAN GILLIS,

IN CHARGE OF SOUTHEAST ALABAMA EXPERIMENT TATION, ABBEVILLE, HENRY COUNTY.

Soil, Sandy; Sub-soil, Sand and Clay Mixed.

It is clearly shown by the results of this experiment that the soil on the Southeast Alabama Experiment Station is deficient in the three main elements of plant food. In 1891 plot No. 9 gives largest yield of any except Plot No. 15—stable manure—and gives an increased yield over average of no manure, of 735 pounds per acre. While in 1892 the increase is not so large (414 pounds), yet the facts indicate best results from the use of complete fertilizer. Floats with green cotton seed give better results for the two years than floats with nitrate of soda.

Plot No.	Pounds of Fertilize per Plot.	Pounds of Fertilizer Per Acre.	Lbs. Cotton 1st Picking	Lbs. Cotton 2nd Picking	Lbs. Cotton 3rd Picking	Lbs. Cotton 4th Picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda	96 lbs. Nitrate Soda	..	4	9½	9½	23	368
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate	.	5	8	9	22	352
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash	..	5	7	10	22	352
4	No Manure	No Manure	..	4	6½	11	21½	344
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash		7	9	9	25	400
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate	4	14	14	8	40	640
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	3	8½	10	6½	28	448
8	No Manure	No Manure	.	4	6	7	17	272
9	6 lbs. Nitrate Soda, 15 lbs Acid Phosphate, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs Acid Phosphate	4	16	17	7½	44½	712
10	15 lbs. Floats	240 lbs. Floats	..	5	8½	6	19½	312
11	6 lbs. Nitrate Soda, 15 lbs. Floats	96 lbs. Nitrate Soda, 240 lbs. Floats	..	6	7	7	20	320
12	No Manure	No Manure		4	8	5	17	272
13	53 lbs. Green CottonSeed	848 lbs. Green CottonSeed	5	11	9	5	30	480
14	15 lbs Floats, 53 lbs. Green CottonSeed	240 lbs. Floats, 848 lbs. Green CottonSeed	7	10½	8	3	28½	456
15	265 lbs. Stable Manure	4,240 lbs. Stable Manure	8	17	13	6	44	704
16	15 lbs. Acid Phosphate, 15 lbs. Cotton Seed Meal	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal.	8	14	10	4	36	576

EXPERIMENT MADE BY Dr. J. GORDON,

Healing Springs, Washington County.

Soil, Sandy Loam; Sub-soil, Sandy Loam.

In the experiment made by Dr. Gordon for 1891, plot No. 2, acid phosphate, gave 80 pounds more than plot No. 9, complete fertilizer; 336 pounds more than plot No. 6, nitrate of soda with acid phosphate, but 184 pounds less than plot No. 16, cotton seed meal with acid phosphate, while in 1892 plot No. 2 gives 152 pounds less than plot No. 6, 96 lbs. less than plot No. 9, but 112 pounds more than plot 16. The results of these experiments are so conflicting that no conclusion can be made. Floats with green cotton seed give a slight increase over floats with nitrate of soda for the two years.

Plot No.	Pounds of Fertilizer per Acre.	Pounds of Fertilizer per Plot.	Lbs. cotton 1st picking.	Lbs. cotton 2nd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda ...	96 lbs. Nitrate Soda	10	5	15	240
2	15 lbs. Acid Phosphate ...	240 lbs. Acid Phosphate .	20	6½	26½	424
3	4 lbs. Muriate Potash...	64 lbs. Muriate Potash....	8	9	17	272
4	No Manure	No Manure	7	8½	15½	248
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash....	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash....	9	6½	15½	248
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate ...	96 lbs Nitrate Soda, 240 lbs Acid Phosphate ..	26	10	36	576
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate .	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate ...	26	8½	34½	552
8	No Manure	No Manure	6	6	12	192
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash...	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate....	26	6½	32½	520
10	15 lbs. Floats	240 lbs. Floats.	30	6½	36½	584
11	6 lbs. Nitrate Soda, 15 lbs. Floats	96 lbs. Nitrate Soda, 240 lbs. Floats	25	8½	33½	536
12	No Manure	No Manure	8	8	16	256
13	53 lbs. Green Cot. Seed...	848 lbs. Green Cot. Seed..	21	9	30	480
14	15 lbs. Floats, 53 lbs. Green Cot. Seed...	240 lbs Floats, 848 lbs. Green Cot. Seed...	27½	9	36½	584
15	265 lbs. Stable Manure.....	4240 lbs. Stable Manure...	26	7	33	528
16	15 lbs. Acid Phosphate, 15 lbs. Cot. Seed Meal..	240 lbs. Acid Phosphate 240 lbs. Cot. Seed Meal.....	13	6½	19½	312

EXPERIMENT MADE BY MR. URIAH JOHNSON.

Trinity Station, Morgan County.

Soil, Red Sandy Loam; Sub-soil, Red Clay.

In Mr. Johnson's two years experiments it is clearly shown by the increased yield of plot No. 2 over 1 and 3, that phosphoric acid is the element most deficient in his soil, but in combination results are conflicting. In 1891 plot No. 9 gave 128 pounds more than plot No. 6, while in 1892 plot 6 gives 352 pounds increase over plot No. 9. Floats, with green cotton seed, give the best results in 1891, while floats with nitrate of soda give best results in 1892. Further experiments are necessary to be made on this soil before any conclusions can be drawn.

Plot No.	Pounds of Fertilizer per Acre.	Pounds of Fertilizer per Plot.	Lbs. cotton 1st picking.	Lbs. cotton 2nd picking.	Total yield per Plot.	Total yield per Acre
1	6 lbs. Nitrate Soda.......	96 lbs. Nitrate Soda	16	8	24	384
2	15 lbs. Acid Phosphate ...	240 lbs. Acid Phosphate .	34	6	40	640
3	4 lbs. Muriate Potash....	64 lbs. Muriate Potash....	14	8	22	352
4	No Manure.............	No Manure	12	8	20	320
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash....	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash....	18	10	28	448
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate ...	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate ...	32	10	62	992
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate ...	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate ...	34	8	42	672
8	No Manure.............	No Manure	12	8	20	320
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash....	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate ...	28	12	40	640
10	15 lbs. Floats	240 lbs. Floats.	22	6	28	448
11	6 lbs. Nitrate Soda, 15 lbs. Floats..........	96 lbs. Nitrate Soda, 240 lbs. Floats	32	8	40	640
12	No Manure.	No Manure...........	12	8	20	320
13	53 lbs. Green Cot. Seed...	848 lbs. Green Cot. Seed..	24	10	38	608
14	15 lbs. Floats, 53 lbs. Green Cot. Seed...	240 lbs. Floats, 848 lbs. Green Cot. Seed...	36	8	34	544
15	265 lbs. Stable Manure.....	4240 lbs. Stable Manure...	40	4	44	704
16	15 lbs. Acid Phosphate, 15 lbs. Cot. Seed Meal....	240 lbs. Acid Phosphate 240 lbs. Cot. Seed Meal.....	....	..	44	704

EXPERIMENT MADE BY J. C. KILLEBREW,

Newton, Dale County.

Soil, Sandy Loam; Subsoil, Red Clay.

In Mr. Killebrew's experiment for 1891, nothing is gained from the use of acid phosphate, as is shown when plot No. 6 is compared with plot No. 9, while in 1892 it is clearly seen that phosphoric acid is the leading element needed. The increase of plot No. 2 over average of unmanured plots 4, 8 and 12, is 256 pounds per acre. Plot No. 6 gives an increase of 288 pounds, and plot No. 9 gives 576 pounds increase. The results from plot No. 16 are very marked. In 1891 the increase over plot No. 9 is 16 pounds, but in 1892 it is 160 pounds per acre. Floats with green cotton seed, and floats with nitrate of soda, give same results in 1891, but in 1892 floats with green cotton seed give 544 pounds more than floats with nitrate of soda, but no more than green cotton seed alone, as in plot No. 13.

Plot No.	Pounds of Fertilizer per Acre.	Pounds of Fertilizer Per Plot.	Lbs. Cotton 1st picking.	Lbs. Cotton 2nd picking.	Lbs. Cotton 3rd picking.	Total yield per plot.	Total yield per acre.
1	6 lbs. Nitrate Soda....	96 lbs. Nitrate Soda. ..	14	20	8	42	672
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate..	20	18	12	50	800
3	4 lbs. Muriate Potash.	64 lbs. Muriate Potash..	12	10	12	34	544
4	No Manure...........	No Manure..........	14	10	10	34	544
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash.	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash .	16	14	12	42	672
6	6 lbs. Nitrate Soda, 5 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate	24	16	12	52	832
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	16	20	12	48	768
8	No Manure..........	No Manure..........	12	12	8	32	512
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	26	24	20	70	1120
10	15 lbs. Floats..........	240 lbs. Floats	14	16	6	36	576
11	6 lbs. Nitrate Soda, 15 lbs. Floats..........	96 lbs. Nitrate Soda, 240 lbs. Floats............	16	16	12	44	704
12	No Manure..........	No Manure	12	14	10	36	576
13	53 lbs. Green Cot. Seed	848 lbs. Green Cotton Seed	30	28	20	72	1248
14	15 lbs. Floats, 53 lbs. Green Cot. See.	240 lbs. Floats, 848 lbs. Green Cotton Seed	28	26	24	78	1248
15	265 lbs. Stable Manure.	4,240 lbs. Stable Manure..	32	36	20	88	1408
16	15 lbs. Acid Phosphate, 15 lbs. Cot'n Seed Meal	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal	32	30	18	80	1280

EXPERIMENT MADE BY J. A. LOGAN,

Clanton, Chilton County.

Soil, Mulatto and Sandy; Sub soil, Red Clay.

It is clearly shown by the results of two years' experiments made by Mr. Logan that his soil does not need potash. In 1891 plot 6 gave an increase over plot 9 of 112 pounds, and over plot No. 16 of 48 pounds; while in 1892 plot No. 6 gave 16 pounds more than plot No. 9, and 8 pounds more than plot No. 16.

These amounts are small but they are valuable facts, and show that it is a waste of money to use potash on such soils, as the yield of cotton is decreased. It should be stated here that cotton seed meal contains some potash, is why the comparison is made between plot No. 6 and plot No. 16. Floats with green cotton seed gave better results for the two years than floats with nitrate of soda.

Plot No.	Lbs Fertilizer Per Plot.	Lbs. Fertilizer Per Acre.	Lbs. Cotton 1st picking	Lbs. Cotton 2nd picking.	Lbs. Cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs nitrate soda ..	96 lbs. nitrate soda	11	20	4	38	608
2	15 lbs. acid phosphate	240 lbs. acid phosphate..	20	19	3	42	672
3	4 lbs. muriate potash.	64 lbs. muriate potash..	12½	19½	5½	37½	600
4	No manure.	No manure.....	10	17	5½	32½	520
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash..	10½	25	8½	42	672
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate..	30	28	6	64	1024
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate.	20	26½	7	54½	872
8	No manure.	No manure..........	10½	18½	6	35	560
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate...	23	33	7	63	1008
10	15 lbs. floats	240 lbs. floats	16	25	6	67	752
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	15	27½	80½	53	848
12	No manure..........	No manure..........	11½	20	8½	39	624
13	53 lbs. green cotton seed	848 lbs. green cotton seed	15	25½	15½	56	896
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed.	19½	28½	10	58	928
15	265 lbs. stable manure.	4240 lbs. stable manure...	28	30½	10½	69	1104
16	15 lbs. acid phosphate 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal.	22½	33	8	63½	1016

EXPERIMENT MADE BY MR. WILLIAM MARTIN,

GREENSBORO, HALE COUNTY.

oil, Sandy Loam; Subsoil, Clay.

No conclusions can be made from Mr. Martin's work, as we have only one year's experiment to compare. The following statement shows the results for 1892.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking	Lbs cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot	Total yield per Acre.
1	6 lbs. nitrate soda	96 lbs. nitrate soda .	30	10	8	48	768
2	15 lbs. acid phosphate	240 lbs. acid phosphate	20	20	4	44	704
3	4 lbs. muriate potash	64 lbs. muriate potash	30	10	6	46	736
4	No manure.	No manure	16	10	4	30	480
5	6 lbs. nitrate soda, 4 lbs muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash.	32	14	6	52	832
6	6 lbs. nitrate soda, 15 lbs. acid phosphate	96 lbs. nitrate soda, 240 lbs. acid phosphate.	36	32	10	78	1248
7	4 lbs. muriate potash 15 lbs. acid phosphate	64 lbs. muriate potasc, 240 lbs. acid phosphate.	68	16	20	104	1664
8	No manure. . . .	No manure	30	18	8	56	896
9	6 lbs. nitrate soda, 15 lbs acid phosphate, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate	50	20	14	84	1344
10	15 lbs. floats .	240 lbs. floats	52	16	16	84	1344
11	6 lbs nitrate soda, 15 lbs. floats.	96 lbs nitrate soda, 240 lbs. floats..........	32	10	12	54	864
12	No manure . .	No manure	42	16	8	66	1056
13	53 lbs green cotton seed	848 lbs. green cotton seed	68	16	12	96	1536
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	34	8	10	52	832
15	265 lbs. stable manure.	4240 lbs. stable manure	28	14	6	48	768
16	15 lbs. acid phosphate, 15 lbs cotton seed meal	240 lbs acid phosphate. 240 lbs cotton seed meal	36	12	10	58	928

EXPERIMENT MADE BY J. W. MIZE,

REMLAP, BLOUNT COUNTY.

Soil, Red Sandy; Sub-soil, Sticky, Mineral Nature.

In the experiments made by Mr. Mize nothing is gained by the use of potash. In 1891 plot No. 6 gave 144 pounds more than plot No. 9, and plot 16 gave 176 pounds increase over plot No. 9, while in 1892 plot No. 9 gives an increase of 8 pounds over plot No. 6 and 98 pounds over plot No. 16.

These results are conflicting, and no conclusion can be drawn. Floats, as in plots No. 11 and 14, gave same yield in 1891, while in 1892 floats, with green cotton seed, give an increase of 224 pounds over nitrate of soda with floats.

Plot No.	LBS FERTILIZER PER PLOT.	LBS. FERTILIZER PER ACRE.	Lbs. Cotton 1st picking	Lbs. Cotton 2nd picking.	Lbs. Cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda	96 lbs. nitrate soda......	4	7	2	13	208
2	15 lbs. acid phosphate	240 lbs. acid phosphate...	15	16½	8	39½	632
3	4 lbs. muriate potash.	64 lbs. muriate potash...	4½	7½	2½	14½	232
4	No manure...........	No manure..............	3½	5	2	10½	168
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash..	5½	8	4	17½	280
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate...	16½	19	10	45½	728
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate...	12½	15½	6	34	544
8	No manure..........	No manure..........	4	6½	1½	12	192
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate...	18	20	8	46	736
10	15 lbs. floats	240 lbs. floats	6	8½	3	17½	280
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	5	6½	3½	15	240
12	No manure..........	No manure..........	3½	7	4	14½	232
13	53 lbs. green cotton seed	848 lbs. green cotton seed.	4½	6	3½	14	224
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed.	10½	13	5½	29	464
15	265 lbs. stable manure..	4240 lbs. stable manure...	12	15½	6	33½	536
16	15 lbs. acid phosphate. 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal.	14½	17	9	40½	648

EXPERIMENT MADE BY W. H. NEWMAN.

Reported by B. M. Duggar, Canebrake Experiment Station, Uniontown, Perry County.

The following tabulated statement is the result of the experiment as conducted on the Uniontown Experiment Station:

Plot No.	Pounds of Fertilize per Plot.	Pounds of Fertilizer Per Acre.	Lbs. Cotton 1st Picking.	Lbs. Cotton 2nd Picking.	Lbs. Cotton 3rd Picking.	Lbs. Cotton 4th Picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda ...	96 lbs. Nitrate Soda.....	9	35½	17	....	61½	984
2	15 lbs. Acid Phosphate..	240 lbs. Acid Phosphate..	16½	54½	22½	..	93½	1496
3	4 lbs. Muriate Potash...	64 lbs. Muriate Potash...	17	37½	19	..	73½	1176
4	No Manure............	No Manure..........	14½	42½	20½	..	77½	1240
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash...	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash...	14½	30	14	..	58½	936
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate..	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate..	13½	24½	11½	..	49½	792
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate .	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	6½	24½	9	..	40	640
8	No Manure...........	No Manure....	9	31	21	..	60	960
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash..	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	12	32½	21	....	65½	1048
10	15 lbs. Floats...........	240 lbs. Floats	15	24½	10½	..	50	800
11	6 lbs. Nitrate Soda, 15 lbs. Floats......	96 lbs. Nitrate Soda, 240 lbs. Floats..	14	25½	8	....	47½	760
12	No Manure........ ..	No Manure..... ...	18	29	13	...	60	960
13	53 lbs. Green CottonSeed	848 lbs. Green CottonSeed	12	24½	7	...	43½	696
14	15 lbs. Floats, 53 lbs. Green CottonSeed	240 lbs. Floats, 848 lbs. Green CottonSeed	15	31½	8½	..	55	880
15	265 lbs. Stable Manure	4,240 lbs. Stable Manure	13	23½	4½	...	41	656
16	15 lbs. Acid Phosphate, 15 lbs. Cotton Seed Meal	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal.	15	17	3½	...	35½	568

EXPERIMENT MADE BY J. P. OLIVER,

DADEVILLE, TALLAPOOSA COUNTY.

Soil, Gray Sandy; Subsoil, Clay.

In Mr. Oliver's experiments for the two years the indications are that his soil is deficient in the three main elements of plant food. In 1891 plot No. 9 gave best results, and in 1892 plots No. 9 and 16 gave the same yield. Floats with green cotton seed gave best results in 1891, while floats and nitrate of soda gave best resnlts in 1892.

Plot No.	Pounds Fertilizers per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking.	Lbs. cotton 2nd picking.	Lbs. cotton 3rd picking.	Lbs cotton 4th picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda..	96 lbs. nitrate soda	0	5	3	$6\frac{1}{2}$	$34\frac{1}{2}$	232
2	15 lbs. acid phosphate	240 lbs. acid phosphate	7	3	5	3	18	288
3	4 lbs. muriate potash	64 lbs muriate potash	0	4	$3\frac{1}{2}$	8	$15\frac{1}{2}$	248
4	No manure ...	No manure	0	1	2	8	11	176
5	6 lbs nitrate soda, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash	0	3	$2\frac{1}{2}$	9	$14\frac{1}{2}$	232
6	6 lbs. nitrate soda, 15 lbs acid phosphate	96 lbs. nitrate soda, 240 lbs. acid phosphate	17	23	6	3	49	784
7	4 lbs. muriate potash 15 lbs. acid phosphate	64 lbs. muriate potash, 240 lbs. acid phosphate	8	9	7	5	39	624
8	No manure	No manure.	0	2	3	6	11	176
9	6 lbs. nitrate soda, 15 lbs. acid phosphate 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate.	14	24	7	7	52	832
10	15 lbs floats	240 lbs. floats	6	$16\frac{1}{2}$	$7\frac{1}{2}$	8	38	608
11	6 lbs. nitrate soda, 15 lbs. floats ...	96 lbs. nitrate soda, 240 lbs. floats	12	$22\frac{1}{2}$	9	8	$51\frac{1}{2}$	824
12	No manure.	No manure.	0	4	4	9	17	272
13	53 lbs green cot. seed	848 lbs. green cotton seed	12	16	$7\frac{1}{2}$	6	$41\frac{1}{2}$	664
14	15 lbs. floats, 53 lbs. green cot. seed	240 lbs. floats, 848 lbs. green cotton seed	12	16	$8\frac{1}{2}$	4	$40\frac{1}{2}$	648
15	265 lbs. stable manure	4240 lbs. stable manure	18	23	$6\frac{1}{2}$	3	$50\frac{1}{2}$	808
16	15 lbs. acid phosphate, 15 lbs. cot. seed meal.	240 lbs. acid phosphate, 240 lbs. cotton seed meal	22	22	6	2	52	832

EXPERIMENT MADE BY J. C. OTT,

Florence, Lauderdale County.

Soil, Grey and Gravelly; Subsoil, Clay.

No experiment was reported by Mr. Ott for 1891. Conclusions cannot be drawn from one year's work. The following statement shows results for 1892.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer Per Acre.	Lbs. Cotton 1st Picking	Lbs. Cotton 2nd Picking	Lbs. Cotton 3rd Picking	Lbs. Cotton 4th Picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. Nitrate Soda	96 lbs. Nitrate Soda	12	12	16	10	50	800
2	15 lbs. Acid Phos ..	240 lbs. Acid Phosphate	12	10	12	8	42	672
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash.	8	10	14	8	40	640
4	No Manure	No Manure	6	8	12	8	34	544
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda. 64 lbs. Muriate Potash	10	14	14	10	48	768
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate.	18	16	20	12	66	1058
7	4 lbs. Muriate Potash 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate.	14	14	14	10	52	832
8	No Manure. ..	No Manure.	10	10	12	8	40	640
9	6 lbs. Nitrate Soda, . 15 lbs. Acid Phosphate 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	18	18	22	14	72	1132
10	15 lbs. Floats .	240 lbs. Floats	10	10	16	10	46	736
11	6 lbs. Nitrate Soda, 15 lbs. Floats.	96 lbs. Nitrate Soda, 240 lbs. Floats	12	12	22	10	56	896
12	No Manure ...	No Manure .	8	8	14	8	38	608
13	53 lbs. Green Cot. Seed	848 lbs. Green Cot. Seed	14	18	18	12	62	992
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs. Floats, 848 lbs. Green Cot. Seed	12	12	14	10	48	768
15	265 lbs. Stable Manure	4240 lbs. Stable Manure.	12	10	16	10	48	768
16	15 lbs Acid Phosphate 15 lbs. Cot. Seed Meal,	240 lbs. Acid Phosphate 240 lbs. Cot Seed Meal	18	18	12	10	58	928

EXPERIMENT MADE BY J. W. PITTS,

Creswell Station, Shelby County.

Soil, Thin Brown or Mulatto; Sub-soil, Stiff Clay.

In this experiment it is clearly shown in two years' results that potash is not needed in this soil. Comment seems unnecessary. In 1891 plot No. 6 gave an increase over plot No. 9 of 48 pounds, and plot 16 gave 112 pounds more than plot No. 9. In 1892 plot No. 6 gave 208 pounds more than plot No. 9, and plot No. 16 gave 192 pounds more than plot No. 9. These are not large amounts, but they are hard facts, and Mr. Pitts is wasting money when he buys potash for his soil.

Floats with green cotton seed give best results in 1891, while floats with nitrate of soda give an increase in 1892.

Plot No.	Pounds Fertilizer per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot.	Total yield pr Acree.
1	6 lbs. nitrate soda ...	96 lbs. nitrate soda ...	9	10	9	28	448
2	15 lbs. acid phosphate..	240 lbs. acid phosphate..	29	21	10	60	960
3	4 lbs. muriate potash. .	64 lbs. muriate potash	7	10	11	28	448
4	No manure..........	No manure	2	7	4	13	208
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda 64 lbs. muriate potash	2	3	6	11	176
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate	35	17	5	57	912
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 250 lbs. acid phosphate	21	13	5	39	624
8	No manure.........	No manure......... ..	3	3	4	10	160
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate .	28	13	3	44	704
10	15 lbs. floats..........	240 lbs. floats	13	9	5	27	432
11	6 lbs. nitrate soda, 15 lbs. floats..........	96 lbs. nitrate soda, 240 lbs. floats	23	14	7	44	704
12	No manure.	No manure	5	4	4	13	208
13	53 lbs. green cotton seed	848 lbs. green cotton seed	8	6	6	20	320
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	17	13	8	38	608
15	265 lbs. stable manure. .	4240 lbs. stable manure	46	25	8	79	1364
16	15 lbs. acid phosphate, 15 lbscotton seed meal .	240 lbs, acid phosphate, 240 lbs. cotton seed meal	41	12	3	56	896

EXPERIMENT MADE BY S. A. PRUITT,

Chess, Pike County.

Soil, Light Sandy; Sub-soil, Red and Yellow Sandy.

The best results in this experiment for the two years are from plot 16—cotton seed meal with acid phosphate. Plot No. 9, complete fertilizer, gave a marked increase over plot No. 6 for each year, and the indications are that the soil is deficient in the three main elements of plant food. Floats with green cotton seed give a decided increase over floats with nitrate of soda for the two years

Plot No.	Pounds Fertilizer Per Plot.	Pounds Fertilizer Per Acre.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking	Lbs. cotton 3rd picking	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ..	96 lbs. nitrate soda ..	24	14	....	38	608
2	15 lbs. acid phosphate	240 lbs. acid phosphate	40	40	..	80	1280
3	4 lbs. muriate potash.	64 lbs. muriate potash	28	14	....	42	672
4	No manure..........	No manure.........	28	16	....	44	704
5	6 lbs. nitrate soda, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash	30	18	..	48	768
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate	40	22	..	62	992
7	4 lbs. murate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate	28	12	...	40	640
8	No manure.	No manure.........	32	12	...	44	704
9	6 lbs. nitrate soda, 15 lbs acid phosphate, 4 lbs. muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate	52	24	...	76	1216
10	15 lbs. floats	240 lbs. floats.........	36	18	...	54	864
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	40	22	..	62	992
12	No manure.	No manure.	32	12	...	44	704
13	53 lbs. green cotton seed	848 lbs. green cotton seed	36	22	..	58	928
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs. green cotton seed	40	30	..	70	1120
15	265 lbs. stable manure..	4240 lbs. stable manure..	52	28	..	80	1280
16	15 lbs. acid phosphate, 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal	56	28	...	84	1344

EXPERIMENT MADE BY J. H. RADNEY,

ROANOKE, RANDOLPH COUNTY.

Soil, Sandy Loam; Subsoil, Clay.

Results of Mr. Radney's experiments are so conflicting that further work will have to be done before any conclusions can be drawn. His best results in 1891 are from plot No. 6, nitrate of soda with acid phosphate; while in 1892, plot No. 9, complete fertilizer, gives 136 pounds more than plot No. 6, and plot 16 gives an increase of 398 pounds over plot No. 6. Where floats with nitrogen are compared, floats with nitrate of soda give best results in 1891, while floats with green cotton seed give best results in 1892.

Plot No	Pounds Fertilizer Per Plot.	Pounds Fertilizer Per Acre.	Lbs. cotton 1st picking	Lbs. cotton 2nd picking	Lbs. cotton 3rd picking	Lbs. cotton 4th pick'ng	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda	96 lbs. nitrate soda	2	5	6	2	15	240
2	15 lbs. acid phosphate	240 lbs. acid phosphate	10	12	14	3	39	624
3	4 lbs. muriate potash	64 lbs. muriate potash	3	6	5	2	16	256
4	No manure	No manure.	2	4	6	1	13	208
5	6 lbs. nitrate soda, 4 lbs muriate potash	96 lbs. nitrate soda, 64 lbs. muriate potash	2	5	8	2	17	272
6	6 lbs nitrate soda, 15 lbs. acid phosphate	96 lbs. nitrate soda, 240 lbs. acid phosphate	16	15	10	2½	43½	696
7	4 lbs. murate potash, 15 lbs. acid phosphate	64 lbs. muriate potash, 240 lbs. acid phosphate	6	8	12	1	27	432
8	No manure. ..	No manure.	1	4	7	2	16	256
9	6 lbs. nitrate soda, 15 lbs acid phosphate, 4 lbs. muriate potash	96 lbs nitrate soda, 64 lbs. muriate potash, 240 lbs acid phosphate	13	20	18	1	52	832
10	15 lbs. floats	240 lbs. floats ..	2	4	3	2	11	176
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs floats	9	12	8	3	32	512
12	No manure.	No manure.	1	5	4	2	12	192
13	53 lbs. green cot. seed.	848 lbs. green cotton seed	..	..	..			...
14	15 lbs. floats, 53 lbs. green cot. seed	240 lbs. floats, 848 lbs. green cotton seed	17	15	10	3	45	720
15	265 lbs stable manure	4240 lbs. stable manure.	..	.	..	..	..	...
16	15 lbs. acid phs'phate, 15 lbs. cot. seed meal.	240 lbs. acid phosphate, 240 lbs. cotton seed meal	23	25	20	1	69	1094

EXPERIMENT MADE BY W. H. SELLERS.

GENEVA, GENEVA COUNTY.

Soil, Sandy; Subsoil, Red Clay and Sand.

The indications are, from results of two years' experiments by Mr. Sellers, that his soil is deficient in the three main elements of plant food, as plot No. 9 gives best results for the two years' work. No comparison can be made as to floats with nitrogen. No results having been reported from floats and green cotton seed in 1891.

Plot No.	Pounds of Fertilizer per Acre.	Pounds of Fertilizer Per Plot.	Lbs. Cotton 1st picking	Lbs. Cotton 2nd picking	Lbs. Cotton 3rd picking	Total yield per plot.	Total yield per acre.
1	6 lbs. Nitrate Soda....	96 lbs. Nitrate Soda. ..	...		.	8½	136
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate.	.	..	.	18	288
3	4 lbs. Muriate Potash	64 lbs. Muriate Potash .	.	...	.	13	208
4	No Manure.	No Manure			..	9	144
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash..	..			13	208
6	6 lbs. Nitrate Soda, 5 lbs. Acid Phosphate	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate	..	...	..	26	416
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	..	...	.	21	336
8	No Manure..	No Manure	..	.	.	8½	136
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate	..	..	..	28	448
10	15 lbs. Floats..	240 lbs. Floats	...	...	.	13	208
11	6 lbs. Nitrate Soda, 15 lbs. Floats....... ...	96 lbs. Nitrate Soda, 240 lbs. Floats	..	..	..	17	272
12	No Manure	No Manure	...	...		9	144
13	53 lbs. Green Cot. Seed	848 lbs. Green Cotton Seed	..			13	208
14	15 lbs Floats, 53 lbs. Green Cot. See	240 lbs. Floats, 848 lbs. Green Cotton Seed	..	..	.	17	272
15	265 lbs. Stable Manure	4,240 lbs Stable Manure .	..	..	...	17	272
16	15 lbs. Acid Phosphate, 15 lbs. Cot'n Seed Meal	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal	..	..	..	17½	280

EXPERIMENT MADE BY T. A. SNUGGS.

Holly Pond, Cullman County.

Soil, Sandy and Gravelly; Subsoil, Yellow Sandy.

The two years work of Mr. Snuggs clearly shows that his soil is deficient in the three main elements of plant food, as plot No. 9 gave a large increase over everything for the two years, when floats with nitrogen are compared. Floats with green cotton seed give best results for each year.

Plot No.	Pounds Fertilizers per Plot.	Pounds Fertilizer per Acre.	Lbs. cotton 1st picking.	Lbs. cotton 2nd picking.	Lbs. cotton 3rd picking.	Total yield per Plot.	Total yield per Acre.
1	6 lbs. nitrate soda ...	96 lbs. nitrate soda ..	15	16	6½	37½	600
2	15 lbs. acid phosphate.	240 lbs. acid phosphate.	22	17½	6	45½	728
3	4 lbs. muriate potash	64 lbs. muriate potash.	12½	16½	10½	39½	632
4	No manure	No manure	13	16½	11	40½	648
5	6 lbs. nitrate soda, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash.	12½	19	14	45½	728
6	6 lbs. nitrate soda, 15 lbs. acid phosphate.	96 lbs. nitrate soda, 240 lbs. acid phosphate.	31	23	8½	62½	1000
7	4 lbs. muriate potash, 15 lbs. acid phosphate.	64 lbs. muriate potash, 240 lbs. acid phosphate.	28	23½	8½	60	960
8	No manure	No manure.	14½	18	9½	42	672
9	6 lbs. nitrate soda, 15 lbs. acid phosphate, 4 lbs. muriate potash.	96 lbs. nitrate soda, 64 lbs. muriate potash, 240 lbs. acid phosphate.	32½	23½	9½	65½	1048
10	15 lbs. floats	240 lbs. floats	14	17	9	40	640
11	6 lbs. nitrate soda, 15 lbs. floats	96 lbs. nitrate soda, 240 lbs. floats	16½	25½	17	59	944
12	No manure.	No manure...........	13½	17	12	42½	680
13	53 lbs. green cotton seed	848 lbs. green cotton seed	18	21	10	49	784
14	15 lbs. floats, 53 lbs. green cotton seed	240 lbs. floats, 848 lbs green cotton seed	16	20½	14	50½	808
15	265 lbs. stable manure	4240 lbs. stable manure	30	24½	10½	65	1040
16	15 lbs. acid phosphate, 15 lbs. cotton seed meal	240 lbs. acid phosphate, 240 lbs. cotton seed meal	20	18½	11	49½	792

EXPERIMENT MADE BY Mr. Z. T. STROUD,

Aberfoil, Bullock County.

Soil, Light Gray; Sub-soil, Clay.

It is clearly shown by the results of two year's experiments by Mr. Stroud that his soil is different in the three main elements of plant food as plot No. 9 give best results for two years.

When floats with nitrogen are compared, floats with green cotton seed give best results for the two years.

Plot No.	Pounds of Fertilizer Per Plot.	Pounds of Fertilizer per Acre.	Lbs. Cotton 1st pick'ng	Lbs. Cotton 2nd picking	Lbs. Cotton 3rd picking.	Total yield per Plot.	Total yield per Acre
1	6 lbs. Nitrate Soda..	96 lbs. Nitrate Soda.....	9	4	..	13	208
2	15 lbs. Acid Phosphate	240 lbs. Acid Phosphate..	8	2	..	10	160
3	4 lbs. Muriate Potash...	64 lbs. Muriate Potash..	9	5	...	14	224
4	No Manure..	No Manure..	6	1	..	7	112
5	6 lbs. Nitrate Soda, 4 lbs. Muriate Potash	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash..	19	9	...	28	448
6	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate.	96 lbs. Nitrate Soda, 240 lbs. Acid Phosphate.	15	2	....	17	272
7	4 lbs. Muriate Potash, 15 lbs. Acid Phosphate.	64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	16	8	...	24	384
8	No Manure	No Manure..	5	2½	....	7½	120
9	6 lbs. Nitrate Soda, 15 lbs. Acid Phosphate. 4 lbs. Muriate Potash.	96 lbs. Nitrate Soda, 64 lbs. Muriate Potash, 240 lbs. Acid Phosphate..	31	9	....	40	640
10	15 lbs. Floats.	240 lbs. Floats.	6½	1	..	7½	120
11	6 lbs. Nitrate Soda, 15 lbs. Floats..........	96 lbs. Nitrate Soda, 240 lbs Floats.	8	1	....	9	144
12	No Manure..	No Manure......... ..	6	1	..	7	112
13	53 lbs. Green Cot. Seed	848 lbs. Green Cotton Seed	20	2	..	22	352
14	15 lbs. Floats, 53 lbs. Green Cot. Seed	240 lbs. Floats, 848 lbs. Green Cotton Seed	20	2	...	22	352
15	265 lbs. Stable Manure.	4,240 lbs. Stable Manure	24	3	....	27	432
16	15 lbs. Acid Phosphate 15 lbs. Cot. Seed Meal.	240 lbs. Acid Phosphate, 240 lbs. Cotton Seed Meal.	18	2	..	20	320

Summary.

Thirty-six reports were received by this station from forty-two experiments begun in 1891, and twenty-five out of thirty-six reported results in 1892, from which the following is gathered by comparing results for two years:

Seven of these soils are deficient in the three main elements of plant food, and are benefited by the use of a complete fertilizer, as in plot No. 9, while eight of them are not deficient in potash as is shown by the increased yield of plot No. 6, nitrogen and phosphoric acid, over plot No. 9, complete fertilizer. In the balance of the experiments results are too conflicting for any conclusions to be drawn.

FLOATS WITH NITROGEN.

It will be found by comparing results of floats and nitrate of soda with floats and green cotton seed for two years, that only in one experiment has nitrate of soda with floats given best results, while fourteen give best results to floats with green cotton seed and the balance of the results are conflicting.

It will be seen from the foregoing that floats with green cotton seed give best result sand the thought is suggested that as nitrate of soda is more easily leached from the soil and more readily taken up by the plant, the supply.of nitrogen is exhausted in an earlier state of the plant's growth, but the opposite conditions existing in green cotton seed, the nitrogen, being less available, gives the support to the plant during the entire growing season and thus coming in contact with the floats for a greater length of time makes them more available.

Bulletin No. 43, : : : May, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

EYE DISEASES OF DOMESTIC ANIMALS,

BY C. A. CARY.

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EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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Page 6, line 7 of explanation of fig. 1, for "equeous" read *aqueous.*

Page 6, line 13 of explanation of fig. 1, for "samal" read *small.*

Page 10, lines 22, 24, 32 for "agueous" read *aqueous.*

Page 11, line 1 for "agueous" read *aqueous.*

Page 11, lines 23, 28 for "vitrious" read *vitreous.*

Page 11, line 33 for "Membrane" read *Membrana.*

Page 12, line 19 for "membrane" read *membrana.*

Page 15, line 4 for "Costic" read *Caustic.*

Page 15, line 13 for "stiches" read *stitches.*

Page 17, line 10 for "conjested" read *congested.*

Page 21, line 31 for "incision" read *excision.*

Page 23, line 14 for "diptheretic" read *diptheritic.*

Page 23, line 15 for "conjunctivitas" and "fallicular" read *conjunctivitis* and *follicular.*

Page 27, line 18 for "conjested" read *congested.*

Page 29, line 3 for "agueous" read *aqueous.*

Page 30, line 2 for "conjested" read *congested.*

Page 30, line 6 for "is" read *are.*

Page 43, line 1 of explanation of fig. 13, for "Luxuration" read *Luxation.*

Page 48, line 17 for "Exothalmus" read *Exopthalmus.*

Page 50, line 4 after "is" insert *found.*

Page 59, line 10 for "Wallach" read *Willach.*

Page 63, line 2 for "appearances" read *appearance.*

Page 64, line 12 for "attscks" read *attacks.*

ANATOMY OF THE HORSE'S EYE.

[When reading note the location of the parts of the eye as illustrated in Fig. 1.]

The eyeball or globe is a spherical shell whose interior is filled with liquid or semi-liquid parts, called the humors or refracting media of the eye.

The wall or shell of the eye is formed by three distinct coats—the external, the middle and the internal.

The outer or external coat is divided into two distinct parts—the sclerotica and the cornea.

The sclerotic is a very tough, white membrane, forming about four-fifths of the outer coat of the eye. The muscles that move the eyeball are attached to the back part and the outer surface of the sclerotica. Its internal surface is loosely united to the middle or choroid coat of the eye by small blood vessels, nerves and loose fibrous tissue. In front, the sclerotica shows an elliptical opening with its greatest diameter from side to side and shortest diameter from above to below; the edge or border of this opening is bevelled on the inner side, and the cornea fits in it as the watch crystal fits in the watch case.

The sclerotic is well supplied with blood vessels and nerves, and a little below the middle of the back part, the optic nerve passes through it and the choroid to form the retina or internal coat.

The cornea is a very transparent membrane forming the anterior part (about one-fifth) of the external coat of the eye. Its outline is elliptical, like the opening it closes. It consists, from without to within, of the following layers:

The external layer is the conjunctival epithelium spread over the outer surface of the cornea; in some animals this layer is not separated from the middle layer by a thin elastic limitary membrane, called Bowman's membrane.

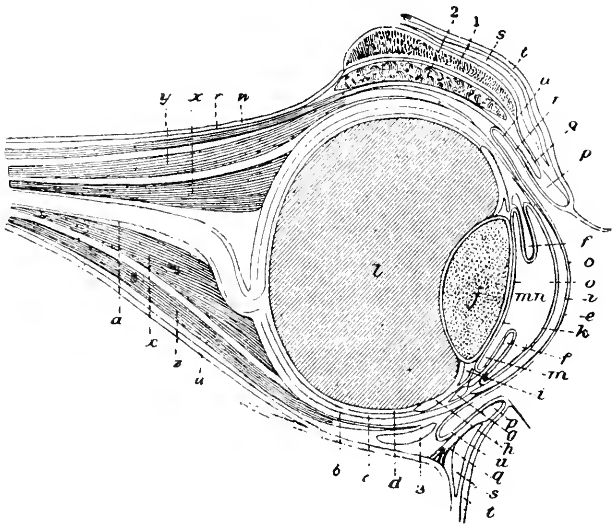

FIG. 1.

Diagramatic Section of the Horse's Eye (after D'Arboval) showing the relative position of the various parts. In reading the description of the anatomy of the eye frequent reference should be made to this cut.

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a, Optic nerve; *b*, Sclerotic; *c*, Choroid; *d*, Retina; *e*, Cornea; *f*, Iris; *g*, *h*, Ciliary circle, (or ligament) and processes given off by the choroid though represented as isolated from it, in order to indicate their limits more clearly; *i*, insertion of the ciliary processes on the crystalline lens; *j*, Crystalline lens; *k*, Crystalline capsule; *l*, Vitreous body; *m*, *n*, Anterior and posterior chambers; *o*, Theoretical indication of the membrane of the equeous humour; *p*, *p*, Tarsi; *q*, *q*, Fibrous membrane of the eyelids; *r*, Elevator muscle of the upper eyelid; *s*, *s*, Orbicularis muscle of the eyelids; *t*, *t*, Skin of the eyelids; *u*, Conjunctiva; *v*, Epidermic layer of this membrane covering the Cornea; *x*, Posterior rectus muscle; *y*, Superior rectus muscle; *z*, Inferior rectus muscle; *w*, Fibrous sheath of the orbit (or orbital membrane); 1, Section of orbital arch; 2, Lachrymal gland; 3, Section of samal oblique muscle.

The middle layer is the principal and the thickest part of the cornea; it is fibrous, tough, unyielding and continuous, with the sclerotic; its external surface, in most animals, is covered with Bowman's elastic limitary membrane and its inner surface is separated from the internal layer of the cornea by Descemet's elastic limitary membrane.

The internal layer is composed of a single layer of many sided cells which contain large neuclei. The cornea has but few blood vessels. The vessels form loops around its border, and in the sheep they advance to the middle of its surface.

The middle coat of the eyeball consists of the choroid, the ciliary processes and the iris.

The choroid is a thin, vascular, dark colored membrane, spread over the inner surface of the sclerotic, investing the posterior four-fifths of the eyeball, and terminating, in front, at the ciliary ligament; there bending inward to form the ciliary processes.

The choroid is divided into two zones or unequal parts by the *ora serrata*—a zigzag line that corresponds to the point where the retina changes its character or near the anterior border of the retina. The posterior zone or part, in the horse, is not uniform in color, being perfectly black in the lower part; this is abruptly terminated at a horizontal line that passes about one-eighth of an inch above the place where the optic nerve passes through the sclerotic and choroid. From this line on the segment of a circle from two to three-fifths of an inch in height it shows most brilliant colors: at first blue, then an azure-blue, afterwards a brownish blue, and after this the remainder of the eye is occupied by an intense black. The bright portion, or upper half of the choroid is the *tapetum*. The anterior zone or ciliary part of the choroid includes the ciliary ligament and the ciliary body. The ciliary muscle circle or ligament is a grayish circular band of unstriped muscular fibres about one-sixteenth of an inch broad; the fibres are radial and circular, the former arises from the junction of the cornea and sclerotic to pass back to the choroid opposite the ciliary processes; the latter are internal and pursue a circular course around the place of attachment of the iris.

By the contractions of this muscle, it plays an important part in accommodating or adjusting the eye to the perception of objects at different distances.

The ciliary body forms a ring which overlaps before and behind the ciliary muscle and lies between the choroid and iris, or rather it connects the choroid to the iris.

The *ciliary processes* consist of 110 to 120 radiating folds formed by the plaiting and folding inward of the choroid at its anterior margin; these are received between the corresponding folds of the suspensory ligament of the lens.

The dark color of the choroid is due to the coloring matter, pigment in the cellular or internal layer of this membrane. The pigment absorbs the rays of light which pass through the retina and thus prevents their becoming reflected and confusing the vision. The brilliant metallic colored tapetum is generally observed in nocturnal animals (horse, etc.), and especially in the carnivora. It is believed that by reflecting rays of light a second time through the retina, it gives the animal a clearer and better vision at night.

This is the cause of the glare or "balls of fire" perceived in the eyes of the cat and other carnivora in the dark.

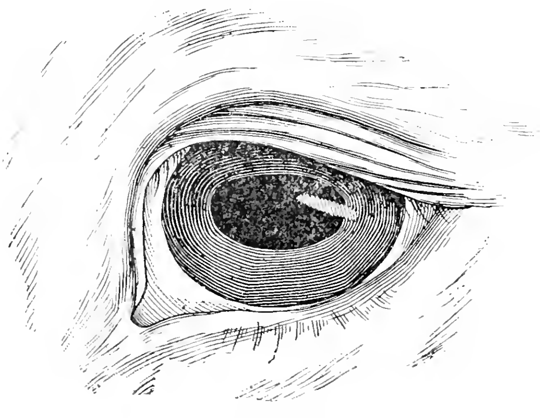

FIG. 2.
Normal Horses Eye (after Goubaux and Barrier).

The iris is elliptical in shape like the cornea; it is a thin, perforated, contractile curtain, suspended behind the cornea in the aqueous humor, in front of the crystalline lens, forming the anterior portion of the middle coat of the eyeball; it is composed of radiating and circular muscular fibres and a fibrous frame work. Its anterior surface is covered by a layer of polyhedral cells on a fine basement membrane; its posterior face is opposite the lens and ciliary processes, and is covered by a thick layer of pigment called the uvea; loose preduncalated portions of this pigmented layer may project through the pupillary aperture; they most frequently project from the superior border of the pupil and extend into the anterior part of the aqueous chamber, where they are known as "soot balls" or *corpora nigra*. These black, spongy masses may obstruct the passing of the light into the eye, but if they are small, little harm is done by them. These "soot balls" are brownish black and are larger when along the upper border of the pupil than when at the lower border.

The color of the eye depends upon the quantity of pigment in the uveal layer of the iris. In man, the color of the iris varies with the different individuals; while in the horse it is generally of a brownish yellow hue; sometimes, however, it is nearly white or bright gray—the animal possessing such eyes is said to be "wall eyed." The aperture or elliptical central opening in the iris forms the pupil, which is expanded or enlarged when the radial muscular fibres of the iris contract; and it is contracted or decreased in size when the circular muscular fibres contract. Strong sunlight produces contraction of the pupil; while weak light or darkness causes the pupil to expand.

The internal coat of the eyeball or shell is the retina. It lies on the inner surface of the choroid to which it loosely adheres.

This most essential, delicate, grayish, transparent, nervous membrane is thicker behind than in front, and extends as far forward as the ciliary body, terminating in a ragged edge—called the *ora serrata.* The retina is formed by the expansion of the optic nerve; the nervous elements are imbedded in and spread over a fibrous frame-work. At the point of entrance of the optic nerve is found, on the retina, a small oval elevation, known as *optic pupilla.* From its centre and its border emerge and radiate the blood vessels of the retina. This disc or elevation is the only portion of the retina where the sense of vision is wanting, and is, in consequence, called the *blind spot.* In the exact centre of the retina posteriorly corresponding to the axis of the eye, is a triangular yellow space called the *macula lutea*—the spot where vision is most distinct and perfect. The extreme complexity in the arrangement of the nervous elements of the retina may be partially comprehended by the fact that they are divided into ten different microscopic layers. These various nervous elements receive the impression of the inverted image or picture of the object or objects in the field of vision and the optic nerve conveys this impression or perception to the brain.

The humors or semiliquids of the eye are the Agueous Humor, the Vitreous Humor and the Crystalline Lens.

The agueous humor is a watery liquid that is found in the small chambers in front and behind the iris. It is secreted by Descemet's membrane, which lines the chambers containing the humor. This humor maintains the convexity of the cornea, facilitates movements of the iris and the lens, and, to some extent, assists in the refraction of the light passing through it to the lens and the retina.

If by surgical operation, accident or disease, this humor is permitted to escape from the agueous chambers, it is rapidly regenerated.

The crystalline lens is a double convex, clear, semi-solid body, and lies behind the pupil with its anterior surface immersed in the agueous humor and its posterior face imbedded in the vitrious.

The suspensory ligament extends from its periphery to the ciliary body and thus assists in holding the lens in position and establishes a union between it and the ciliary muscle. The lens is enveloped by an elastic capsule very like Descemet's layer of the cornea. The proper tissue of the lens is arranged in concentric layers that under the microscope are found to be composed of fibres; the external layers of the lens are almost liquid, but they gradually increase in hardness toward the center. The lens receives neither blood vessels nor nerves; it absorbs its nutriment from its capsule through a delicate layer of cells on its surface.

The anterior surface of the lens is flatter or less convex than its posterior surface. By the contraction of the ciliary muscle the convexity of the lens is changed and the degree of refraction varies; thus the eye is adjusted for, or made to accommodate itself to, different distances. The chief use of the lens is to refract (change the direction of or bend) the rays of light, which enter the eye. It causes the rays to converge or unite or focus upon the retina.

The vitrious humor occupies about two-thirds of the interior of the eye—all of the cavity of the eye behind the crystalline lens. It is transparent, colorless, jelly-like in consistency and contains a few embryonic cells, while its major part is amorphous or without distinct parts. The hyaloid membrane envelopes the vitrious mass and is in contact externally with the retina and the posterior convex surface of the lens. This humor assists in the refraction of light. If it escapes, it is not regenerated.

The accessory organs of the eye are the Orbital Cavity, the Muscles of the Eye, the Eye Lids, the Membrane Nictitans and the Lachrymal Apparatus.

The orbital cavity is situated at the side of the head, near the union of the cranium and face; it has the form of a long and fibrous cone open at the base or in front, with the optic nerve entering the small foramen at its apex or back part.

The muscles of the eye are seven in number: the posterior, the superior, the inferior, the external, the internal, the superior great oblique and the inferior small oblique. These muscles all lie in the orbital cavity behind the eyeball; their posterior ends are attached to bony walls of the posterior part of the orbital cavity; while their anterior ends are attached to the surface of the sclerotic—each one to that part of the sclerotic surface indicated by its special name.

The eyeball is turned upward, downward, outward, inward, etc., according the contraction of one of these special muscles. If the internal muscle is stronger or shorter than the external the eye is turned inward, and if held in that relative position constantly the condition of "cross eye" is produced.

The protective organs of the eye are the eye lids and the membrane nictitans. The eyelids are two movable curtains covering and protecting the front of the eye. They are attached by their external borders to the rim of the bony orbit: their external surfaces are covered by the skin; their internal faces are moulded on the anterior surface of the eye, and are lined by the conjunctiva—a mucous membrane which is also reflected above and below on the eyeball—(the conjunctiva is very sensitive and vascular and is painfully irritated by small seeds, particles of dirt, etc., that may get "into the eye"). The framework of the lids is formed by a fibrous plate attached to the orbital rim and terminating at the free border of each lid by a small tendinous arch called the tarsus. Attached to the outer surface of this fibrous plate, common to both lids, is the orbicular or sphincter muscle of the eyelids, which by its contraction "closes the eye" or brings the free borders of the eyelids together. The elevator muscle pulls the superior lid upward, and the lower lid drops when the orbicular muscle ceases to contract; thus the eye is opened.

On the outer part of the free border of the upper lid are large eye lashes—but the lashes of the lower lid are fewer in number and smaller. On the inner part of the free border of each lid are little oil glands which lubricate the free margins of the lids and keep them from growing together or adhering to one another during sleep.

The membrana nictitans, third eyelid, the "haw," or the eye washer," is placed at the inner angle of the eye; its framework is a fibro-cartilage, elastic and irregular in shape, thick at its back part, and thin at its anterior or free part, which is covered by the conjunctiva. This lid is continued behind by a strong, fatty cushion, which insinuates itself between all the muscles of the eye. This lid is moved over the anterior surface of the eyeball to remove dust particles, small seeds, etc. It has no special muscle, but is pushed over the eye when the eyeball is drawn backward into the orbital cavity or socket by the posterior muscle of the eye. When this lid is continually drawn, or pushed out, over the eye, as in tetanus, lock jaw, etc., some persons say the horse is affected with the "hooks;" and occasionally the barbarous treatment of cutting off these protecting and useful lids is practiced. It would be about as sensible to cut off the hands of a man to keep him from rubbing his eye when it becomes irritated by dust, etc.

The Lachrymal Apparatus comprises the gland which secretes the tears and the canals which carry the extra tear fluid to the external openings of the nasal cavity. The lachrymal or tear gland is situated above the eyeball and below the rim of the orbit; it secretes the tear fluid which is carried to the surface of the eye by little ducts or canals that open in the inner surface of the eyelids. The tears are spread over the eye by the movement of the lids called winking. At the inner or nasal angle of the eye is a little round body, usually black or brown; it is a fold of the conjunctiva and is designed to direct the tears toward the opening, located in each eyelid near the internal angle, by which the tears pass into the lachrymal ducts that carry the superfluous tears to the lachrymal sack. This tear sack is a little reservoir which receives the tears from the ducts of the upper and lower lids, and passes the tears into the lachrymal canal. The lachrymal canal passes downward and slightly inward, at first through a bony canal, and terminates on the inner surface of the outer wing of the nostril; the opening or orifice of this canal looks as if it were punched out of the tissues and is sometimes mistaken for an ulcer.

DISEASES OF THE EYELIDS.

TUMORS of various kinds are occasionally found on the eyelid. The upper lid is a favorite place for warts—diseased, excessive growths of the outer layers of the skin. The exciting cause of warty growths is at present thought to be a very minute plant or animal parasite. It is best to excise them with the knife; or, if small, to snip them off with the scissors, being careful not to cut deeper into the eyelid than the thickness of the skin. After the bleeding has partially ceased and the blood has been wiped away with a clean, moist sponge or cloth, the raw surface may be touched or cauterized with lunar caustic or a small pledged of cotton dipped in strong carbolic acid. Melanotic (black, pigmented) tumors are occasionally found on the eyelids of white horses. If they are small and are removed in the early stage of growth, they are not so liable to return; but if they involve considerable tissue or are of long existence, they are very liable to return after removal. All small tumors of the eyelids may be removed in a manner similar to that described for warts.

Pedunculated tumors may be ligated by tying a strong cord around the pedicile close to the skin; if it does not fall off in a few days another strong thread may be tightly tied around it at the same place. Caustic medicines (Lunar Costic or Tri-Chlor-Acetic Acid) may be applied, once every four or five days, until the tumor can be pulled away by the fingers. Care must be taken not to get these caustics into the eye; it is best not to use caustics except on tumors with large, thick bases that cannot be ligated or excised.

WOUNDS OF THE EYELIDS.

These occur through bites, tearing on nails, harness, hooks of snaps, barbs of wire fences and other projecting points, about the stable or stall. If the wound is fresh the edges may be brought together by stiches one-third of an inch apart; ordinary white silk thread may be used.

INFLAMMATION OF THE EYELIDS.

Various injuries and bruises of the eyelids may occur when a horse is rolling or throwing his head during colic attacks, or other painful diseases; or neighboring tissues may be injured or bruised and the inflammation extend to the eyelids.

The writer has repeatedly observed the eyelids of cattle attacked by ringworm, a transmissable parasitic disease of the skin, causing not only inflammation of the eyelids but also of the conjunctiva, extending at times to the cornea.

Constitutional diseases (authrax, Texas fever, purpura) may be attended by swollen and inflamed eyelids. Small wounds may admit germs into the tissues of the eyelids and produce inflammatory swellings.

Inflammation, resulting from wounds, bruises, etc., may be reduced by bathing the eye in cold water and applying antiseptic solutions. In ringworm the crusts and scales must be washed and scraped from the skin and then a one per cent. solution of corrosive sublimate may be applied, once per day for three or four days. Other parts of the body and other animals affected with ringworm must be treated in the same way; since this parasitic skin disease is transmissible. Inflamed, swollen eyelids from constitutional diseases may be remedied by treating the disease with which they are associated.

ENTHROPITM—FOLDING INWARD OF THE LID.

The free margin of the lid is folded in against the eyeball; generally the entire margin of the lid is rolled inward, but, at times, only that half near the inner or nasal angle of the eye is thus affected.

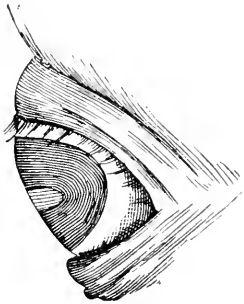

FIG. 3.

Entropium—Folding inward of the lower lid; the eye-lashes and hair rub over the conjunctiva and cornea, when the eye lid or eye-ball is moved, producing inflammation by constant friction.

This disease occurs most freqently in the dog but occurs also in the horse, the ox and the sheep. It has been observed in some animals at birth; and, no doubt, a tendency toward this disease is inherited—especially among dogs. Spasmodic contractions of the orbicular muscle that closes the eye, a relaxation or loose condition of the skin and an excessive development of the skin and tarsus of the lid, are said to be prominent factors in producing entropium. Scar tissue—resulting from wounds, ulcers, etc., on the inner surface of the lid—contract, or make tense, the conjunctiva to such a degree that it pulls the free border of the lid inward; while the contraction of the orbicular muscle (in winking) would roll or fold the lid.

One or both lids of one or both eyes of the dog may be affected; but, as a rule, only the lower lid of one eye in the horse is so diseased. The constant friction, occasioned by the continual rubbing of the eyelashes over the conjunctiva and the cornea, produces great irritation, which, if long continued, results in inflammation. The conjunctiva becomes conjested, light red and slightly swollen; the cornea may be clouded and at times ulcers form on its surface; the tears flow in excess; and the animal constantly attempts to close the eye. As soon as the lid or lids are returned to their normal position, the inflammation, cloudiness, etc., begin to disappear and the eye to retain its normal condition. Treatment consists in removing by excision a portion of the relaxed and loose skin. In the horse a strip of skin, one-fourth to one-half inch broad, is cut away parallel to, and about one-half inch from, the margin of the lid. The elliptical strip may be removed by using small, sharp shears. The free edges of the skin are then brought together by silk stitches, about one-half inch from one another. As a rule, in the course of a week the stitches may be removed. In the dog the relaxed skin may be excised much farther from the margin of the lid and the gaping wound may be left to heal without bringing the edges of the skin together with stitches. It is, however, safer and better to stitch up the wound.

ECTROPIUM—ROLLING OUTWARD OF THE LID.

In this disease the eyelid is drawn away from the eyeball, the conjunctival surface turned outward, the free border (lower lid) downward; the eyelid is rolled outward and downward, leaving the eye unprotected, subject to constant irritation from air and dust and rapid evaporation of tears. This condition produces chronic inflammation of the conjunctiva and leads to the formation of clouded spots and vascularity of the cornea. This disease also occurs most

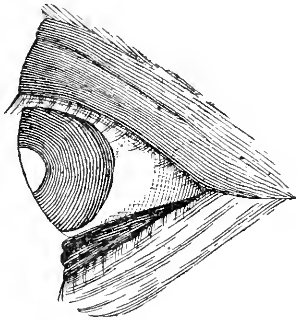

FIG. 4.
Ectropium—Folding outward of the lower lid.

frequently in dogs, but may appear in the horse, ox and sheep. It is caused mostly, in the horse, by scar tissue in the neighborhood of the lower eyelid; this makes the skin so tense that the traction pulls the lid from the eyeball. Inflammatory swellings and new growths on the conjunctiva may also cause it. Dogs with deep set eyes and in a poorly nourished condition suffer with this disease. Ectropium is treated by cutting away a narrow strip of the conjunctiva parellel with margin of the lid. The shears may be used, but no stitches are required.

PTOSIS—FALLING OF UPPER LID.

When the upper lid hangs abnormally downward and outward from the eyeball, without folding or rolling, it is called drooping of the lid or Ptosis. It is usually associated with paralysis of the facial nerve, and may occur on one or both sides. In paralysis of both nerves there is constant dribbling of saliva, paralysis of the lips, the nostrils and the upper eyelids. This is said to result from an injury of the facial nerve or some of its larger branches. The injury is usually produced by bruises or due to pressure of the bridle or of a yoke. In the first stages of the paralysis, it may be improved by reducing the inflammation or by removing the pressure on the nerve or its branches. But, as a rule, paralysis of one or both facial nerves is incurable. Yet the drooping of the eyelid may be removed by a surgical operation too complicated and difficult for unskilled hands.

DISEASES OF THE HAW OR MEMBRANA NICTITANS.

The conjunctival mucous membrane which covers the haw may be inflamed when the other parts of the conjunctiva are diseased. Also the haw may be pushed out over the eye when the eyeball is drawn back into the socket, which is done in certain eye diseases and for protection. In such cases uninformed persons say the horse has the "hooks" and at once proceed to cruelly cut them out. It is scarcely necessary to remark that nearly every case of so-called "hooks" is only a symptom of another disease and would certainly disappear if the real disease were removed.

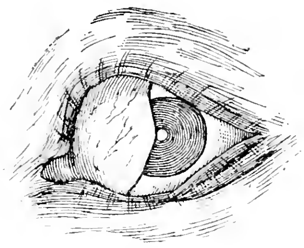

FIG. 5.

Abnormal extension of the haw or "eye-washer" as observed in tetanus (lockjaw) inflammation of the haw, etc. This continued projection of the haw, is many times called "hooks."

In some instances the haw is injured by being torn at the upper part of its free margin or it may be torn or cut in other places by injuries. Nearly all cases of injury recover without treatment, but should the separated or divided haw continue to irritate other parts of the eye, it may be removed. Occasionally tumors appear on the haw or eye-washer; if small and harmless they may be left undisturbed or clipped off with the shears; but if large and harmful, the entire haw (if necessary) may be removed. In cutting away the torn haw, or the tumor and haw, the animal should be securely and safely confined (by casting or otherwise) and a few drops of a ten per cent. solution of cocaine may be put into the eye; after waiting a few minutes for the cocaine to take effect, the haw or tumor may be grasped with small forceps and completely excised with the shears; during the next few days cleanse the eye, two times per day, with warm water, and a one per cent. solution of carbolic acid. After repeated or severe attacks of inflammation of the conjunctiva, or repeated attacks of moonblindness, the haw remains more prominent and farther projected over the eyeball than normal. In tetanus, or lock-jaw, in horses, the haws are partially or completely extended over the eyeball—especially on exposure to strong light or when the head is elevated.

DISEASES OF THE TEAR APPARATUS.

In all cases where the tears are running down over the side of the cheek and there is no swelling or redness of the lids in their normal position, it is wise to examine carefully the lachrymal or tear apparatus. Most frequently the lachrymal canal is obstructed at its opening into the nostril; this may be relieved, as a rule, by removing the dirt and pus-like matter which clogs the opening.

Sometimes the canal is obstructed in its superior part near the tear sack; then it is best to inject by means of a small syringe, carbolized water or a two per cent. solution of boracic acid, into the canal at its lower or nasal opening. If the tear canal, tear sack and tear ducts are open or pervious, the water will pass out at the tear points near the inner angle of the eye on the margin of each lid. Occasionally the canal or the tear ducts are obliterated, resulting from catarrhal or infectious inflammation and from fractures of bones along the course of the canal. In such cases it may be made pervious by forcing a small silver probe into the canal; but sometimes the canal is so completely obliterated that it is impossible to open the old passage way for the tears. When the conjunctiva or the eye lids are inflamed and when the under lid is everted in ectropium, the openings of the tear ducts are closed or are so displaced as to prevent the passing of the tears into the ducts. After recovery from these diseases, the tears cease to flow over the cheek.

DISEASES OF THE TISSUES SURROUNDING THE EYE AND IN THE ORBITAL CAVITY.

Fractures, bruises and wounds may take place in the bones and tissues surrounding the eye, and must be treated according to the conditions presented. Generally speaking, continual application of cold water baths or fomentations to the injured parts will materially reduce and prevent inflammation. Tumors or new growths of various kinds may appear in the orbital cavity outside of the eye ball. As a rule, they are very serious and eventually necessitate the removal of the eye ball with its surrounding tissues and sometimes requires excision of the eye lids and the skin with other tissues in the neighborhood of the eye. Whenever cancerous growths begin to spread or extend to the parts around the eye it is well to cut away all the parts involved. Such malignant growths are liable to return, even after several removals. Deep seated, spreading tumors of the orbital region should always be considered as very serious and as nearly always incurable without complete incision.

DISEASES OF THE CONJUNCTIVA.

Conjunctivitis.—Inflammation of the mucous membrane lining the eye lids and reflected over the eye ball around the cornea.

Causes.—1. Mechanical and chemical irritants.—Small seeds, pieces of hay, straw, glumes, wheat or barley beards, small insects, coal dust and other kinds of dust, sand, hair, smoke, entropium, parasites—all foreign bodies that act as mechanical or chemical irritants may produce conjunctivitis. Not infrequently has the writer observed this disease in a very severe form, resulting from injudicious and ignorant application of caustic and blistering salves, liniments or quack eye washes. Striking the animal in the eye with a whip, or stick; bruising or wounding the eye lid or parts near the eye may excite inflammation in the conjunctiva. Cold, sharp or excessively dry winds may also cause it.

2. It is associated with other diseases, as—ulceration of the cornea, periodic opthalmia, occasionally with Texas fever and anthrax, influenza, strangles (distemper in horse), rinderpest, and, now and then, in the course of other infectious diseases; often it is associated with catarrhal inflammation of the mucous membrane of the nasal passages, sinuses of the head and of the lachrymal canal and ducts. Inflammation of the conjunctiva and the cornea is quite often observed in sheep when they are affected with "head scab," or parasitic skin disease, confined to the short wool regions of the sheep. Conjunctivitis is also associated with sheep pox. Cattle are attacked by an enzootic inflammation of the conjunctiva and cornea, which is considered in detail under diseases of the cornea. Diptheritic conjunctivitis appears in fowls.

Symptoms.—On the irritated and inflamed spot of the conjunctiva there will be red streaks of strongly congested blood vessels, the mucous membrane will be slightly swollen ; this inflammation may in a short time extend to all parts of the conjunctiva and involve the circumference of the cornea ; the eye is very sensitive to light, and is kept closed continually. During the early stages the secretion of tears is greatly increased and they flow in profusion over the cheek, but during the more intensive or severe inflammation a mucus exudate appears, which is of light gray color and contains small semi-transparent flaky particles. If the inflammation is still more severe the exudate or secretion appears as a grayish yellow or a green fluid which consists of pus cells and tears. At one time, in severe cases, the secretion may be pus mixed with serun, and at another it may be pus mixed with mucus. An organized membraneous exudate is present in diptheretic conjunctivitas and to a limited extent in fallicular conjunctivitis. The superficial layer may be involved in severe cases, while in other instances all the layers and the submucous tissue may be involved in the inflammation; these distinctions are not always well defined; but as a rule, great intensity and long duration of the inflammation indicate that the entire conjunctiva and submucous tissues are affected.

TREATMENT.—The first thing to do is to remove the cause if it can be discovered. If the animal is very sensitive about having the eye examined, it is best to put a twitch on his nose. Place the thumb on the lower lid and the index finger on the upper; by gradual and firm pressure, open the eye and look carefully for a hay seed or any foreign body or irritating particles that may be in view. After completely cleansing the index finger and removing the long, rough or sharp margin of the finger nail, it may be pushed around under the lids and under the haw in search of the irritant; this must be done with great care, and it is always best to put a few drops of a three per cent. solution of cocaine into the eye before introducing the finger. Following this search and the removal of the irritant, the eye may be washed with pure cold water or with a solution of corrosive sublimate 1 part and pure water 5000 parts. Bathing the eye in very warm water will relieve the pain and sensitiveness; while cold water fomentations will remove the fever. A great many cases of conjunctivitis readily yield to the simple method of adjusting a large, clean wet cloth over the eye, keeping it moist by pouring cold water on it every hour. It is generally best to put the animal in a dark stall, but unless such a place is well ventilated I prefer the open and well ventilated box stall. The following prescription has met with great favor in Germany:

Borax, 6 grains; Aqua Amygdalæ Amaræ, 2 drachms; Gum Arabic, 2 drachms; Pure Water, 2 ounces. Apply to the conjunctiva by putting several drops into the eye twice per day.

In purulent conjunctivitis, when pus is present in the eye secretion, one may employ corrosive sublimate 1 part, water 1000; or nitrate of silver 4 grains and water 1 ounce. In a few seconds after applying the nitrate of silver solution, the eye may be washed with a weak watery solution of common salt; this checks the burning irritation of the silver nitrate. It is safer to use the solution of corrosive sublimate. Diptheritic conjunctivitis develops in chickens, doves and other fowls that are affected with diptheria of the mouth, the throat and the nose. The healthy should be separated from the diseased fowls; the diptheritic membranes should be removed from the mouth and eye; and the mucous membranes should be covered or penciled over (by means of a feather or small brush) with a 1 to 2 per cent. solution of corrosive sublimate or with 1 to 2 per cent. solution of silver nitrate. In 20 to 30 seconds after applying the nitrate of silver solution, bathe the eye and other affected parts with a weak solution of salt water. When chronic inflammation of the follicles of the inner surface of the haw is present, it may be relieved by using a 1 per cent. solution of corrosive sublimate; this should be applied as previously directed, being very careful that the fluid does not come in contact with other parts of the eye. As a rule, follicular conjunctivitis occurs only in dogs. When it will not yield to medical treatment, the inflamed follicular spots are clipped off; or part or all of the haw may be removed. Nitrate of silver solutions should be discarded in all cases where the cornea is also involved, since it is liable to leave permanent opacities of the cornea.

DISEASES OF THE CORNEA.

WOUNDS.

The transparent cornea may be injured by a stroke of the whip, by hard straw or hay stems, by thistles, and occasionally by sharp objects—glass, nails, splinters, hedge thorns, and wire barbs. Small rough or sharp objects that get into the eye not only injure the conjunctiva but also may scratch or even penetrate the cornea. In fact, many of the chemical and physical causes of injuries to the conjunctiva in like manner effect the cornea.

The shunning of light by closing the eye and an extra secretion of tears are always present during the active stages of the inflammation. The seriousness or severity of an injury depends upon the extent of surface affected and whether the outer or middle layers are separately or conjointly injured; or whether the entire thickness of the cornea is perforated. If there be but a small spot of the outer layer injured, recovery takes place in a few days, by keeping the eye covered with a clean cotton or linen cloth saturated in a solution of 1 part carbolic acid to 100 parts of water. If the deeper or middle layer of the cornea be injured, it will require more time for healing and is liable, in the horse, to leave a scar—a whitish upaque spot. Treatment may consist in the continued application of the 1 per cent. carbolic acid solution, or in applying continually a cloth saturated with a solution of 5 to 10 parts of antipyrine and 100 parts of water. After the painful and feverish stage is past a few drops of a solution of 2 parts of potassium iodide and 100 parts of water may be used two times per day. If the cornea be perforated the aqueous humor escapes, and this leads, in most cases, to inflammation of the entire eye, resulting in loss of sight and generally in the destruction of the eyeball.

Occasionally a perforating wound heals by granulation, the iris becomes free and sight is restored. But most frequently in such cases the iris remains attached to the wound or scar tissue of the cornea and prohibits the light from passing into the eye. If the perforation is near the margin of the cornea, a few drops of a solution of 1 gr. of eserine to 1 ounce of water may be applied, two times per day. But if the perforation is near the centre of the cornea a few drops of a solution of atropine 1 gr. to water 1 oz. may be used, night and morning. By the use of eserine the pupil is contracted and the free borders of the iris are taken away from the marginal wound in the cornea. By the use of atripine the pupil is expanded and the borders of the iris are removed from the edges of the central corneal wound. Infectious and general inflammation of the eye may be obviated by adjusting over the eye a cotton or linen cloth moistened every half hour with a solution of carbolic acid 1 part to water 100 parts; or corrosive sublimate 1 part and water 1000 parts.

KERATITIS OR CORNEITIS.

Inflammation of the cornea may involve the superficial layer, or the middle layer of the cornea; it may embrace only part of the cornea or may be diffuse—extend over the entire cornea. The partial or limited form is generally the result of injuries of the cornea. The friction of the eyelashes in entropium, small sharp substances, and irritating salves, are common causes of local inflammation of the cornea. Diffuse inflammation is associated, as a rule, with infectious conjunctivitis in cattle and sheep; and, at times, appears in the course of cow-pox and sheep-pox, and of diptheria in fowls; and in the course of influenza and the acute attacks of moon-blindness, in the horse.

Symptoms when the outer layer alone is affected: As soon as the cornea becomes inflamed, the animal avoids the irritating light by partially or entirely closing the eye, and tears flow down over the cheek. The cornea becomes opaque at a not sharply limited spot or over its entire surface; this opacity may be grayish blue, gray or light gray in color. One may see this opacity best by viewing it, not from directly in front of the eye, but from one side. If the inflammation is of long duration blood vessels will be found in the cornea, which may be seen in their conjested condition near its border. When the opacity and the other symptoms appear suddenly (without blood vessels forming in the cornea), recovery is quite certain to occur in a few days. The darker the opacity or cloudiness the weaker the infiltration or the less damage in the cornea to be repaired. Light gray and white colored opacities denote intensive changes which require eight to ten days for their complete removal. If blood vessels form in the cornea of the horse, a permanent opaque spot may remain; but in the dog the complete removal of the opacity will usually occur.

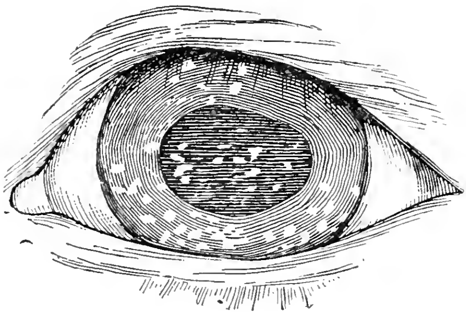

FIG. 6.

KERATITIS PUNCTATA—Inflammation of the internal or posterior layer of the cornea produces a spotted apacity; the dots or opaque white spots may be larger or smaller than those in the cut and may extend over the entire surface of the cornea. Another form of keratitis punctata is developed as mentioned in the text.

If the middle layer or principal part of the cornea be inflamed, the opacity develops slowly, is grayish blue, gray or light gray in color. The opacity is generally irregular in form—cloudy, striped or ray shaped; these points or spots extend over the entire cornea. When inflammation produces such spotted or irregular dotted opacity, it is designated *keratitis punctata* (see Fig. 6). This spotted appearance of the cornea is due to the dotted opacities in the outer layer while the inner layer may be evenly clouded in all its parts. The deeper seated opacity may be observed by viewing the cornea from one side; this is perceived best by illuminating the eye in a dark stall or room. A yellow colored, sharply limited opacity, announces the formation of a corneal abscess.

Shunning the light and an excessive flow of tears are always present during inflammation of the outer surface of the cornea or the formation of an abscess. In acute cases the opacity may entirely or partially disappear in three to six weeks. Should the opacity continue longer, from improper treatment or non-disappearance of the cause, vascularization (formation of blood vessels) with abscess formation or ulceration of the cornea appears; thus the prospects of recovery are decreased, while the danger of a pus-like exudate appearing in the agueous humor or the perforation of the cornea increases. Not infrequently do these bad results appear in cow-pox, sheep-pox or infectious conjunctivitis and keritītis among cattle and sheep.

TREATMENT.—Examine the eye critically, being especially careful to discover and remove any irritating foreign body or particles. Bathing the eye in very warm water twice per day and then adjusting over it a clean cloth, saturated with a 1 per cent. solution of carbolic acid, will, in most cases, be sufficient. But, should there be an abscess or an ulcer present, the cloth might be saturated with a solution of corrosive sublimate 1 part and water 1000 parts: and during the reparative stages warm water baths night and morning, and the application of the following salve, will aid in the removal of the opacity: Calomel, 30 grains; iodoform, 30 grains; vaseline, 5 drachms. Instead of this salve one may apply with a feather a small quantity of equal parts of pulverized calomel and iodoform.

INFECTIOUS CONJUNCTIVITIS AND KERATITIS, OR INFECTIOUS INFLAMMATION OF THE CONJUNCTIVA AND CORNEA.

This eye disease is most frequently found in cattle, but may appear in sheep, horses and goats. It is said to occur only during the summer months, but the writer saw it in a herd of cattle in February and March in south-eastern Iowa. That winter was exceptionally warm. It attacked cattle of all ages; but calves and the young cattle seemed to be predisposed to it. A number of young colts, running in the same field with the cattle, were similarly affected. Several outbreaks of this eye disease have been reported to me as occurring during the spring and summer months of 1892, in Alabama.

The disease announces its presence by an increased flow of tears; the eyelids are closed and slightly swollen. The conjunctiva becomes swollen, its blood vessels conjested and, in severe cases, a purulent discharge appears.

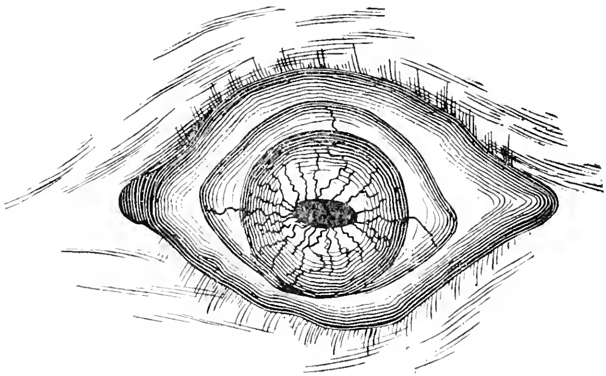

FIG. 7.

An illustration of an abscess and the attending vascularization of the cornea as observed in infectious keratitis and conjunctivitis in cattle. The black spot in the cut represents the yellow abscess and the radiating lines the blood vessels in the cornea.

Young animals seem to have a general fever, hanging of head, loss of appetite, and consequent emaciation; loss of appetite, etc., is most probably the result of pain instead of fever. These symptoms continue to increase for the first eight or ten days. About the third day from the first appearance of the disease, the cornea will exhibit a small delicately clouded spot, near its centre, which will gradually extend over the entire cornea, giving it a milk white appearance. The centre of the opaque cornea is at first pearly white in color, but in a short time a straw colored or yellow spot appears; this spot signals the formation of an abscess. The cornea at the yellow spot is rough and surrounded by a wall of thick, swollen, pearly white tissue. From this yellow centre (see Fig. 7) numerous blood vessels take their course toward the sclerotic border of the cornea. The yellow centre is generally longer from side to side, shorter from above to below, and is said to be occasionally mistaken for "an oat grain in the eye" by uninformed laymen. The abscess generally erupts or breaks open on the outer corneal surface leaving an ulcer to heal by granulations forming over its sides and bottom. In cattle, as a rule, the scar tissue is entirely removed and the cornea becomes clear and completely normal. However, in horses and occasionally in cattle a permanent pearly white opacity remains, causing partial or complete blindness. Some cases do not advance to the stage of abscess formation; in others the abscess may not erupt; while in still others the abscess may be so large that when it breaks open, the pressure of the aqueous humor against the remaining thin portion of the cornea will perforate it; this sudden removal of pressure on the lens may rupture the capsule of the lens and permit it to escape; the entire eye is thus involved, resulting in total loss of sight and of the eyeball.

The cause of this spreading eye disease is unknown, yet there are indications that point towards a germ or a microorganism as an exciting cause. Billings claims that it slowly extends over a herd from one animal to another; one eye may be at first affected, but in a short time the other eye is attacked. According to some of the German authorities the disease spreads quite rapidly—in a few days attacking 50 in a herd of 300; in 7 days attacking 20 in a herd of 40.

TREATMENT.—Separate the sick from the healthy; apply a solution of corrosive sublimate 1 part, water 2,000 parts; saturate a clean cotton cloth with the above solution and adjust the cloth over the eye; keep the cloth moist with the solution. During the purulent discharge from the conjunctival sack, the eye may be washed night and morning with warm water.

ULCER OF THE CORNEA.

Loss of substance or destruction of a limited portion of the cornea may result from the erupting of a corneal abscess, as in infectious keratitis; it may also appear in suppurative inflammation of the conjunctiva or cornea, and it is occasionally found associated with influenza in the horse; very often it is observed in the course of influenza (distemper) in the dog.

Ulceration of the cornea appears to be caused by an infectious or contagious microbe, since the disease is transmitted from one eye to the other, and occasionally appears as a disease that may extend to a number of animals in a locality.

An ulcer may appear near the center of the cornea or near its border; the cornea surrounding it is generally opaque; the bottom of the ulcer may be greenish yellow or gray white in color; the borders of the ulcer are, in the early stage, so abrupt that it appears as if it had been cut out with an iron punch. It may extend in depth to the internal layer of the cornea, then the reparative process may begin. Shortly after the formation of the ulcer, the cornea becomes vascular; the blood vessels give the opaque cornea around the ulcer a reddish tinge. As soon as the developing blood vessels reach the advancing borders of the ulcer the process of repair begins and continues slowly until the ulcer completely disappears, leaving behind a pearly white scar in the horse, but in the ox and the dog this opacity is, as a rule, removed.

If the ulcer is located near the border, the healing process progresses more rapidly than when it is in the centre of the cornea, because the developing blood vessels can reach the ulcer sooner and thus check its advancement. If the internal layer of the cornea is destroyed by the penetrating ulcer, the inflammation extends to all parts of the eye ball and generally results in loss of the entire organ.

Treatment.—Prof. Moeller very highly recommends aqua chlorata diluted with 2 or 3 parts of water. A solution of corrosive sublimate 1 part and water 1,000 parts may be employed; or a 2 to 4 per cent. solution of boracic acid. It is not advisable to use silver nitrate as it generally leaves a permanent opacity in the cornea. In examing the eye care should be exercised to prevent transmitting the purulent irritating discharge with its microbes, from the diseased eye to the healthy one. It is also best to separate the diseased animal from all others. If the cornea is perforated, a 1 per cent. solution of eserine or atropine may be used as advised in perforations of the cornea under the head of corneal wounds.

OPACITIES OF THE CORNEA.

Scar tissue, infiltrations and organized exudates that supervene or result from injuries, inflammation, ulcerations and abcesses are termed opacities. These opacities remain after the inflammation has subsided or after the wound or ulcer has healed, and are not to be confounded with the opacities attending active inflammation. Slightly foggy, weakly clouded, translucent, grayish blue or gray spots, not sharply limited, are mostly found in the outer layer of the cornea and are sometimes called *nebulæ*. If the opacity is semi-transparent, sharply limited, gray or milk white, it is designated *macula*. If the opacity is a dense, completely opaque, pearl white, gray or white, regularly distributed or in large spots or stripes, it is called a *leucoma*. There are also chalk-like, well defined opaque spots which are formed by using acetate of lead or silver nitrate with common salt, calomel or corrosive sublimate; insoluble precipitates are thus deposited in the corneal tissue. Black colored opacities may be spotted or cloudy and are due to bleeding from the vessels in the vascular cornea, or to adhesions of detachments of the pigmented iris; the latter may occur as a result of the attachment of the outer surface of the iris with the inner surface of the cornea.

The harm produced by opacities depend upon their location; an opaque spot in the center of the cornea cuts off more light than one located near the border. Total blindness is better (more safe) than partial blindness; hence, large and dense opacities are preferable to weak and diffuse opacities, unless the latter can be removed. Scar tissue, from ulcers, wounds or abscesses, can not be removed in the horse; it may in some instances disappear in the ox, but in the dog, it is, as a rule, entirely removed. Chalk spots, streaks or stripes, as a rule, are permanent—not amenable to treatment. Weak and superficial opacities may be improved and many times can be removed by judicious treatment.

The following ointment may be employed: Yellow oxide of mercury, 4 grains; atropine, 1 grain; vaseline 4 drachms. Put a small quantity under the eye lid; then with fingers on the outer surface of the lids work or move them around over the cornea in radial and circular directions. Finely pulverized calomel may be thrown into the eye by placing a small quantity in a quill and blowing it into the eye. This should not be repeated oftener than once per week. In case the horse will not permit the blowing of the calomel into the eye, it may be used in the form of a salve, by mixing it with vaseline. A salve of potassum iodide 10 grains and vaseline 1 ounce may be employed. Some authorities recommend massage treatment—placing two fingers upon the upper eye lid and with slight pressure moving it in a circular direction over the opacity. This massage treatment may be repeated daily unless signs of inflammation should appear.

STAPHYLOMA OF THE CORNEA.

The bulging forward and outward of the cornea is designated staphyloma. It may be partial or complete, depending upon whether a part or all of the cornea is involved. Thinning of the cornea by ulceration and eruption of large abscesses, so reduce the resisting power of the cornea that the intra ocular pressure (pressure of the aqueous humor, etc.) distends, projects or pushes the cornea outward. The scar tissue resulting from ulceration is also unable to withstand the intra ocular pressure and the cornea bulges forward, forming a partial staphyloma. A staphyloma from either of the foregoing causes is generally opaque, gray or white colored. In the healing of perforating wounds, the iris may adhere to the scar tissue, should the corneal scar then become distended it would carry with it the iris and the result would be called an Iris-staphyloma.

Occasionally intra ocular pressure pushes forward the entire transparent cornea.

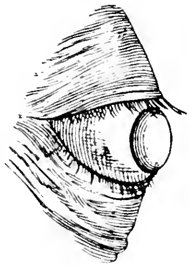

Fig. 8.
Total Corneal Stophyloma (after Armatage).

The treatment of staphyloma is mainly preventative. In impending perforations of the cornea from ulceration, wounds or abscesses, a compress bandage and a 1 per cent. solution of eserine may be employed. In cases of established perforation the eserine or atropine may be used as before directed for perforating wounds of the cornea. Proper treatment of abscesses, ulcerations and wounds of the cornea will also prevent the formation of a staphyloma.

NEW GROWTHS ON THE CORNEA.

Pterygium (see fig. 9) is a peculiar fleshy growth consisting of an abnormal development from the conjunctiva. It has been observed in horses, dogs and cattle. Its usual situation is at the inner side of the eye ball; it is triangular, or fan-shaped, with the apex extending almost to the center of the cornea; generally it is loosely attached to the cornea

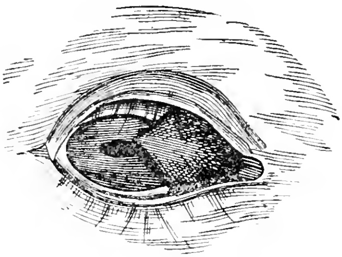

Fig. 9.

Pterygium.—Fleshy growth on the conjunctiva and cornea (after DeSchweinitz).

and the conjunctiva. Sometimes it is present at birth and at times it results from the repairing of an ulcer near the border of the cornea. It is believed that animals exposed to smoke, dust, heat and slight injuries to the cornea are predisposed to its development. Treatment consists in removing the loose pterygium with the knife or shears; this should be done by a surgeon after the animal is cast or confined and a solution of cocaine is applied to the eye. The cornea usually remains opaque at the spot from which the tissue is removed. When a pterygium results from the contracting scar tissue pulling the conjunctiva over a part of the cornea, it should be left undisturbed.

A Dermoid is a small, skin-like growth, which usually appears on the nasal side of the eye ball, partly on the cornea and partly on the conjunctiva. The outer surface is generally covered with long hair that project outward between the lids. (See fig. 10).

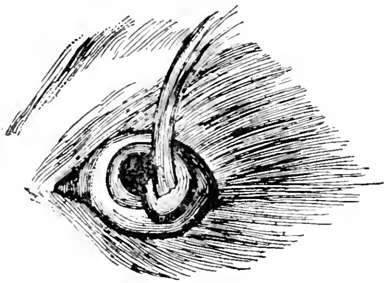

FIG. 10.

DERMOID.—Left eye of dog (after Gurlt).

It occurs in calves, pups, colts and lambs and is most frequently present at birth; but, according to some authors, it may be acquired after birth. The hairs interfere with the rays of light and the dermoid, as a whole, irritates the cornea and conjunctiva. Treatment consists in removing the dermoid by means of the knife or shears. The animal is cast and the eye is anesthized with cocaine; then the loosely attached skin-like growth is carefully dissected from the cornea and conjunctiva; a permanent opaque spot remains, but the constant irritating action is removed.

DISEASES OF THE IRIS.

IRITIS or inflammation of the iris is generally associated with diseased conditions of the ciliary bodies, or the choroid coat; because, a close connection exists between these parts of the eye, in location, attachments and blood supply.

Iritis also appears in the course of inflammation of the entire eye ball, in periodic opthalmia (moon-blindness); it occurs also, in some instances, in connection with influenza, strangles (distemper), infectious inflammation of the lungs and pleura, in acute muscular rheumatism, in inflammation of the navel in young animals and occasionally in connection with catarrhal inflammation of the conjunctiva or ulceration of the cornea. Penetrating wounds or injuries near the margin of the cornea excite inflammation in the iris. Very rarely does iritis appear alone—without other parts being involved at the same time.

Owing to the fact that the iris is richly supplied with blood vessels, it is disposed to produce exudates, or to bleeding from its surfaces. The exudate may be flaky and gray, floating in the aqueous humor; or it may be pus-like and form a yellowish sediment at the bottom of the aqueous chamber.

These exudates may be tinged with blood or the entire aqueous humor may be colored by blood from the vessels of the iris. The exudates from the posterior surface of the iris falls between the iris and anterior or front surface of the lens: this pushes the iris forward; unless the iris is moved by the expansion of the pupil, the back or posterior surface of the iris becomes firmly attached to the capsule of the lens. The iris may, also, become attached to the posterior surface of the cornea: this frequently results from perforating wounds or ulcers of the cornea. The discoloration, swollen condition of the iris, and the flaky, purulent or bloody exudates can not be observed in many cases, because the cornea is so clouded or opaque. However, in the first or the last stage of such cases, one may be able to view the iris. During the "clearing up" period in moon-blindness one may observe the iris, faded somewhat in color, with its pupillary margin more or less ragged and irregular. Generally the tears flow in excess, dread of light and extreme sensitiveness are present during the active stage of iritis.

In the treatment of iritis the chief aim is to prevent the pupillary or free margin of the iris from forming attachments to the capsule of the lens or the posterior surface of the cornea. For perforations of the cornea directions for treatment have been given. To prevent adhesions to the capsule of the lens, the pupil may be kept expanded, during the active stage of the inflammation, by the use of atropine. The following has proven very beneficial in the hands of the writer: atropine 1 grain; potassium iodide 5 grains; pure water 1 ounce. A few drops may be put between the lids two times per day. The application of hot water will stimulate the absorbents and hasten the removal of the exudates and, at the same time, reduce the pain; while cold water fomentations will best reduce fever and inflammation.

CLOSURE OF THE PUPIL.

If the iris, *during the extreme contraction of the pupil*, becomes bound down to the capsule of the lens throughout its entire pupillary margin, it may leave a small, clear pupillary opening; this condition is denominated *exclusion of the pupil.* But if the pupil be completely obliterated during extreme contraction of the pupil when the iris is attached to the capsule of the lens, or the small pupil becomes filled in with an opaque, inflammatory deposit or exudate, the condition is termed *occlusion of the pupil.* The destruction of the pupillary attachment of the iris to the lens capsule is soon followed by the formation of a cataract—opacity of the lens. The anterior division of the aqueous chamber is completely separated from the posterior and the iris is bulged forward at all parts except at its marginal attachments to the lens capsule.

If the attachments of the iris to the capsule are not firm and solid, the iris may be torn loose by the use of atropine. In case that does not succeed, the iris may be mechanically separated or detached by a surgical operation ; or a new pupillary opening may be made by the operation known as irodectomy. These operations can only be performed by a skilled surgeon and are, many times, done after the lens has become opaque or the operation is followed by opacity of the lens, destroying the vision. The writer observed a case of occlusion of the pupil in both eyes of a three year old horse that was brought to the free clinic at the experiment station in Auburn. The cornea and aqueous humor were transpaparent, and the occlusion was very probably a result of acute iritis. A strong solution of atropine was dropped into the eye but the iris was so firmly fixed it could not be detached.

Excessively developed or large "soot balls" "grape-like bodies," hanging from the inner aspect of the superior part of the free margin of the iris, interfere with, or obstruct, the passage of light into the eye. The large, brown, flake-like bodies are quite frequently the cause of shying and cases have been recorded where complete blindness appeared as a result of these "soot balls" entirely closing the pupil. By a surgical operation they could be removed; this should be attempted only by a skillful operator.

Some white horses possess such a high degree of sensitiveness of the eye to light that in clear sunshine the pupil is closed by complete conntraction and the animal cannot see until the sun sets.

CATARACT.

All opacities of the crystalline lens, regardless of size, origin or condition, are embraced by the general name cataract. A false or spurious cataract is produced by collections of pigment on the capsule of the lens, resulting from the tearing loose of the attachment of the iris to the capsule. It appears in dark, almost black, colored spots on the anterior surface of the capsule. True cataract means that there must be opacity in the substance of the lens or its capsule. If the opacity is in the substance of the capsule it is known as capsular cataract, and when in the substance of the lens, it is designated lenticular cataract. Lentiular cataract may be partial or complete; the former when a small portion of the lens substance is involved and the latter when the entire lens becomes opaque. The causes of cataract are various; and in some cases are not distinctly understood. Occasionally a cataract may be present in one or both eyes

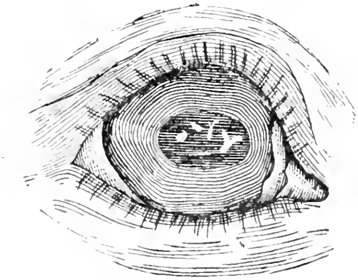

FIG. 11.

PARTIAL CATARACT (after Armatage).—The opaque spot or spots in the lens or its capsule may be seen through the pupillary opening. Spots in the cornea should not be mistaken for the deeply located opacities in the lens.

at birth. Heredity, no doubt, exercises a great influence in the production of cataracts during fœtal life and also predisposes an offspring to the disease in later life. Cataract frequently manifests itself in the course of diabetes mellitis (sugar in the urine) but there is no positive proof that the sugar in the system causes the cataract. Hemorrhages (bleeding) in the aqueous chamber lead to straining of the capsule; the coloring matter of the blood is deposited in the capsule and the dark colored opacity remains after the blood is absorbed or removed from the aqueous chamber. Disturbances in the nutrition of the lens in old age is said to be the cause of senile cataract. In old age the lens substance becomes more and more solid; this leads to irregularity in its density; also prevents changes in the curvature of the lens that are necessary in the adjustment, or its accommodation, to different distances. The constant straining of the eye to bring a hardened lens to the various positions or forms for different distances, would lead to perverted nutrition and possibly to inflammation, in the capsule, the lens, the ciliary ligament or ciliary bodies. The nutrition of the lens may

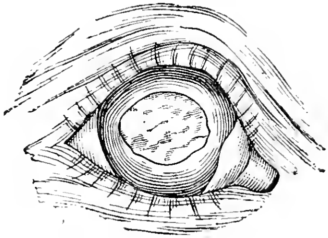

Fig. 12.

Total Cataract (after Armatage).—The opaque lens gives the entire pupil a grayish white color.

also be perverted by inflammation primarily in the lens itself or from extension of inflammation in the iris, the ciliary bodies or the ciliary ligament, to the lens. Active inflammation in the lens or the surrounding parts, (from wounds, injuries or other diseases) generally leaves inflammatory products or deposits in the substance of the lens or its capsule, which form permanent opacities. Strokes on the head that produce sudden concussion are said to cause opacities in the lens. There are many cases of cataract, the cause of which cannot be determined; but the most prolific cause of cataract in the horse is periodic opthalmia (moon blindness). Straining the eyes to see objects in imperfectly lighted barns or stalls, no doubt, plays an important part in producing cataracts as well as other eye diseases.

Occasionally small spurious cataracts of the capsule disappear, because of the great activity of the cells of the capsule. But opacity of the lens substance very rarely disappear; because changes in its structure take place very slowly for it contains no blood vessels or nerves.

Sometimes small gray specks may remain unchanged; but, as a rule, the little gray star like opacity gradually increases unil total lenticular or capsular opacity appears.

In examining the eye for a cataract one may readily see a gray, a bluish gray, a greenish yellow, a brown or a pearl white reflection in the pupillary opening: the form (star-shaped, cloudy, fog-like, feathery, streaked, or scattered dots, ball-shaped, etc.,) can be determined if the opacity be sufficiently developed. The exact location and form or the small, beginning white speck may not be visible to the observers unaided eye, especially out in the clear sunshine or when the ground is covered with snow. The animal should be placed so that the light falls upon the affected eye from a clear window or an open door in front of the animal. The observer then looks into the pupillary opening, standing in in front or to one side; it is well to observe the eye from various points of view. If the pupil is contracted or too small to admit of sufficient examination, a few drops of a solution of atropine (1 gr. atropine to 1 ounce of water) may be put into the eye to expand the pupil. The lens may, also, be examined by placing the animal in a dark room and illuminating the eye with a candle, or a candle and a double convex lens, or with a candle and a small concave mirror (see methods of examining the eye).

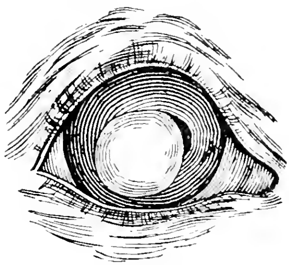

Fig. 13.

Luxuration (dislocation) of the opaque lens into aqueous chamber; the lens lies in front of the iris, almost completely obstructing the passage of the light through the pupil.

Treatment of cataracts in domestic animals consists chiefly in prevention. The reducing of all inflammations of the eye, the prevention of periodic opthalmia, keeping the surroundings of the animal in proper condition and maintaining sufficient light for the animal to see distinctly in all parts of the stall without straining the eyes. As a rule it is best to have the light enter the stall or barn from behind the animal, or from both sides. In man the opaque lens is removed by a surgical operation, and a double convex lens is adjusted in front of the eye thereafter. But this is impracticable among domestic animals, since the double convex lens can not be adjustad to the eye, and the eye would always be hypermetropic (farsighted), permitting the animal to see close objects indistinctly and therefore inducing it to shy or become frightened. However the opaque lens is occasionally removed in horses and dogs to eliminate the unsightliness of the cataract; but there is always more or less danger of losing the entire eye ball.

AMAUROSIS.

Paralysis (palsy) of the retina or optic nerve has been technically named amaurosis. This condition may depend upon tumors in the brain, injury to the optic nerve between the brain and the eye-ball, or inflammation of the retina. Parasitic cysts quite often appear in the brain of sheep and the amaurotic condition of the eye is a characteristic symptom.

Abscesses sometimes implicate the roots of the optic nerve and amaurosis supervenes. Temporary amaurosis is present during the intoxication period of lead poisoning; poisoning from *Kalmia latifolia* ("ivy"); during the comatose condition of the cow in parturient apoplexy (milk fever); and in congestion of the brain. Inflammation of the retina is nearly always present in moon blindness and occasionally it termi- in paralysis of the retina—amourosis. Detachment of the retina from the choroid, hemorrhage from the retinal blood vessels, and emboli (plugging by clotted blood) of retinal blood vessels and excessive loss of blood, cause temporary or permanent amaurosis. If, in the course of inflamation, if the retina pigment is deposited in the retina, it produces night blindness—a condition that prevents the animal seeing at night. Extreme sensitiveness of the retina, as observed in Albinos and in some white horses, leads to day blindness. In such cases, the pupil is so nearly or completely closed that the animal can not see in clear sunshine, or when the ground is covered with snow; but during twilight, on cloudy days, and at night vision is normal. Amaurosis sometimes results from castration.

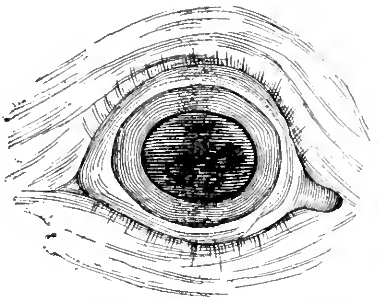

FIG. 14.

AMAUROSIS.—The pupil is greatly expanded, gray-blue in color and the eye appears bright, glassy, very clear (after Armatage).

In well established cases of amaurosis there is total blindness; yet there are no opacities in any of the tissues or humors of the eye. The eye is bright, clear, and perfectly transparent. The animal steps high, stumbles over, and runs against objects in its way. If, at a short distance, you noiselessly threaten to strike it, there is no winking or manifestations of fear. The ears are very sensitive to sound, and the outer ears are constantly on the alert to catch all noises. The pupil is expanded to its extreme limit; the iris is immovable and insensitive to light. Leading the animal from the dark into the light, or from the light into the dark, does not change the size of the pupil or move the iris; while in the normal eye the pupil expands in darkness and contracts on being brought to light. The pupillary reflex (the light reflected from the retina outward through the pupil) is, as a rule, grayish-blue; but may, at times, appear more gray than blue, or present a more or less distinctly green color.

TREATMENT.—When amaurosis is a result of another disease, it is evident that the disease of which it is a symptom should be treated. In cases of recent standing, good nutitive food, extra care and a nerve tonic (drachm doses of nux vomica two times per day) may be employed with advantage. But treatment of long standing cases always proves valueless.

GLAUCOMA.

This name is applied to several varieties of a disease whose chief symptom is increased ocular tension. The increased intro-ocular pressure is a direct result of the jelly-like vitrious humor becoming thin, more watery and greater in quantity. This condition may appear independent of any other disease, but it generally appears, accompanied by, or as a sequel of, inflammation in the choroid or the ciliary bodies. However, the exact cause in many instances is unknown. The extra amount of lymph or watery secretion within the eye has been explained in various ways. Some have claimed that it was due to obstructions in the intro-ocular lymph vessels, which carry off the extra amount of lymph; others have suggested that the extra supply of water was due to excessive secretion by the choroid, and especially the ciliary bodies. The development of glaucoma is slow, its course is nearly always chronic and of a more or less intermittent form. Old animals which have far-sighted (hypermetropic) eyes are predisposed to glaucoma.

SYMPTOMS.—Increased hardness of the eye-ball, or rise of intra-ocular tension, is the most prominent symptom. These conditions may be determined by placing the index finger of the right hand upon the upper lid of the left eye and the index finger of the left hand upon the upper lid of the right eye; then compare the tension or hardness of one eye with the other by palpating with the tips of the fingers; in increased hardness, firm pressure of the finger tip produces no impression; but the tension may be doubtful unless there is a marked difference in the impressions made upon the two eyes. The pupil is generally greatly expanded and the lens, as a rule, remains transparent, but may in rare instances be opaque. The depth of the anterior part of the aqueous chamber is diminished; the front surface of the iris is almost in contact with the internal surface of the cornea. The iris in some cases appears swollen and it is sluggish in movement or entirely inactive. The slight diffuse cloudiness of the cornea and the aqueous humor produces the sea green (glaucoma) color of the pupil. The episcleral and conjunctival vessels are more or less congested. But the excavation or sinking or depression of the optic nerve can not be seen without the aid of an opthalmoscope; this cupping of the optic disc is due to the intraocular pressure; the cup is called the glaucomatous cup and the yellow halo around it is known as the glaucomatous ring.

Treatment consists in preventing inflammatory adhesions between the iris and cornea by using eserine. Also, reduce inflammation of the iris, ciliary bodies and choroid, that may lead to glaucoma; this may be accomplished by using hot or cold water fomentations. A well developed case can only be relieved by irodectomy. If eserine is used constantly it must be in a weak solution (1-10 to 1-16th grain to one ounce of water.) Irodectomy consists in removing a portion of the iris; in glaucoma one-fifth to one-fourth of the iris should be removed; or what is known as the broad peripheral irodectomy can be done only by a skilled surgeon.

HYDROPTHALMUS.

This is an enlargement of the eye ball due mainly to an increased secretion of the aqueous humor, as in glaucoma. Sometimes the eye ball becomes twice its normal size; the cornea is generally so opaque that one cannot see the inner parts of the eye. In consequence of the enlarging of the eye ball the attachments of the lens are partially or entirely torn loose and the lens may float in the vitreous or the aqueous humor. The enlargement of the eye may appear suddenly, in twenty-four hours; or may advance slowly. Seldom is it relieved by treatment. Occasionally the cornea is ruptured and the eye ball lost. In the early stage, the cornea may be punctured, thus allowing the extra amount of aqueous secretion to escape; this has, in some cases, proven beneficial; however, it cannot be done by the novice or the inexperienced.

DISLOCATION OF EYE BALL—EXOTHALMUS.

The eye-ball may be pushed out of its socket by tumors that originate behind the ball; sometimes by bleeding, from deep penetrating injuries, congestion of blood vessels; by horns of cattle, by biting and scratching among dogs and cats, also by dislocation of the lower jaw in the smaller animals. Occasionally an animal has its eye dislocated by having it crowded out with a blunt stick or club in the hands of a cruel boy or attendant. If the eye is not lacerated, bruised or seriously injured and the optic nerve is not torn, the ball may be returned to its cavity and a compress bandage applied over it to keep it in place. This should be done as early as possible or the swelling of the parts around the eye will prevent returning it to its proper place. However, the outer angle of the eye may be divided if necessary to admit the eye ball to the socket. Should the eye ball be badly injured or in case it is impossible to return it to the socket the entire protruding parts may be cut away as deeply within the eye socket as possible; a pledget of cotton, saturated with a one per cent. solution of carbolic acid er corrosive sublimate may be pressed into the cavity; a compress bandage should then be placed over the eye.

When the eye is dislocated by growing tumors in its socket, or if there are malignant or fungoid tumors within the eye, or if the eye is very badly injured, it may be necessary to extirpate the eye ball, its muscles and the surrounding tissues. For this the animal must be cast, anæsthised with chloroform or some other anæsthetic; an assistant holds the eye lids apart; the operator grasps the cornea or the internal or external rectus muscle with the forceps in his left hand; the eye ball, the tumor, or the entire contents of the orbital cavity, if necessary, are then removed, with the shears or knife. The bleeding is checked by applying a pledget of cotton, and a compress bandage as before described.

ANIMAL PARASITES OF THE EYE.

Filaria papilosa is a small, round, white worm that is found most frequently in the vitreous humor; but is occasionally observed in the aqueous humor and commonly spoken of as the "snake in the eye." It is from one-half to two inches in length, and it is very probable that the young filaria reach the eye by way of the blood vessels, and develop in the humors of the eye. However it is scarcely probable that the humors of the eye are the natural habitat or home of this parasite, since the same worm has been found in other parts of the body. One man reports that he observed a worm in the aqueous humor during a period of six years. But a few months is usually the length of time this parasite lives in the eye. A number of cases are recorded where this parasite has produced inflammation of the cornea and iris, with an extra flow of tears and opacities of the cornea and aqueous humor; these conditions may subside in a short time and leave a slight cloudiness of the cornea and aqueous humor. In certain districts in India this parasite is very frequently in the eye of the horse and if not removed the eye goes blind. This worm has also been observed in the eyes of cattle. The worm may be removed from the aqueous chamber by cutting a small opening in the cornea at its upper border near the sclerotic margin; then remove the worm with small forceps. Before operating it is necessary to cast the horse or ox; anæsthise it with chloroform or æther and apply a ten per cent. solution of cocaine to the eye. After operating keep the eye moist and cool by frequent or constant cold water applications, and occasionally put into the eye a few drops of a one per cent. solution of carbolic acid or boracic acid, or a weak solution of corrosive sublimate.

Filaria lachrymalis is a small, white, round worm one-half to one inch long; it lives in the lachrymal ducts, under the haw or eye washer and sometimes under the eyelids; it causes inflammation of the conjunctiva and lachrymal ducts and may close the tear ducts Remove the worms from the tear ducts and the conjunctival surfaces by using small forceps; then apply, two or three times per day, a few drops of a corosive sublimate solution (1 part c. s. to 1000 parts of pure water).

As elsewhere mentioned, Willach has discovered in the eye the young forms of various round and flat worms, and he claims that these animal parasites play an important part in producing periodic opthalmia.

Since nearly all parasites gain admission into the system by way of the alimentary canal, infection may be prevented by observing a few precautions. Impure drinking water is probably the most common carrier of the various animal parasites. Hence always give animals water from deep wells or pure springs, and never from ponds, rivers, or stagnant lakes. The digestive tract may become infected with these parasites by ingesting infected food. In all cases where parasites are found in the alimentary canal (manifested by the occasional passing of parasites with the feces), it is advisable to give one-half to one drachm doses of sulphate of iron or sulphate of copper in the ground food two times per day for one week; then give a purgative, consisting of one pint of raw linseed oil or one ounce of Barbadoes aloes.

STRABISMUS, SQUINTING OR CROSSEYE.

In this defect the visual axis or line of one or both eyes deviates from the normal. In other words, the eye ball is turned inward, outward, upward or downward by the excessive contraction of a muscle or as a result of the paralysis of one of the muscles of the eye. In converging (inward) strabismus, the external rectus muscle may be paralysed and thus be unable to counteract the contractions of the internal rectus, its antagonist. This weakness, partial or complete paralysis of one or more muscles of the eye may be due to the pressure of tumors on the nerve of the muscle, rheumatism, tumors at the base of the brain or injuries of the muscle. Squinting or crosseye may be treated by section of the antagonistic muscle, but this can be done only by a skilled veterinarian. However this defect is rare in domestic animals and may be detected by noting the squinting appearance and carefully comparing one eye with the other. When strabismus is present it causes considerable shying, which is especially annoying in nervous animals.

SOME OF THE CAUSES OF INDISTINCT VISION AND SHYING.

Hypermetropia or farsightedness is that defective condition of the eye which causes the principal focus to fall bebind the retina, as illustrated in figure 15—H. In other words, the parallel rays which enter the eye come to a focus behind the retina. As a rule, the axis of the eye or the diameter from before to behind is too short and the cornea may appear less convex or flatter than normal. Removal of the crystalline lens (as is sometimes done in cataract) produces farsightedness. Convex glasses are used in hypermetropia in man, but are impractical with animals. Distant objects may be seen distinctly but the images of objects at a short distance are blurred and sometimes distorted into frightful forms. Hence farsighted horses are frequently frightened, or are caused to shy as a result of indistinct vision.

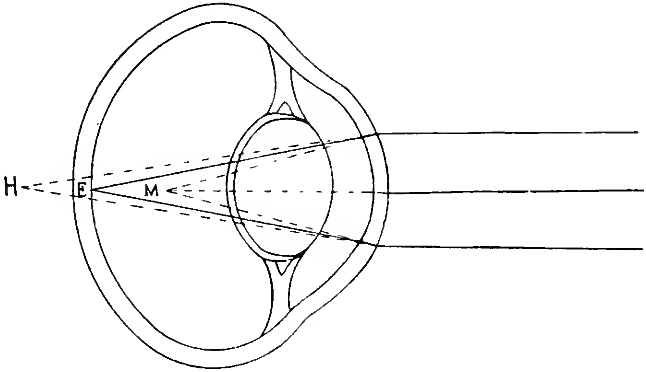

Fig. 15.

Diagramatic section of an eye (after Mœller) to show:

That the parallel rays of light, which enter the normal eye, converge or focus on the retina, making a distinct image.

That, in the farsighted eye, the parallel rays focus at H behind the retina, forming a blurred image on the retina.

That, in the shortsighted eye, the parallel rays converge at M in front of the retina, forming a very indistinct image on the retina.

Myopia or shortsightedness is a condition in which the refractive index of the eye is too great or the axis of the eye is too long; the parallel rays come to a focus in front of the retina (as in fig. 15—M.); or the principal focus falls in front of the retina. In shortsightedness the cornea may appear very convex or conical as it frequently appears in cattle.

Close or near objects can be seen distinctly but distant objects may be distorted or become very indistinct. Concave glasses are used by farsighted persons; but since the use of glasses is impractical for animals, shortsightedness, therefore, becomes a permanent cause of shying and fright.

In the Normal or Emmetropic eye, the principal focus falls on the retina, and distinct images of all objects, at near or far distances, form on the retina (fig. 15—E). The cornea, the aqueous humor, the lens and the vitreous humor take part in the formation of the image—the refraction and collection of the rays of light. The cornea is the principal refracting medium when the eye is at rest; but the changes in the convexity of the lens (caused by the contractions of the ciliary muscle) are the means by which the eye is adjusted, or accommodates itself, to different distances.

In the far-sighted, short-sigted and normal eye the curvature of the cornea and of the lens is regular; but sometimes the curvature of the cornea may be so irregular that one part or meridian may produce short sightedness, another part produce far-sightedness while still another meridian may be normal. This condition produces a very much distorted image and is a fruitful source of shying or the cause of fear and fright. Irregularities in the meridians of the cornea produce the condition known as astigmatism. This defective vision may also be caused by an oblique position of the lens. There are several kinds and degrees of astigmatism, all of which are very difficult to distinguish and can only be relieved by the use of proper glasses which are inapplicable to animals.

Slight cloudiness or opaque spots in the cornea, weak cloudiness of the aqueous humor, beginning cataract, beginning amaurosis or beginning glaucoma are accompanied by indistinct vision, and consequently produce frequent shying. In fact, partial blindness from any cause is always attended by indistinct vision and shying, fear or fright.

PERIODIC OPTHALMIA—MOONBLINDNESS.

This is an eye disease peculiar to horses and mules. Before the development of veterinary science the belief was prevalent that the moon exerted a direct or indirect influence upon the eyes; because the inflammatory attacks recurred at monthly or somewhat regular periods. Thus the names "moon blindness" and "mooneyed horses" originated. But as veterinary science progressed, extensive clinical and anatomical investigations made known the fact that moonblindness was a periodic or recurring inflammatory disease of the entire eye, involving primarily the iris, the choroid coat and the ciliary bodies.

Symptoms.—This disease makes its appearance very suddenly—generally beginning in the night; in the morning the eye is found closed, extremely sensitive to light with a very great flow of tears down over the cheek. In some instances there is systemic fever, while in other milder cases, it is not manifest; but, as a rule, the horse or mule is dull, wanting in vigor, and energy, indicating constitutional disturbance. The eye ball is drawn backward into the orbital cavity, by the retractor muscle; this makes it appear smaller than the healthy eye; after several attacks the eye ball is said to shrink in size—decrease in actual volume. The conjunctiva exhibits slight swelling and diffuse reddening; the surface

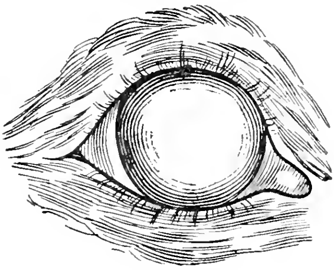

Fig. 16.

Diffuse cloudiness of the cornea as observed in moon blindness and in inflammation of the cornea. The internal structures of the eye are cut off from view by the total opacity of the cornea (after Armatage).

blood vessels of the sclerotic are congested; this produces a light red ring, or seam around the cornea (pericorneal injection.) The cornea near its outer border exhibits a weak, diffuse cloudiness, which soon extends over the entire cornea; in the beginning this cloudiness is weakly marked and the cornea appears as if it were glass with a thin layer of fat spread over it. In the advancement of the disease the middle or principal layer of the cornea becomes affected, which leads to intense, diffuse cloudiness and occasionally to vascularization of the cornea; the latter is distinctly visible at its border in a few days after the beginning of the attack. Sometimes a pearl white opacity may appear at some spot on the outer surface of the cornea. In the beginning the slight cloudiness of the cornea does not prevent one from viewing the iris, the lens and sometimes the vitreous humor and the retina. The purulent or flakey exudate in the aqueous humor and the excessive contraction (almost entire

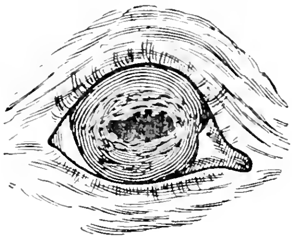

FIG. 17.
This cut represents the free border of the iris attached at points to the capsule of the lens, producing an irregular, ragged outline of the pupil and wrinkling of the iris. This may be observed after several attacks in periodic opthalmia (modified from Armatage).

obliteration) of the pupil hide from view all the internal parts of the eye. The iris appears rough on its outer surface, slightly glazed, lighter colored than normal; at times it is covered with a grey exudate. The ciliary portion of the iris is bulged forward and outward; the movements of the iris are slow and weak; it is quite insensible to variations in light, and the pupil does not expand in the dark. The color of the pupil when visible during its contraction is greyish green. Atropine causes the iris to expand slowly, weakly and irregularly; at points the pupillary border of the iris adheres to the capsule of the lens; the remaining parts are free; expansion of the pupil under such conditions produce irregularities in the iris and in the outline of the pupil (see fig. 17). At the lower part of the aqueous humor, in the anterior chamber, there is a gray-yellow, partly sedimentary, partly flocculent exudate, which sometimes is colored with blood. The quantity of the exudate varies; in the early stage of the attack—especially in the later attacks—it is visible by focal illumination as a slight cloudiness; at the height, or severest stage, of the attack the aqueous chamber is almost entirely filled; the exudate settles to the lower part of the aqueous humor, and is gradually absorbed and entirely disappears in the course of ten to fifteen days.

No prominent changes are exhibited in the conjunctiva; however, the pigmentation of the conjunctiva of the eye ball makes it difficult to observe variations in its blood vessels. Occasionally the conjunctiva becomes swollen and produces a slimy, serous secretion. In cases where the vitreous humor can be observed in the early stage of the attack it is found to be clouded. In the active, inflammatory stage, the eye ball is found, by palpation, to be sensitive and hard. Opacity of the lens appears during the later attacks, and, as a rule, when the lens become entirely opaque (total cataract) the periodic attacks cease in that eye. In six to eight days after the beginning of the attack the inflammatory appearances begin to subside, the sensitiveness to light and extra flow of tears abate; the exudate in the anterior eye-chamber begins to disappear; the pupil begins to expand and the iris may react with regularity. After about fourteen days from the beginning of one of the early attacks the inflammatory changes will have so completely disappeared that casual observation fails to discover anything abnormal in the recently diseased eye. However, a careful and critical examination discovers that the iris is still attached to the capsule of the lens; or one may find on the capsule pigment masses which were left there in the breaking away of the iris from the capsule; the iris is lighter in color—lighter brown, very like the color of dead leaves. Occasionally the iris is so pressed forward that it comes in contact with the cornea and the anterior division of the aqueous chamber appears obliterated. The pale green appearance of the pupil indicates more or less cloudiness of the lens or vitreous humor. In most cases, especially after the later attacks, there remains a bluish ring around the margin of the cornea—a diffuse cloudiness—the upper eyelid, instead of presenting a continuous arch, exhibits an abrupt bend a short distance from the inner angle; the upper lid and the eyebrow are also more wrinkled than usual; after a few attacks the eye ball shrinks in volume, is smaller than normal, and in the interval between attacks the eye ball, by palpation, exhibits uncommon softness. In most instances cloudiness of the vitreous humor and detachment of the retina can only be discovered by first expanding the pupil with atropine and then examining the eye with the opthalmoscope. After the disappearance of the acute inflammatory symptoms, or after the inflammation has subsided and all damages are partially repaired, or the eye has "cleared up," it may remain free from another attack for a month, for two or three months or even for a year. However, as a rule, the attacks occur somewhat regularly every four or six weeks until the eye becomes entirely blind. This disease generally results in the formation of a total cataract and occasionally in paralysis of the retina or optic nerve—amaurosis. The attacks may vary in severity in the different cases, but the successive attacks in each case grow more severe and leave behind more distinct and prominent signs of approaching total blindness. Five to seven attacks, as a rule, completely destroys the sight; thereafter that eye remains free from periodic inflammatory attacks; the other eye is then liable to become similarly affected until it goes blind. Rarely are both eyes thus diseased at the same time, but they may be attacked alternately until each one becomes blind.

The diagnosis of periodic opthalmia is not difficult. The previously mentioned symptoms and course of the disease are generally quite distinct. There are exceptional conditions and times when the owner or observer will be in doubt. During the first attack, when the cornea and the aqueous humor are so badly clouded that the pupil, the iris and all internal parts of the eye are invisible, one can not determine beyond question whether it is a case of simple iritis or iritis associated with some form of influenza. In some attacks the cornea may be so opaque for a time that one is unable to discover whether the aqueous humor is clouded or not; in such a case the owner may believe that the cornea is injured in some way. Time alone will bring forth or make clear the other symptoms. Again, during the interval between the first and second or between the second and third attacks, the before mentioned symptoms may be indistinctly marked; it will then be necessary to wait for the appearance of another attack. But in all the doubtful, indistinct cases, the characteristic fact of its recurrence in the same eye will remove all doubts in the mind of the owner if not in the mind of the buyer.

Causes.—A number of different microbes have been found in the tissues and humors of eyes affected with moon blindness. Vigezzi has found a micrococcus which he believes to be the direct cause of the disease; Trinchera discovered an immovable, curved bacillus; R. Koch found a short bacillus, rounded at its ends; Richter found a diplococcus and a triplococcus. However, no positive proofs have as yet been discovered, by experimentation or otherwise, that would justify a positive declaration in favor of any microbe. In fact the investigators have found a germ associated with the disease; but, if the microbe has been cultivated on artificial media, the eye disease has never been artificially transmitted or produced by means of the germ.

Willach examined 37 eyes from 24 horses and has discovered a variety of forms and kinds of round and flat worms; most of them were found in the humors and represented the young stage in their development. Similar parasites were also discovered in the alimentary canal, the liver and the lungs. Wallach believes that these worm-like parasites migrate from the alimentary canal during their early life—chiefly by way of the blood vessels—and thus reach the eye; these migrations take place periodically or at such times as the egg or young forms of the parasites reach the alimentary canal in the food or water. This theory would, of course, explain the periodic nature of the disease and many other phenomena connected with it. But the worm-like forms were found only in the examination of dead eyes, whereas the limited number of cases and want of transmission or actual production of the disease by experiment will not justify, beyond question, the 'far-fetched' conclusions.

On river bottoms, on moist clay soils, on marshy grounds, on moist coast lands of seas and lakes, in malarial districts, this disease is said to be most prevalent. In 1875, a regiment was moved from Frankfurt on the Main to Hofgeismar; at the former place moon blindness never appeared; during the first year, at the latter place, 5 cases appeared among the horses of the regiment; the second year 12; the third year 11; the fourth year 14, and the fifth year 42. The regiment that was stationed at Hofgeismar was moved to Frankfurt; during the last five years of this regiment at Hofgeismar there were 130 cases of periodic opthalmia, and during the first five years at Frankfurt not a single case appeared. Hofgeismar, Saarburg, St. Avold and other places in Germany seem to be peculiarly adapted, by their moist clay soils, to the development of the microbe, the parasite, the gas or miasmatic factor that causes this disease. Records also show that on certain low lands of Belgium, France, Spain, Italy. Austria and England, this eye disease prevails extensively. Likewise in our own country certain localities have more cases of moonblindness than others.

The writer has observed that this disease is more prevalent in the southern states, than in the central or northwestern states. Compare the number of cases in the dry, cool climate of South Dakota with the moist, warm climate of Alabama and the result shows the extremes—the almost complete absence in the former State and the unpleasant prevalence in the latter. It is said to occur less frequenly on lime soils. Clay soils will retain moisture longer and as a rule are richer in organic materials than sandy soils; consequenly germs, malarial parasites, etc., will grow abundantly on the moist clay soil.

The disease appears on sandy soil if there is sufficient moisture; it will also appear on moderately high rolling land irrespective of the kind of soil if there be sufficient moisture—as a rainy season followed by a warm season with occasional heavy rains. A number of cases have been observed at Auburn, 800 feet above the sea level, with a gray sandy soil; however, there are red clay districts not far from Auburn. I, also, have reports of its appearance on sandy soils in other parts of this state.

In the period from 1879 to 1890, appeared 2183 cases of periodic opthalmia among the horses of the Prussian army. Of this number 585 were in the 15th army corps; 358 in the first; 339 in the 11th; 145 in the 10th; 135 in the 5th; about 80 in the 2nd, the third and the 8th; about 70 in the 7th; about 60 in the 4th, the 6th, the 9th and the 14th; 49 in the guard corps. It will be observed from the above records that the disease prevailed quite extensively in the respective localities of the first five of the army corps above mentioned; while in the districts of those last mentioned the disease was comparatively rare.

Cloudy weather, or moist air, so common and constant on wet lands, is said to be a factor in causing this disease. Rank, succulent fodders, grown on wet lands, associated with a damp, sultry atmosphere, is conducive to the production of a lymphatic temperament or constitution—a horse with a coarse open texture of bones and muscles, with an excess of connective tissue, with thick skin, legs covered with an abundance of long hair and with labored, sluggish movements. No doubt, such animals are predisposed to moonblindness. Fodder, hay or grass, from low, swampy or wet soils may also contain the germs or malarial parasites which are believed by some to cause this disease. In some localities of Europe the hay and fodders, grown upon certain soils, are said to be the cause, or the carriers of the cause from the soil to the animal.

A constant stimulating diet of corn, rye or barley grain—especially in summer or when given to the growing colt—contain too much of the fat and heat producing food and not sufficient proportion of the muscle and bone forming food; the horse so fed may be very fat but less able to resist the germs of disease, more liable not only to moonblindness but also to "big head" and other constitutional diseases. Constant feeding of corn will certainly make the periodic attacks occur more frequently and also augment their intensity. This has been proven by a number of trials. A reliable farmer living near Auburn had a fine young mare that had been attacked two or three times; he believed the corn was making the disease worse; hence he withheld the corn and thereafter fed her upon oats; the eyes were not again attacked, and they recovered so completely that her owner could never observe anything wrong with them. Certainly the feeding of corn alone did not produce the disease, but after the real exciting cause had established it, the corn either maintained a supply of food for the microbe or diminished the general vigor of the animal or the resisting power of the leucocytes--germ destroying cells of the body. High feeding associated with irregular exercise, feeding irregularly and using unwholesome, decayed or partially rotten hay, fodder or grain; also the surface water of runs, ditches, ponds and shallow wells receiving the impurities from barns, barn yards or outhouses--all these are contributing causes and many times the impure water may convey the microbe, the originating cause, into the system.

Overworking an animal, no doubt, depresses the vigor and resisting power of the animal; thus attacks are more liable to begin or recur during the severe, exhausting spring plowing and summer work. During the time of breaking the colt and of the eruption of permanent teeth the attacks are excited to greater severity and are called forth more frequently. The eruption of nearly all the permanent teeth occur during the last half of the third, fourth and fifth years of age. The small teeth that usually appear just in front of the first molar on either side of the upper jaw, very rarely in lower jaw, are commonly called wolf teeth or "blind teeth." Many people believe that this little tooth in some mysterious way affects the eye, causes it to go blind "by pressing on the nerve of the eye." This is, to say the least, very unreasonable if not nonsensical. Those little teeth never affect the eye. No doubt they are broken off many times when a horse has an attack of periodic opthalmia and the eye "clears up" in ten to fifteen days--not because the little tooth was pulled or broken off with a punch--but because that eye disease appears and disappears periodically. Heredity is certainly a strong predisposing cause of the disease. It does not originate the disease but the offspring inherits the tendency or weakness of the eyes, that permits the originating excitant to call forth the disease with little resistance. This transmission, from sire or dam to the offspring, of defective tendencies is, no doubt, responsible for the appearances of periodic opthalmia in certain families when the original blood was so contaminated. In France the government discourages, and prohibits when possible, the use of blind stallions or mares for breeding purposes. The farmers and stockmen of the country have observed and noted the influence of heredity in the production of moonblindness. From the replies to a circular letter which I sent to farmers and stockmen in all the counties of Alabama, twenty-one stated that heredity was a primary or secondary factor in the cause of periodic opthalmia.

Poor or badly ventilated and improperly lighted stalls or barns are also causal factors. Prof. Williams of Edinburgh says: "Fifty years ago thousands of horses became annually blind from opthalmia; now-a-days one seldom sees a case of blindness from this cause. This happy result is due to the enlightened writings of Coleman on ventilation and the advance of veterinary science—facts which the public seem to ignore." In improperly lighted stalls or barns the light is so weak, or small in quantity, that the eyes are continually strained in order to see distinctly; or the light enters from a small window directly in front of the horse, placing the horse on the shady side of the objects in front of him, and this in combination, or contrast, with the constant glare of the window, is certainly as trying on the eyes as insufficient light. The light should come from behind or from either side of the animal in quantity sufficient to make all objects in the stall distinctly visible. It has been suggested that exposure to cold, or to any of the atmospheric influences which ordinarily produce acute catarrh or cold in the head, will cause an attack of moonblindness. The records of the disease in the German army show that more cases occur in winter than during any other season. But in this State the majority of cases appear in the spring and summer.

A rheumatic condition of the system is said to play an important part among the long list of causes of moon-blindness. It, however, like many other depressing diseases and influences, is only a preparing or predisposing cause or condition which can not originate the disease but may excite frequent attacks and increase its severity. . Smoke, pungent vapors, hayseeds, dust or any local irritants or injuries may awake the latent tendency or augment the intensity of an attack. In short, whatever depresses the vigor or debilitates the system will aid in originating the disease and will also increase the intensity and frequency of the attscks: anything that strengthens the constitution or improves the animal vigor will be a protective or assist in preventing periodic opthalmia.

The essential and originating cause is very probably a microbe, a miasmatic germ, an animal, worm-like parasite or the poisonous product of a germ. The natural habitat or its native place of propagation and development seems to be on moist lands that are, during one season, extremely wet and at other times dry enough to bring forth crops. The surface water of such districts, and the fodders, grasses and hays grown on such lands, transmit or carry the germs into the system of the animal.

During January, 1893, the veterinary department issued about two hundred circular letters containing questions relative to eye diseases among domestic animals; these were mailed to farmers and stockmen in all the counties of Alabama, and they were also published in many of the daily and weekly papers of the State. The principal question in the circular letter read as follows:

"Are horses and mules in your beat or county affected with what is commonly called moonblindness? If you have such an eye disease please state how frequently it occurs, and what is your view of the cause of it."

I received in all nearly 125 replies. From these replies I have obtained the following records on periodic opthalmia or moonblindness:

Eighty (80) cases were reported in such a manner as to leave in doubt just when they occurred; 33 cases were reported as being in existence at the time (January and February) of replying; 7 parties report that the disease was prevalent in their respective beats ten to twenty years ago, but not of late years. During the first three months of 1892 and during the same time in 1893, 21 cases have come under my observation at the free Saturday clinic; these cases were from the country and towns surrounding Auburn, and represent fully ten per cent. of all the diseased cases that appeared at the free clinic during the same time. The above records certainly indicate that periodic opthalmia is a common disease among horses and mules of Alabama; and according to the reports on other eye diseases it is the most prevalent and frequent cause of blindness.

The reports do not give data sufficient for one to state in just what beats it occurs, but they do show that moonblindness has been, or is at present, in nearly every county in the State; that annually a great many valuable horses go blind as a result of it. Generally speaking, the reports seem to indicate that the disease is most prevalent in the low lands or malarial districts of the State; yet the knowledge given of the local geography of the places from which the reports come, is not sufficient for one to make an accurate comparison.

From the replies I find that a variety of opinions were expressed as to the cause, and a great many failed to express their views, while others said they did not know. Let me now give a concensus of the opinions expressed. Six parties believed that improper and irregular feeding are important factors in the cause of moonblindness; 3 say "not enough variety in diet;" 4 believe "too much fodder and grain and not enough hay" is the cause; 1 says "feeding corn to colts;" 9 claim "feeding corn as an exclusive grain diet" is the direct cause; 3 give "exposure to cold" the credit; 1 says the "eruption of permanent teeth and the shedding of colt teeth;" 1 says "blind teeth;" 1 makes "high feeding and irregular exercise" responsible; 11 claim that "overwork" in various ways is a potent causal factor; and 21 say heredity, especially in blind or "weak-eyed" breeds, is the chief cause; six (6) parties traced the history directly to a blind sire or dam. Surely the above ideas, relative to the cause of periodic opthalmia, show that the stock owners of Alabama have been searching for the cause; and if they have not discovered the actual originating cause, they have found factors that intensify or conditions that make the disease worse. Some have suggested that home-bred horses are more disposed to this disease than horses or mules brought here from other states; yet others claim that the opposite is true. I am of the opinion that the animals freighted here from Kentucky, Missouri, Illinois, etc., are far more liable to contract periodic opthalmia than home-bred horses; because the diet of the northern horse is very greatly changed and he must also become acclimated —his system must be adjusted to new climatic conditions.

The susceptibility of an animal is determined to some extent by age. From the reports of cases where age was mentioned, and also from the records of European authorities, the period of greatest frequency is from 3 to 9 years of age. Some have placed this danger period from 2 to 7. Yet it should be remembered that periodic opthalmia does occur outside of the above age limits, for I have reports of cases 12, 13 and 15 years old.

Treatment.—Taking into consideration our indefinite knowledge of the originating cause and the numerous attending, exciting and predisposing causes, and the fact that the disease generally results in total blindness in one or both eyes, it is evident that preventative treatment is the most profitable and reasonable. The drainage, ventilation and light in most barns are sadly neglected and generally very defective. The barn is usually resting on the ground and the stalls are filled with clay which becomes saturated with urine. The clay allows very little moisture to pass through it; the urine, which falls upon it and with which it becomes saturated, passes off mainly by evaporation. With little ventilation or drainage below it, the clay rarely becomes dry and the atmosphere of the stall is constantly saturated with unhealthy gases (ammonia, etc.,) from the fermenting urine and decomposing organic matter of the feces. Such unhealthy conditions can be greatly improved by following the methods usually adopted in building houses in this climate. The floor of the barn should be from two to three feet above the ground; this may be accomplished by making the brick or stone pillars for underpinning the required height and using strong plank two inches thick for flooring.

Lattice work between the outside pillars will permit free circulation of air under the barn and prevent the use of the basement for a dog house, pig pen or as a place for fowls. This will give good, cheap drainage below with excellent under ventilation. The ventilation of the box stall (the best and healthiest kind of stall) should be so arranged that the hot and light air may escape through an opening or series of openings in the upper part of the outer wall, permitting it to pass directly out of the barn. Similar openings should be located in the outer wall near the floor to allow the heavy gases (carbonic acid gas exhaled by the lungs, etc.) to escape. Besides these openings lattice box stall doors and lattice outer hall doors and windows should always be in use for summer ventilation. There may be objections (its hardness and the drying out of the feet) to standing a horse on a plank floor; but these may be overcome by bedding or littering the box stall; by occasionally soaking the feet in water, and, when nearly dry, oiling them with an ointment made of one part of pine tar to eight or ten parts of lard or cotton seed oil. The light should, as before mentioned, enter from behind or from both sides of the animal; in the box stall the light should thus enter when the horse is standing at the manger. Furthermore, the light should be so arranged and of sufficient quantity to enable the horse to see distinctly in all parts of the stall.

The water supply and time of giving water to horses should be carefully considered. All surface water, from ponds, brooks, rivers and shallow wells should be avoided. Spring water, taken directly from the spring, filtered rain water or other kinds of filtered water, or water from deep wells are best, and less liable to contain disease-producing germs. The horse and the mule should always be given warter before feeding grain—never after, unless it be given two hours after feeding.

A constant corn diet is to be avoided, especially as a food for colts. It is extremely doubtful if corn for colts is ever advisable. Furthermore, it is injudicious to feed horses or mules upon corn as the only grain food at any other time except in the cold period of winter. In fact, there is no time in this climate when corn alone is really needed or demanded by the system. Far better results will be obtained by using oats as the staple or chief grain food; and, at times, equal parts of ground corn and cow peas, or equal parts of ground corn, cow peas and oats, or equal parts of ground corn and wheat bran, may be substituted for oats alone. Corn should never be fed to horses with weak eyes or with diseased eyes. Corn and fodder (leaves) form the staple articles of food, for horses and mules, in some parts of this State with a climate that will produce green rye for soiling during the entire winter and green sorghum and green millet for summer. Corn is too stimulating and contains too much heat-producing material; the corn fodder is a dry, rough food, which in combination with corn is liable to lead to attacks of constipation, producing passive congestion of the blood vessels of the brain and the eyes. To be sure this does not always occur, but many times an attack of periodic opthalmia may thus be called forth. Variety in rations should always be considered, and extended according to local food supply; watch the effects of the quality and the quantity of the various foods, and many times you will be able to regulate the diet of the animal according to your experience in feeding it. No fixed or absolute laws can be made to fit all cases; horses have their individual peculiarities as well as persons.

High feeding, with irregular exercise; excessive and exhausting work; exposure to cold (rheumatic influences) are to be avoided as far as possible, especially with animals affected with periodic opthalmia or predisposed to it.

The indiscriminate use of blind animals for breeding purposes can not be too strongly condemned. Heridity is certainly the most potent predisposing cause of periodic opthalmia. Mares with weak eyes and with a lymphatic temperment and structure should not be bred to stallions of similar temperment and form.

Proper *curative treatment* will sometimes check the progress of the disease, and may, in rare instances, result in permanent relief. During the active inflammatory stage bathe the eye in cold or hot water for 1 to 2 hours morning and evening; after each bathing put into the eye a few drops of the following solution: Potassium Iodide, 10 grains; Atropia Sulphate, 1 grain; Boracic Acid, 10 grains; Pure Water, 2 ounces. This medicine may be used for 6 or 8 days until the eye begins to clear up; then use the same prescription, omitting the Atropia Sulphate. When possible adjust over the eye a cotton cloth or small bag of cotton, kept constantly wet with cold or hot water. It is well to keep the horse, during the inflammatory stage, in a dark box stall if the ventilation, cleanliness and drainage of the stall is healthful and good. If the horse is constipated a mild purgative (one-half pound of Glauber's salts or one-half pint of raw linseed oil) may be given. Constipation may be thereafter avoided by giving a bran mash once or twice per week. Moderate and regular exercise or easy work is beneficial, but keeping the affected horse or mule at hard work is decidedly injurious. In every instance it is wise to remove, when possible, all predisposing or attending causes.

As indicated in several reports from different parts of the State, periodic opthalma seems to be disappearing in certain localities. It will certainly decrease in frequency, or entirely disappear, in nearly every beat in Alabama when the stock raisers comply with the hygienic laws, governing the health of horses and mules. The principles of feeding, ventilation, drainage, breeding and sanitation in general must be studied and practiced, from a scientific stand point. Besides Alabama can and should raise her own mules and horses. Healthier, better and cheaper animals can be bred and raised in this State than the majority of those that are annually shipped here from other States.

METHODS OF EXAMINING THE EYES.

Remove the blind bridle or any harness obstructions to free vision. Tie a cloth over one eye and then lead the animal over obstructions that will cause stumbling or high stepping. Repeat this test with the other eye blindfolded. If the animal with one eye blindfolded stumbles over low objects the vision of the other eye is defective. Note the attentive and erect position of the ears indicating that they are attempting to compensate for the defective sight. Carefully compare the fullness or prominence of one orbital region with the other; note that in fat or young animals the orbital cavity is full and that in poor or old animals the eye socket is not completely filled and the orbital rim or bony border is prominent. Excessive fullness of one orbital region would indicate that the eye lids or the tissues, surrounding the eye ball, are swollen, or it would indicate the presence of a tumor in the orbital cavity. Closely observe the form, position and condition of the eye-lids; the presence and position of the eye lashes; also, compare the curve of the free border of one upper lid with the same lid of the other eye. Examine carefully the secretion at the miner angle of the eye. The tears are like water; mucus appears gray and flocculent; pus mixes with the tears and appears yellow and cloudy; in the dog pus sometimes is colored green. If the mucus and pus are mixed the mucus flakes are colored yellow. An excessive quantity of tears, mucus or pus is manifest by the flowing of the secretions down over the cheek. The presence of the mucus, pus or an extra quantity of tears flowing over the cheek should induce the observer to look closely for foreign particles in the eye, inflammation of the conjunctiva, abscess or ulceration of the cornea and closure of the lachrymal ducts. For further examination the animal should be taken to a barn or stall. It is best to use a stall with one window or one door; the animals head should be turned to the open door or to the window, allowing the light to fall on the eye from directly in front or from an angle to the right or left of the front. The eye may be opened by gently and firmly pressing the lids apart with the thumb and index finger, using the right hand with the left eye, and the left hand with the right eye. To see the conjunctiva of the upper lid, it may be everted by grasping the eye lashes with one hand and everting the lid over the fore finger of the other hand. Examine closely the haw or "eyewasher" and all parts of the conjunctiva for signs of injury, inflammation and irritating particles. Examine also the opening of the tear ducts.

The observers attention is next directed to the size, form and position of the eye ball. It is always advisable to compare one eye with the other that the abnormal may be judged by its deviation from the normal. If the eye ball projects outward and forward excessively, dislocation of the eye ball, hydropthalmus (excess of water in the aqueous humor) or a tumor in or behind the eye may be suspected. If the eye ball is drawn backward into the eye socket, severe inflammation is present, attended by extreme sensitiveness to light, as in the beginning of an attack of moon blindness. A decrease in volume or size of the eye ball, (after repeated attacks of periodic opthalmia and in tuberculosis of the eye ball) is manifest by apparent drawing of the eye into the socket and the more or less infolding of the upper lid near the inner angle of the eye. The tension and hardness of the eye ball may be tested by palpation upon the upper eye lid, with the index finger; both eyes should be tested at the same time that one may be compared with the other. Note the presence or absence of the congestion of the pericorneal bloodvessels; its presence indicates inflammation of the ciliary bodies, the iris and sometimes the choroid coat.

The cornea may be next viewed from various positions, noting carefully its curvature, its opacities, the presence or absence of ulcers, abscesses, vascularization, swellings or new growths. The location, color and limitations of the opacities should first be determined. The weaker the opacity or cloudiness the more blue the color; intense opacities are white. Black opacities of the cornea signify pigmentation from iris adhesions or from blood stains. Striped and pearl like opacities, with sharp limitations, point to scars or chronic changes in the cornea; chalk spots result from the employment of silver and lead salts in wounds and ulcers of the cornea. Viewing the cornea in profile, or from one side, will enable one to locate the opacity, revealing in a degree what layers of the cornea are involved; and to a certain extent enables one to determine the curvature of the cornea, especially in partial or total staphyloma and extremely flat or very conical forms of the cornea. If the transparency of the cornea will permit, investigate the aqueous humor, searching for the gray, floculent exudate or the yellow, sedimentary pus exudate, or the red colored exudate in blood effusions; these may be present in penetrating wounds of the cornea, iritis and moonblindness.

The color, condition of the outer surface, movements and attachments of the iris should next be examined. The iris may become grayish brown by the deposition of inflammatory products in its substance, or become gray from the deposit of an exudate on its surface. The bluish-green color of the iris, manifest after one or two attacks of periodic opthalmia, is due to an atrophied (shrinking) condition of the iris. Occasionally in cattle a tubercular growth develops from the iris and completely fills the aqueous chamber of the eye. The iris may be attached by inflammatory adhesions to the capsule of the lens (as in iritis or moonblindness); or it may thus adhere to the posterior surface of the cornea (a result of penetrating wounds and ulcers). By the use of atropine, if the pupil is small or contracted, or eserine if the pupil is large or expanded, these adhesions may be destroyed or their permanent presence made known by the immovable iris and unchangeable form of the pupil. The iris, when attached to the capsule of the lens or to the cornea, may appear rough on its outer surface and its pupillary border is more or less irregular. The ragged, irregular border of the pupil should not be mistaken for the large brown "soot balls" that appear so frequently along the upper and lower parts of the pupillary border of the iris. The movements of the iris should also be watched when the animal is taken from the sunlight into the barn, or from the dark stall into the sunshine. If the pupil contracts regularly in bright light and expands regularly in partial darkness, the action of the iris is normal. But should the pupil remain greatly expanded under all conditions of light and darkness, one would suspect partial or total amaurosis. If the pupil remains partially or greatly contracted under all conditions of light and darkness, one should suspect adhesion of the iris to the capsule of the lens.

The pupillary reflex or color of the pupil is the reflection of light from the retina and the choroid. The normal color of the pupil varies with the variations in its size or in its degrees of expansion or contraction; its color also changes with the variations in the light. By great expansion of the pupil it appears blue-green; by medium expansion it appears blue-black; by great contraction it appears black. The color of the pupil in amaurosis is generally lighter, more clear and glassy than in the normal eye. When the pupil is small atropine should be used to produce maximum expansion. Or, the animal may be taken into a moderately dark stall where the color of the light reflected from the upper part of the retina and choroid will be green, and that reflected from the optic papilla (spot where the optic nerve enters the eye ball) will appear light red. This light red color is very distinct in carnivorous animals.

Cloudiness of the lens or the vitreous humor changes the color of the pupil according to the intensity of the cloudiness. Total cataract gives the pupil a gray, a white or a whitish-yellow color; while by a partial cataract the normal color of the pupil is cut off at the points or places of local opacities of the lens or its capsule. In cloudiness of the vitreous humor the pupil becomes more or less distinctly green. A liquid condition of the vitreous humor combined with cloudiness of the same also produces a distinct green pupil. Sudden or great movement of the cloudy vitreous humor, is a certain proof of its fluidity. The observer should view the pupil from various positions; by the use of the hand or a black hat the superfluous rays of light, or those coming from certain directions, may be cut off. The observer should not mistake the images of white objects (white shirt fronts, windows, holes in the building), for white or gray opacities in the lens or other parts of the eye.

Dislocation of the lens, falling of the opaque lens into the anterior or aqueous chamber of the eye has its appearance suggested by figure 13. But if the opaque lens should fall into the vitreous humor, the upper part of the pupil may remain transparent, and the small appearing optic papilla might be visible; yet a portion of the white or gray opaque lens could be seen through the lower part of the pupil; as a rule, the iris remains passively inactive and its pupillary border floats in the aqueous humor. Sometimes the lens may be partially dislocated or may have some shred-like, or hanging thread-like, attachments to its old location; these conditions would present different views in the pupil.

In order to be more accurate in locating and discovering opacities, the animal should be placed in a dark room where the eye may be illuminated by the use of a lamp or candle. The lamp may be placed in different locations, in front of, and outward from, the eye to be inspected; opacities will then be made more distinct. Three images of the flame may be seen as illustrated in figure 18. In the normal eye the first image is the largest, upright, the most distinct and reflected from the front surface of the cornea; the second image is smaller, upright and reflected from the anterior surface of the lens; the third one is the smallest, inverted

Fig. 18.

This cut (after Schlampp) shows the images of the candle's flame. The animal should be placed in a dark room or stall, or the test may be made at night in an ordinary stall; the candle is held a short distance in front of the eye to be examined and the following images, as above illustrated, will be seen. The first upright image is reflected from the cornea; the second upright image of the flame is reflected from the capsule on the anterior surface of the lens; the third or inverted and small image of the flame is reflected from the capsule on the posterior surface of the lens. The dark back-ground of the cut represents the pupil.

and reflected from the posterior surface of the lens. In the normal eye it will be noticed that these images are more or less distinct and that, as the lamp or candle is moved, the first two images of the flame will move in the same direction that the candle moves, but the third or inverted image moves in an opposite direction to that of the candle. As the candle is moved about in front of the eye, it may reach a place where the first two upright images remain clear and distinct, but the smallest and inverted image becomes cloudy and indistinct; this would indicate that the substance of the lens or the posterior part of the capsule is opaque at the point or spot where the candle's rays attempt to pass through. If the second image becomes indistinct the opacity lies in the anterior part of the capsule; if the first image becomes hazy and diffuse the cloudiness is in the cornea. Total cloudiness of the cornea would obliterate all three images, and the diffuse cloudiness of the aqueous humor obliterates the second and the third image.

A small double convex lens may be used, as illustrated in figure 19, to focus or collect the rays from a candle or lamp in a dark room or stall. Or, a concave mirror (with a small, round opening in its center for the observer to look through) can be used to collect and reflect the rays from a candle or from an open door or window; in using the mirror the candle

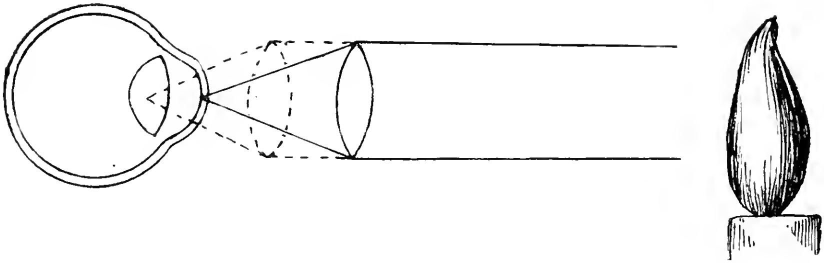

FIG. 19.

This cut (after Schlampp) illustrates how the double convex lens is employed in illuminating the eye or parts of the eye for the purpose of examination. The examination is made in a dark room or at night; the glass lens is moved forward and backward until the candle's rays are focussed upon the desired part or various parts, as it is upon the cornea and lens in the above cut.

or window should be backward from the head and outward from the shoulder or body. By employing the double convex lens or concave mirror, the transparent or opaque condition of the cornea and the aqueous humor may be distinctly observed and many opacities can thus be seen that are invisible in ordinary daylight. By employing atropine to expand the pupil, slight opacities of the lens may be made distinct and cloudiness of the vitreous humor may be observed. These methods of illuminating the eye also enables one to carefully examine the condition of the iris.

The opthalmoscope is an instrument that is used by occulists to look at the retina, its bloodvessels, the papilla optica, and to determine the degrees of farsightedness, shortsightedness, astigmatism, etc. Its use, however, requires great skill and much practice; hence, directions for using it will be omitted, since they would be of little value to the average man.

In preparing this bulletin, the writer has made frequent and extended references to the following books, pamphlets, and medical journals:

Mœller's—"Augenheilkunde."
Schlampp's—"Augenuntersuchungen."
Ellenberger-Shütz—"Jahresbericht über Veterinär Medicin. Jahr 1891."

Bayer's—"Bildliche Darstellung des Gesunden und Kranken Auges Unserer Hausthiere."
Williams—"Principles and Practice of Veterinary Surgery."
Reports of Bureau of Animal Industry on "Diseases of the Horse" and "Diseases of Cattle."
De Schweinitz's—"Diseases of the Eye."
Chauveau's—"Comparative Anatomy of Domestic Animals."
"Berliner Threrärztliche Wockenschrift."
Billings—"Bulletin of the Nebraska Experiment Station, June, 1889."

APPENDIX.

The following are some of the diseases that have been reported to this department as occurring in different parts of this State:

"Pink-Eye" has been reported as occurring among horses, mules and cattle. A large number of the cases of so-called "Pink-Eye," among horses and mules, was due to inflammation of the conjunctiva and sometimes of the cornea, associated with influenza, cold in the head, or strangles (distemper). An inflammation of the mucous membrane of the nasal passages may extend to the mucous membrane (the conjunctiva) of the eye by way of the tear canal and the tear ducts; or, some of the mucous discharge from the nostril may accidentally get into the eye. A few cases of "Pink-Eye" among cattle were associated with malignant catarrh; while nearly all "Pink Eye" cases among cattle have been outbreaks of infectious conjunctivitis and keratitis.

"Hooks" have been reported, in a number of instances, as a prolific cause of blindness. One man spoke of "bone hooks" and "fat hooks," but failed to explain the technical meaning of these terms. However, the indiscriminate practice of cutting out the haw or "eye washer" when the eye is affected with conjunctivitis, moon blindness, or tetanus (lockjaw) is certainly useless, if not barbarous.

One case of night blindness; and as previously mentioned, 134 cases of periodic opthalmia have also been reported.

Reports of four outbreaks of head scab among sheep have been received. This is a disease of the skin, and is caused by a mite (sarcoptes scabiei, var. ovis) which attacks the skin of the short wool regions of the head and legs. In attacking the skin of the eyelids, it produces entropium which leads to inflammation of the conjunctiva and cornea. Scrape the crusts from the affected places and apply any good sheep dip, once every eight days for one month.

The writer has also observed a few cases of diphtheritic conjunctivitis among turkeys and chickens. Separate the sick ones from the healthy and wash the eyes and the diseased surfaces of the mouth and throat with a weak solution of corrosive sublimate (1 to 500).

CEREBRITIS (Blind Staggers) has occurred in several counties of Alabama during the past winter and early spring. It has occurred, in nearly every instance, as a result of feeding rotten or mouldy corn. Curative treatment is usually ineffectual; it is best to prevent it by ceasing to feed damaged, mouldy corn.

The writer has received a great many reports, and has also observed cases, of "Big Head," (*osteo porosis*)—a disease of the bones, manifest by enlargement of the facial bones, of the lower jaw bone and the bones of the limbs, and nearly always leading to the "breaking down" of the horse after a long period of more or less severe rheumatic lameness. This disease is generally fatal. Excellent care with the variety in diet, as suggested to prevent moonblindness, will be good preventative, as well as palliative, treatment in this disease.

A few cases of malignant catarrh ("hollow horn?") have been reported and also a few cases of Parturient Apoplexy ("milk fever") among cattle.

Hog cholera raged in several counties last year, and has appeared in some counties this year. The disease has done the most damage in beats and counties where hogs have been allowed to run at large. To be sure it occurs in stock-law districts, but it does not there spread so rapidly; and in some instances the spreading of the disease has been checked or stopped at the border line between stock-law and non-stock-law districts. Since the germs of this disease are propagated mainly by filth and bad sanitary conditions, it pays best to work along the line of prevention. Keep hogs and pigs confined to a certain pasture, or lot; see that these places are kept free from stagnant pools or filthy holes and that the water supply is pure. Also remember that the omniverous hog can not live under any condition or eat all things with impunity. It is well to keep a mixture of equal parts of charcoal, wood ashes, sulphur and common salt (pulverized and thoroughly mixed) constantly in reach of the hogs; also, keep a small box of nut coal in the hog lot continually.

This department is desirous of receiving reports of all diseases among domestic animals, especially all outbreaks of infectious, contagious, or spreading diseases that appear in Alabama. Questions relating to animal diseases will be gladly received and promptly answered. Address all such communications to the Veterinarian of the A. & M. College and Experiment Station.

AGRICULTURAL * EXPERIMENT * STATION

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, ALABAMA.

BULLETIN NO. 44, - - MAY, 1893.

TOBACCO PLANT.

ALEX. J. BONDURANT

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Alabama Printing Co., Montgomery, Ala.

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TOBACCO.

The scientific facts pertaining to agriculture, so far as they have been discovered, are scattered through many books and agricultural publications: few of these publications are accessible to the ordinary farmer.

Some service may be done to the farmers generally and especially in the cotton States by collecting some important facts that are accurately and certainly known and the experience of intelligent farmers and scientific men on the subject of "Tobacco Culture" and presenting these to the public in compact form. The investigation of this subject was commenced last year and methods of cultivation and management of this crop was given in Bulletin No 37, March, 92.

I. Object of Experiment.

Experiments to a limited extent were undertaken the past year in tobacco, with seed fromseveral varieties that are raised in Virginia, North Carolina, Florida, Connecticut and Cuba to ascertain, if possible, the kinds that are best adapted to this climate, and tofind out if the culture of tobacco, as a staple crop, could be made profitable in Alabama.

Experimentation was conducted only in a general way, more with reference to the growth of the different varieties planted and their qualities, than to the particulars of fertilizers suitable to the crop and methods of curing.

Raising Plants.—These experiments were commenced the middle of February; at that time preparation was made for raising the plants in the open air beds burnt in the woods. The first seeding was made 13th of February; from this bed very few of the plants came up. The 7th day of March two open air beds were made which were left without any covering. At the same time a hot bed was made, the seed sown and the bed covered with cheese cloth. From these beds the seed soon germinated, and in ten days from the time of sowing some of the plants could be seen. The cold spell of weather, which commenced March 19th, when ice to the thickness of a quarter of an inch was formed, destroyed most of the plants in the open air beds during germination, those which were protected under the covering of cheese cloth in the hot bed fared much better, and while large numbers were killed by the freeze, the proportion was much less than in the open beds, and it was from the hot beds that plants were raised for planting the experimental grounds.

April 7th, other seed were sown for late plants for replanting; these were principally of the Cuban varieties obtained from the Florida station; no plants of any consequence were raised from these seed. It was demonstrated from the experiments made in the raising of tobacco plants, that the young plants were easily affected by cold and quickly killed by freezing weather in this climate, in fact, seemed to be affected sooner in this respect than in many localities in the old tobacco raising States. To avoid this difficulty, it is advisable, when practicable, to raise the plants under covered beds, in preference to open air beds.

Another important discovery was made in raising plants on the Station, viz: That the flea beetle, commonly called tobacco fly in the old tobacco States, seems to be abundant in this section, attacking the plants soon after they come up, and in uncovered beds, destroying the plants unless insecticides were promptly applied. It was further ascertained that the plants under canvass made a more rapid growth and presented a healthier appearance, and were ready for transplanting much earlier than those in the open air or uncovered beds.

Transplanting the Plants.—The transplanting of the plants from the plant-bed to the experimental grounds was commenced May 18th, and continued as the season was favorable for transplanting up to the middle of June. A few of the first plants which escaped being killed by the March freeze were left to grow in the open air bed, these made a rapid growth and were topped the 6th of June, and were cut and ready for curing the 1st of August.

Of the different varieties planted the Cuban varieties were the first to get their growth and were ripe and ready for cutting early in August. These were much blistered and made leaf of poor quality, owing to their rapid growth and early maturing during the month of July, which was a wet month, making unfavorable conditions for the growth of tobacco of good quality. Another important fact was observed in connection with Cuban varieties, that is, that the leaves were coarse and thick, not so well adapted for either wrappers or fillers for cigars, too strong for any smoking purposes.

The varieties from Virginia, North Carolina and Connecticut did not make as rapid growth as the Cuban varieties, and did not ripen until September, and continued to ripen until October. Some plants of good size and quality were obtained from these varieties which would make a good quality of chewing tobacco and cigars. The curing was imperfectly done, as it had to be cured by the air process in the gin house; and while a small quantity of bright leaf was secured by this method, the proportion of bright tobacco was thereby greatly reduced.

Making Cigars.—With the view of testing the quality of the tobacco raised on the Station for cigar purposes, and as instruction to the agricultural students, an experienced cigar maker was employed to make up a small quantity of the tobacco into cigars.

This experiment of cigar making demonstrated that some of the tobacco was suitable for this purpose. During the process of making, when the cigars were in a damp condition, they were weighed. It took from 120 to 125 of the smaller size to weigh a pound, and from sixty to eighty of the larger size to weigh a pound.

From the above the conclusion can readily be drawn as to the profits arising from tobacco when manufactured into cigars, and this experiment should encourage the growers of tobacco in this State to strive to raise a good grade of cigar leaf.

Tobacco growing is one of the most profitable branches of tropical and semi-tropical agriculture; the subject has been much neglected by writers of agricultural literature. The importance of the subject to the farmer may be estimated when it is considered that next to the cereals used as staple articles of food there is probably no plant so widely and generally grown as tobacco, and certainly none that is used by a greater number of the human race. It is proposed in this bulletin to give a brief history of the plant; to notice some of the leading varieties, some instructions for its successful cultivation and management with a view to encourage the cultivation of a plant that can be generally grown in this State, the climate and soil of which, it is believed, suits it admirably, in sufficient quantity not alone to satisfy all local demands, but to open up a large and profitable export trade.

II. Botanical Characteristics of Tobacco.

The tobacco plant is known to botanists by the generic name of Nicotiana. The genus Nicotiana belong to the Nightshade family to which order belong the Potato, Tomato, Capsicum, Henbane and deadly Nightshade

Of some fifty known varieties of the genus Nicotiana, it is claimed that all are natives of America, except two, namely: Nicotiana Suaveolens, which is a native of Australia, and is known as "Native Tobacco," and Nicotiana Fragrans, a native of New Caledonia.

The best known species are as follows:

(1.) Nicotiana Tabacum, of which there are two varieties, viz: Macrophylla (Maryland tobacco) and Angustifolia (Virginia tobacco). Each of these two varieties is divided into several sub-varieties.

The Macrophylla is the variety which affords the famous Cuban and Manilla tobaccos: it has a fine leaf which is soft and thin, and is much valued in the trade for the fine qualities of the leaf for binders and wrappers in making cigars.

Angustifolia is the most commonly cultivated variety in the United States.

(2.) Nicotiana Rustica, best known as Hungarian tobacco, is largely grown in Europe and Asia. There are also two varieties, a large leaved and a small leaved kind, both of which yield tobacco of good quality.

(3.) Nicotiana Persica, a type produced by climatic influences, but long thought to be a distinct type.

(4.) Nicotiana Crispa. This species is much grown in Syria and on the Mediterranean coast.

(5.) Nicotiana Repanda, a Mexican variety. It has small leaves, used for imparting the peculiar aroma to Mexican cigars and cigarettes.

The remaining species, notably Nicotiana, glauca, glutinosa, longiflora, nana and sanguinea, are of no commercial importance, being of interest only to the botanist and horticulturist.

III. Climatic Conditions.

Of the many conditions which affect the quality of tobacco, the most important is climate; other conditions may be, in a measure, modified, but very little can be done with regard to climate. The most rational mode of overcoming this difficulty would be in the selection of seed of the varieties which have been grown with success under similar climatic conditions as prevailin the district proposed to be cultivated.

In this State, with its range of climate from semi-tropical to temperate, a wide margin is permitted to the grower, and seed can be procured suitable to all parts of the State. In tobacco, as in all other crops, the aim of the grower should be to produce the kind which will command the highest price. The most valuable tobaccos are the Cuban and Manilla, and they owe their fame mostly to the favorable conditions under which they are grown. These places possess a tropical heat, but at the same time are tempered with the sea breeze, and there are, no doubt, parts of the coastal districts of this State which may produce an article that could favorably compare with these tobaccos.

Tobacco thrives best in a good rich soil, rich in vegetable mould, but light soil containing a good amount of organic matter and well drained will produce an excellent smoking tobacco, and on such soil the finest leaves are grown. The more clay in the soil the thicker the leaves become, and the aroma becomes less, and is consequently less suited for the finer qualities of smoking tobacco, although the weight of yield may be heavier.

Black prairie land will probably yield more to the acre than any other kind of land in this State, but the tobacco will not possess so fine a quality—on such soil it grows larger, has coarser stems and a heavier leaf, and is not so good for wrappers, or fine cut or cigarettes and cigars as the upland tobacco on sandy soils. Though tobacco is a hardy plant and will grow under varied conditions, yet to become a profitable crop, it must not be grown in a situation very different from that to which it is suited by nature. It must be remembered that the plant is a native of a warm climate, and thrives best in a moist atmosphere: therefore, in such a climate, by employing ordinary means, tobacco may be made to yield a profit not attainable in less favored situations. A warm, moist climate will permit of the selection of the varieties that sell at the highest price in the market, and in a suitable soil the profit will be such as is not often or easily realized from any other crop.

From a table at hand, which gives the essential features of the crops of cotton for the year 1888, in the United States, it appears that the yield per acre for cotton was one hundred and eighty pounds—price per pound, eight and a half cents. Value per acre, fifteen dollars and thirty cents.

With tobacco, the average annual production during the past decade has been about one-sixth that of cotton. The average yield per acre has been about seven hundred and twenty-five pounds, with an average of eight and one-half cents per pound, making the value of tobacco per acre sixty-one dollars and sixty-two and a half cents.

As the Havana tobaccos command the highest price, growers everywhere attempt to introduce and cultivate them. The difficulty in growing these varieties is, they speedily degenerate if the conditions are not favorable. Virginia tobacco is the most favored in temperate climates, as it does not require such a high temperature, but on account of its botanical characteristics it is not much liked by cigar or cut tobacco manufacturers. A high price is generally commanded, no matter of what variety, which possesses either a light mahogany, cinnamon, or golden color, and fine aroma, with thin ribs far apart and even. The wider the leaf and the less they are worm eaten, or torn, the greater the number of wrappers which can be cut from a pound for making cigars, consequently manufacturers will pay more for grades possessing these qualities than for others. There are among growers as many varieties of tobacco as there are varieties of cabbage, each section favoring a particular kind.

It may, however, be said of the varieties most generally grown in America, that the Kentucky, Virginia and Maryland are employed for chewing, pipe and cigarette smoking, while the Connecticut seed leaf and Havana are most in use for fillers and wrappers in the manufacture of cigars.

Tobacco is now cultivated through a wider range of temperature than any other tropical plant, and whether grown amid the plains of South America, or in the rich valleys of South side Virginia, or as far north as Connecticut, develop its finest form and perfection of leaf.

During the last half century the plant has been developed to a greater extent than during the three hundred years succeeding its discovery. Its cultivation and management have been reduced to an approach to an exact science, and the quality of the leaf is, in a great measure, within the control of the growers of the plant: until quite recently it was supposed that the varieties that grew in the tropics could not be cultivated with success in the temperate regions, but recent experiments have demonstrated the fact that the tobacco of Cuba can be grown with success in many parts of the United States. The tobacco raised in the tropics is the finest in flavor, while the more temperate regions produce the finest and best colored leaf.

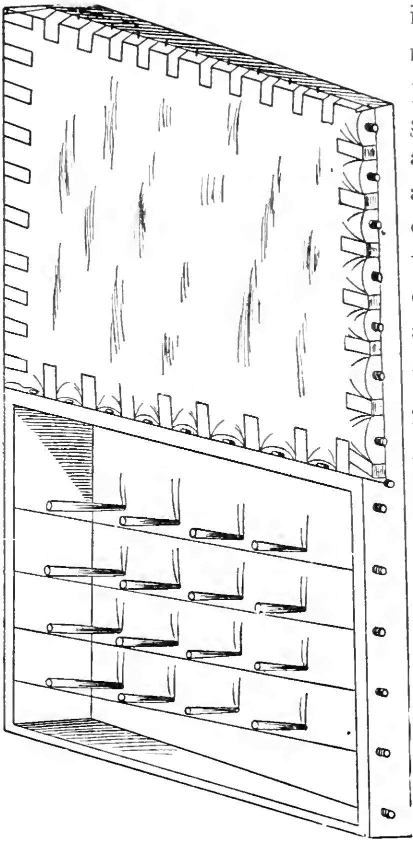
The tobacco of the tropics, as to the uses to which it is put, is limited, while the tobacco of the more temperate regions can be used for all the purposes for which the plant is needed.

Formerly but little attention was paid to the color and texture of the leaf, the principal object being the production of a leaf of large size, rather than one of good color and of silky texture. Now, these are most important conditions, and give value to the tobacco in proportion to the perfection of these qualities.

IV. Raising the Plants.

The first operation necessary in starting tobacco growing is the making of a seed-bed for raising the plants. A warm sheltered position should be selected for this. It is a common plan to burn a pile of brush-wood on the land selected for raising the plants to supply potash. and at the same time destroying the seeds of weeds, or the eggs of insects.

A more recent plan of raising the plants is under a covering of cheese cloth in a hot bed. Plate No. 1 is an illustration of the modern method of covering the plants during their growth both in the open air and hot beds. The area of the seed bed will of course depend upon the extent of the proposed cultivation and as usually about one square inch in space is allowed to each young plant in the seed-bed, it will require a seed-bed of thirty-six square feet, say nine by four feet. to supply plants for an acre planted at equal distances of three feet apart. An ounce contains enough seed to plant from six to seven acres, but as it has not a high percentage of vitality it is usual to sow at the rate of half an



ounce for an acre. The bed ought to be covered with a covering of cheese cloth, or fine brush, or short leaf pine straw. This not only protects the plants from the cold, sudden freezes, which are common in the early spring in this latitude about the time germination commences, but checks too rapid evaporation from the earth, keeping the surface moist. When the young plants first appear above the surface they are very tender; they require frequent watering of weak liquid manure and top dressing with fertilizers. All weeds must be carefully removed and the flea beetles which often destroy all the young plants in a few days must be watched for and insect remedies applied. In from five to six weeks the plants will be ready for transplanting.

V. Field Culture.

Land on which it is intended to grow tobacco should be well ploughed; on compact soils the ploughing should be deep. An intelligent rotation of crops carried out with an intelligent knowledge of the needs of the tobacco crop will be the aim of the practical farmer. Before transplanting the young plants from the seed-bed the land should be ridged, the distance between the ridges depending on the kind of tobacco to be planted —the larger kinds requiring more room than the smaller-leaved and tall sorts; but they should be far enough apart to allow a free passage between the rows of plants without injuring the plants. Generally from three to three and a half feet apart between the rows, and the same between the plants will be sufficient. Where the surface is level the plough may be run lightly over the field at right angles, thus forming small hills on which the plants are planted.

Choice of Soil.—The growers of the plant in Virginia are very particular in the selection of soil for the plant. The lands which they find best adapted are the light red or chocolate colored lands and the richest low grounds. The selection of soil will depend upon the color of leaf in demand, as the soil as well as the fertilizers determine to some extent the color and texture of the leaf.

The effect produced by planting tobacco too near the sea is injury to the leaf, which is apt to be thick and unfit for a cigar wrapper. In some countries, however, notably Cuba, the leaf grown near salt water is equal in color and texture to any grown in the interior.

Generally the plant obtains its finest form and quality of leaf on lands bordering the largest rivers. This is true of the tobacco lands ot Connecticut, Kentucky, Virginia and North Carolina, as well as of those in the islands of Cuba and San Domingo; but some of the finest tobacco grown in the United States is grown in countries some distance from large rivers.

When possible, select the kind of soil for tobacco that will produce the color and texture desired. For Connecticut seed leaf a light moist loam is the best soil. For the bright tobaccos, such as are raised in Virginia, North Carolina and Maryland, the soil should be light and friable, or what is commonly called a sandy loam, not too flat, but of a rolling, undulating surface not liable to overflow in excessive rains. New cleared in these last named States is considered better than long cultivated soils. In Cuba the planters select the red soil as the best for fine tobacco. Some planters, however, prefer a soil mixed of one-fourth sand and one-half to three-fourths of decayed vegetable matter.

Both the Cuban and American planters concur in asserting that a large quantity of silicious matter in soils is essential for the growth of good cigar tobacco. The rich clay loams on the banks of the James River in Virginia do not grow the highest price tobacco, while the less fertile silicious soils of other sections will produce tobacco of superior quality for chewing and smoking. Tobacco of high grade will not grow in the calcareous regions. A better soil is one that rests upon the primary foundation.

VI. Transplanting.

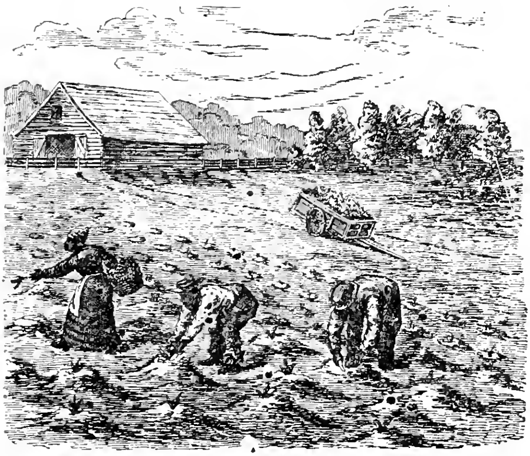


Figure 2.

—Figure 2 shows the plan of placing and setting the plants.

Transplanting should be done in the evening or on a cloudy day. Before transplanting, the seed-bed should receive a good watering so that the plants can be drawn without injury to the roots.

The planting is similar to the planting of cabbage and is no more difficult. A good plan is, for a boy to walk between the ridges, placing the plants alternately to right and left, being followed by the planters, who place the plants in the hills or ridges, taking the precaution to leave the bud well above the surface.

In a few days any missing hills which occur should be replanted, and during the early growth a close watch must be kept for the cut worm, bore worm, and other injurious insects. When the plants have taken root they grow very quickly and subsequent cultivation is simple, though requiring care.

When the plants are from six to nine inches high they require to be hilled, by mounding the earth around the plants, to protect them from falling when the soil is wet or from being blown down by heavy winds. One or two hoeings are necessary during the growing period to keep down the weeds, as everything that detracts from the growth of the plant is detrimental to the quality of the leaf.

VII. Chemical Properties.

An analysis of the ashes of tobacco by Professor Johnson shows the following constituents in their several proportions (per cent.):

Potash	12.14
Soda	0.07
Lime	45.90
Magnesia	13.09
Chloride of Sodium	3.49
Chloride of Potassium	3.98
Phosphate of Iron	5.48
Phosphate of Lime	1.49
Sulphate of Lime	6.35
Silica	8.01
	100.00

From this analysis it will be observed that of the mineral matters contained in tobacco, the following predominate: silica, potash, lime and magnesia, with a large proportion of the phosphate of iron and sulphate of lime.

There is in tobacco a volatile akali which may be known by its smoke changing the color of flowers—turning red to purple and purple to green. Different kinds of tobacco are distinguished by the peculiar odor emitted. This variation is in part due to the different modes of curing the leaf.

Recent Investigations.—Many new investigations have been made as regards the tobacco crop, referred to under the following heads.*

*Dr. J. Nessler, of Karlsruhe (Landw. vers. Stat. 40, pp. 395-438) Experiment Station Record, October, 1892.

(1) Demands of the trade especially with reference to burning qualities.

(2) What amount of chlorine is allowable and what amount of potash essential to the desired burning quality.

(3) Effect of soil on the burning quality.

(4) Amounts of chlorine and potash removed from the soil by different crops and effect of previous cropping on the burning quality of tobacco.

(5) Amounts of potash and chlorine furnished the soil in different manures.

(6) Effect of manuring on burning quality.

(7) Effect of previous cropping and manuring on the properties of tobacco other than that of burning.

(8) Injurious and beneficial methods of cropping and manuring tobacco.

The various properties of the tobacco leaf, burning qualities, size, weight, color and fermentive properties, are all more or less affected by the variety of tobacco, the soil, time, and manner of manuring, climate and the time of ripening.

The properties of tobacco may also be affected by the manner of curing and the weather during the curing. The fact that so many factors play an important part in determining the quality of tobacco makes this part of the subject a difficult and tedious one to study and understand. To secure the desired burning quality, the amount of chlorine must not rise above a maximum, nor the amount of potash sink below a minimum. From studies made of forty-six samples of tobacco, grown in Baden, Germany, on different soils and with different manures, the conclusion was, that tobacco continued to glow longer, *i. e.*, burned better, the more potash and less chlorine (sodium chlorine) it contained.

In general, tobacco will be of inferior burning quality, which contains more than 0.4 per cent. of chlorine, and less than 3.5 per cent. potash.

Effect of Soil on Burning Quality of Tobacco.—As a result of the studies referred to above, it was found that while tobacco from sandy soils contained on an average only 0.29 per cent. of chlorine, that from heavy soils contained 0.92 per cent. of chlorine, and that tobacco from light soils averaged 2.8 per cent. potash, while that from heavy soils averaged 2.4 per cent. From these indications, to secure the best burning quality, tobacco should be grown on light soils, and not on heavy clay soils.

Effect of Fertilizers on Burning Qualities of Tobacco.—As previously stated, that to be of good burning quality, tobacco should not contain more than 0.4 per cent. chlorine to 2.5 per cent. potash (that is, six times as much potash as chlorine), consequently, fertilizers for tobacco should contain at least six parts of potash for every part of chlorine that is at the disposal of the plant. The closer the relation between potash and chlorine in a fertilizer the less it is adapted for tobacco. A number of experiments have been made, with potassium nitrate, potassium sulphate, potassium muriate, gypsum and common salt as fertilizers for tobacco.

The chlorine compounds always injured the burning qualities, and the potassium sulphate and potassium nitrate often improved this quality, though not always—the failure being due, it is believed, to the potash not being sufficiently distributed through the soil, or where heavy applications were made to the formation of too concentrated solutions.

The tobacco plant gets its growth and maturity rapidly, and requires a constant supply of plant food from the soil, but on the other hand it is exceedingly sensitive to concentrated solutions. It is important that the fertilizer, especially the potash, be thoroughly mixed with the soil to a depth to which the roots extend. This may be accomplished in a measure by applying the fertilizer sometime in advance of planting.

Previous Culture of Land for Tobacco.—The quality of the soil and the manuring are largely responsible for the early and late ripening and the regular and irregular ripening of tobacco.

Tobacco plants ripen later on soils rich in organic matter, except in the case of sandy soils, where the organic matter decomposes rapidly. Heavy applications of nitrogenous manures retard ripening. Tobacco richly manured with liquid manure, night soil, barnyard manure, or nitrate of soda, ripens late.

If the plants are set late on fields so manured, or those rich in organic matter, the leaves may not have time to ripen, and a greenish leaf will result, which, in burning, gives an unpleasant odor and bitter taste, and bitter taste in chewing also.

Formulas for Fertilizers for Tobacco.—The following fomulas for fertilizing tobacco have been recommended:

Formula No. 1.—From 900 to 1250 pounds of wood ashes, or 350 pounds of potassium sulphate per acre, the applications being made to deep soils late in the fall, or to shallow soils before the first plowing. In the spring before setting the plants 135 to 180 pounds of nitrate of soda may be applied when the land is not heavily manured. In rainy seasons, when the plants lose their dark green color, and fail to grow well, 90 to 135 of nitrate of soda per acre may be applied while the plants are small.

Formula No. 2.—Two hundred and seventy-five (275) pounds of low grade sulphate of potash, 250 pounds of acid phosphate (12 per cent.) and 100 pounds of sulphate of ammonia (a by-product of gas liquor) or 280 pounds of cotton seed meal. Sulphate of ammonia, it is stated, is one of the most concentrated forms in which ammonia can be applied to the soil, and is, at the same time, one of the most active and readily available forms, being decidedly quicker in its action than any form of organo-nitrogenous matter.

Magnesium carbonate, a new product of the Stassfurt industry, of Prussia, Germany, containing 18.5 per cent. of potash, is said to possess good properties in improving the quality of tobacco. In the Connecticut valley, where fine cigar leaf is raised, nearly all kinds of domestic, commercial, and special fertilizers are used. Of domestic fertilizers, horse manure is considered the best, as it produces the finest and lightest colored leaf of any known fertilizer. Cotton seed meal, when used with domestic manure, is an excellent and strong manure.

Mapes formula is a favorite with many growers of fine cigar leaf in Connecticut.

VIII. The Stalk.

Figure 3.

Figure 3 represents a full grown tobacco stalk, with the leaves taken off.

The tobacco stalk varies with the varieties of the plant.

All of the species cultivated in the United States have stalks of a large size, much larger than many varieties grown in the tropics.

The American varieties have erect, round, hairy, viscid stalks and large fibrous roots, while the foreign varieties are harder and much smaller. The size of the stalk corresponds with that of the leaves; the two larger stalks in the figure show the American, and the smaller stalk the foreign. The size of the stalk corresponds with that of the leaves, and with such varieties as are planted in Virginia, North Carolina, Kentucky, and other old tobacco States, will be found to be larger than the Spanish and Syrian tobacco, which have a much smaller, but harder stalk. The stalk must be hard and strong to support the long, palm-like leaf, which, in some varieties, grows to a length of two and half to three feet.

The Leaves.—The plant bears from eight to twenty leaves, according to the species of the plant.

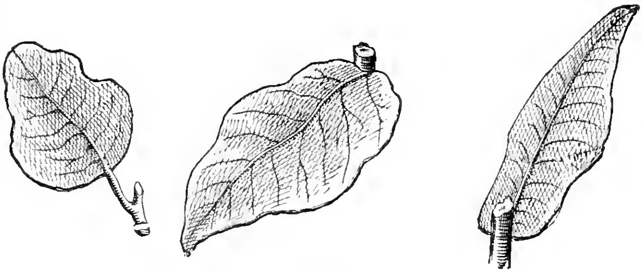


FIGURE 4.

They have, as represented in figure 4, various forms: ovate, lanceolate, and pointed. Leaves of a lanceolate form are the largest, and the shape found on most varieties of the American plant.

The color of the leaves when growing, as well as after curing and sweating, varies, and is frequently caused by the condition of the soil. The color, while growing, may be either a light or dark green, which usually changes to a yellowish cast as the plant ripens. The ground leaves generally ripen first, turning yellow and during wet weather will rot and drop from the stalk if not gathered. The color of the leaf, after curing, may be determined by the color of the leaf while growing: if dark green while maturing in the field, the color will be dark after curing and sweating, and the reverse if of a lighter shade of green. If the soil be dark, the color of the leaf will be darker than if grown upon light soil. The kind of fertilizers applied to the soil, as well as the soil itself, has much to do with the texture of the leaf, and should be duly considered by all growers of the plant.

The Flower.—The flowers of the tobacco plant grow, as is shown in figure 5, in a bunch on the summit of the plant, and are of a pink, yellow, purple or white color, according to the variety of the plant.

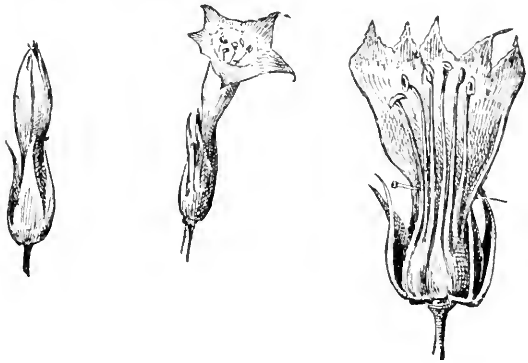


FIGURE 5.

After the buds appear they blossom in a few days and remain in full bloom two or three weeks, when they perish.

The Capsule.—When the flowers drop from the fruit bud, the capsules grow very rapidly and soon attain full size, as shown in figure 6.

FIGURE 6.

This occurs only in those plants which have been left for seed and remain untopped. In form, the fruit bud resembles an acorn, though more pointed at the top; in some species, of a dark brown, in others of a light brown color, containing two cells filled with seed, similar in shape to the fruit bud. Some writers state that each cell contains about one thousand seed. The fruit buds of Virginia tobacco, as well as of most varieties grown within the limits of the United States, are much larger than those of Havana, Syrian and numerous other species of the plant, while the color of these last named varieties is a lighter shade of brown.

The color of the seed also varies according to the varieties of the plant. The seeds of some species are of a dark brown, while others are of a lightér shade.

The seed are so small that the variety to which they belong can not be determined except by planting or sowing them. The plants selected for seed should be left growing late in the season. Strong, healthy plants generally produce large, well-filled capsules, and these should be selected by the grower for seed. The largest and finest capsules on the plant mature first, while the smaller ones grow much slower and are frequently several weeks changing from their green to brown color. Many of the capsules contain imperfect seed and some do not contain any seed at all.

The Sucker.—The sucker makes its appearance at the junction of the leaves and stalk, as indicated in figure 7.

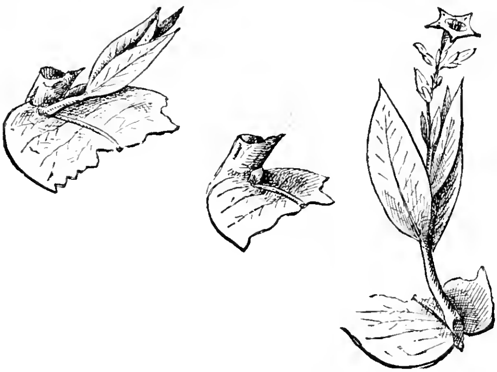


FIGURE 7.

Usually these are not seen until after the plant has been topped, when they come forward rapidly and if not plucked off in a short time develop into strong, vigorous shoots.

The growth of the suckers is injurious to the leaf, retarding their size and maturity, and affect the quality as well as the maturity of the plant. When the plants are fully ripe and ready to harvest, the suckers will be found to be growing around the root of the plant.

This is one of the most reliable evidences of its maturity, as it denotes the ripening of the entire plant.

Breaking off the suckers hastens the ripening of the leaves and gives a lighter shade of color, no matter on what soil the plants are grown.

Topping.—Topping is simply breaking off the bud at the top of the stalk, as represented by figure 8.—

FIGURE 8.

to prevent the plant running up to flower and seed.

By this means the best growth of the leaves is secured, and they at once develop to the largest possible size; will ripen sooner, while the quality is much better.

There are various methods of topping, as well as different periods. Some planters top as soon as the capsules appear, while others wait until the plants are in full blossom. If topped before the plants have come into blossom, it should be done as soon as possible, as a longer time will be required for the leaves to grow and ripen than when topping is delayed until the plants are in bloom. Top the plants at a regular height, leaving from nine to twelve leaves, so that the field will look even and also make the number of leaves to a plant uniform. The above method of topping refers more especially to cigar rather than cutting leaf. Those varieties of tobacco suited for cutting leaf should be topped as soon as the flower bud appears; top low, thereby throwing the strength of the stalk into a few leaves, making them large and heavy. Let it grow from five to six weeks after it is topped, so as to have it thoroughly ripe, thereby giving it the bright, rich, golden color, entirely different from cigar leaf, but desirable for chewing leaf. The custom in the old tobacco States is to top for English shipping from eight to ten leaves; for coal curing, from ten to twelve. In some sections of the United States the plants are not topped at all; the leaves are left upon the stalk until they are fully ripe, when they are taken off.

IX. Insect Pests.

The two most destructive pests that prey upon the tobacco plant after being transplanted to the field are the "cut worm" and the "horn worm", as shown by figure 9.

FIGURE 9

The cut worm commences its work of destruction in a few hours after transplanting in the field.

During the night this worm begins by eating off the small or central leaves, and often so effectually as to destroy the plant. The best time to find and destroy these pests is early in the morning, when they can be found nearer the surface; with the heat of the sun they burrow deeper in the soil.

Soon after they disappear, the fight with the horn worm commences.

Figure 10 shows the Sphinx, or moth, the parent of the horn worm, the larvae and the horn worm.

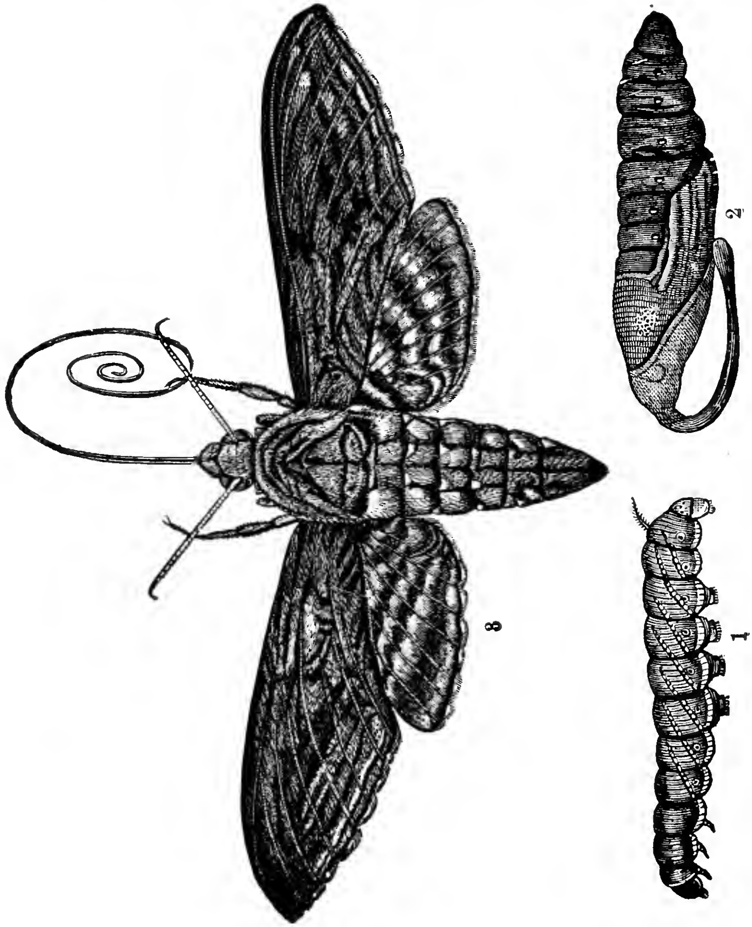


Figure 10.

The horn worm feeds upon the finest and largest leaves; eats the leaves in the finest parts of them. They leave large holes which render the leaf worthless for a cigar or chewing wrapper, leaving it fit only for fillers. As the Sphinx, that lays the eggs usually deposits two crops of eggs on the tobacco plant during its growth, it will require much time and labor to destroy the eggs and worms. If this is neglected, the crop will be much injured and will not be sought after by good judges of tobacco.

X. Varieties of Tobacco and Harvesting.

Figure 11 represents the Connecticut seed leaf as it appears ready for harvesting.

Figure 11.

Tradition indicates that this variety was introduced originally into the New England States by B. P. Barber, and it is thought to belong to the Cuban variety. The varieties cultivated in the United States and known as "seed leaf" tobaccos, are grown in Connecticut, Massachusetts, Vermont, and eastern and western States.

All of the seed-leaf of the United States is used exclusively in the manufacture of cigars, and is celebrated for cigar wrappers from the superiority of its color and texture, and the good burning quality of the leaf.

The plant grows to the height of about five feet, with leaves from two and one-half to three feet in length, and from fifteen to twenty inches broad. The color of this tobacco after curing is either dark or light cinnamon.

There are two principal varieties of Connecticut seed-leaf, broad and narrow leaf—of these two, the broad leaf is considered the finest, cutting up to better advantage in cigar making, and ripening and curing fully as well.

This tobacco has not that fine flavor of Cuban tobacco, but in texture is considered equal to it. It burns freely, leaving a white or pearl colored ash, which is one of the best evidences of a good cigar tobacco.

The leaf is firm and strong, and sufficiently elastic to bear considerable manipulating in manufacture. Thorough cultivation by the growers has made this quality of tobacco one of the most profitable of any cigar tobacco grown in the United States.

FIGURE 12.

This figure represents a plant of Virginia tobacco maturing seed. Virginia tobacco has acquired a reputation which has gradually increased for more than two hundred and fifty years.

The plant grows to the height of from three to five feet; the leaves are long and broad, and when cured are of various colors, from a rich brown mahogany, cinnamon, to a fine golden yellow. The finest quality of Virginia tobacco comes from the southside counties, but the amount is small compared to the quantities of dark raised on the lowlands of the Dan and James rivers and their tributaries. The tobacco grown in the southside and southwestern counties of Virginia is much lighter in color, and of much softer and finer texture than the ordinary Virginia tobacco.

Havana Tobacco.—This famous variety of tobacco, as is shown in figure 13, is considered the finest flavored for cigars that is now cultivated.

FIGURE 13.

This variety, it is stated, grows to a height of from six to nine feet, with oblong, spear-shaped leaves. The leaves when young are of a dark green color, and have rather a smooth appearance, changing at maturity into yellowish green. This variety grows quickly, and by careful pruning a fine colored leaf is obtained, varying from a straw color to a dark brown or black.

The finest is grown in Vuelta de Abajo, which for nearly a century has been celebrated as a fine tobacco producing district. The Havana tobacco ripens in from eight to ten weeks after being transplanted.

The stalk and leaves are not as large as the Connecticut seed-leaf, but it is better in flavor.

Cutting the Plant.—Figure 14 represents harvesting the plant.

FIGURE 14.

There are two methods of harvesting, cutting down the whole plant or gathering the leaves singly. The former is the one that has been practiced for a long time by tobacco planters; the latter, which is of recent origin, is regarded by many as the most scientific method.

Both these plans of gathering have their advantages. The first is the easiest and permits of quicker handling, but the leaves have to be assorted afterwards, while the latter permits the sorting of the leaves in the first operation, and the development of a greater number of mature leaves.

For cutting, a heavy knife is used, and the method is similar to cutting sugar cane, the plant being held with the left hand and cut close to the ground.

The plants should be removed to a shady place to prevent their becoming sunburnt.

Putting on the Stick.—This is shown by figure 15.

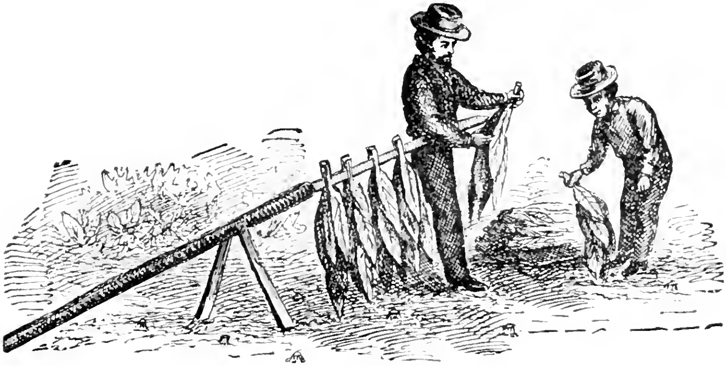


FIGURE 15

After the plant is wilted and becomes pliant and in good condition to handle without breaking, it should be placed on the stick.

Some tobacco growers hold the opinion that the plants should be harvested without wilting at all, stringing on the stick as soon as cut, and carrying them immediately to the tobacco barn. The reason for this is, that often at the time of cutting the plant the ground is hot, and the plant becomes very warm and quickly sunburned. When hung on the stick, which is four and a half feet in length, six to eight large plants are the usual number.

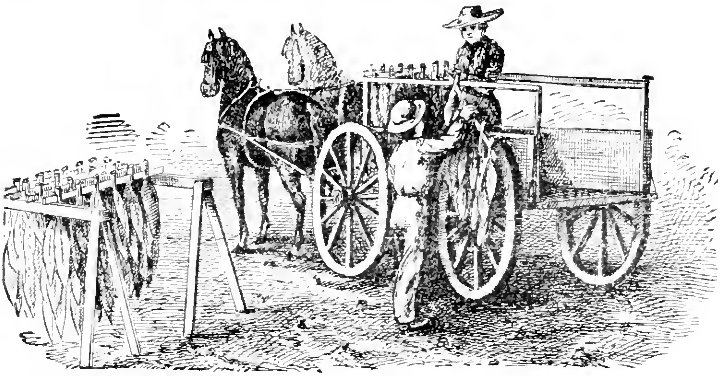


FIGURE 16.

Carrying to the Barn.—This figure shows how the sticks are placed on a frame in the field and loaded on the wagon for taking to the tobacco barn.

XI. Modern Virginia Tobacco Barn.

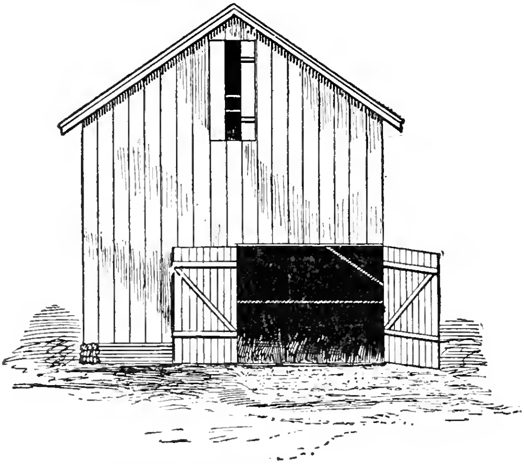


Figure 17.

The process of curing now commences, and on the success of this operation depends in a great measure the ultimate value of the crop. No matter how fine the plants may be, or how large the production, an error in curing is sufficient to destroy, in a great degree, the work of the season. The tobacco barn should be built with windows and doors sufficient to insure a free current of air. The barn should be high enough to permit three rows of plants being hung one above the other, say 16 to 18 feet from floor to roof.

There are several methods of curing, viz: Air curing, sun curng, firing with open fires, and curing by flues.

Air curing is the process of curing the plant in shade or barn, as seen in figure 18.

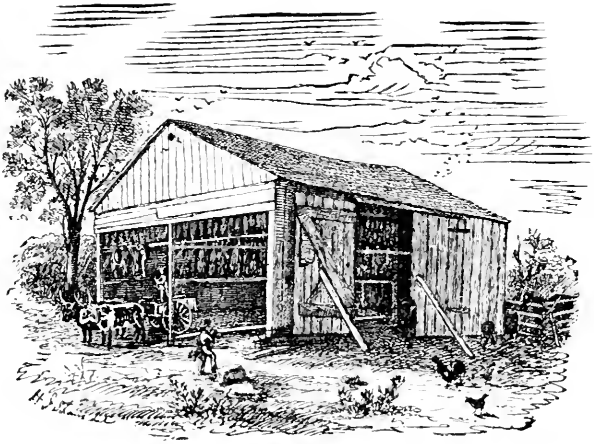


FIGURE 18

Sun curing is the method of curing in the open air, while firing is the process of curing as above stated, either by open fires or flues in the tobacco barn. The latter method is the one generally practiced in the tobacco sections in Virginia, North Carolina, and to some extent in the west, and is considered the best way of curing cutting leaf.

Method of Curing.—There are two common methods practiced of handling tobacco for curing,—the older and long favored method of cutting and hanging the whole stalk with the leaves attached, and the method of detaching the leaves from the stalk before hanging,—a method which is comparatively new in this country, but is employed to considerable extent in Germany and France.

These methods are too long to be discussed fully in this bulletin for the purpose of passing on the merits of either.

A recent experiment conducted at the North Carolina Experiment Station, with a view to settling the matter, indicates that a comparison between the weight of one-half a crop of tobacco cured on the stalk and the other half cured separate from the stalk shows a difference of weight of 128 pounds per half acre in favor of the latter. Major R. L. Ragland, a large and successful grower of tobacco in Virginia, states that he has for years employed both methods with success, and there is no doubt that in parts of Virginia and North Carolina the method of stripping the leaves has recently come into decided favor.

A contrary view is held by Prof. Wagner, of Darmstadt, Germany, a most reliable authority, and one in whom the Germans have great faith. He says: If the leaf is picked before it is ripe, it needs a process of subsequent ripening to give it a good quality. This is impossible if the leaf is separated from the stalk. With this view another German writer, W. Tscherbatscheff, also agrees.‡ An experiment conducted by Nessler shows that the dried constituents of tobacco cured on the stalk, and separate from it, show no appreciable difference in weight.*

These opinions are conflicting and irreconcilable at present, and further investigation will have to be made to settle the question.

XII. Snow's Modern Tobacco Barn.

This new process of harvesting and curing tobacco was introduced by W. H. Snow, of Highpoint, North Carolina. Figure 19 shows the view of this modern barn.

‡ *Tscherbatscheff W. Der Tabak und Seine Kultur in den Nordamerikanischen Staaten, Laudwirth Schaftliche Jahrbucher*, 1875, *p.* 102.

*Wagner, I. C., p. 38.

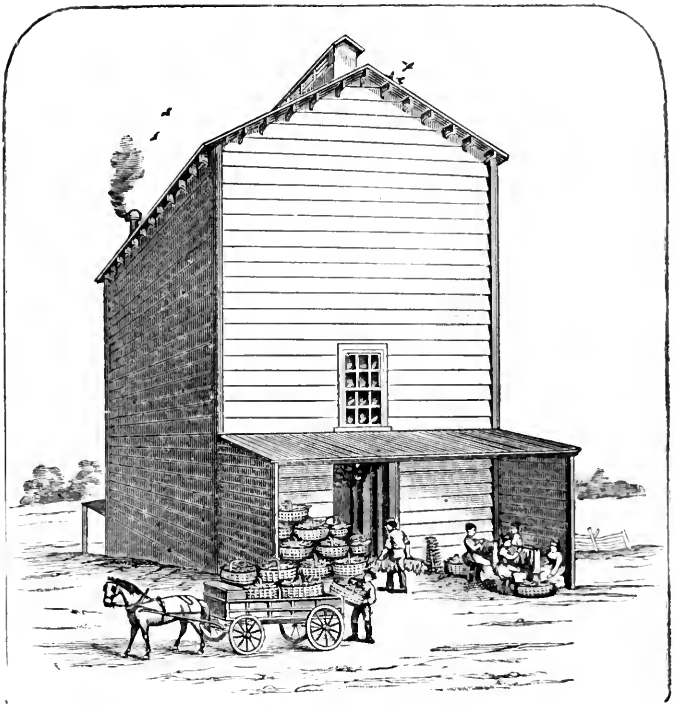


FIGURE 19.

It is not necessary at present to give details for the construction of this barn and apparatus. It is claimed that this system of curing tobacco in the Snow Modern Barn has important advantages. The leaves are stripped from the stalks in the field and brought to the barn in baskets, and strung about the width of a finger apart on pointed wires which project at right angles from a wooden stick. As the sticks are filled they are placed in movable racks in the barn, and as fast as a rack is filled it is raised by a simple device to the top of the building. This is continued until the barn is filled, leaving only as much space between racks as is required for the hanging leaves.

Plan of Housing.—The plan of housing in this barn is illustrated by Figure 20.

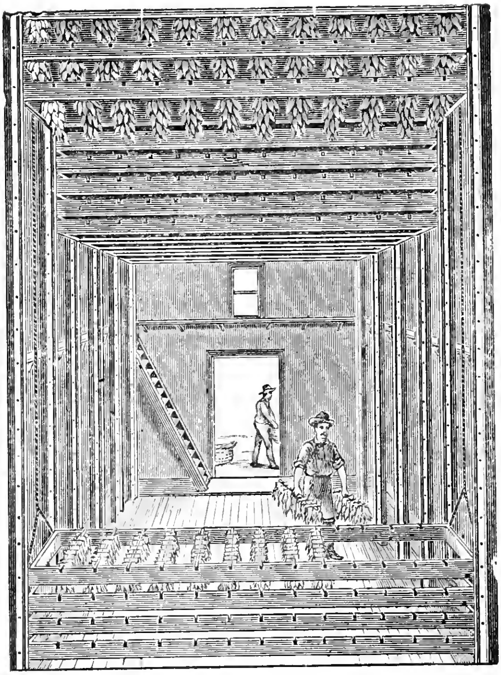


FIGURE 20.

Advantages of the Method.—The following are some of the important advantages claimed for the Snow process over the old.—

I. The planter can begin to house his crop from two to four weeks earlier, as the bottom leaves which ripen first can be taken off and cured as soon as they are ripe.

II. As the lower leaves are pulled off those left on the stalk ripen up more rapidly, which enables the planter to get in his crop earlier in the season.

III. The tobacco can be stored in a much smaller space and with no risk of losing color or molding when bulked down.

IV. Tobacco can be cured with a more uniform color.

V. Less fuel will be required, and the risk of setting fire to the barn will be greatly lessened.

Many other advantages are claimed for this new system over the old, which I will not now enumerate.

Flues and Flue Curing.—The cut 21 represents the furnace and pipe which is extensively used in flue curing.

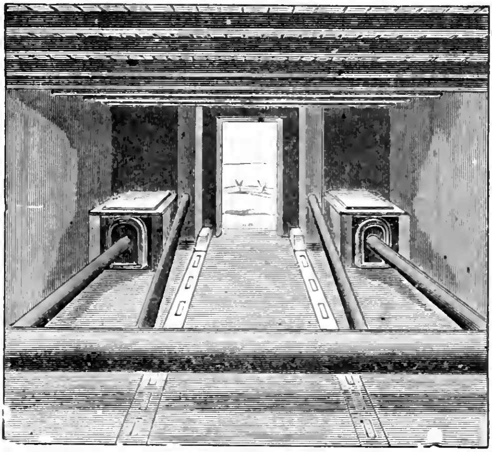


FIGURE 21.

Flues have almost entirely superseded open fires for curing yellow tobacco as being cheaper and better every way. The heat is more readily controlled by the use of flues, and the tobacco cured by this process is cleaner, brighter and sweeter. The flue is regarded as the best mode for applying heat in the curing process for any type of tobacco requiring the application of artificial heat, and is fast superseding the open wood fire.

The Stove.—The stove as represented in figure 22 is

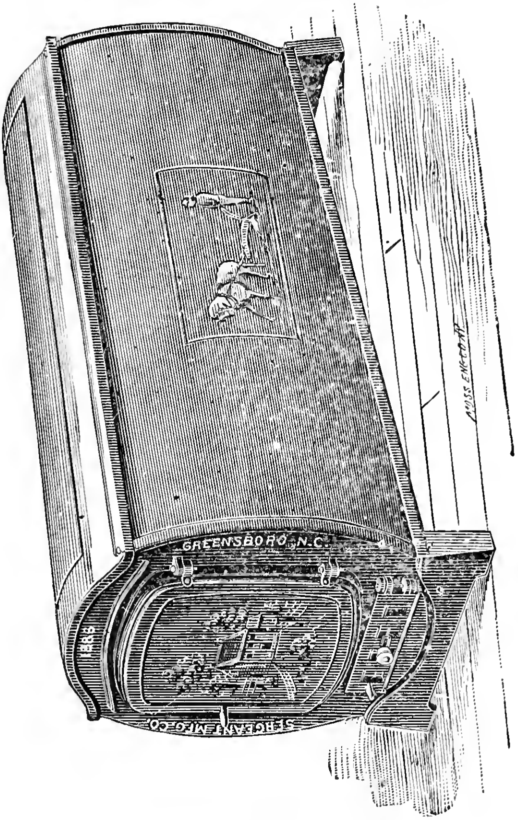


FIGURE 22.

the kind usually used. This is placed in the basement of the barn. The doors of the stoves open from the outside. The stoves are covered with brick or stone arches extending two feet beyond the rear ends of the stoves.

XIII. Stripping.

This process is represented by Figure 23.

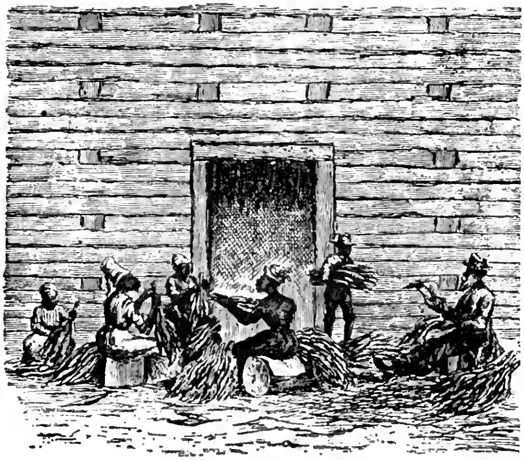


Figure 23.

After the tobacco is thoroughly cured it has to be stripped. The leaves become soft and pliant in damp weather and can be readily taken down out of the barn for stripping. After taking down, the plants should be packed, in order to be kept moist until stripping.

This operation consists in taking the leaves from the stalk and tying them in bundles after assorting the various qualities and keeping them separate. Each hand or bundle of the best grades should contain at least twelve leaves. In the old tobacco States the plant is usually made into three grades—long, short, and lugs, or worm eaten leaves.

In Cuba the leaves are divided into four classes; first, the leaves at the top of the plant, which constitute the best quality, from the fact that they get more equally the benefit of the sun's rays by day and the dew at night; second, the leaves which are next to the above; third, the inferior or small leaves; fourth, the lug leaves, or those nearest the ground.

The assorting of the plant previous to putting in hands or bundles is an operation that requires judgment and a practiced eye. This mode of assorting colors in stripping is similar to that of shading cigars, in which the utmost care is taken to keep the various colors and shades by themselves. Assorting the plant does not imply that it is carried to its fullest extent in point of color, as in shading cigars, but simply keeping those general colors by themselves, like light and dark brown leaves. Figure 24 shows the bundle after it has been stripped, assorted and tied.

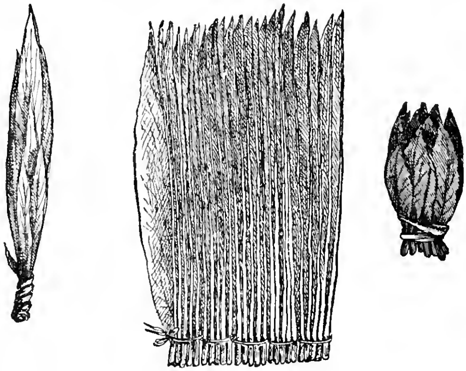


FIGURE 24.

Packing.—This is shown by figure 25.

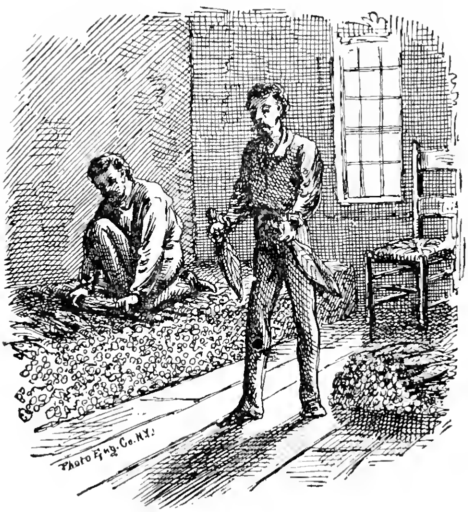


FIGURE 25

After the process of stripping is completed the hands should be packed to keep them moist or as near possible in the same condition as when stripped. Select a cool, dry place in the center of the floor of the tobacco barn. It should be packed loosely or compact according as the hands are moist and dry.

Hand the tobacco to the packer, who presses the hands firmly with his knees and hands, laying the tobacco in two rows—keeping the pile about the same height, filling in occasionally with a middle row until all is packed. The different qualities should be packed separately. They can be packed any height or length desired, but usually from three to five feet high will be found convenient height, while the length may be proportioned to the height or not. After the tobacco is packed, it should be covered with boards and gently weighted with stone or pieces of timber. If the tobacco is packed down in a good case, or keeping condition, which requires experience to determine, it can remain packed until ready for prizing.

Prizing, Casing and Baling.—This is shown by figure 26.

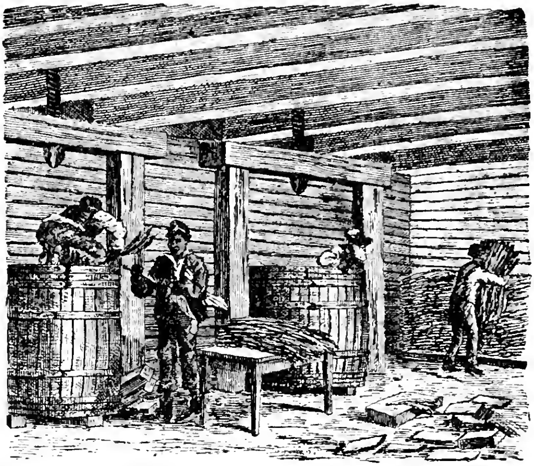


FIGURE 26.

The term prizing originated in Virginia. In the sense in which it is to be taken here is a local word, which the Virginians claim the credit of creating. It is the act of pressing or squeezing the article which is to be packed into any package by means of certain levers, screws, or other mechanical force,—this requires the combination of judgment and experience, otherwise the tobacco may become bruised.

All leaf used for cutting purposes and export in America is prized in hogsheads; cigar leaf is usually cased or baled. In some tobacco sections about 800 pounds net is packed in one parcel, while in others from 1000 to 1800 pounds. Tobacco in good condition to prize must be damp enough to bear the pressure without breaking and crumbling, while it must not be too moist or it will rot in the case.

The hands or bundles are packed in the hogshead, or the case in two tiers—when nearly filled, it is subjected to a strong pressure as is shown in figure 27.

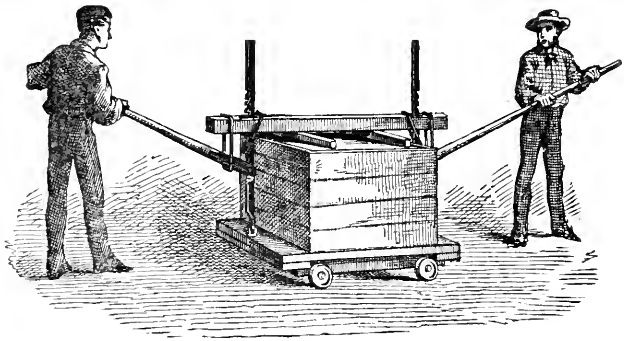


FIGURE 27.

The tobacco should be cased hard so that the mass will rise but little when the pressure is removed. When tobacco is prized or cased in the spring, it will commence to "warm up" as the summer comes, and will go through a sweat. After "going through a sweat" the leaves take on a darker color, and lose the rank flavor which they had before.

* After much correspondence and delay, the plates for this Bulletin were procured from The American Publishing Company, Hartford, Connecticut, Historical Publishing Company, Philadelphia, Penn., and Orange Judd Company, New York—and the issuing of the Bulletin has been delayed from this cause.

Bulletin No. 45, : : : June, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

INJURIOUS AND BENEFICIAL INSECTS.

Some Insect Pests of the Farm and Garden.

J. M. STEDMAN.

CONTENTS.

☞ The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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INJURIOUS AND BENEFICIAL INSECTS.

SOME INSECT PESTS OF THE FARM AND GARDEN.

J. M. STEDMAN.

It is the intention of this bulletin not to discuss in a scientific way original or other observations on insects, but to put into popular language the facts already known to Entomologists, in regard to some of the insects effecting the farm and garden crops, and to do so in such a way as to be of service to the busy farmer, who has little or no time, and less inclination, to procure the necessary literature, and study out for himself the life histories and methods of attack of these insects, and of the means of destroying them or of preventing their ravages. Hence this bulletin has no claim to originality other than the form of expression. It is written expressly for the farmers of Alabama. The discussion of the life histories of the insect is given only in so far as it is important that the farmer should know it, while the methods of destroying the pests receive prominent attention.

It is our purpose to issue several small bulletins on injurious insects, taking them up in the order of their food plants, instead of grouping them together in one large bulletin that will take so much of the farmers time to read that it will be laid on the shelf, whereas a small one now and then would be read. Persons wishing these or any or all bulletins can get them free by simply sending a postal card requesting the same and giving their address to President W. L. Broun, Auburn, Ala., or simply Experiment Station, Auburn, Ala.

Bulletins on Fungus and other diseases of plants will also be issued.

GENERAL REMARKS.

In order to arrive at the best results in combatting insects, it is important that we should understand at least the general life history of the insects in question, that we may thus know at what stage in its development means can best be taken to destroy it. Some insects can best be fought in the egg stage, others in the larva or worm stage, a few in the pupa stage, and still others in the adult stage; while many can be controlled in two or more stages. To arrive at this in a scientific way forms one of the great problems of the economic entomologist.

The larger number of our insects have four well defined stages of growth. The first is known as the *egg* state and of course in itself can do no harm. In a few cases these eggs are deposited in clusters or groups and in such a way that we can gather and destroy them, or when this is not practicable, they can be killed by spraying them with kerosene emulsion or soda and caustic soap.

Many insects winter in this egg stage as well as in the pupa or in the adult state, and since they frequent sheltered places, as leaves, rubbish and brush along fences and ditches, etc., it becomes important that all such useless material be gathered and burned every Fall, thereby destroying many insects that otherwise would appear the following Spring. Hence clean farming is one sure road to success.

The second, or *larva* or worm state is the one in which most insects do their greatest amount of injury, since it is here that most of the growth and feeding takes place. Many insects are injurious only in this larva stage, as our cotton-worm, cabbage worm, cut-worm, etc , and all other moths and butterflies. Some exceptions to this rule are to be found, as in our grasshoppers and most beetles, that do as much damage in the adult as in the larva stage in many instances. While again, the Rose-chafer that does little or no damage in the larva stage, as an adult, does much injury to our vineyards. The larva or worm does not resemble in the least the adult insect in most cases, and hence unless one be familiar with the subject, he cannot tell the adult insect by the larva. The caterpillar or worm changes to a butterfly or moth, the maggot to a fly, and the grub to a beetle. It is in this second stage that most insects are to be controlled.

The third, or *pupa* state is usually a quiet, inactive and perfectly harmless stage. Since many insects winter in this condition we can take advantage of it, and resort in the Fall to a general cleaning up and burning of all rubbish, leaves, etc., and to the burning over of stubble and to late plowing.

The fourth, or *adult* or imago stage is the perfect insect, such as a butterfly, moth, beetle. fly, etc., and it is in this state only that the eggs are deposited from which a new brood developes. As stated under the second or larva state, most adult insects except grasshoppers and beetles are in themselves harmless to the farm and garden crops; they deposit the eggs, however, on the respective plants on which the larvæ feed, and in view of this we can take means to prevent such a deposit and hence protect the plant. This is especially true and important in those cases where the larva is a borer and hence cannot readily be gotten at in that stage. Hence the necessity of covering up the base of peach trees with straw, cotton seed, ash, etc., to keep the adult from getting at the proper place to deposit her eggs, or of spraying apple trees with Paris green or London purple to prevent the coddling moth from getting into the apple, or of covering the trunks of trees with a sticky or poisonous wash to prevent the borer from entering. All preventive applications must be made just before the adult insect appears, and must be kept up at frequent intervals as long as the adult is in a condition to lay eggs.

So far as the farmer is concerned vegetable feeding insects can be divided into three groups. I. Those insects that live, either in the young or adult stages or both, within the tissues of the plant. These are called borers. They feed upon the juices and tissues inside the plant. II. Those that suck the juices of plants, in which case one finds no parts of the plants eaten away, but the leaves shrivel up and dry or turn another color. These are called sucking insects. They pierce the plant with their mouth-parts and simply suck the juices. III. Those that eat the parts of plants, in which case we find places eaten away, or parts eaten or cut off, as we say. These are called biting insects. They feed upon at least the outer parts of plants and in most cases the inner tissues at the same time.

REMEDIES.—From the nature of the case, it is evident that each of the three groups of insects as above described will require a different mode of treatment.

In general (special and exceptional cases will be noted under their respective heads) the best if not the only way to get rid of the borers is either to dig them out or, as has lately been successfully done in the case of the peach tree borer, pour hot water on that part of the tree that is infected. The application of chemicals after the insect is once inside the plant is of little or no use, since the plant would be killed before the insect could be reached. The application of chemicals to prevent their entering has succeeded in some cases. Paris green or London purple mixed with water (see formula under insecticides) and thrown in the form of a spray (apparatus for spraying will be explained later) on to the plant or parts of the plant liable to be infected, has resulted in lessening the attack in a number of cases where the insect or its young eat their way in through the outer tissue, but where the adult deposits its eggs inside the tissue beneath the outer layer, this method is of little value. The application of certain substances like coal tar, tobacco, etc., is sometimes used as a repellant. Methods and contrivances to keep the insect away will be noted under the special insect.

The sucking insects cannot be destroyed by putting poison like Paris green on the plant, since these insects do not eat the outside of the plant and hence not the poison. They can insert their mouth-parts through the surface of a leaf covered with Paris green, for instance, and not eat it, but suck the pure juice from the part beneath. They must be killed by simple contact with some chemicals, and a substance like Paris green, which is very poisonous to insects if it be eaten, may not affect the insect in the least to have it covered with the poison. Perhaps the most effectual substance with which to kill sucking insects is what is known as Kerosene Emulsion. (See formula under Insecticides.) This must be thrown on the plant in the form of a spray by means of some kind of a force pump. (See spraying apparatus.) Pyrethrum is an active substance in killing by contact nearly all kinds of insects, but unfortunately it is of late years so adulterated that it is almost useless for the farmer. It comes in the form of a powder and can be dusted on the plants by means of a bellows or mixed with water and thrown on in the form of a spray. (See Insecticides.)

The biting insects can be destroyed by poisoning the parts of the plants effected. To accomplish this we can resort to a large number of chemicals, compounds and patent insecticides. Some of the most useful being Paris green, London purple, White Hellebore, etc. A number of the patent insecticides (so called) that are advertised to kill *all kinds* of insect enemies are of no value to the practical farmer.

The mode of applying the different poisons to kill biting insects varies with the kind of plant infested and also with the insect. Some are simply dusted on to the plant as a powder, others sprayed on with a force pump. The methods of applying each substance will be given under their respective heads. (See Insecticides.)

INSECTICIDES.

The various substances, compounds and mixtures used to destroy or drive away insects can be divided into three groups. First, internal poison, that kill by being eaten with the natural food of the insect. Second, external remedies, that kill the insect by contact, either by irritating the skin, or by stopping up the breathing pores. Third, repellants, including substances that keep the insects away by offensive odors or by mechanical barriers.

INTERNAL POISONS.

Paris green is the most important insecticide of its class. It kills by virtue of the arsenic that is here in chemical combination with copper. It comes in the form of a fine powder and can be purchased at about thirty cents per pound. It can be used either as a powder to be dusted, or as a liquid to be sprayed on the plants. As a powder it is to be well mixed with from twenty to forty, and even eighty, times its bulk of flour, Plaster of Paris or air slacked lime; and can then be evenly and thoroughly dusted on to all parts of the plant by means of some kind of bellows or other powder dusting machine. (See machines for applying Insecticides.) One pound of Paris green to the acre is usually sufficient provided the dusting be done evenly and thoroughly. Paris green is sometimes used undiluted, or very slightly so (one part of Paris green to three parts of flour) as is the usual case with cotton, when the poison is placed in two heavy sacks made of some strong cloth, as 8 oz. osnaburg, and fastened to each end of a five foot pole. It is the thoroughness with which this poison is applied and not the strength that secures success. As a liquid Paris green is to be mixed with water in the proportion of one pound poison to from 150 to 200 gallons water. Paris green does not dissolve in water, and since it is very heavy and tends to settle quickly, it is very essential that the liquid be often and thoroughly stirred. It is to be sprayed on the fruit trees and other plants by means of some kind of force-pump and hose with a spraying nozzle. (See machines for applying Insecticides.) One should be exceedingly careful in spraying peach trees not to get the mixture too strong, since the leaves of this plant are very tender and easily "burned" by Paris green or London purple. A mixture of one pound Paris green to 250 gallons of water should be used on peach trees, and that only when the leaves are young. Apple trees should be sprayed just after the flowers have fallen. Small fruits and vegetables are not easily injured, if at all, by Paris green.

London Purple is about as good as Paris green as an insecticide in many cases, and has this advantage, that it is much cheaper, costing about fifteen cents per pound, and is also a much finer powder and hence remains suspended in water much longer. It is to be used in the same way and in the same proportions as Paris green.

Hellebore (white) is a powder poison made from a plant. It kills both by being eaten and by contact. It can be used as a powder to be dusted on to the plant either full strength or diluted with flour, or as a liquid, one pound Hellebore to 40 gallons of water, to be sprayed on the plant. It costs about twenty-five cents per pound. It is used less extensively than Paris green or London purple, but is especially excellent in destroying the currant worm.

White Arsenic is not to be used when Paris green or London purple can be had, since it is dangerous to have about and is apt to burn the leaves.

EXTERNAL POISONS.

Pyrethrum is a powder made from the flowers of a plant and is very poisonous to insects, but is perfectly harmless to man and domestic animals. It kills insects by contact, and can be most successfully used as a powder to be dusted by means of a bellows or other powder dusting machine. Pyrethrum is hard to obtain pure or at least in a fresh condition. It loses its strength by standing, and should be kept well corked. It may be used as a spray in the proportion of one pound of Pyrethrum to 40 gallons of water. Pyrethrum is very useful for killing the cabbage worm, or insects destroying parts of plants that are ready to be eaten by man. It is also of great use in clearing rooms of flies, musquitoes, &c., and fleas and lice on domestic animals.

Kerosene Emulsion is perhaps the best substance to be used for sucking insects. It is made as follows: "Dissolve one half pound of hard soap in one gallon of boiling water, and while the liquid is still hot, but not near a fire, add two gallons of Kerosene. The whole is then violently churned until it forms a creamy mass, which will thicken into a uniform jelly-like mass on cooling, and the oil remains incorporated in the mass, and will not separate or rise to the top. The churning can best be done by means of a force pump with a small nozzle, pump the liquid back into the vessel containing the liquid. The emulsion thus obtained will keep indefinitely." When ready to use, thoroughly mix one part of the emulsion with nine parts cold water. This is to be thrown in the form of a spray on the plants by means of some kind of a force pump and spraying nozzle. (See machines.)

The kerosene emulsion will injure no foliage, and since it kills insects by contact, it is the most effectual remedy against the chinch bug, plant lice, bark lice, melon bug and other sucking insects, and also for the cabbage worm, and white grub, and will even kill eggs in some cases. It is of the greatest importance that the emulsion be forcibly, thoroughly, and evenly applied, as can be done only by the use of some force pump arrangement.

Carbolic Acid Emulsion is made by adding Carbolic Acid (the crude material, dry to get a good strength) one part to 5 or 7 parts of the soap solution similar to that used in making the Kerosine Emulsion. The liquid is to be churned in the same manner as the Kerosine Emulsion, to form an Emulsion.

This Carbolic Acid Emulsion is one of the best preparations to protect plants against lice and fruit trees against borers. It can be sprayed upon the trunks of fruit trees or rubbed on by means of a cloth. Every fruit tree should be treated in this way, especially the young trees, about two weeks after the trees blossom.

Tobacco Decoction is made by adding refuse tobacco, which can be obtained at small cost from tobacco factories, to boiling water, in the proportion of one pound of tobacco to two or three gallons of boiling water. As soon as the water has cooled, strain out the tobacco, and the decoction is then ready to use. It is to be sprayed upon the leaves, and is an effectual remedy against the striped flea beetle, and the cucumber, watermelon and squash flea beetles. It will also drive away some bugs from similar plants. It is also valuable as an insecticide against lice and ticks upon domestic animals, and has the advantage over Kerosene Emulsion in that it leaves the hair in a better condition.

Bisulphide of Carbon is a liquid that is of great use in destroying the Phylloxera of grape, ants, insects in stored grain, and other insects which can be reached by means of a vapor. For Phylloxera and ants it is to be poured upon the top of the ground above them.

For grain insects and insects affecting clothing, it is placed in shallow dishes and kept in the closed room. The vapor from this liquid is extremely explosive, and must not be used in a room or near the least trace of fire, even a lighted cigarette may cause a great explosion. Bisulphide of Carbon can be had from the manufacturer for from 10 to 12 cents per pound in 50 pound cans.

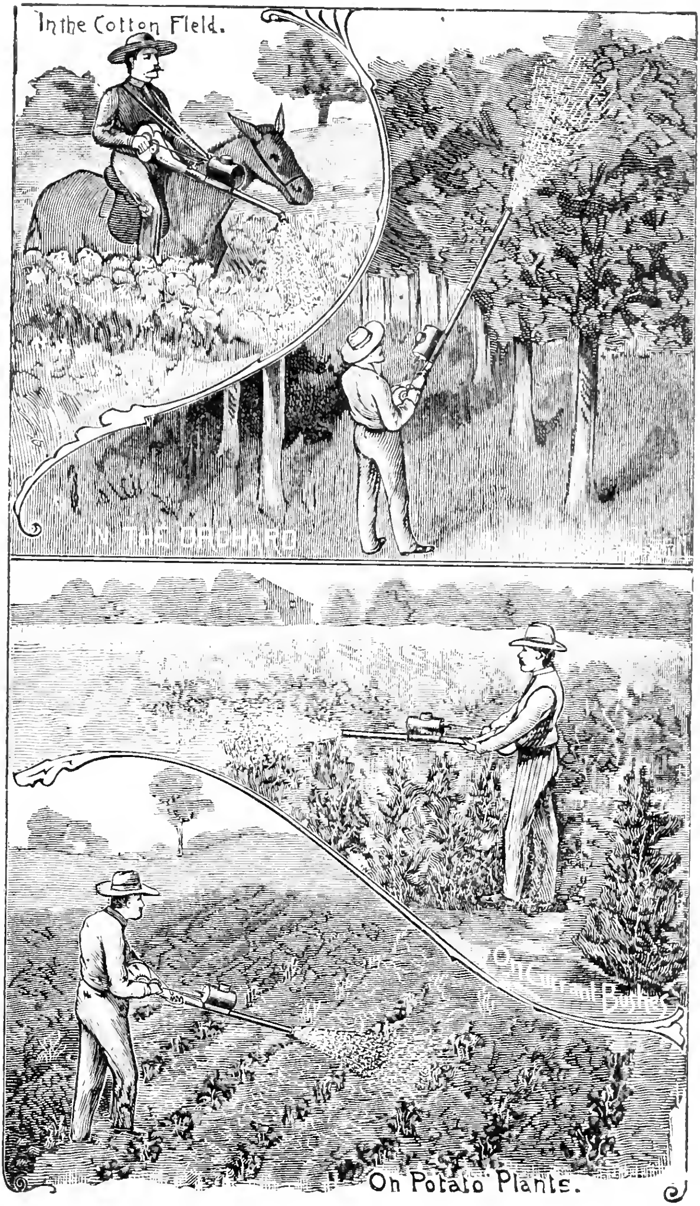
MECHANICAL ARRANGEMENTS.

These are intended to act as barriers to keep away insects, or as traps to capture them. They will be described under the special insect which can thus be best treated.

MACHINES FOR APPLYING POISONS.

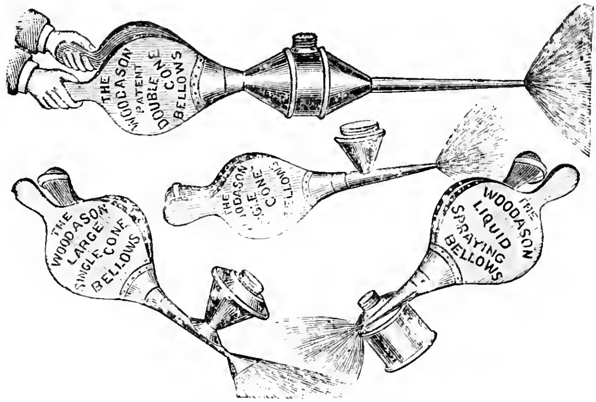
There are a great many kinds of machines and devices manufactured and sold by dealers for applying insecticides and fungicides, some of which are very good, and every farmer, fruit grower and gardener should have at least one. In order to save the purchaser time and trouble in making a selection, a few of the more important machines are here figured, together with the price and manufacturers address.

It is of course important, whenever possible, that one provide himself with two machines, one for using a powder, the other for spraying a liquid; but in case only one can be purchased, a force pump and spraying nozzle should be selected, since one can often mix the powder with the water and apply it in this way.



LEGGETT BROS. POWDER-GUN.

One of the best machines for dusting a powder on plants is Leggett's Powder-gun. It works by turning a crank, and throws the powder in a fine dust constantly and evenly, and the supply can be easily regulated so that one or one half pound of Paris green or London purple can be evenly distributed over an acre. This instrument has been highly recommended by all who have tried it. The price of this gun delivered complete with four extra tubes, shoulder strap and oil can is six dollars. This machine can be purchased from the makers, Leggett & Bros., 301 Pearl St., New York.

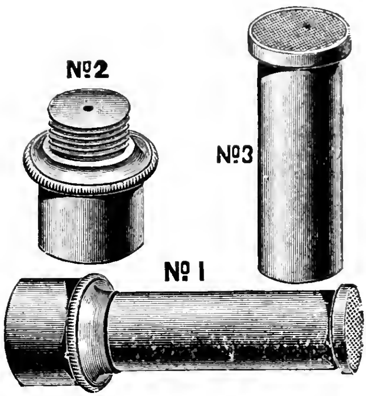


Another very simple and effective machine is Woodason's Liquid and Powder Spraying Bellows, of which four styles are made. The Double Cone Bellows for dusting Paris green, London purple or Pyrethrum, can be purchased for $3.00, and will be found a very simple and economic machine. The liquid spraying bellows can be had for two dollars.

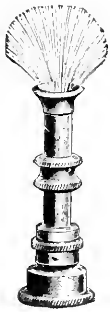
These machines will be found very useful, and are highly recommended. They are manufactured by Thomas Woodason, 2900 D. St., Philadelphia, Penn., or they can be purchased of H. A. Kuhus, Atlanta, Ga.

In the purchasing of machines for spraying liquids; three things should be taken into account. The pump should be made of such materials as will not be easily affected by the chemicals used, there should be some automatic device for keeping the liquid constantly stirred, and the spraying nozzle should be one that is not easily clogged and one that will throw a fine and uniform spray. There are many nozzles manufactured for this purpose, almost any of which can be purchased from a dealer in force pumps.

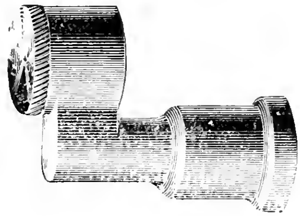
The names of some of the different spraying nozzles are "Masson," "Cyclone," "Vermorel," "Boss," "Graduating," and "Climax." Some of these nozzles, such as the "Boss" and the "Graduating," can be made to throw a fine or coarse spray, or a solid stream. They are all of value and range in price from a dollar to a dollar and a quarter.



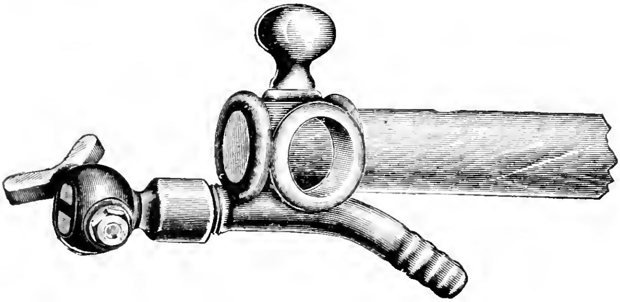
CLIMAX NOZZLE



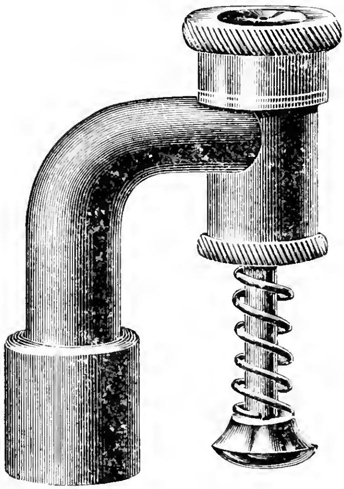
GRADUATING NOZZLE.



CYCLONE NOZZLE.



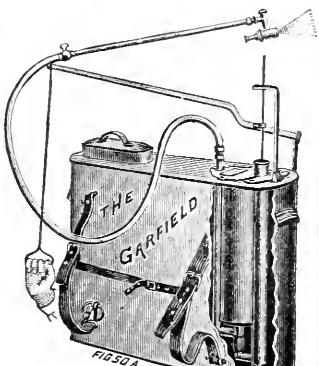
MASON NOZZLE.



VERMOREL NOZZLE.

Climax Automatic Agitator Pump.

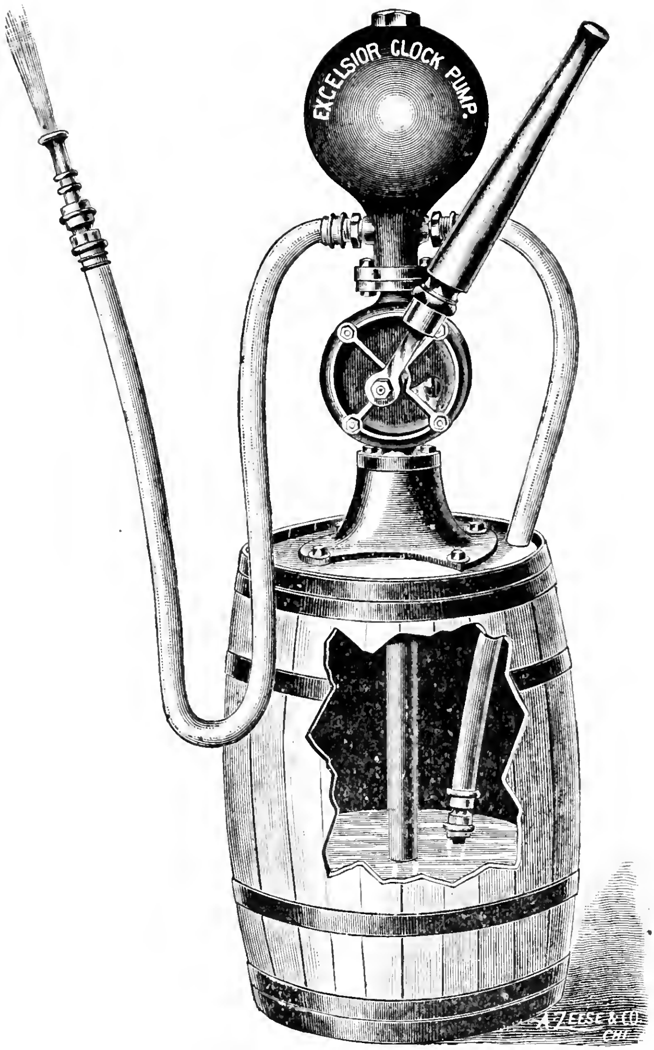
The "Climax Automatic Agitator Pump," manufactured by the Nixon Nozzle and Machine Co., Dayton, O., is an excellent machine for spraying Paris green or London purple in water, since it has an automatic device for keeping the liquid constantly stirred. The price of the pump, however, is a little high, being $15.00.



Field Force Pump Co.

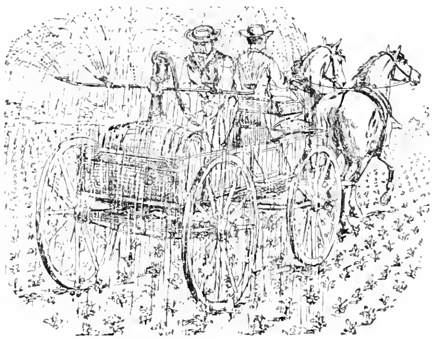
The Field Force Pump Company, Lockport, New York, manufacture a pump that can be mounted on a barrel, and has a second hose reaching to the bottom of the barrel, which keeps the liquid constantly stirred by forcing part of it back into the barrel. These pumps are comparatively cheap, and can be had for $10.00.

The same company also manufacture a knapsack sprayer, known as the Garfield. This machine is to be carried upon the back, while the person pumps with one hand and holds the nozzle with the other. This pump is very convenient, and costs but $12.00.

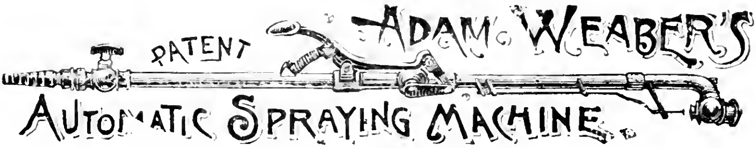

EXCELSIOR CLOCK PUMP.
A. ZEESE & CO. CHI.

Excelsior No. 8

William Stahl, Quincy, Ill., also manufactures a number of different styles of pumps, including a knapsack pump. The Excelsior Spraying Outfit No. 8, which costs but $2.50, consists of a pump and hose that can be used in a pail; they also manufacture more durable and more costly machines for use in a similar way. They manufacture an Excelsior Clock Pump that is extremely useful, since it can be mounted upon a barrel and has a second hose extending down to the bottom, which keeps the liquid well stirred, while the lever handle can be used at any angle. The price of this pump is $13.00.



The Goulds M'f'g., Co., Senaca Falls, New York, are the manufacturers of a large number of pumps similar to the above, including the Knapsack Sprayer. The method of using some of their pumps for orchard and field work is shown in the above cuts.



Adam Weaber & Son, Vineland, N. J., are also the makers of some excellent spraying machines. One of their nozzles that will be found convenient to use in connection with a number of machines of various makers, is shown in the above cut.

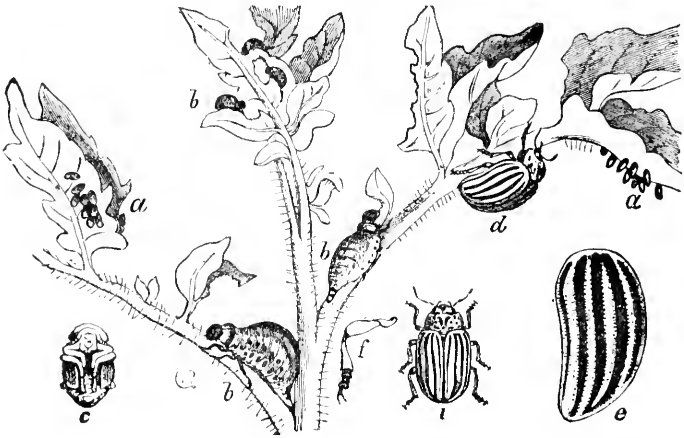
I wish to acknowledge the kindness of the various firms above mentioned, in loaning us the cuts here used to illustrate machines.

INSECTS.

THE POTATO PLANT.

COLORADO POTATO BEETLE.

The Colorado Potato-Beetle has appeared in Alabama this year for the first time. This insect has occurred in immense numbers throughout the northern and eastern parts of the United States, having originally come from the west. It has done immense damage to the potato crop, and when not kept in check it will strip the plants completely of their leaves.



COLORADO POTATO BEETLE.—*a*, eggs; *b*, larvæ; *c*, pupa: *d*, *d*, adult beetles; *e*, enlarged wing cover of beetle.

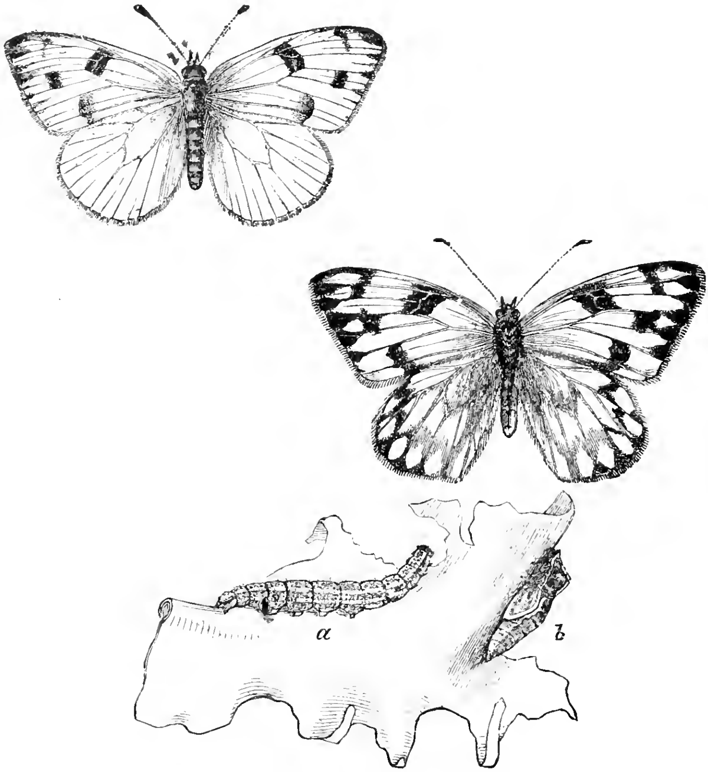
The adult insect is a beetle nearly one-half inch in length, of a yellow color, with dark longitudinal stripes and orange legs and belly. It deposits its eggs in clusters, usually on the underside of the leaf; these hatch in about a week into small grub like larvæ, at first of a light yellow color, but changing to orange or red with a few black spots along the side, as they grow larger. They eat almost continually and with great rapidity, and keep their bodies distended with food. In a few weeks they become full grown and descend just beneath the surface of the ground, where they transform to the pupa stage. They remain in the pupa stage about ten days, and then come forth as a perfect insect. These then pair and the female soon deposits her eggs, and another brood follows with the work of destruction. There are about four broods in a season, and unless they are held in check, it is easy to see that they increase in numbers with great rapidity. The adult beetle, only, lives through the winter, secluded under rubbish, leaves, etc., and comes out in the Spring to deposit eggs.

Remedies.—Fortunately this insect can be readily held in check by sprinkling or dusting the plants with Paris green or London Purple, used either as a powder or in a liquid state. In using these remedies as a powder, the poison can be diluted by mixing with four times its bulk of flour. This can then be applied by means of a dusting machine or powder gun, or it can be sifted on by means of a tin can with a few small holes in the bottom. It is better to dust the plants early in the morning when the dew is on them. In using the poisons as a liquid, 1 pound of the poison to 50 gallons of water, can be sprayed upon the plants by means of some spraying machine, or the liquid can be carried in a pail and sprinkled on the plants by means of a brush-broom. It is important that the liquid be frequently stirred, otherwise the poison will settle to the bottom, especially Paris green. Fortunately the larvæ as well as the adults are destroyed by these remedies. It is important that the application be made as soon as the insects appear, and should be kept up as often as they appear in damaging numbers. This is especially true with the young potato plants, since they will eat every leaf in a remarkably short time.

CABBAGE PLANT.

CABBAGE BUTTERFLY.

There are two species of the common cabbage butterfly in Alabama. One known as the southern cabbage worm is a native of this country. The other known as the imported cabbage worm was introduced from Europe about 1857, and has since spread nearly all over the United States and Canada, and has almost exterminated the native species. The life histories and habits of these two insects are so nearly alike that, for our present purposes, a description of those of the imported cabbage worm will answer for both.



Southern Cabbage Butterfly:—Adult male and female. *a*, larva; *b*, pupa.

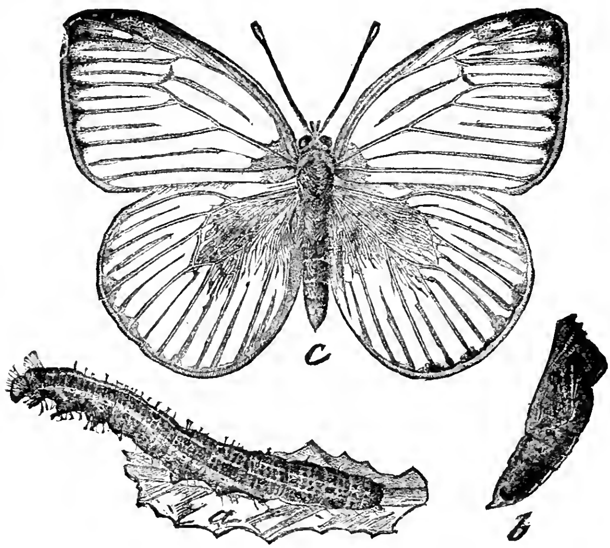
The adult butterfly is so common and well known to every gardener and farmer, that a description of it is unnecessary. suffice to say it is a small white butterfly, with a few black spots near the margin of the wings, which measure about two inches in expanse. The female butterfly deposits her small yellowish eggs upon the leaves of the cabbage plant. In a few days the little green larvæ hatch and immediately begin to feed upon the foliage. They eat with considerable rapidity, and become full grown in about two weeks. As a rule the larvæ then leave the cabbage plants and seek some sheltered place, and change to pupæ, which are naked and without a cocoon. Occasionally the pupæ will be found on the cabbage plants. They remain in the pupa state about ten days, and then the adult butterfly comes forth ready to deposit eggs, which soon hatch into another brood of worms. There are several generations each year, and it can be readily seen that if left to themselves, they will increase in number with great rapidity. This insect passes the winter in the pupa state.

Fortunately these insects have a number of natural enemies that tend to keep them in check. The adult butterflies fall a prey to birds, and a bug that catches them and sucks their juices. The larvæ and pupæ fall a prey to birds, and are greatly subject to the attack of certain insects both predaceous and parasitic. The larvæ are also sometimes killed in great numbers by a certain disease.

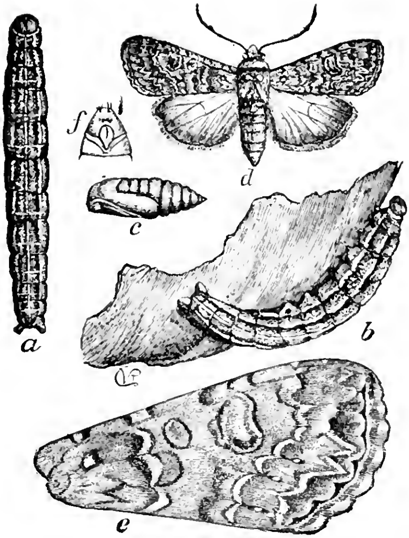
Remedies.—The cabbage worms are readily killed by a number of easily applied remedies. When the plants are very young Paris green or London purple can be applied without danger. It may be used either as a powder or mixed with water. When the plants are of any considerable size Pyrethrum either mixed with five times its bulk of flour and, dusted on the plants, or mixed with water and sprayed upon them, will prove an excellent remedy, provided the Pyrethium is good. Kerosene emulsion will kill them, but when the plants are nearly headed, it may taint the leaves.

Dr. C. V. Riley says that the cabbage worm can be killed by the use of hot water sprinkled upon the plant by means of an ordinary sprinkling pot. If the water be boiling in the pot, it will kill the worms and yet not be too hot to kill the leaves by the time it reaches them. It is essential whatever remedy you use, that it be applied at frequent intervals, as new broods come on every few days. There need be no fear about the use of Pyrethrum, since it is not poisonous to man. As regards the use of Paris green, there need be little or no fear if it be used properly, that is, reduced to the proper strength and put upon the plants evenly. The worms will be killed by a very small amount that would not affect man, and the first rain will wash the most of it off.

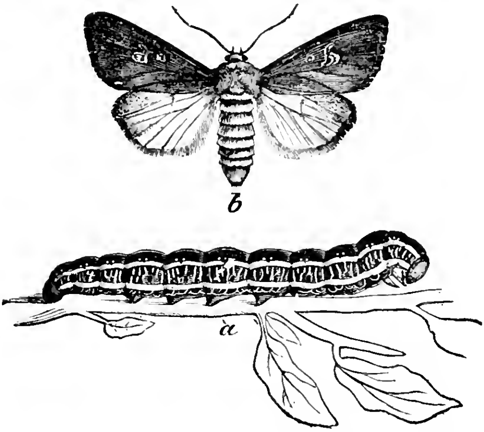
OTHER CABBAGE WORMS.



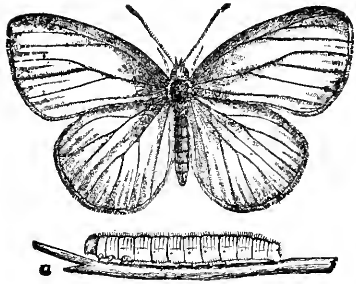
Cabbage Worm.—*a*, larva; *b*, pupa; *c*, adult.



Cabbage Worm.—*a*, *b*, larva ; *c*, pupa ; *k*, adult.



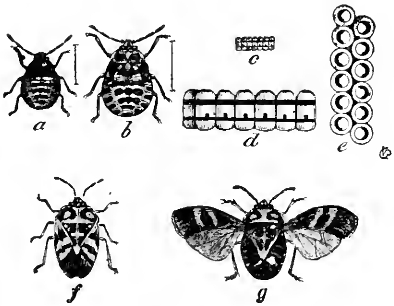
Zebra Cabbage Worm.—*a*, larva ; *b*, adult.



CABBAGE WORM.--larva and adult.

HARLEQUIN CABBAGE BUG.

This is a small sucking insect of a dark color with orange yellow markings. It is not confined to the cabbage plant alone, but feeds upon a number of cruciferous plants. The adult lives through the winter, and deposits its eggs upon the



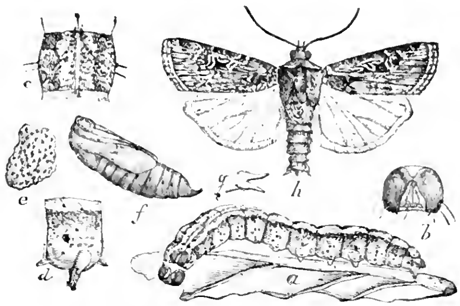
HARLEQUIN CABBAGE BUG.--*a*, *b*, young: *c*, *d*, *e*, eggs; *f*, *g*, adult natural size.

young plants as soon as they are set out. The eggs hatch in about a week or less into a minute insect resembling very much the adult, except that it is smaller and has no wings. The insect pierces the plants by means of its mouth parts and sucks the juices. It develops in a little less than two weeks into an adult insect. This insect does not pass through the inactive pupa stage of most insects, but feeds continually from the time it hatches, and is extremely destructive to the cabbage plant. A few of these insects will kill a plant in a single day. There are several broods each season.

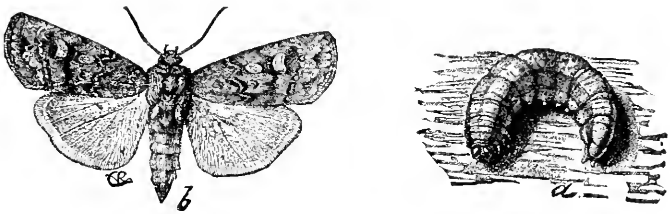
REMEDIES.—It is of the greatest importance that this insect be fought as soon as it appears in the Spring, otherwise they will increase beyond our control. The same substances which are used to combat the cabbage worm, with the exception of Paris green, viz: Kerosine Emulsion, Pyrethrum and hot water, are used to kill these insects.

CUT WORMS.

There are about ten different species of cut-worms that attack the cabbage. The habits and life histories are so nearly alike that for our purposes we can treat of them in general.



CUT WORM.—*a*, larva; *f*, pupa; *h*, adult.



CUT WORM.—*a*, larva; *b*, adult.

The adult is a small nocturnal moth, with an expanse of wings of about $1\frac{1}{2}$ inches. The female deposits her eggs usually upon the branches of bushes. As soon as the eggs hatch, the larvæ descend to the ground and feed while young upon various plants, usually grass. They are about half-grown when winter comes, and they then seek shelter by crawling under some object or burrowing in the ground. They pass the winter in this condition and come forth in the Spring in search of food. They now attack a large variety of plants. Nearly all garden vegetables are attacked by them. They soon become full grown, and in early Spring enter the ground, and just below the surface turn to the pupa stage. In three to four weeks they turn to the adult and emerge as a moth, the female then depositing eggs for another brood. Some species of cut worms have more than one brood in a year.

Remedies.—One of the best methods to kill the cut worms is to place clover, cabbage or other leaves upon the soil before the garden is planted; these leaves to be poisoned with Paris green or London purple, either by dusting with the powder or dipping them in a solution of the poison. The worms crawl about in search of food, eat the leaves, and are killed before the cabbage or other plants are up. The cut worms are easily trapped by placing boards on the ground between the rows of vegetables, and killing in the morning the worms that get beneath them during the night. Occasionally the worms can be successfully fought by digging them out of the ground.

COTTON PLANT.

COTTON WORM OR COTTON LEAF WORM.

This insect is too well known throughout the cotton growing States to need any description, either of the adult, its habits or its life history.

REMEDIES.—The cotton insect is easily destroyed and its ravages prevented by the use of Paris green or London purple. The larva or worm stage is the best one in which to fight this insect. We simply have to poison the leaves on which they feed, in order to kill them, and it is surprising what a small amount of either of the above poisons is necessary. The amount of poison used is of little value provided it is so distributed as to cover every leaf. The application of the poison should be made just as soon as the worms appear, and if well done there need be no damage resulting from these worms.

One pound of Paris green or London purple to the acre is sufficient. It is sometimes used undiluted, but more often it is mixed with from three to five times its bulk of flour. The cheapest method of application is as follows: Make two sacks of some heavy cloth, 8 oz. osnaburg if the undiluted poison is to be used, but thinner cloth if diluted; these sacks should be about one foot long and four or five inches in diameter; leave it open along the whole length of one side; sew up both ends firmly. Get a hard wood stick five feet long and about 1½ inches thick and 2 inches wide, and bore an inch hole near each end. Firmly tack a bag to each end of this stick in such a way that the stick will form the upper portion of the bag; the bag will have its length in the direction of the stick, and there will be but one opening into the bag, viz: the hole in the stick. The bags can now be filled, by means of a funnel, with pure Paris green or London purple, or that thoroughly mixed with about three times its bulk of flour.

The pole is to be carried by the man on horseback, who rides between the rows, holding the pole across the horse, and shakes or taps the pole with a stick, thus causing the powder to sift through the sacks on the plants. It is essential that the sacks do not touch the leaves or become wet in any way, otherwise the powder will not sift through. The workman should keep out of the dust as much as possible, and should dust his clothes and take a bath at the close of his work; it is well also to brush or wash the mule. The above apparatus can be made in a short time by any farmer, and the poison and flour will cost him no more than 50 cents per acre, and money can be made by having these ready for use at a moment's notice before the cotton is up.

It is of the greatest importance that the poison be applied just as soon as the worms first make their appearance, since every day that is neglected may cost a great many dollars. A single application of the poison, if not followed by a heavy rain, is usually all that is necessary to protect the crop. With the above precautions, and especially that of promptness and thoroughness in the application of the remedy, no farmer need fear trouble from the cotton worm.

The Paris green or London purple may also be applied by mixing it with water in the proportion of one pound of poison to a barrel of water, and spraying it upon the plants by means of a force pump and spraying nozzle. There are many machines for this purpose. (See machines for applying insecticides.) Where a farmer has a large crop of cotton every year, it will be to his advantage to purchase a spraying machine that can be used with a mule.

The adult moth of the cotton-leaf-worm can be trapped by placing a shallow basin of kerosine, molasses, or even water upon poles at intervals about the cotton-field, and putting a lantern just above or in the basin. The moths are attracted at night by the light and fall into the oil or molasses from which they cannot escape. This method has proved very successful in many localities.

BOLL WORM.

The boll-worm like the cotton-worm needs no description to a farmer living in the Southern States. (For figure of boll-worm see corn-worm under corn-plant.)

As is no doubt generally known, the boll-worm is the same thing as the corn-worm. It often migrates from the corn-field to the cotton field, as soon as the ears of corn begin to harden, and then eats its way into the cotton boll. In migrating it frequently also eats the leaves of the cotton to a slight extent.

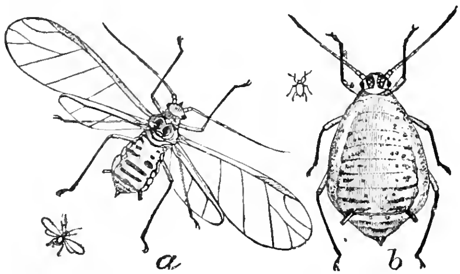
The adult moth deposits her eggs upon the leaves of the cotton plant, and the young crawl to the bolls into which they eat their way, but frequently in doing so, they eat of the leaves. It has often been said that the boll-worm feeding upon the inside of the boll, as it principally does, cannot be poisoned by ordinary means. However, from what has been said, one can easily see that if there be poison upon the leaves of the cotton-plant when the boll-worm migrates to it from the corn, or when the young are hatched from the eggs laid upon the cotton leaf, that those worms that do eat of the leaf, will be poisoned. Hence the poisoning of the leaves for the cotton-leaf-worm will also greatly lessen the number of boll worms; and an application of the poison at a time just before or as soon as the boll-worm begins to migrate from the corn, will save much money. The poisoning for the third brood of the cotton worm and of the boll worm may be done simultaneously. The application of the poison for the boll-worm is accomplished in the same way as given for the cotton-worm.

Perhaps the most widely used method of destroying the boll-worm is to trap the adult moth. The moth is not only attracted by light, but is also attracted by sweets. Hence the placing of lanters in basins of some liquid about the the field, or the placing of simply basins containing molasses and vinegar in the proportion of 4 parts of vinegar to 1 part of molasses, will catch large numbers of the moths. They are attracted by the odor of the mixture, and in trying to sip it, they fall into the liquid and cannot escape. Since the moths fly only at night, the basin should be visited every evening, the moths taken out and the liquid replenished.

From what has been said in regard to the cotton-worm and boll-worm, it will be seen that we can fight both worms by the same remedies and at the same time.

APHIDS ON COTTON.

Aphids, or plant lice, as they are commonly called, are small, usually wingless insects, frequently of a green color. They pierce the leaves of the cotton-plant and suck its juices. Since they are not biting insects and do not eat the tissues, they cannot be killed by the use of the poisons applied to destroy the cotton worm or boll worm.



Plant Lice or Aphids.—*a*, male ; *b*, female.

The cotton-plant louse is not as common or destructive an insect except in extreme cases, as the boll worm and cotton-worm. Whenever the plant louse does occur to a threatening extent it is easily destroyed by the use of Kerosine Emulsion. (See Insecticides.)

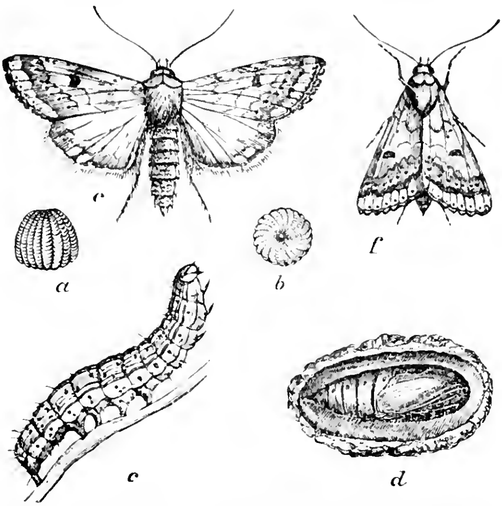
THE CORN PLANT.

CUT WORMS.

The cut-worm has been already described as affecting cabbage. They are also very destructive to corn, often necessitating re-planting. It is not necessary to describe them again. The remedies to be used in the case of their attacking corn are the same as those to be used in the case of cotton. (See cut worms under the cabbage plant.)

CORN-WORM OR BOLL-WORM.

This is perhaps the most destructive insect affecting corn, especially the roasting ears. The worm is the same that attacks the cotton bolls, but prefers the corn while it is soft to cotton, and only migrates to the latter when the corn becomes too hard.



Corn-Worm or Boll-Worm.—*a*, *b*, eggs greatly enlarged; *c*, larva; *d*, pupa; *e*, *f*, adulta.

The female moth deposits her eggs among the silks of the young ears. As soon as the larvæ hatch they eat their way into the ear, and feed upon the young kernels of the corn. They remain here eating the corn for several weeks, and sometimes eat the entire length of the ear, although they usually confine their depredations to the extremity. If the corn becomes too hard before the worms are full grown, they migrate to the cotton plant and enter the boll; otherwise they simply leave the corn, and burrow just beneath the ground, where they make a frail cocoon of silk and sand, within which they change to a pupa. In about two weeks they come forth as adult moths. There are four or five broods during the summer. The first broods attack the corn, as a rule, the latter broods attacking the cotton bolls, the corn at this season of the year being too hard for them to eat.

The cotton or boll worm winters in the pupa stage.

REMEDIES.—Owing to the peculiar habits of the corn worm, no successful means has yet been devised to control them on a large scale against attacking corn. The only remedy is hand picking. The ends of the ears can be opened and the worms picked out and destroyed. Their presence can usually be told by a premature ripening of the silk. Trapping the moths as suggested under the cotton plant can be used to a good advantage.

I wish to acknowledge the kindness of Dr. C. V. Riley, and also of the U. S. Department of Agriculture through Dr. Riley, for the cuts of the insects used to illustrate this Bulletin.

It is hoped that whenever a fungus or other disease, or an insect attacks a plant in sufficient quantities to attract attention, that the person will send a note and a sample or specimen of the same to J. M. Stedman, Biologist, A. & M. College, Auburn, Ala.

Bulletin No. 46, : : : June, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

RYE VS. ENSILAGE.

ALEX. J. BONDURANT, AGRICULTURIST.

A. F. CORY, ASSISTANT AGRICULTURIST.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

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THE EFFECT OF RYE AND ENSILAGE ON THE YIELD OF MILK.

The ensilage question is one of some interest to all of the farmers of Alabama, it is of especial interest to those few who are thinking of building silos. That ensilage is a good feed is beyond all question; whether or not it pays even in cold climates seems from the best evidence to depend on "Local circumstances and seasonal peculiarities."

In Bulletin number 5, second series, volume 3, of the Ohio Experiment Station, after reviewing the work of nine other stations, the following conclusions are drawn: "While the results of these experiments are somewhat contradictory, those which bear evidence of the greatest thoroughness agree in indicating that there is practically no difference between the feeding values of a given quantity of corn, cured as ensilage, and an equivalent quantity cured as dry fodder, provided equally good husbandry has been used in both cases.

Whether corn may be cured and preserved more economically by one process or the other depends largely upon local circumstances and seasonal peculiarities."

The above quotation gives the standing of the silo question in the northern States where ensilage is most used; what the standing may be in Alabama and other States of the same latitude where green feed can be had the whole year round without silos, remains to be settled by experiment.

GREEN RYE AS OPPOSED TO ENSILAGE.

Last winter some simple experiments on Rye and Ensilage were conducted on this station, the object being to compare the effect of these two feeds on the yield of milk.

Four thoroughbred Jersey cows were used in the experiment. Before beginning the test the milk from each cow was carefully weighed for four days. The cows were then divided into two lots of as nearly equal milk producing capacity as possible.

Kate Hazen 1st and Ransom's Pride were called for convenience lot 1, Hattie Signal 2d, and Miss Hattie Pogis were called lot 2.

Up to the beginning of the experiment all of these cows had received the same feed.

During the experiments both lots were given the same quantity of grain and fodder, the only difference in the feed being in the Rye and Ensilage. The regular grain feed per day was four quarts of corn and cob meal and two quarts of cotton seed meal, oat straw and shucks and during the latter part of the experiment pea hulls were used as dry fodder. The grain feed was made small in order to more clearly show the effect of rye and ensilage. The low yield of milk is due partly to the small grain feed and partly to the cold and rainy weather.

The experiment was begun on the morning of February 3d, and continued until the night of March 2d, making 28 days.

It is divided into two periods of fourteen days each. Du- the first period lot 1 was fed rye, and lot 2 ensilage. During the second period lot 1 was fed ensilage and lot 2 rye.

At the beginning of the test, the quantity of rye fed per day to each cow was 30 pounds. This was increased to 40 and on the fifth day of the test to 50 pounds. Kate Hazen 1st, failed to eat all of her rye and for the remainder of the experiment only 40 pounds of rye per day was fed to each cow. At the beginning of the 2d period the rye given to lot 2 was raised in the same way to 50 pounds. Both cows in this lot failed to eat all of the 50 pounds, and the quantity given per day for the remainder of this period was

40 pounds. The ensilage was measured, but several times it was weighed and the weight fed per day found to be about 25 pounds. None of the cows ate all of the ensilage given.

The ensilage used was a fairly good quality of sour ensilage made of corn cut just after the grains had glazed.

The rye used was cut every evening. It was sown thickly in drills two feet apart on well manured land and was ready for the first cutting in November.

The following tables give the daily yield of milk from each cow :

FIRST PERIOD.

	Lot I, Rye.			Lot II, Ensilage.		
February.	Kate Hazen 1st weight of milk in pounds.	Ransom's Pride—weight of milk in pounds.	Yield of milk from both cows.	Hattie Signal 2nd weight of milk in pounds.	Miss Hattie Pogis weight of milk in pounds.	Yield of milk from both cows.
3	11¼	9¼	20½	8¾	13¼	22
4	12½	11¼	23¾	9	15	24
5	13¼	11½	24¾	9	13¾	22¾
6	14	12	26	9½	14¼	23¾
7	13¾	12¼	26	9½	13½	23
8	13½	13¼	26¾	9½	13¾	23¼
9	11¾	12½	24¼	9½	14½	24
10	12¼	13¼	25½	9½	14	23½
11	12¼	12½	24¾	9½	13¼	22¾
12	14¾	13¼	28	10¼	13½	23¾
13	14	12¾	26	9¼	13½	23¾
14	14¼	12½	26¾	9¾	13½	23¼
15	14¼	12¾	27	9¾	14¾	24½
16	14	12½	26½	10½	14¼	24¾
	185¾	171½	357¼	133¼	194¾	328

Total yield of Lot I . . . . 357¼ pounds.
Total yield of Lot II . . . . .328 "
Balance in favor of Rye . . 29¼ "

SECOND PERIOD.

	Lot I, Ensilage.			Lot II, Rye.		
February.	Kate Hazen 1st weight of milk in pounds.	Ransom's Pride—weight of milk in pounds.	Yield of milk from both cows.	Hattie Signal 2nd weight of milk in pounds.	Miss Hattie Pogis weight of milk in pounds.	Yield of milk from both cows.
17	13½	12¾	26¼	10¼	14¾	25
18	12	11½	23½	10	15½	25½
19	12	10¼	22¼	10½	16	26½
20	12	9½	21½	11	16¾	27¾
21	11¾	9¾	21½	10¾	16¼	27
22	12¾	10¾	23½	11¾	17¼	29
23	12¾	11½	24¼	12	17½	29½
24	13¼	11½	24¾	11¾	18¼	30
25	12¾	11	23¾	12¼	18	30¼
26	12½	11½	24	12	18½	30½
27	12¼	11	24¼	12	17¾	29¾
28	11¾	11¼	23	11¾	17½	29¼
Mch.						
1	12½	11¾	24¼	12½	19	31½
2	13½	10¾	24¼	12	18¾	30¾
	175¼	154¾	330	160½	241¾	402¼

Total yield of Lot I . . . . 330 pounds.
Total yield of Lot II . . . . 402¼ "
Balance in favor of Rye . 72¼ "

The following is a summary of the important points in the above tables :

DURING THE FIRST PERIOD.

Lot 1, fed on rye yielded 357¼ lbs. milk.
Lot 2, fed on ensilage yielded 328 lbs. milk.
Balance in favor of rye 29¼ lbs. milk.

DURING THE SECOND PERIOD.

Lot 1, fed on ensilage yielded 330 lbs. milk.
Lot 2, fed on rye yielded 402¼ " "
Balance in favor of rye 72¼ " "

Lot 1, fed on rye, first period yielded $357\frac{1}{4}$ lbs. milk.
Lot 1, fed on ensilage 2d period yielded 330 " "
Balance in favor of rye $27\frac{1}{4}$ lbs. milk.

Lot 2, fed on ensilage, first period yielded 328 lbs. milk.
Lot 2, fed on rye second period yielded $402\frac{1}{4}$ "
Balance in favor of rye $74\frac{1}{4}$.

The above experiments simply show the effect of rye and ensilage on the flow of milk. The effect of these feeds on the yield and quality of butter remain to be determined by future experiments.

Those farmers who are thinking of building silos had best bear in mind the following points:

1st. Corn cured as ensilage has no more feeding value, than an equivalent quantity cured as dry fodder.

2d. In order to make good ensilage it is necessary to have a good silo, a good ensilage cutter, and steam power.

3d. Green rye can be raised at the rate of ten tons per acre. In the winter of 1889-'90 rye sown in drills two feet apart on this station was cut four times between October 30th and February 27th, and yielded 21,392.50 per acre. The yield will of course vary some with the severity of the winters.

In order to make good ensilage some capital is necessary.

Rye for winter use requires only time, a liberal use of manure, and some labor.

Very few farmers can even think of making ensilage; but every man can afford to have a rye patch.

It is expected to continue the experiment on rye and ensilage next winter.

Bulletin No. 47, : : : July, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

FRUITS.

ALEX. J. BONDURANT, Agriculturist.
JAMES CLAYTON, Assistant Horticulturist.

CONTENTS.

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F. J. Bivins .... Clerk, and Assistant Botanist.

* To be filled.

† In charge of Soil Tests.

A RECORD

—OF—

Experiments in Fruit Culture.

By James Clayton, Assistant in Horticulture.

After eight years experiments in comparing the different varieties of fruits on the Experiment Station, detailed accounts of which have been published in our Bulletins from time to time, it is deemed advisable to give a final summary of the results. This is done in as plain and simple form as possible, in order that persons who contemplate planting fruit, may select that which has proved successful, and avoid the failures.

The soils of this Station are of gray sandy, and light clay nature, and therefore the conclusions drawn are sufficiently accurate and definite to render them valuable to all those who live on similar formations.

GRAPES.

In 1886 a vineyard with northern exposure was planted in 48 varieties of grapes, six of each kind, excepting a few varieties of which more than six were planted, as shown in Bulletin No. 29, pages 11 and 12. In the Spring of 1892 *all* of the varieties were found *dead* except the Concord, Delaware, Ives and Perkins, the original of which was as follows:

Concord	110	vines,
Delaware	106	"
Ives	109	"
Perkins	107	"

In removing the posts and the debris of the *dead* vines six each of the above four were taken up, though living and vigorous—which reduces the original number, not counting a few that had previously died, to:

Concord	104	vines.
Delaware	100	"
Ives	103	"
Perkins	101	"

On careful investigation July 1, 1893, we find we have

Concord,	dead,	60,	living	44.
Delaware,	"	7,	"	93.
Ives,	"	11,	"	92.
Perkins,	"	29,	"	72.

It will be seen from these figures that the Delaware and Ives are the most hardy, while the Concord and Perkins are reasonably so. These four make an admirable succession of fruit, the Perkins ripening early in July—then the Delaware and Concord, and last of all, the Ives, holding on until the Memory comes in.

In the New Vineyard, with Southern exposure, planted in 1889 (See Bulletin No. 29, page 15), the results are almost identical. Out of 78 varieties planted only 17 are alive July 1, 1893, and of these, the four which stood the test in the Old Vineyard, with the addition of the Martha, Norton's Virginia, Empire State, Warren and Cynthiana, are the only ones of any value. However, it would be unjust to place the Green Mountain, Northern Muscat and Moore's Diamond, in the list of failures, as at present they are vigorous and promising, but further trial is necessary to show what they will do.

Not one of the Concord, Delaware, Ives, or Perkins planted in the New Vineyard, has died.

These facts are conclusive testimony to the value of these four which we call standards, and we advise our people not to spend money for fancy varieties, when they can so easily propagate these which furnish all the requisites for market, table and wine, and should satisfy the most exacting taste.

THE SCUPPERNONG.

Of the eight varieties of the Rotundifolia or Muscadine type, planted in 1886, (see Bulletin No. 29, page 18,) all are giving perfect satisfaction, and we call attention to some of the different varieties of this most excellent grape. By planting the ordinary Scuppernong, the Memory, the Mish, and Flowers, one can have a constant supply of this fruit until frost. The Memory and Mish are especially desirable, combining superior quality with vigorous growth and great productiveness. The Flowers has not the fine quality of the Memory and Mish, but being the latest to ripen is very valuable, and is unsurpassed by any grape for wine making. The James has been highly recommended by some who claim that it will bear fruit longer than any other variety, but our experiment has not verified this claim. While we have nothing but praise for it as a grape, the season is no longer than that of the scuppernong, and by the average taste would be classed as a "very good Muscadine."

APPLES.

Of the 45 varieties planted in the Spring of 1886, only the following 17 have given satisfaction, and are considered worthy of being recommended for general planting. A brief description of these varieties may not be out of place.

SUMMER VARIETIES.

Red June.—Dark red, conical, flesh white and crisp, very good in quality. Tree a vigorous grower and profuse bearer, entirely free from blight. Ripe June 15.

Astrakan Red.—Light red with stripes, flesh white and crisp, good in quality. Tree vigorous and prolific, slightly attacked by blight. Ripe June 15th.

Early Harvest.—Bright yellow, fine flavor. Tree medium as to growth, prolific, slightly attacked by blight. Ripe June 25th.

Carolina Watson.—Red with stripes, flesh white and crisp, delightful perfume, a large, beautiful apple. Tree vigorous and prolific, slightly attacked by blight. Ripe July 1.

Horse.—An old standard, of good quality. Tree vigorous and prolific. Ripe July 25.

FALL VARIETIES.

Elgin Pippin.—Bright yellow, conical, flesh white and crisp, medium to large. Tree large and vigorous, almost free from blight. Ripe August 10.

Simmons Red.—Yellow skin, nearly covered with red, flesh yellow, quality very good, medium to large. Tree vigorous, profuse bearer, almost free from blight. Ripe August 20, and continues into September.

Carter's Blue.—Dull, greenish red, crisp and sugary—large, flat. Tree vigorous, not prolific, almost free from blight. Ripe September 10.

Kittageskee.—Yellow, flesh yellow and firm, small to medium. Tree vigorous and very prolific—almost free from blight. Ripe Sept. 25.

Tuscaloosa Seedling.—Yellow skin, nearly covered with dark red, flesh yellow, a good keeper, and very good quality, medium to large. Very little blight. Ripe Sept. 25.

Romanite.—Green, with red cheek, flesh firm and crisp, subject to bitter rot. Tree vigorous and very prolific, slightly attacked by blight. Ripe October 1.

Horn.—Green, with dark, red cheek, firm and crisp, a good keeper, small to medium. Tree small but vigorous, very little blight. Ripe October 1.

WINTER VARIETIES.

HEWES' VIRGINIA.—Dark red, small, profuse bearer, tree small but vigorous, very little blight. Ripens in October.

LIMBER TWIG.—Dull, rusty red, medium size, flesh firm and crisp, a good keeper, tree vigorous and prolific, almost free from blight. Ripe in October.

STEVENSON'S WINTER.—Green with dark red, flesh firm, a good keeper, vigorous and prolific, very little blight. Ripe in October.

BEN DAVIS, OR N. Y. PIPPIN.—Greenish yellow, covered with red, flesh firm, a good keeper, medium to large. Tree vigorous but not very prolific, very little blight. Ripens in October.

WINE SAP.—Dark red, small to medium, very good, vinous, good keeper, tree vigorous and a profuse bearer, very little blight. Ripe in October.

The following varieties have a good growth of tree, but do not fruit well:

Hames,
Habersham Late,
American Golden Russet,
Rawl's Jennet,
May,
Cannon Pearmain,
Yopp's Favorite,
Hiley's Eureka.

The following have been badly attacked by blight, and are not satisfactory.

Summer Queen,
Yellow English.
Cook's Seedling,
Shockley,
Shannon Pippin,
Thornton Seedling,
Terry's Winter,
Southern Golden Pippin.

The following varieties are proved to be entire failures here:

Family,
Rhodes' Orange,
Chattahoochee Greening,
Equinettilee,
Buncombe,
Laurens Greening,
Oconee Greening,
Palmer,
Pryor's Red,
Bradford's Best,
Taunton,
Junaluskee.

PEARS.

In 1885 forty varieties of pears were planted, a description of which can be found in Bulletin No. 30, page 9—all of which have succumbed to the blight, excepting the Keiffer, Garber's Hybrid, Duchesse d' Angouleme, Mount Vernon, and Winter Nelis. While the Large Duchesse and Smith's Hybrid, and LeConte are not entirely dead, they are so badly affected that very little hopes are entertained of their recovery. When the blight first attacked these trees, the most vigorous efforts were made to eradicate it, by pruning and burning the diseased portions, but with no avail. So many enquiries are made about this blight, that the following quotation is made from Bulletin No. 8, 1889. U. S. Dept. Agriculture by Dr. Geo. Vasey, and Prof. B. T. Galloway, in reply to a letter from C. H. Franklin, Union Springs, Ala. "This malady is caused by one of the most minute of living organisms, a species of bacteria. They are frequently spoken of, as disease producing germs, and the malady they occasion belongs to the same category of germ diseases now definitely proven to occur among animals and plants. These germs are of extreme tenacity, and are borne from place to place, and from tree to tree, by the atmosphere which is never so quiet but that its movements are sufficient to keep such minute bodies afloat. At present we know of no certain means for rendering the trees insusceptible to the disease. Fumigation, spraying, or washing the tree with various known fungicides, notably sulphur and lime, have given no positive results. As the disease is local and spreads slowly, it is possible, as has long been known, to effectually check its progress by amputation. The smaller limbs should be cut off a foot or two below the lowest manifestation of the disease, and the spots on the trunk and larger limbs shaved out, cutting deep enough to remove all discolorations. The instrument used should be kept disinfected with carbolic acid or otherwise, to guard against conveying the disease to freshly cut surfaces, and the newly cut surfaces ought to be painted over, to exclude the germs that might reach them through the atmosphere."

It is to be hoped that our scientists may soon discover some remedy for this dreadful scourge, and we are glad to note that the Biologist of this Experiment Station is now making investigations in this line.

PEACHES.

In 1885 an orchard of 37 varieties of budded trees, 2 of each kind, and 50* seedlings, were planted; a few died in transplanting and three of the budded trees have since died. At the present writing, July 1, 1893, they are all in a healthy, vigorous condition, and, last year especially, bore an abundant crop of delicious fruit. The following list gives a complete succession from June to November, in the order of ripening, with a brief description :

ALEXANDER.—Of all early peaches tried this is the one preferred; fine color, semi cling, quality good, medium size and prolific. Ripe May 25 to June 10.

*One row of the seedlings was not counted in the report given in Bulletin No. 11, which explains the difference in this number.

HALE'S EARLY.—Above medium size, prolific, white nearly covered with red, very juicy, high flavor, quality good semi-cling. Ripe June 20 to July 1.

EARLY TILLOTSON.—Small to medium, very prolific, white covered with red, very good quality, freestone. Ripe June 25 to July 10.

AMELIA.—Large and prolific, conical, white nearly covered with red, juicy, high flavor, sweet, quality best for home use; freestone. Ripe July 5 to 15.

CRAWFORD'S EARLY.—Large and productive, yellow with red, flesh yellow, juicy and rich, freestone. Ripe July 15 to 25.

CRAWFORD'S LATE.—Resembles Crawford's Early, but larger, and about two weeks later.

STUMP THE WORLD.—Very large, white with bright red cheek, quality very good, freestone. July 15 to 30.

THURBER.—Large, very prolific, white covered with greenish red, very juicy, high flavor, freestone. Bears some fruit every year, and in good crop years abundantly. Ripe July 15 to 30.

ELBERTA.—Large, yellow with red cheek, flesh yellow, juicy, very good quality, prolific, but has not given the satisfaction here that it has met in Georgia; freestone. Ripe July 20 to August 5.

DUGGARS' GOLDEN.—Medium to large, light yellow, firm and juicy; best quality. Ripe July 25.

GEN. LEE; and

STONEWALL JACKSON, seedlings of Chinese Cling, which they resemble, but are improvements on the parent stock, both clings. Ripe July 25 to August 10.

EATON'S GOLDEN.—Medium size, prolific, golden yellow, red cheek, juicy, sweet, quality very good, cling. Ripe August 20 to Sept. 1.

DENNING'S SEPTEMBER.—Large, yellow, quality good, cling. Ripe August 25 to September 10.

Stinson's October.—Medium, white, firm, quality good. Ripe September 10 to October 1.

Hudson's November.—Medium size, white with red cheek, firm, quality good. Ripe October 20 to November 1.

A few new varieties have been added, which only came into bearing last year, (1892) and promise well: Burke, Arietta, Parnell's No. 1, and Parnell's No. 2.

The Burke, cling, is a delicious peach, resembles the Chinese Cling. Ripe July 14.

Arietta, freestone, resembles Stump the World; ripens July 25.

Parnell's No. 1 and No. 2, freestones, large white and medium red; ripen June 25 to July 1.

PLUMS.

In 1885, the following varieties of plums were planted: Weaver, Brill, Hendrix, Missouri, Cumberland, Indian Chief, Hughes, Southern Golden, Bassett's American, Hattie, Newman, Mariana, and 36 Wild Goose planted on different stocks.

Of all these, at this date July 1, 1893, only the Weaver, Southern Golden, Hattie and the Wild Goose grafted on peach stock, are now living and can be recommended.

Nine new varieties of the Japan type, were presented by G. H. Miller & Sons, Rome, Ga., in the Spring of 1889. The following bore their first crop in 1892. Magnificent fruit, ripening from June 6 to 30. Botan, Botankio, Chabot, Maru and Ogon. The other four are vigorous trees, but have not yet borne any fruit.

QUINCES.

Five varieties of quinces were planted in 1885, but only the Champion, and the Chinese or Quincedonia, have ever borne any fruit.

CHERRIES.

Eight varieties of cherries planted have *all* proved entire failures.

MULBERRIES.

Of the six varieties of mulberries planted, only two can be recommended, the Hicks and the Claude. They are rapid growers, of equal merit, and bear fruit for about three months.

NUT BEARING TREES.

Pecans, English and Black Walnuts have been planted, and are growing finely on the Station grounds. We advise the planting of these nuts on every farm in the State. The Pecan will bear at eight years old, and Walnuts from five to six years.

RASPBERRIES.

The difficulty in propagating the Black Cap raspberry, and the shortness of its bearing season, will prevent its ever becoming popular for open culture, but in shaded places, near walls and fences, it will do fairly well.

Of the 16 varieties of the red cap raspberries tested here, the preference is given to the Turner and the Cuthbert. They put up a great many shoots which must be treated as weeds, and kept down, reserving only enough to make the next year's crop, but the length of their fruiting season, their excellent quality, and great productiveness, make them the most valuable of any variety.

STRAWBERRIES.

From the long list of different varieties of strawberries tested on the Experiment grounds, (See Bulletins No. 2, 1887, and No. 2, 1888 old Series, and Bulletins Nos. 1, 20, and 29, new series,) the following six have proved most successful and desirable. They are given in the order in which they stand as to excellence.

1st Sharpless, 2d Wilson, 3d Belmont, 4th Bubach, 5th Eureka or 1001, 6th Haverland.

The Everbearing all died during the Summer of 1891. The Banquet, Smeltzers, Early No. 2, and Waller's Seedling, are new varieties and promise well.

MELONS.

For several years experiments have been conducted with watermelons and cantaloupes. in order to ascertain which of the many varieties offered by the seedsmen, are worthy of being recommended to our people. Of the 28 varieties of watermelons tested up to the present time, preference is given to the following: 1st Cuba, 2d Sugar Loaf, 3d Jones, 4th Pride of Georgia, 5 Cuban Queen, 6th Jordan's Gray Monarch. We advise to plant Kolb Gem only for shipping.

In cantaloupes 30 varieties have been tested, and we recommend the following, any of which will give perfect satisfaction if properly planted: 1st Improved Pine Apple, 2d Nutmeg, 3d Netted Gem, 4th Extra Early Hackensack, 5th Baltimore or Acme, 6th Atlantic City, and 7 Nixon.

NOTE.—For preparation of land, planting, cultivation, pruning, &c., see Bulletins Nos. 4, 10, 11, 28, 29 and 30, new series.

So many applications have been made recently for information about nursery stock, that it is thought well to give the following suggestions—not with a view to *advertise* any one, but simply to be of use to our people, by giving them the address of reliable parties with whom we have dealt.

Buy nursery stock direct from the nursery, if possible never from second hands. Always buy one year old plants—they give much better satisfaction than two year old.

Application by postal card to the following nurseries will procure a Catalogue.

Langdon Nurseries, Mobile, Ala.
Huntsville Nurseries, Huntsville, Ala.
P. J. Berckmans, Augusta, Ga.
G. H. Miller & Sons, Rome, Ga.
E. J. Van Lindsay, Pomona, N. C.

Bulletin No. 48, : : : July, 1893.

Agricultural Experiment Station

—OF THE—

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

ISSUED BY THE

Department of Agriculture,

MONTGOMERY, ALA.

H. D. LANE, Commissioner.

L. A. SMITH, Chief Clerk.

1. **The effect of Organic Matter on Natural Phosphates.**
2. **Commercial Fertilizers.**

N. T. LUPTON, State Chemist.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Commissioner of Agriculture, Montgomery, Alabama, or Agricultural Experiment Station, Auburn, Alabama.

THE BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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THE EFFECT OF DECOMPOSING ORGANIC MATTER ON NATURAL PHOSPHATES.

N. T. Lupton, State Chemist.

FLOATS AS A SUBSTITUTE FOR ACID PHOSPHATES.

During the past few years especial attention has been called to the fertilizing value of natural or raw phosphates, when applied alone in the form of floats, and when mixed with organic matter, such as cotton seed and cotton seed meal. If floats can be shown to produce as good results as acid ulated phosphates, which is claimed by some, the cost of commercial fertilizers ought to be greatly reduced and the extensive deposits of soft, aluminous phosphates found in Florida and elsewhere find a ready sale. While the results of experiments are somewhat conflicting, there appears to be conditions under which floats, or fine ground raw phosphates do produce as good, if not better results, than acid phosphates. The presence of decomposing organic matter is generally regarded as the most important of these conditions, but chemists are not agreed as to the precise nature of its action.

THE EFFECT OF NATURAL PHOSPHATES ON PLANT GROWTH.

Liebig, in his letters on "Modern Agriculture," published in 1859, advances the theory that organic matter undergoing decay accumulates carbonic acid in the soil, and when rain falls it dissolves the carbonic acid and thereby acquires the power of taking up phosphate of lime. This carbonic acid water does not withdraw from the soil the phosphate of lime contained in it, but wherever it meets with the granules of apatite, or phosphorite, it dissolves a certain portion. Under these circumstances, a solution of phosphate of lime must, consequently, be formed, which spreads in all directions around each granule. Wherever this solution comes in contact with soil not already saturated with phosphate of lime, the soil will take up and retain a certain portion of this salt. The portion of soil now saturated with phosphate will oppose no further obstacle to the wider diffusion of the solution.

Voelcker (Bied. Centr. 1880–866, 867) as quoted in the journal of the Chemical Society (Eng.) vol. 24, second series, page 640, draws the following conclusions:

1. Phosphates are not readily taken up by plants in a soluable form [water soluble], but must be returned to an insoluble condition before they yield their useful properties.

2. The efficacy of insoluble calcium phosphate corresponds with the minuteness of division in which it is found in a fertilizer.

3. The finer the particles in a phosphatic material, the more energetic its action as a manure.

Fleischer and Kissling (Bied. Centr. 1883–155, 161) on the application of insoluble phosphates to soils, found that the action of moorland soils when mixed with insoluble phosphates is to render a portion of the phosphate soluble in water, amounting to 55 per cent. in one case, of the total phosphoric acid; a portion at the same time was reduced to the di-calcium salt, and in one compost heap as much as 17 per cent. of the total acid was brought into this form.

The general out-come of the above mentioned experiments is that it is more advantageous to apply insoluble phosphate than superphosphate on humous soils, as they are capable of bringing insoluble phosphate into a soluble condition. This applies, however, only to peaty soils, or those containing decomposing organic matter. The presence of lime hinders this action.

In volume 30 of the journal of the Chemical Society (Eng.), page 773, is an abstract of an article from the journal of the Royal Agricultural Society, 1884, by Dyer, which states that the first experiments made in 1882, in a stiff clay soil containing no calcium carbonate, ground and unground coprolites were used. The comparison was made with sweedes both with and without manures, in each case, the better results was from undissolved phosphate. On the same plots, the following year, oats were grown without further addition of manure, and the produce was again, on an average, better where the undissolved phosphate had been employed. The following year 225 bushels of lime per acre were plowed in before sowing. The same quantities of manure were applied as before. The season was dry and the crop small, but in this case the produce was better where the dissolved phosphate had been used. The ground coprolite contained more than twice as much phosphoric acid as the superphosphate.

Coming nearer home, we find that experiments made at the Alabama Agricultural station are of similar import.

In bulletin No. 22, new series, January 1891, we find the following statement: "In several experiments previously conducted to ascertain the comparative agricultural value of the phosphate rock ground to impalpable powder, known as floats, with that of acid ulated phosphate, the results have indicated that used in conjunction with cotton seed meal, floats are more profitable than the acid phosphate, taking into consideration the fact that floats contain nearly twice the per centage of phosphoric acid. The soil used in these experiments was sandy drift that had been lying out many years. No commercial fertilizer had been previously applied to it." The following conclusion is drawn from the experiments made: "A part of the phosphoric acid in floats plainly becomes available to plants the first season. This is facilitated by combining them with cotton seed meal. Floats and cotton seed meal have uniformly equaled acid phosphate and cotton seed in producing power."

EXPERIMENTS IN THE FIELD TO TEST THE ABOVE MENTIONED RESULTS.

To test more thoroughly the comparative productiveness of ground raw phosphate and acid phosphate under different conditions and to determine whether decomposing organic matter converts insoluble into soluble phosphate, two sets of experiments were carried out, one on the farm and the other in the chemical laboratory, the results of which will now be given.

The materials used were carefully analyzed by Dr. Anderson, assistant chemist, with the following results:

The acid phosphate used gave

Water Soluble Phosphoric Acid (P_2O_5)	9.10	per cent.
Citrate " " "	2.94	"
Acid " " "	2.32	"
Total phosphoric acid (P_2O_5)	14.36	"

The Florida phosphate reduced to a fine powder similar to floats, gave

Moisture	4.18
Insoluble matter	32.39
Total phosphoric acid (acid soluble)	16.54
Iron and aluminium oxides	8.89

None of the lime phosphates were soluble in water and only 0.32 was soluble in ammonium citrate. The analysis shows an inferior grade of raw phosphate. The material purchased as "South Carolina floats" contained 2.26 per cent. of available phosphoric acid in the form of citrate—soluble acid and a total phosphoric acid of 28.73 per cent. The available phosphoric acid in each of the materials used may be stated as follows:

1. Cotton seed meal, available acid (P_2O_5)	3.19	per cent.
2. Cotton seed, " " "	1.03	"
3. Florida ground phosphate " "	0.32	"
4. South Carolina floats, available acid "	226	"
5. Acid phosphate, " " "	12.04	"

Two qualities of land were selected at the station for the field experiments, one a strong red soil, the other a poor sandy soil. The results obtained were as follows on the poor soil the fertilizers were sown broad cast:

	Lbs. seed cotton (per acre.)
1. 400 lbs. pulverized Florida phosphate	290.5
2. 800 " " " "	219.8
3. 400 " acid phosphate	196.7
4. 800 " " "	144.2
5. No fertilizer	106.4
6. 400 lbs. Florida phosphate with 400 lbs. cotton seed meal	249.2
7. 800 lbs. Florida phosphate with 800 lbs. cotton seed meal	322.7
8. 400 lbs. acid phosphate with 400 lbs. cotton seed meal	252.0
9. 800 lbs. acid phosphate with 800 lbs. cotton seed meal	320.6
10. No fertilizer	233.8

Each plot was one-seventh of an acre and the usual precautions were taken to remove disturbing elements and have the conditions of cultivation and growth as uniform as possible. The details of the work were under the immediate supervision of Mr. Clayton, assistant agriculturist. On the strong red soil the fertilizers were applied in the drill with results as follows:

	Lbs. seed cotton (per acre.)
1. 200 lbs. Florida phosphate with 200 lbs. cotton seed meal	1016.6
2. 400 lbs. Florida phosphate with 400 lbs. cotton seed meal	1105.6
3. 200 lbs. acid phosphate with 200 lbs. cotton seed meal	844.8
4. 400 lbs. acid phosphate with 400 lbs. cotton seed meal	1108.8
5. No fertilizers	863.2
6. 200 lbs. Florida phosphate with 400 lbs. cotton seed	919.2
7. 400 lbs. Florida phosphate with 800 lbs. cotton seed	1182.4
8. 200 lbs. acid phosphate with 400 lbs. cotton seed	1178.4
9. 400 lbs. acid phosphate with 800 lbs. cotton seed	1387.2
10. No fertilizers	931.2
11. 400 lbs. Florida phosphate	892.8
12. 400 lbs. acid phosphate	975.2
13. 400 lbs. cotton seed meal	1271.2
14. 800 lbs. cotton seed	1294.4

The land was not uniform in natural productiveness, but improved in quality from the first to the last plot. While the results are not perfectly uniform, the pulverized raw phosphate evidently produced as good, if not better, results than the acid phosphate whether used alone, or mixed with cotton seed and cotton seed meal.

EXPERIMENTS IN THE CHEMICAL LABORATORY.

Anticipating these results experiments were carried on in the laboratory during the summer to determine whether they are due to the fact that decomposing organic matter converts insoluble or acid-soluble lime phosphate into the available or citrate soluble condition. For this purpose half-gallon wide-mouthed jars were used and the following mixtures placed in each:

No. 1. 2 lbs. Florida phosphate with $\frac{1}{2}$ lb. cotton seed meal.
" 2. 1 lb. " " " $\frac{1}{2}$ " " " "
" 3. 2 lbs. South Carolina floats with $\frac{1}{2}$ lb. " " "
" 4. 1 lb. " " " " $\frac{1}{2}$ " " " "
" 5. 2 lbs. Florida phosphate " $\frac{1}{2}$ " cotton seed.
" 6. 1 lb. " " " $\frac{1}{2}$ " " "
" 7. 2 lbs. South Carolina floats " $\frac{1}{2}$ " " "
" 8. 1 lb. " " " " $\frac{1}{2}$ " " "

The contents of each jar were rubbed up in a porcelain mortar, moistened with water and mixed as thoroughly as possible. The mixtures were stirred frequently, in fact, nearly every day. Fermentation began within a day or two and continued during the whole period of the experiments. Samples for analysis, that is, for the determination of the available phosphoric acid, were taken from the jars and analyzed with results as follows:

Per cent. of available P_2O_5 —found.

Date of taking sample.								
July 2...	0.99	1.69	2.68	3.04	0.58	0.54	2.77	——
" 9...	1.25	1.62	2.89	2.64	0.72	0.95	2.33	22.7
" 16...	1.25	1.61	2.89	2.82	0.72	0.80	2.29	2.26
" 23...	1.16	1.80	3.37	3.22	0.84	0.49	2.37	2.39
" 30...	1.12	1.60	3.02	3.38	0.72	0.53	1.81	2.70
Aug. 6...	1.41	1.79	2.87	3.15	0.82	1.08	2.49	2.57
" 20...	1.41	1.57	2.73	3.26	0.81	1.00	2.15	2.53
Sep. 3...	1.50	2.16	2.75	3.27	1.16	1.10	1.96	2.51
" 17...	1.41	1.75	2.56	2.91	1.07	0.89	2.04	2.32
Oct. 1...	----	2.28	2.97	3.14	0.99	1.26	2.57	2.51

The above results seem to show that the fermentation of the cotton seed and cotton seed meal had very little, if any, effect on the Florida ground phosphate or the South Carolina floats in converting the insoluble into soluble phosphate. The variation in the results though favoring to some extent the conclusion that there is a slight increase in the available phosphoric acid, may be accounted for on the ground of personal error, or the want of uniformity in the mixing of the materials, since it is difficult, if impossible, to secure perfect uniformity—in a mixture of ground phosphate and cotton seed.

If decomposing organic matter renders insoluble phosphates available as plant food to any considerable extent, the question of cheap phosphates will be solved and the farmer enabled to purchase fertilizers at a much less cost than at present. That so desirable a result may be reached, is the wish of all who are interested in developing the great agricultural industry of our conntry. The conclusion from these experiments is certainly favorable to the use of floats or finely ground natural phosphates in place of commercial acid phosphates, especially when mixed with cotton seed or cotton seed meal.

STATE LABORATORY.

AGRICULTURAL AND MECHANICAL COLLEGE.

AUBURN, ALA., June 1, 1893.

HON. H. D. LANE,

Commissioner of Agriculture,

Montgomery, Ala.

Dear Sir: Enclosed please find tabulated results of Analyses of Commercial Fertilizers, materials used in their manufacture, natural phosphates, etc., made in the State Laboratory from July 1, 1892, the date of my last published report, to June 1, 1893.

These include samples sent by manufacturers and dealers of the different brands offered for sale within the State.

The Commercial values are estimateds 1st on the minimum of available phosphoric acid (water and citrate-soluble acid), Nitrogen, and Potash, guaranteed by the manufacturer, and 2nd on the amounts of these constituents actually found by analysis. The value used are as follows:

Water-Soluble	Phosphoric	Acid	....	5 cents	per	pound.
Citrate	"	"	"	5	"	"
Nitrogen	"	"	"	17½	"	"
Potash	"	"	"	5	"	"

A few of the samples reported were sent directly to this office and may not appear on your books. In such cases, where the results are of general interest, they are included in the list for publication.

Respectfully,

N. T. Lupton,
State Chemist.

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

ACID PHOSPHATES WITH POTASH AND NITROGEN.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.				Potash.	Nitrogen.	Commercial value.
			Water Soluble	Citrate Soluble.	Acid Soluble.	Total.			
2708	Bowker's Cotton Fertilizer............	George P. Crawford, Columbia, Ala....	5.55	3 30	1.59	10.44	1.60	1.89	$17 06
2713	Troy Perfect Guano, No. 2............	Mark Butler, Andalusia, Ala...........	7 55	1.98	4.34	13 87	1.00	0.77	13 2
2714	" " " " 1............	" " "...........	5.94	1 63	3.89	11.46	1.75	3.38	17 65
2717	Etiwan Guano.	B. T. Hatcher, Columbus, Ga.	9 33	2 83	2.03	14 19	2.15	1.82	20 68

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates containing Potash.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Potash.	Commercial value.
2635	Stono Acid Phosphate	O. W. Cooper & Co., Oxford, Ala	6.93	3 57	2 48	12 98	1 76	$12 26
2637	Edisto Acid Phosphate	Edisto Phos. Co., Charleston, S. C	8 88	2 62	1 97	12.47	1 91	12 41
2671	Home Mixture Guano	Matt. Wilson, Kennedy, Ala	7.29	11.84	2 29	21 42	1.78	20 91
2675	Farish Furman Formula	J. E. Marshall, Irondale, Ala	8 21	3 91	1 27	13 39	3 63	15 75
2691	Edisto Acid Phosphate	W. R. Bailey, Athens, Ala	3 19	5 96	1 65	10 84	1 38	10 53
2700	Scott's High Grade Acid Phosphate	Hurt & Greer, Edwardsville, Ala	13 71	1 26	2 35	17 32	0 45	15 42
2705	Bowker's Dis. Bone Phosphate	Howle Bros., Edwardsville, Ala	9.86	1 94	0 97	12 77	1 72	13 52
2707	Farish Furman Formula	F. M. Lowery, Bankston, Ala	6 84	3 17	0.51	10 52	2.72	12 73

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

ACID PHOSPHATES WITH POTASH AND NITROGEN.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Potash.	Nitrogen.	Commercial value.
2630	Webb's Excelsior	John C. Webb, Demopolis, Ala	3 95	0.83	0 63	5.41	1.37	4.20	$20 85
2636	Georgia State Grange Fertilizer	O. W. Cooper, Oxford, Ala	8 67	0.83	2 85	12.35	2.17	1.75	17 79
2638	Winkler's Ammoniated Dissolved Bone.	Mont. Fertilizer Co., Montgomery, Ala.	3.77	5.39	2.10	11.26	2.04	2.00	18 50
2639	Bowker's Special Fertilizer	Bowker Fertilizer Co., Savannah, Ga	7.91	1.17	1 38	10.46	5.05	3.78	27 36
2641	Fertilizer	E. W. Reeves, Coosada, Ala	5.17	2 85	3 15	11.17	2.23	2.24	18 19
2645	Cotton and Corn Fertilizer	R. B. Brown Oil Co., St. Louis, Mo	9 25	0.90	0 37	10.52	1.91	1 89	18 67
2646	Winkler's Ammoniated Dissolved Bone.	National Acid Co., New Orleans, La	6.60	2.01	1.27	9.88	2.11	2.38	19 05
2648	Farmer's Pride Guano	Edisto Phosp. Co., Charleston, S. C	5 91	2.14	5.41	13.46	1.56	1.89	16 22
2650	Ammoniated Superphosphate	" " " " "	6.77	2.29	3 58	12 64	1.36	1.33	15 07
2651	Monarch Guano	" " " " "	5 76	2.24	5.46	13.46	1.38	1.89	15.99
2653	Blood, Bone and Beef Fertilizer	Meridian Fert. Co., Meridian, Miss	9.03	1.37	2.53	12.93	2.26	1.96	19.52
2655	Guano	John R. Engrim, Enterprise, Ala	7.92	1.59	1.36	10.87	2.59	1.96	18.96

2657	Gossypium Phospho	J. M. Huston, Town Creek, Ala	8.01	2.86	1.18	12.05	2.08	2.24	20 79
2659	Farmers' Club Guano	Evans & Carmichael, Goodwater, Ala	8 49	1 45	1.20	11.14	1.11	1.73	17 10
2660	Baltimore Dissolved Bone	Slingluff & Co., Baltimore, Md	8 25	2 06	1 78	12.09	1 90	1 05	15 88
2663	Wando Soluble Guano	Wando Phoph. Co., Charleston, S. C	8 25	2.98	3 83	15.06	1 74	1 96	19 83
2665	Fertilizer	D. W. Power, Georgiana, Ala	5.03	3 81	2 90	11 74	3 17	1 61	17 64
2667	Bone Compound	Baldwin Fert. Co., Port Royal, S. C	8 24	2 90	3 0	14 20	..	1 96	18 00
2669	Stono Soluble Guano	O. W. Cooper & Co., Oxford, Ala	7.06	2 53	1 66	11.25	1 46	1.90	17 70
2670	Stern's Am. Raw Bone Superphosphate	" " " " "	6.23	3 17	2 09	11.49	2 38	2 15	19 30
2672	Buffalo Bone Guano	Matt. Wilson, Kennedy, Ala	7 91	1.10	1.42	10 43	1 22	1.82	14 50
2673	Vandiver's Ammoniated Dissolved Bone	Vandiver & Co., Montgomery, Ala	8 99	3 60	2 09	14 38	1 29	1 40	18 48
2677	Golden Rod Guano	W. J. Ellis, Keyton, Ala	6 75	3 16	3 80	13 71	1.37	1 47	16 45
2679	Patapsco Guano	T. J. Daniels, Troy, Ala	9.89	0 10	1.52	11 51	2 00	1.54	17 38
2681	Eutaw Fertilizer	J. B. McMillan & Co., Talladega, Ala	10.35	0 94	2.51	13 80	1 75	1.54	18 43
2683	B. D. Sea Fowl Guano	" " " "	3 81	6 62	1.84	12 27	1 55	2 14	19 47
2684	Soluble Specific Guano	" " " "	7.91	3 04	1 59	12 54	2 58	3 01	24 06
2685	Patapsco Am. Soluble Phosphate	" " " "	7.06	3 44	1 23	11 73	1.83	2.59	20 39
2686	Golden Rod Guano	T. F. Windham, Daleville, Ala	8 96	1 20	1 09	11 25	2 38	1.89	19 15
2687	Golden Rod Guano	H. R. Brackin, Daleville, Ala	9.93	1.28	0 87	12 08	2 41	1.54	19 01
2689	Rainbow Guano	R. B. Higden, Kennedy, Ala	8.84	2.72	2.79	14 95	1.90	1 05	17.14

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

ACID PHOSPHATES WITH POTASH AND NITROGEN—Continued.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	Phosphoric Acid.				Potash.	Nitrogen.	Commercial Value
			Water Soluble.	Citrate Soluble.	Acid Soluble.	Total.			
2690	Edisto Guano..	S. P. Smith, Strond, Ala	5 95	5 01	1 30	12.26	1.47	2 03	$18 53
2696	Ober's Special Am. Dis. Bone	Ober, Sons & Co., Baltimore, Md	7 85	2 41	2 15	12 41	1.84	1 75	18 22
2697	Ober's Sol. Am. Superph. Lime	" " " "	7.33	2 91	3 79	14 03	2 32	1 89	19 17
2698	Lee Fertilizer	E. H. Floyd, Tuckersburg, Ala..	3 91	7 06	1.20	12 17	1 92	1.61	18 53
2699	Scott's Animal Am Guano.	Hurt & Greer, Edwardsville, Ala.	9 99	1.11	3 19	14 29	1 50	2 00	19 60
2701	Kennesaw H. G. Guano..	Howles Bros., " "	9 26	2 03	3 95	15 24	1 34	1.40	17 23
2702	" Blood and Bone Comp	" " "	6.32	4.21	5.23	15 76	1 23	1 05	15 43
2704	Bowker's Cotton Fertilizer.	" " "	6 45	2 41	2 09	10 95	1.86	1 68	16 60
2706	Georgia State Grange Fertilizer	" " "	8 55	1 55	1.34	11.44	1.27	1.75	18 50

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial value.
			Water Soluble	Citrate Soluble.	Acid Soluble.			
2345	Fertilizer	E. McDaniel, Leesburg, Ala.	8.71	1.39	3.22	1.75	1.55	$23 52
2346	Complete Fertilizer	Marks & Gayle, Montgomery, Ala.	6.10	2.35	1.74	2.03	2.05	22 63
2349	Coweta H. G. Fertilizer	Coweta Fertilizer Co., Newnan, Ga.	8.16	2.24	1.15	2.10	2.88	26 69
2350	"W. O. C." Fertilizer	" " " " "	7.68	3.06	1.20	2.38	2.56	27 95
2352	Coweta Animal Bone Fertilizer	" " " " "	8.00	4.45	1.20	1.89	2.69	28 73
2353	Aurora Amd. Phospho	" " " " "	7.68	0.90	1.32	1.75	2.57	22 26
2357	Fertilizer	E. K Rothschild, Claiborne, Ala		0.25	0.21	0.14	2.19	3 10
2380	Fertilizer	W. I. R. Thompson & Co., Montg'y, Ala.	8.65	1.20	1.36	1.82	2.31	24 17
2381	Goulding's Bone Compound	J. E. Anderson, Andalusia, Ala	6.91	1.96	1.51	1.75	1.41	21 53
2387	Imp. Amd. Dis. Bone	Imperial Fert. Co., Charleston, S. C.	8.58	2.01	2.43	1.50	1.23	17 07
2388	Sterling Guano	" " " "	7.73	1.53	2.86	1.82	1.17	16 82
2389	Ammoniated Fertilizer.	" " " "	8.06	1.79	3.70	2.20	1.27	18 85

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
2394	Imp. Amd. Fertilizer	Imperial Fert. Co., Charleston, S. C.	8.22	1.40	3.92	2.31	1.31	19 01
2395	Ammoniated Dissolved Bone	" " " "	8.31	2.35	2.36	1.61	1.14	17 43
2400	Blood and Bone Guano	" " " "	7.79	1.70	2.63	1.89	1.01	17 12
2401	Soluble Guano	" " " "	7.48	2.16	2.47	1.82	1.21	17 24
2402	Lockwood Cotton Guano	" " " "	7.50	2.20	2 30	1.82	1.08	17 10
2403	Imp. Soluble Guano	" " " "	7.95	1.75	2.47	1.82	1.17	17 24
2404	Perfection Guano	McMillan & Harrison, Mobile, Ala.	5.93	3.34	1.07	2.10	2.38	19 00
2407	Royal Soluble Guano.	Royal Fertilizer Co., Charleston, S. C.	8.75	1.14	2.99	1.75	1.62	17 59
2408	Royal Ammoniated Fertilizer	" " " " "	9.48	1.75	2.09	2.73	1.93	19 91
2412	Furman Soluble Bone	Adair & McCarty Bros., Atlanta, Ga.	7.31	3.95	1.20	1.40	1.13	17 29
2415	Adair's Ammoniated Dissolved Bone	" " " "	7.57	2.34	1.45	1.96	1.44	18 21
2417	Buffalo Bone Fertilizer.	" " " "	8.04	2.39	1.45	2.24	1.50	19 77

2417	Buffalo Bone Guano	Adair & McCarty Bros., Atlanta, Ga	8.04	2.39	1.45	2.24	1.50	19 77
2418	Furman H. G. Fertilizer	" " " "	7.18	2.82	1.97	2.17	1.79	19 38
2418	Furman H. G. Guano	" " " "	7.18	2.82	1.97	2.17	1.79	19 38
2420	Planter's Sol. Guano, Planter's Sol. Fert.	" " " "	6.89	3.41	1.37	2.11	1.88	19 53
2421	Edisto Ammoniated Superphosphate	Edisto Phos. Co., Charleston, S. C.	8.81	2.35	1.39	1.47	2.02	18 33
2422	Edisto Ammoniated Dissolved Bone	" " " "	6.99	2.08	2.22	2.10	1.52	17 90
2423	Edisto Soluble Guano	" " " "	6.79	2.04	2.09	1.96	1.31	17 00
2424	Edisto Ammoniated Fertilizer	" " " "	7.21	1.65	3.50	6.66	1.44	19 61
2428	King Guano. Soluble Sea Island Guano South America Guano. Empire Guano. Giant Guano.	The Rasin Fert. Co., Baltimore, Md.	8.71	1.40	1.77	2.03	1.70	18 91
2429	"Soluble Specific"	" " " "	8.71	1.81	1.07	2.52	2.13	21 47
2430	Reese's Pacific Guano	John S. Reese & Co., Baltimore, Md	1.32	9.63	0.92	1.82	1.27	18 59
2431	Excellenza Soluble Guano	" " " "	1.31	9.52	0.94	1.82	1.29	18 49
2432	Champion Corn and Cotton Fertilizer	Jos. F. Reeves, Ballard, Ala	....	....	0.31	0.63	0.67	2 87
2433	Sea Gull Soluble Guano	Montgomery Fert. Co., Montgomery, Ala.	6.50	3.22	3.12	2.00	1.90	18 62
2436	Montgomery Blood and Bone	" " " "	4.87	7.02	2.99	2.10	1.83	21 07
2437	Ammoniated Dissolved Bone	" " " "	6.22	3.15	3.95	1.33	1.29	15 31
2438	Alliance Sol. Guano	" " " "	8.23	1 53	4.14	1.68	2.22	17 86
2440	Capital City Stand. Guano	" " " "	8.04	2.20	4.14	1.68	2.03	18 15

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash—Continued..

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
2441	Scott's Animal Amd Guano....	Geo. W. Scott M'f'g. Co., Atlanta, Ga.	9 58	6 88	2.67	1.75	0.86	17 44
2443	Gossypium Phospho.	" " " " ..	8 70	1.16	1.83	2.38	1.82	20 01
2444	Hanselle's State Stand Guano.	" " " " ..	9 00	1 40	3.40	2 20	1 14	19 24
2448	Bone Compound.	Goulding Fert. Co., Pensacola, Fla	9.00	1 75	0 86	2.03	1 30	19 16
2453	Vegetable Fertilizer	Stan. Guano & Chem. M'f'g Co., N.O., La	7 32	1 80	0 31	3.43	4 40	25 42
2454	Sternes' Am. Raw Bone Super. Phos. ..	" " " " "	7.15	1 80	0 95	2 24	1.72	18 51
2457	Champion Farmers' Choice	" " " " "	7.15	1.29	0 82	2.24	2 21	18 49
2458	Pure Ground Bone.	" " " " "	....	8 38	13 48	3 36	....	20 14
2459	"Fruit Tree"	" " " " "	....	7 58	11.58	3 36	3.65	22 99
2460	Standard Amd. Soluble Guano..........	" " " " "	7.41	1 67	0 95	2.24	....	17 02
2461	Crocker's Sol. Dis. Bone Super Phos.	Crocker Fertilizing Co., Buffalo, N. Y.	5 97	3 09	1 14	1 26	1.58	16 25
2462	" " Amd Super Phos.......	" " " " "	5 64	2 48	1.84	1 61	2.07	15 83

2463	Guano	J. M. Lowe, Reeder's Mill, Ala	6.60	3.64	0.95	2.66	2.03	21.58
2464	Farmers' Best	S. A. Mountain, Mobile, Ala	....	0.40	1.84	1.40	0.75	6.05
2466	Eutaw Fertilizer	Ashepoo Phos. Co., Charleston S, C.	7.34	2.12	3.06	1.89	1.13	17.20
2468	Ashepoo Fertilizer	" " " "	7.22	2.12	2.99	1.96	1.32	17.52
2473	Standard Home Mixture Guano	Meridian Fert. Factory, Meridian, Miss	8.69	1.86	1.14	1.90	2.34	19.54
2475	Troy Perfect Guano	Troy Fertilizer Co., Troy, Ala	8.32	0.59	2.42	1.82	1.62	16.90
2477	Farmers Alliance Guano	" " " "	7.79	1.66	1.80	1.82	1.62	17.44
2479	Empire Guano. Giant Guano King Guano. South America Guano. Soluble Sea Island Guano	The Rasin Fertilizer Co., Baltimore, Md.	7.41	2.44	2.16	2.00	1.89	18.74
2480	Amd. Dis. Bone Phos	Lister's Ag. & Chem. Wks, Newark, N. J	7.34	1.80	1.91	1.40	1.35	15.39
2483	Bowker's Crown Guano	Bowker Fert. Co., Charleston, S. C	7.15	2.35	0.95	1.29	1.37	15.38
2484	Bowker's Nassau Guano	" " " "	7.66	2.13	0.88	1.26	1.29	15.49
2485	Bowker's Cotton Fertilizer	" " " "	7.54	1.54	1.33	1.26	1.29	14.78
2487	W. O. C. Guano	Coweta Fertilizer Co., Newnan, Ga	8.8[illegible]	2.19	1.39	2.73	3.59	24.21
2488	Coweta H. G. Guano	" " " "	8.56	1.56	1.52	2.38	3.71	22.15
2489	Aurora Amd. Phospho Guano	" " " "	8.43	1.55	1.32	1.89	3.83	20.42
2490	Coweta Animal Bone Fertilizer.	" " " "	8.56	2.12	3.51	2.3[illegible]	2.54	21.30
2491	A. A. P. Acid Phos. with Am. and Potash	" " " "	8.56	2.19	4.72	1.47	2.00	17.89
2496	Diamond Cotton Food	Savannah Guano Co., Savannah, Ga	9.47	2.26	1.10	2.17	2.53	21.85

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrogen	Potash	Commercial Value
			Water Soluble	Citrate Soluble	Acid Soluble			
2497	Our Own Ammoniated Bone	Savannah Guano Co., Savannah, Ga.	9.57	2.62	0 96	2.24	2.42	22 47
2498	Excelsior	" " " "	9.85	2 43	1.14	2 10	2 40	22 03
2500	Standard Bone Guano	" " " "	9.27	3 03	0.67	1.50	5 32	22 86
2501	Corn and Cotton Fertilizer	Cincinnati Desiccating Co., Cincinnati, O.	1.91	7.59	3.22	2.10	1 03	17 88
2502	Atlantic Fertilizer	Atlantic Phos. Co., Charleston, S. C.	8 75	1.93	1 14	2 31	1.00	19 76
2505	Ammoniated Dissolved Bone	Chicora Fertilizer Co., Charleston, S. C.	10 29	0.40	0.75	1.82	2.05	19 11
2507	High Grade Fertilizer	" " " "	9.77	1.10	0.69	2.06	1 46	19 54
2509	Soluble Guano	" " " "	10 03	0.91	1 07	1.82	1 30	17 61
2510	McCarty's Sol. Bone with Am. and Potash	Adair & McCarty Bros., Atlanta, Ga.	8 11	3 27	4.53	1.05	1 35	16 40
2511	Elephant Guano	Albany Fert. Co., Albany, Ga	8.75	2.38	3.25	1.90	1.90	19 68
2512	Standard Guano	" " " "	6.85	1.15	1.39	3.08	1 70	20 48
2514	Rome C.& C. Guano; Am. Bone Cerealizer.	Comer, Hull & Co., Rome, Ga	10.08	1.22	2.23	1.68	2.09	19 27

2515	Rome Dis. Bone with Am. and Potash....	Comer, Hull & Co., Rome, Ga..........	9.34	1.32	1.07	1.40	1.86	17 47
2518	Atlantic Soluble Guano	Atlantic Phos. Co., Charleston, S. C. ..	9.30	1 20	1.38	1.68	1.42	17 80
2520	Georgia State Grange Fertilizer....	Baldwin Fert. Co., Port Royal, S. C.....	8.44	1.72	1.09	1.89	2.12	18 89
2521	Ammoniated Dissolved Bone.	" " "	8.39	1.44	0.99	1.75	2.00	17 95
2522	Mobile Standard Guano	Mobile Phos.&Chem.M'f'g Co.Mobile,Ala	8 43	2.32	1.42	2.06	2.66	20 62
2523	Eclipse Soluble Guano.	" " " " " " .	8.20	2.10	1.85	2.00	2 70	20 00
2528	St. George Fertilizer....................	Goulding Fert. Co., Pensacola, Fla......	6.77	1.84	3.34	1.33	2.24	15 68
2529	Georgia State Standard Superphosphate..	Comer, Hull & Co., Savannah, Ga	7.22	1.66	1.69	2 00	2 22	18 10
2530	Pure Am. Bone H. G. Veg. Fert..	" " " "	7.92	4 29	2.23	5.18	5.26	35 50
2531	"Old Reliable".........................	" " " "	8.06	1.35	1.46	1.68	0.68	15 97
2533	Farmers' Am. Dis. Bone.............	" " " "	5 81	3.37	2.51	1.78	1.54	16 95
2534	Reliance Amd. Superphosphate	Walton, Whan & Co., Charleston, S. C..	2.48	7.99	1.54	1.71	1.96	18 41
2536	"Plow Brand".......	" " " " ..	5.30	4.23	2.94	2.52	2.33	20 62
2537	Ammoniated Dissolved Bone.	" " " " ..	6.96	3.88	2.96	1.17	1.53	16 46
2539	Etiwan Am. Superphosphate..........	Etiwan Phosphate Co., " " ..	7 38	2.77	2.99	2.03	1.77	19 02
2541	Etiwan Am. Dis. Bone................	" " " " ..	2 55	7 75	1.20	0.98	2.04	15 77
2543	Etiwan Guano.....	" " " " ..	5 31	4.38	3.12	1.79	1 62	17 57
2544	Ammoniated Dissolved Bone.	Montgomery Fert. Co., Montgomery, Ala.	6 77	2 44	4.72	1 54	1 13	15 73
2545	Dowling's Alkaline Guano...............	" " " "	6.32	2.13	5 23	2.29	2.13	18 59

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid			Nitrogen	Potash	Commercial Value
			Water Soluble	Citrate Soluble	Acid Soluble			
2550	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala	7.56	2.20	1.23	2 07	1.80	18 80
2551	Standard Amd. Sol. Guano	Stand. Guano & Chem. M'f'g. Co., N O., La	6.64	1 50	1 11	2.31	2.00	18 22
2553	Sternes' Amd. Raw Bone Superphos.	" " " "	6.58	1 86	1.0	2.10	2.08	17 87
2554	Vegetable Superphosphate.	" " " "	6.96	1.91	0.49	3.29	5.13	25 51
2555	Fruit Tree, G. V. & N. Stock Fert	" " " "	0.18	7.90	12.70	3.36	8.89	28 73
2558	Planter's Pride Guano	Marietta Guano Co., Atlanta, Ga.	10.22	1.10	1.77	1 75	1.71	19 15
2559	Beef, Blood and Bone Compound	" " " " "	10.33	0.36	0.63	1.30	1.64	16 87
2560	Solid South Guano	" " " " "	9 65	1 31	1.07	1.79	1.55	17 78
2563	Stono Complete Fertilizer	Stono Phos. Works, Charleston, S. C.	6 98	1 49	3.54	1.89	1 33	16.42
2565	Stono Soluble Guano.	" " " "	6.83	3.73	3.02	2.24	1.23	19 66
2566	....	....	....	....	....	....	....	....
2567	Pollard's Pacific Guano	Pacific Guano Co., Boston, Mass	8.02	1.76	1.91	2.17	1.73	19 10

2568	Americus Ammoniated Bone Phosphate..	Williams & Clark Fert. Co., Boston, Mass	8 41	2.34	0.79	1.82	1.24	18 36
2569	Cumberland Bone Superphosphate......	Cumberland Bone Phos. Co., " "	8.72	2 02	0 90	1.68	1.19	17 81
2570	Bradley's Patent......................	Bradley Fertilizer Co., " "	8.10	1.16	2.06	1.99	1.67	17 89
2571	"B. D. Sea Fowl"....................	" " " "	7 83	2 00	2.12	2.03	1 31	18 24
2572	Eagle Ammoniated Bone Superphos	" " " "	9.38	1 56	0.70	1.96	1.01	18 81
2573	Carolina Fertilizer....................	" " " "	6.82	4 32	1.84	1.75	1.15	18 41
2575	Lister's Ammoniated Dissolved Bone....	Lister's Ag. & Chem. Wks , Newark, N. J.	6 00	5.47	2.35	2 10	1.92	20 74
2577	East Alabama Fertilizer..........	East Ala. Fert. Co., Clayton, Ala	9.13	0.9[illegible]	0.82	2.00	2.57	19 61
2578	Ashepoo Fertilizer.....................	Ashepoo Phos. Co., Charleston, S. C....	6.19	2.70	2 67	2.10	1.47	17 71
2579	Eutaw Fertilizer......................	" " " "...	6.90	2.31	2 87	2 03	1.70	18 01
2583	....	....	....	.....	....	...	.....	.....
2587	Soluble Guano	Ashley Phos. Co., Charleston, S. C .	5 12	3 45	5.36	1.75	1.00	15 69
2588	Cotton and Corn Compound	" " " " ...	3.16	5.48	5.39	1.89	1.04	16 29
2589	Complete Fertilizer..................	" " " " ...	3 0[illegible]	5.43	5.54	1.82	1.00	15 88
2590	Ammoniated Dissolved Bone...........	" " " "	7.34	3.11	3.84	1 01	1.14	15 12
2591	Soluble Fish Guano..................	" " " " ...	7.39	1.93	2.71	2.59	1.46	19 84
2594	Southern Soluble Guano	Meridian Fert. Factory, Meridian, Miss.	9 20	1 46	1.10	1 20	1 86	16 72
2595	Fertilizer............................	" " " " .	8.11	2.22	1.36	1 68	2.00	18 21
2596	Bowker's Crown Guano................	Bowker Fert. Co , Savannah, Ga.......	6.61	1.43	2 67	1.68	1.53	15 45

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble	Phosphoric Acid. Acid Soluble	Nitrogen	Potash	Commercial Valu
2597	Bowker's Cotton Fertilizer	Bowker Fert. Co , Savannah, Ga	6.29	2.52	2.24	1.65	1.70	15 28
2598	Bowker's Nassau Guano	" " " "	6.97	2 02	2.19	1.68	1.73	16 60
2600	Lee Fertilizer	Lee Fert. Works, Opelika, Ala	9.07	1.39	0.54	2 00	3.64	21 10
2601	Farmers' Club Guano	" " " "	8.80	1.69	1.15	2.66	2 90	23 70
2604	Wando Ammoniated Dissolved Bone	Wando Phos. Co , Charleston, S. C	8.26	3.02	3.93	0.95	1.43	16 05
2605	Wando Soluble Guano	" " " "	7.98	2.38	3.38	1.68	1.39	17 63
2611	Scott's Ammoniated Guano	Geo. W. Scott M'f'g Co., Atlanta, Ga	9 27	0.87	3 06	1.89	2.00	18 75
2612	C. Ellis Cumberland B. Superphos	Cumberland Bone Ph. Co., Savannah, Ga	7.87	1.64	0 99	1.78	1.95	17 69
2613	Old Dominion Guano	Southern Phos. Co., Atlanta, Ga	8.81	2.54	1.23	2.17	2.58	21 53
2614	South. Amd. Dis. Bone; Patent Pacific	" " " "	9.17	2.94	1 89	2.17	2.07	21 77
2615	Etowah Guano	" " " "	9.85	2.71	1.59	1 40	1.36	18 82
2617	Blood and Bone Fertilizer	Montgomery Fert. Co., Montgomery, Ala.	8.85	0.72	3.72	2.45	2.32	20 46

2618	Sea Gull Soluble Guano	Montgomery Fert. Co., Montgomery, Ala.	8.61	1.32	3.49	2.31	2.17	20 18
2619	Troy Perfect	Troy Fert. Co., Troy, Ala.	5.45	2.68	0.38	2.03	1.88	17 11
2620	Standard Guano	Albany F., F. & I. Co., Albany, Ga	8.45	1.83	1.62	1.82	2.04	18 67
2622	Standard Bone Guano	Savannah Guano Co., Savannah, Ga	10.16	3.28	0.86	1 26	2.15	20 00
2624	Ober's Special Amo. Dis. Bone	Ober, Sons & Co., Baltimore, Md	6.56	0 98	4 00	1.65	2.11	15 42
2625	Ober's Amd. Dis. Bone Phos	" " " "	6.35	1.12	3.93	1.82	2.19	16 03
2626	Ober's Sol. Amd. Superphos	" " " "	8.14	0.59	2.07	1.82	1.91	17 00
2627	Ober's G. A. Cotton Compound	" " " "	8.47	0 32	1.87	1.89	2 02	17 42
2628	Ober's Farmer's Stand. Amd. Phos	" " " "	8.52	0.60	1.98	2.03	1.84	18 06
2630	....	....	....	....	....	....	....	....
2632	Kennesaw H. G. Guano	Kennesaw Guano Co., Atlanta. Ga	5.33	3.26	5.60	2.59	1.76	19 41
2633	Blood and Bone Compound	" " " " "	6.98	3.16	4.57	1.86	2.19	18 84

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

ACID PHOSPHATES WITH POTASH.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial value.
2390	Acid Phosphate	Imperial Fert. Co , Charleston, S. C.	10 63	2.01	1.26	1.22	13 86
2391	Imperial H. G. Bone Ash	" " " "	9.63	1.59	2.00	2.06	13 28
2396	High Grade Acid Phosphate	" " " "	10.82	1.59	1.77	1.26	13 67
2397	Sterling Acid Phosphate	" " " "	11.02	1.53	1.45	1.24	13 79
2398	Imperial Acid Phosphate	" " " "	11 30	1.25	1.45	1.27	13 82
2399	Lockwood Acid Phosphate	" " " "	11.02	2.12	1.52	1.48	14 52
2410	Royal Acid Phosphate	Royal Fert. Co., Charleston, S. C.	11.21	2.67	1.26	1.39	15 27
2414	Adair's Formula	Adair & McCarty Bros., Atlanta, Ga.	8.90	3 25	0 69	2 97	15 12
2419	Farish Furman Formula	" " " " "	9.19	3.38	0 56	2.67	15 26
2425	Edisto Acid Phosphate	Edisto Phos. Co., Charleston, S. C	11.21	2 90	0.75	1.05	15 15
2445	Scott's Potasso Phosphate	Geo. W. Scott M'f'g Co , Atlanta, Ga	12 93	2.24	1.69	2.00	17 17
2469	Ashepoo Bone Ash	Ashepoo Phos. Co , Charleston, S. C	10.03	3.27	1.14	1.45	14 75
2481	Bowker's Dis. Bone Phosphate	Bowker Fert. Co., Charleston, S. C.	7.54	3.91	1.46	1.26	12.71

2503	Atlantic Acid Phosphate..................	Atlantic Phos. Co., Charleston, S. C.......	11.50	1.36	1.33	1.03	13 89
2506	Acid Phosphate	Chicora Fert. Co., Charleston, S. C.	11.37	0.97	0 12	1.07	13 41
2516	Rome Bone and Potash	Comer, Hull & Co., Rome, Ga	13 46	2 61	0 77	1.13	17 20
2540	Etiwan Acid Phosphate....................	Etiwan Phos. Co., Charleston, S. C. ...	10.16	3 25	1.16	1 44	14 85
2548	Sistrunk & Jordan's Alkaline Acid Phos	Montgomery Fert. Co , Montgomery, Ala..	9 77	5 90	3 25	2 01	17 68
2562	Acid Phosphate.	Stono Phosphate Works, Charleston, S. C.	8.56	3 85	1 65	1 17	13 58
2584	Acid Phosphate..	Ashley Phosphate Co., Charleston, S. C.	10 09	2 69	1 70	1.61	14 37
2599	Bowker's Crown Dis. Bone with Potash.	Bowker Fert. Co , Savannah, Ga	7.47	4 13	1.69	1 40	13 00
2606	Wando Acid Phos. with Potash.............	Wando Phos. Co., Charleston, S. C ...	11 60	1 13	1.27	1 20	13 93
2610	H. G. Acid Phos with Potash	Chicora Fert. Co , Charle ton, S. C	11.83	1 62	0.80	1.53	14 98

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid			Commercial Value
			Water Soluble	Citrate Soluble	Acid Soluble	
2351	Coweta H. G. Acid Phos.	Coweta Fertilizer Co., Newnan, Ga.	11.19	3.12	1.99	$21 46
2382	Phosphate No. 5.	McMillan & Harrison. Mobile, Ala.	10.11	3.32	2.81	20 14
2383	Acid Phosphate.	Davis, Marshall & Co., Mobile, Ala	9.58	4.42	2.01	21 00
2384	I. X. L. Acid Phosphate.	Mobile Phosphate & Chemical M'f'g. Co., Mobile, Ala.	12.83	2.08	1.58	22 36
2385	Troy Acid Phosphate	W. H. Chapman, Elba, Ala.	15.45	1.54	2.78	25 48
2386	Ground Phosphate.	E. A. Thompson, Clayhatchie, Ala.	....	2.79	21.54	....
2392	Imperial Dissolved Bone	Imperial Fertilizer Co., Charleston, S. C.	11.88	1.88	1.90	13 76
2393	Dissolved Bone	" " " " "	11.73	2.19	1.75	13 92
2405	Acid Phosphate.	McMillan & Harrison, Mobile, Ala.	9.40	4.17	2.15	13 57
2409	Royal Dissolved Bone	Royal Fertilizer Co., Charleston, S. C	13.18	2.71	1.65	15 89
2413	Furman Acid Phosphate. / Furman H. G. Dissolved Bone	Adair & McCarty Bros., Atlanta, Ga.	10.77	3.44	1.13	14 21
2416	Adair's H. G. Dissolved Bone. / Adair's Acid Phosphate	" " " "	10.82	4.25	0.88	15 07

2426	Edisto Dis. Bone	Edisto Phosphate Co., Charleston, S. C	16.74	0 05	0.56	16 79
2427	Acid Phosphate.	Rasin Fertilizer Co., Baltimore, Md	12.46	3.94	0.43	14 40
2434	Alkaline Acid Phosphate.	Montgomery Fertilizer Co., Montgomery, Ala.	12.17	3.63	3 76	15 80
2435	English Acid Phos. High Grade	" " " " "	12.46	3.44	3.76	15 90
2439	High Grade Acid Phos.	" " " " "	10.44	5.55	3 95	15 99
2446	High Grade Acid Phos.	Geo. W. Scott Manufacturing Co., Atlanta, Ga.	8.91	6.48	0.69	15 39
2447	"Guano"—Phosphate.	C. C. Hamner, Cottondale, Ala	11.32	3.37	4.61	14 69
2449	Superphosphate.	Goulding Fertilizer Co., Pensacola, Fla.	13.68	1.86	0.18	15.50
2455	Acid Phosphate.	Standard Guano & Chem. M'f'g Co., New Orleans, La.	8.94	3.21	1.65	12 15
2456	Dissolved Bone.	" " " " " " "	9.13	2.57	1.78	11 70
2465	Eutaw Acid Phosphate.	Ashepoo Phosphate Co., Charleston, S. C	12.01	1.17	2.61	13 18
2467	Ashepoo Acid Phosphate.	" " " " "	12.01	1.55	2.23	13 56
2470	"Guano"—Phosphate.	R. N. Cartwright, Cartwright, Ala.	5.68	3.24	2.52	8 92
2472	Southern Acid Phosphate.	Meridian Fertilizer Factory, Meridian, Miss.	14.53	1.46	0.31	15 99
2474	Florida Acid Phosphate.	Troy Fertilizer Co., Troy, Ala.	10.54	3.95	3.34	14 49
2476	Troy Acid Phosphate.	" " " " "	10.32	2.09	3.38	12 41
2482	Bowker's Nassau Dis. Bone Phos	Bowker Fertilizer Co., Charleston, S. C	13.61	1.81	0.56	15 42
2492	Acid Phosphate.	Coweta Fertilizer Co., Newnan Ga.	12.84	1.22	0.69	14 06
2493	X. X. X. X. Dis. Bone Acid Phos	Savannah Guano Co., Savannah, Ga	16.07	5.72	0.60	21 79

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Commercial Value
			Water Soluble	Citrate Soluble	Acid Soluble	
2494	X. X. Dissolved Bone Phosphate	Savannah Guano Co., Savannah, Ga	12.61	4.63	0.56	17 24
2495	Dissolved Bone Acid Phosphate	" " " " "	7.78	4.40	0.45	12 18
2504	Atlantic Dissolved Bone	Atlantic Phosphate Co., Charleston, S. C.	13.87	1.61	1 59	15 48
2508	Dissolved Bone	Chicora Fertilizer Co., " "	12.27	2.26	0 43	14 53
2513	Acid Phosphate	Albany Fertilizer Co., Albany, Ga	10.35	3.14	1.59	13 49
2517	Rome Acid Phosphate	Comer, Hull & Co., Rome, Ga	13.36	3.00	0.67	16 36
2519	State Grange H. G. Acid Phosphate	Baldwin Fertilizer Co, Port Royal, S. C.	10.18	4.00	1.38	14 18
2532	Georgia State Standard Acid Phosphate	Comer, Hull & Co., Savannah, Ga	12.08	3.59	0.24	15 67
2535	X. X. Acid Phosphate	Walton, Whan & Co., Charleston, S. C	10.93	3.60	1.32	14 53
2538	Diamond Soluble Bone	" " " " "	10.29	2.71	1.20	13 00

2542	Etiwan Dis. Bone	Etiwan Phosphate Co., Charleston, S. C	11 72	2.00	1.84	13 72
2546	High Grade Acid Phosphate	Montgomery Fert. Co., Montgomery, Ala	12 59	4 10	3 51	16 69
2549	Magnet Acid Phosphate	Davis, Marshall & Co., Mobile, Ala	8 75	4 06	2 03	12 82
2552	Dissolved Bone	State Stand. Guano & Chem. M'f'g Co., N. Orleans, La.	13.10	2.55	0.69	15 65
2556	Acid Phosphate	" " " " " "	13 38	2.84	0.65	16 22
2557	Piedmont Acid Phosphate	Marietta Guano Co., Atlanta, Ga	15 08	2 41	1.05	17 49
2561	Dissolved Bone	Stono Phosphate Works, Charleston, S. C	12 36	3 34	1 37	15 70
2574	Palmetto Acid Phosphate	Bradley Fert. Co, Boston, Mass	13 38	1.45	0 55	14 83
2576	East Alabama Dis. Bone	East Ala. Fert. Co., Clayton, Ala	11 37	3 05	2 01	14 42
2580	Troy Acid Phosphate	Troy Fert, Co., Troy, Ala.	15 08	3 69	0 37	18 77
2586	Dissolved Bone	Ashley Phosphate Co., Charleston, S. C	10 87	3.84	2.47	14 71
2593	High Grade Acid Phosphate	Goulding Fert. Co., Pensacola, Fla	12.69	1.40	0 46	14 09
2602	J. & L. Acid Phosphate	Lee Fert. Works, Opelika, Ala	4 71	8 32	1.84	13 03
2603	XX Acid Phosphate	Manley, Handley & Co, Opelika, Ala	14 09	1 76	0 36	15 85
2607	Wando Acid Phosphate	Wando Phosphate Co., Charleston, S. C	10 29	4.29	2.42	14 58
2616	Southern Acid Phosphate	Southern Phosphate Co., Atlanta, Ga	13 36	2 68	1.65	16 04
2621	Dis. Bone Acid Phosphate	Savannah Guano Co., Savannah, Ga.	13 53	1.87	0 92	15 40
2629	Ober's Dis. Bone Phosphate S. Ca	Ober & Sons Co., Baltimore, Md	12.65	2.65	1.10	15 30
2631	Kennesaw Acid Phosphate.	Kennesaw Guano Co., Atlanta, Ga	14 06	4 96	1.75	18 96

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Acid Phosphates.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Commercial Value
2640	Acid Phosphate	Montgomery Fertilizer Co., Montgomery, Ala.	4.98	5.90	6.36	17.24	$10 88
2647	High Grade Acid Phosphate	National Acid Co., New Orleans, La	12.81	2.43	1.45	16 89	15 24
2649	Farmers' Pride Dissolved Bone	Edisto Phosphate Co., Charleston, S. C	9.68	2.62	1.66	13 96	12 30
2652	Monarch Dissolved Bone	" " " " "	9.45	2.93	1.83	12.41	12 38
2656	Acid Phosphate	W. L. Hutchinson, Starkville, Miss	12.47	3 19	0.96	16.62	15 66
2666	Fertilizer	Thomas Williams, Wetumpka, Ala	2.16	9.90	2.55	14 61	12 06
2668	Sunny South Acid Phosphate	T. P. Harrison, Alexander City, Ala	8 37	4.87	1 69	14.93	13 24
2674	Vandiver's H. G. Phosphate	W. H. Betts, Burnt Corn, Ala	12 41	3.16	1.56	17.13	15 57
2680	Patapsco Acid Phosphate	J. B. McMillan & Co., Talladega, Ala	8.32	4 44	1 71	14.47	12 76
2682	Ashepoo Acid Phosphate	" " " " "	8 17	5 50	5.58	19.25	13 67
2692	Bowker's Nassau Dissolved Bone Phosphate	Bowker Fertilizer Co., Savannah, Ga.	11.73	1 36	1.07	14.16	13 09
2693	Troy Acid Phosphate	J. T. Sims, High Ridge, Ala	10.94	2.76	2.51	16.21	13 70

2695	H. G. English Acid Phosphate	D. B. Young, Forest Home, Ala.	9.90	3 55	3.74	17.19	13 45
2703	Kennesaw Acid Phosphate.	Howle Bros., Edwardsville, Ala.	10.95	3 69	2 55	17.19	14 64
2709	Edisto Dissolved Bone.	G. P. Crawford, Columbia, Ala	10 80	2 59	1 46	15 85	13 39

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893

Miscellaneous Fertilizers.

Station No	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid—Total.	Nitrogen	Lime Phosphate	Iron & Aluminum Oxides.	Commercial Value
2658	Ground Raw Phosphate.	A. J. Pharez, Yalaha, Fla	30 58	......	66 45	4 15	$....
2661	Bone Meal.	W. S. Brown, Birmingham, Ala.	26 60	2 14	..	..	7 49

Analyses Reported by N. T. Lupton, State Chemist, from July 1, 1892, to June 1, 1893.

Miscellaneous Fertilizers.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
2405	Kainite	McMillan & Harrison, Mobile, Ala.	....	....	.	....	12.84	$12 84
2411	Kainite	Royal Fert. Co., Charleston, S. C	....	....	....	...	12 61	12 61
2452	Kainite	Stand. Guano & Ch. M'f'g Co., N. Orleans, La.	...	....	.	....	12 63	12 63
2486	Kainite	Bowker Fert. Co., Charleston, S. C	....	....	...	....	12.66	12 66
2564	Kainite	Stono Phos. Works, Charleston, S. C	....	....	.	....	11.96	11 96
2592	Kainite	Ashley Phosphate Co., Charleston, S. C	....	....	....	...	14 08	14 08
2442	Dried Blood	Zimmer Bros., Mobile, Ala	....	....	0 72	12 88	....	45 04
2524	Concentrated Tankage	Alabama Fert. Co., Montgomery, Ala.	....	....	....	11.27	....	39 44
2471	Natural Phosphate	James Pruitt, Midway, Ala.	.....	....	24.90	..	...	....
2623	Paine's Non-Acid Soft Phosphate	Paine Phosphate Co., Jacksonville, Ala.	....	....	23 27	...	...	....
2451	Ashes	McMillan & Harrison, Mobile, Ala.	....	..	1.72	...	0.38	....
2642	Muriate of Potash	E. D Mann, Citronelle, Ala	....	...	....	...	54 60	54 60
2643	Black Jack Ashes.	" " " "	....	...	....	....	16 48	16 48
2664	Pine Cone Ashes	" " " "	....	....	...	....	7.82	7 82

Analyses Reported by Jas. T. Anderson, Acting State Chemist, from June 1 to July 1, 1893.

Acid Phosphates with 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.
2712	Old Reliable	E. T. Rice & J. D. Porter, Park's Store, Ala	8.25	2 36	1 19	1.68	0 56	$17 06
2713	Troy Perfect Guano No. 2	Mark Butler, Andalusia, Ala	7.55	1 98	4.34	0.77	1 00	13 22
2714	" " No. 1	" " " "	5.94	1 63	3 89	2 38	1.75	17 65
2715	Golden Rod Guano	T. P. Windham, Elba, Ala	8.69	2 16	1 05	1.68	1.82	18 55
2717	Etiwan Guano	B. T. Hatcher, Columbus, Ga	9.33	2 83	2.03	1 82	2 15	20 68
2718	Guano	R. B. Lingo, Alston, Ala	8.70	1 68	0 79	2 10	2.25	19 98
2719	Golden Rod Guano	D. H. Carmichael, Annie, Ala	8 24	1 87	0 75	1.89	2 15	18 87
2720	Farish Furman Formula	J. L. Fowler, Bankston, Ala	9.65	2.33	1.07	....	2 26	14 24
2721	Gossypium Guano	I. N. Davis, Centre, Ala	8.57	1.75	1.14	2.59	1.69	22 07
2722	Eddystone Guano No. 1	J. P. Hall, Midway, Ala	8.05	2.78	2.51	2.24	1 79	20 46
2723	" " No. 2	" " "	1.39	7.71	3.62	2 00	1.74	17 84
2726	Imperial Dis. Bone	J. C. Aikin & Son, Notasulga, Ala	7.89	1.56	2.92	1.75	1.11	16 68

Analyses Reported by J. T. Anderson, Acting State Chemist, from June 1 to July 1, 1893.

ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued..

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
2727	Capital City Standard Guano..........	J. C. Aikin & Son, Notasulga, Ala.....	2.80	7.20	3.52	1.50	2.07	17 32
2729	Ammoniated Dis. Bone................	" " " "	3.99	7.23	2.37	1.68	1.56	18 66
2730	Phosphate (Fertilizer).................	H. C. Ellis, Good Hope, Ala.........	3.02	8.42	1.14	2.03	1.72	20 26

ACID PHOSPHATES.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble	Phosphoric Acid. Citrate Soluble	Phosphoric Acid. Acid Soluble	Commercial Value
2716	Acid Phosphate (Golden Rod Guano Co)..	T. P. Windham, Elba, Ala........................	13.34	3.32	1.54	$16 96
2724	English Acid Phosphate................	J. W. Campbell, Kensie, Ala........................	5.49	7.28	3.04	12 77
2725	English High Grade Acid Phosphate....	J. C. Aikin & Son, Notasulga, Ala..................	7.10	6 31	3 76	13 41
2728	Jernigan & Lipscomb Acid Phosphate....	" " " " "	8 33	5.48	2.19	13 81

Analyses Reported by Jas. T. Anderson, Acting State Chemist, from June 1, to July 1, 1893.

MISCELLANEOUS.

Name.	By Whom Sent.	Insoluble Matter	Iron & Alumin'm Oxides.	Phosphoric Acid	Calcium Carbonate	Magnesia	Potash	Sulphuric Acid
Marl	Davis, Marshall & Co., Mobile, Ala.	50.22	21.84	Trace	18.89	Trace	0 15	..
Supposed Phosphate	T. J. Key, Jackson, Ala.	5.10	1.88	0 18	76 64	0 51	. .	0 32
Marl	" " " "	51.71	16.46	0.24	12 81	0 50	0 74	0.48
Supposed Fertilizer	W. J. Hatcher, Hatcher, Ala.	37.57	.....	Trace	.....	.....	Trace	...

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical.	By Whom Reported.		By Whom Manufactured.	Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial value.
		Name.	Address.				Nitrogen.	Phospho. Acid			Potash.	
								Water Soluble	Citrate Soluble.	Acid Soluble.		
1892												
Oct. 14	Adair's Am. Dis. Bone ..	Adair & McC. Bros	Atlanta, Ga ..	Adair&McCt'yBros	Atlanta, Ga., and Charleston, S. C	200	1 75	6	3	2	1	$16 12
" 14	Planter's Soluble Guano..	" " "	" "	" " "	" "	200	1 75	6	3	2	1	16 12
" 14	Planters' Sol. Fertilizer..	" " "	" "	" " "	" "	200	1.75	6	3	2	1	16 12
" 14	Adair's Formula	" " "	" " ...	" " "	" "	200	. .	7	3	2	2	12 00
" 14	Adair's Acid Phosphate...	" " "	" " ...	" " "	" "	200	....	8	4	2	..	12 00
" 14	Adair's High Gr. Dis. Bone	" " "	" "	" " "	" "	200	....	8	4	2	..	12 00
" 14	Furman's High Gr. Guano	" " "	" "	Furman F.& Im.Co	Atlanta, Ga ..	200	2	6	3	2	1	17 00
" 14	Furman's High Grade Fert.	" " "	" " ...	" "	" "	200	2	6	3	2	1	17 00
" 14	Buffalo Bone Guano.....	" " "	" "	" "	" "	200	1.75	6	3	2	1	16 12
" 14	Buffalo Bone Fertilizer....	" " "	" " ...	" "	" "	200	1.75	6	3	2	1	16 12
" 14	Furman's Sol. Bone with Am. and Potash	" " "	" " ...	" "	" " .	200	.85	6	3	2	1	12 98
Dec. 2	McCarty's Sol. Bone with Am. and Potash	" " "	" " ...	Adair&McC'tyBros	" " .	200	.85	6	4	2	1	13 98
Oct. 19	Ashepoo Fertilizer........	Ashepoo Phos. Co.	Charleston, S. C	Ashepoo Phos. Co.	Charleston, S. C	200	1.85	6 25	2.25	2	1	15 97

Oct.	19	Eutaw Fertilizer.........	Ashepoo Phos. Co.	Charleston, S. C	Ashepoo Phos. Co	Charleston, S. C	200	1.85	6.25	2.25	2	1	15 97
"	19	Ashepo Acid Phosphate..	" " "	" "	" " "	" "	200	.....	8.50	2	1	...	10 50
"	19	Eutaw Acid Phosphate ..	" " "	" "	" " "	" "	200	...	8 50	2	1	....	10 50
"	19	Ashepoo Bone Ash.	" " "	" "	" " "	" "	200	...	8.50	2	1	1	11 50
"	19	Kainite	" " "	" "	" " "	" "	200	...	...		..	11	11 00
"	12	Americus Guano..... ..	Americus G'no. Co	Americus, Ga..	Americus G. Co..	Americus, Ga	200	2	7	2	2	1	17 00
"	12	Eddystone Sol. Guano ...	" " "	" "	" " .	" " .	200	2	7	2	2	1	17 00
"	12	Jno. M. Green's Formula.	" " "	" "	" " .	" " ..	200	2	7	2	2	1	17 00
"	12	Americus Dissolved Bone.	" " "	" "	" " ..	" " .	200	...	10	3	2	..	13 00
"	12	Americus Dis. Bone & Pot.	" " "	" "	" " ..	" " ..	200	....	10	3	2	1	14 00
"	12	Eddystone Sol. Guano ...	Atlanta Guano Co.	Atlanta, Ga ...	Atlanta Guano Co.	Atlanta, Ga .	200	2	7	2	2	1	17 00
"	12	Jno. M. Green's Formula.	" " "	" "	" "	" " ..	200	2	7	2	2	1	17 00
"	12	Rainbow Sol. Guano	" " "	" " ...	" "	" "	200	1	8	2	2	1	14 50
"	12	Atlanta Sol. Bone	" " "	" " ..	" "	" "	200	...	10	3	2	..	13 00
"	12	Sunny South Acid Phos..	" " "	" "	" "	" "	200	....	10	3	2	..	13 00
"	12	Neece's Sol. Bone.......	" " "	" "	" "	" "	200	...	10	3	2	..	13 00
Dec.	1	Atlantic Acid Phos	Atlantic Phos. Co	Charleston, S. C	Atlantic Phos. Co.	Charleston, S. C	200	..	9	2	1½	1	$12 00
"	1	Atlantic Fertilizer	" " "	" "	" " "	" "	200	2	6	2	2	1	16 00
"	1	Atlantic Dis. Bone	" " "	" "	" " "	" "	200	.....	10	2	2½	....	12 00

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1892												
Dec. 12	Atlantic Soluble Guano...	Atlantic Phos. Co.	Charleston, S. C.	Atlantic Phos. Co.	Charleston, S. C	200	1.65	6	2	2	1	14 78
" 8	Soluble Guano...........	Ashley Phos. Co.	"	Ashley Phos. Co.	"	200	2	4	4	2	1	16 00
" 8	Cotton & Corn Compound	"	"	"	"	200	1 75	4	4	2	1	15 13
" 8	Complete Fertilizer......	"	"	"	"	200	1 75	4	4	2	1	15 13
" 8	Ammoniated Dis. Bone....	"	"	"	"	200	1	4	4	2	1	12 50
" 8	Soluble Fish Guano.......	"	"	"	"	200	2.50	4	4	2	1	17 75
" 8	Acid Phosphate...........	"	"	"	"	200	.....	6	4	2	1	11 00
" 8	Dissolved Bone.....	"	"	"	"	200	....	7	5	2	..	12 00
" 8	Kainit..................	"	"	Imported from	Germany.	200	.....	....	....	..	13	13 00
" 9	Prairie Fertilizer.........	Alabama Fert. Co.	Montgomery, Ala	Alabama Fert. Co.	Montgomery, Ala	200	3	6	2	....	3	21 50
" 9	Dried and Ground Blood..	"	"	Armour P'k'ng Co.	Kansas City, Mo.	200	12	....	..	....	..	42 00
" 9	Concentrated Tankage....	"	"	"	"	200	11	....	..	.	..	38 50
" 9	Bone Black..............	"	"	Phil'a Sugar Ref'y	Philadelphia, Pa	200	....	18	6	....	...	24 00

Dec. 9	Acid Phosphate, No. 2...	Alabama Fert. Co.	Montgomery, Ala	Imported from	England.	200	......	16	5	....	....	21 00
" 9	Alabama Fertilizer........	"	"	Alabama Fert. Co.	Montgomery, Ala	200	2	7	2		2	18 00
" 9	Pelican	"	"	"	"	200	2	6	2	..	1	16 00
" 9	Acid Phosphate.	"	"	"	"	200	....	11	2	..	..	13 00
" 9	Kainit....................	"	"	Imported from	Germany.	200	...	...	....	..	13	13 00
" 9	Muriate Potash...........	"	"	" "	"	200	....	....	..	....	83	83 00
" 10	Elephant Guano	Albany Ft & F.I.Co	Albany, Ga....	Albany Ft & F.I.Co	Albany, Ga. ...	200	1.90	7	2	.50	1.90	17 55
" 10	Standard Guano..........	"	"	"	"	200	1.75	7	1.75	1.25	1.60	16 48
" 10	Acid Phosphate...........	"	"	"	"	200	....	10	2	1.50	...	12 00
Oct. 31	Berkley's Soluble Guano..	Berkley Phos. Co.	Charleston, S. C.	Berkley Phos. Co.	Charleston, S. C.	200	2.06	7	1	2	1	16 21
" 31	Berkley's Amd. Fertilizer.	"	"	"	"	200	1 65	7	1	2	1	14 78
" 31	Berkley's Acid Phosphate.	"	"	"	"	200	....	9	1	2	1.50	11 50
" 31	Berkley's Dissolved Bone.	"	"	"	"	200		10	2	2	..	12 00
" 31	Berkley's Dis. Bone, No. 2	"	"	"	"	200	....	10.50	2.50	2	..	13 00
Dec. 5	Georgia State Grange Fert.	Baldwin Fert. Co.	Savannah, Ga	Baldwin Fert. Co	Port Royal, S.C.	200	1.75	8	2	1.50	2	18 13
" 5	Ammoniated Dis. Bone...	"	"	"	"	200	1 75	8	2	1.50	2	18 13
" 5	Georgia State Grange Acid	"	"	"	"	200	... .	10	2	2	..	12 00
1893 Feb. 3	Ammoniated Dis. Bone..	"	"	"	"	200	1.75	8	2	1.50	2	18 13
" 3	Georgia State Grange Fert.	"	"	"	"	200	1 75	8	2	1.50	2	18 13

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1893. Feb. 3	Georgia State Grange Acid	Baldwin Fert. Co.	Savannah, Ga	Baldwin Fert. Co.	Port Royal, S. C.	200	....	10	2	2	...	$12 00
Mar. 11	Bone Compound.........	"	"	"	"	200	1.65	7	2	1.50	..	14 78
1892. Nov. 12	Bowker's Cotton Fertilizer.	Bowker Fert. Co..	"	Bowker Fert. Co	Elizabethp't, N.J Brighton, Mass. Charleston, S. C	200	1.65	6	2	2	1.50	15 28
"	Bowker's Nassau Guano..	"	"	"	"	200	1 65	6	2	2	1.50	15 28
"	Bowker's Dis. Bone Phos. with Potash...	"	"	"	"	200	....	9	2	2	1 25	12 25
"	Bowker's Nassau Dis. Bone Phos..................	"	"	"	"	200	....	10	3	2	.	13 00
"	Bowker's Crown Guano...	"	"	"	"	200	1.65	6	2	2	1.50	15 28
"	Kainit	"	"	Imp. Nat. product,		200	....	....	..	..	12	12 00
Dec. 30	Bowker's Crown Dis. Bone Phos. with Potash	"	"	Bowker Fert. Co..	"	200	....	9	2	2	1.25	12 25
1893. Jan. 30	Nassau Dis. Bone Phos. with Potash	"	"	"	"	200	....	9	2	2	1 25	12 25
Feb. 6	Bowker's Complete Fertilizer for Potatoes	"	"	"	"	200	3.25	6	2	1	5	24 38
1892. Dec. 31	B. D. Sea Fowl Guano....	Bradley Fert. Co.	Boston, Mass..	Bradley Fert. Co..	Boston, Mass...	200	1.85	6.50	2.50	2	1	16 47
"	Bradley's Pat. Sup. Phos.	"	"	"	"	200	1.85	6.50	2.50	2	1	16 47

"	Eagle Am. Bone Sup. Phos.	"	" ...	" ..	" ...	200	1 65	6	2	2	1	14 77
"	Carolina Fertilizer	"	" ...	" .	" ...	200	1 85	6.50	2 50	2	1	16 47
"	Palmetto Acid Phosphate.	"	" ..	" .	" ...	200	..	9	3	1		12 00
Nov. 1	Slingluff's Dis. Bone for Home Fertilizer ...	Boykin,Carmer&C	Baltimore, Md.	Boykin,Carmer&C	Baltimore, Md	167	2.20	9	3	2	..	19 70
"	Home Fertilizer Chemicals	"	"	"	"	213	5 75		..	.	7	27 13
"	Windsor Plaster	"	"	"	"	240	...	....	.	.	...	No Guarantee.
Dec 2	Samson Guano.	David Brown. ..	Albany, Ga ..	David Brown. ..	Albany, Ga ..	.	2	7	1.50	1	1 50	17 00
"	Blood and Bone Guano. ..	" ..	" ...	" ...	" ...	..	2	7	1.50	1	1.50	17 00
1893. Feb. 11	Brown's Cotton and Corn Fertilizer.	R. B. Brown Oil Co	Saint Louis, Mo	R. B. Brown Oil Co	Saint Louis, Mo.	200	2 50	6 50	1	6 50	3	19 25
1892 Oct. 8	Rome C. and C. Guano ..	Comer, Hull & Co.	Savannah, Ga	Comer, Hull & Co.	Rome, Ga ...	200	1.65	6	2	1	1.50	15 27
"	Rome Dis. Bone with Am. and Potash.	"	" .	"	"	200	1	6	2	1	1	12 50
"	Ammon. Bone Cerealizer	"	" .	"	"	200	1.65	6	2	1	1.50	15 27
"	Rome Acid Phosphate ..	"	" .	"	"	200	.....	10	2	1	..	12 00
"	Rome Bone and Potash..	"	" .	"	"	200	....	9	2	1	1	12 00
"	Oglethorpe Acid Phosphate	"	" .	"	Savannah, Ga. & Port Royal, S. C.	200	. ..	10	2	1	..	12 00
"	Cotton Boll Acid Phos	"	" .	"	"	200	...	10	2	1	..	12 00
"	Georgia Standard Dis. Bone Phosphate.. ...	"	" .	"	"	200	...	10	2	1	..	12 00
"	Port Royal Dis. Bone Phos	"	" .	"	"	200	....	10	2	1	..	12 00
"	Oglethorpe Dis. Bone Phos.	"	" .	"	"	200	...	10	2	1	..	12 00

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		Name.	Address.				Nitrogen.	Phospho. Acid Water Soluble	Phospho. Acid Citrate Soluble.	Phospho. Acid Acid Soluble.	Potash.	
1892.												
Oct. 8	Georgia Acid Phosphate..	Comer, Hull & Co.	Savannah, Ga..	Comer, Hull & Co	Savannah, Ga., & Port Royal, S. C	200	.....	10	2	1	...	$12 00
" 8	Georgia State Stand. Phos	" " "	" " ..	" " "	" "	200	......	10	2	1	...	12 00
" 8	Crescent Bone Acid Phos.	" " "	" " ..	" " "	" "	200	......	10	2	1	....	12 00
" 8	Forest City Acid Phos ..	" " "	" " .	" " "	" "	200	....	10	2	1	....	12 00
" 8	Port Royal Acid Phos ..	" " "	" " ..	" " "	" "	200	....	10	2	1	..	12 00
" 8	Ga. State Stand Am. Sup	" " "	" " ..	" " "	" "	200	1.65	7	1	1	2	15 77
" 8	Port Royal Cotton Fert.	" " "	" " ..	" " "	" "	200	1 65	7	1	1	2	15 77
" 8	Forest City Am. Dis. Bone	" " "	" " ..	" " "	" "	200	1.65	7	1	1	2	15 77
" 8	Oglethorpe Am. Dis. Bone.	" " "	" " ..	" " "	" "	200	1.65	7	1	1	2	15 77
" 8	Hardie's Cotton Boll ...	" " "	" " ..	" " "	" "	200	1.65	7	1	1	2	15 77
" 8	Crescent Bone Fertilizer..	" " "	" "	" " "	" "	200	1 65	7	1	1	2	15 77
" 8	Farmers Amo. Dis. Bone.	" " "	" " .	" " "	" "	200	1.65	7	1	1	1	14 77
" 8	Alliance Amo. Dis. Bone..	" " "	" " ..	" " "	" "	200	1.65	7	1	1	1	14 77

" 8	Old Reliable.	" " "	" "	" " "	" "	200	1.65	7	1	1	0.10	13 85
" 8	So. Carolina Am. Dis. Bone	" " "	" "	" " "	" "	200	1.65	7	1	1	0.10	13 85
" 8	Comer, Hull & Co., Pure An. Bone H G V. Fert.	" " "	" "	" " "	" "	200	5	7	1	1	5	30 50
" 8	Georgia Fertilizer	" " "	" "	" " "	" "	200	1.65	7	1	1	2	15 77
1893 Jan. 16	Rome Acid Phosphate	" " "	" "	" " "	" "	200	...	10	2	1		12 00
1892. Nov. 21	The Complete Cotton Fert.	Commercial G. Co	" "	Commercial G. Co.	Savannah, Ga	200	1 65	7	1	2	1	14 78
" 21	Chatham Guano	" "	" "	" "	" "	200	1.65	7	1	2	1	14 78
" 21	Pomona Guano.	" "	" "	" "	" "	200	1.65	7	1	2	1	14 78
" 21	Cherokee Am. Bone ...	" "	" "	" "	" "	200	1.65	7	1	2	1	14 78
" 21	Climax Guano	" "	" "	" "	" "	200	1.65	7	1	2	1	14 78
" 21	Old Time Guano	" "	" "	" "	" "	200	1.65	7	1	2	trace	13 78
" 21	Georgia Bone Compound.	" "	" "	" "	" "	200	....	8	2	2	2	12 00
" 21	Our Dis. Bone Phosphate.	" "	" "	" "	" "	200	.....	10	2	2	trace	12 00
" 21	Chatham Acid Phosphate.	" "	" "	" "	" "	200	....	10	2	2	trace	12 00
" 21	Pomona Acid Phosphate	" "	" "	" "	" "	200	....	10	2	2	trace	12 00
" 21	Chatham Vegetator.	" "	" "	" "	" "	200	2.50	8	2	2	3.50	22 25
" 21	Excelsior Fruit Grower .	" "	" "	" "	" "	200	1.25	4	1	2	8	17 38
" 21	Eclipse Cotton Food ..	" "	" "	" "	" "	200	.83	7	1	2	1	11 91
" 21	Eclipse Acid Phosphate..	" "	" "	" "	" "	200	.....	8	2	2	trace	10 00

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1893												
Jan. 6	Florida High Grade Phos	Commercial G Co.	Savannah, Ga	Commercial G. Co.	Savannah, Ga..	200	....	12	4	2	.	$16 00
Mch. 8	Georgia Bone Guano	"	"	"	"	200	1.65	7	1	2	trace	13 78
1892 Oct. 11	Crocker's Sou. Amo. Bone Superphosphate	Crocker F. & C.Co	Buffalo, N. Y.	Crocker F. & C.Co	Buffalo, N. Y.	200	1.64	5	3	1	2	15 74
" 11	Crocker's South. Dissolved Bone Superphos .. .	"	"	"	"	200	1 23	5	3	1	1.50	13 82
Dec. 17	Home Mixture..	Columbus Fer. Co	Columbus, Ga	Columbus Fer. Co.	Girard, Ala....	200	2	6	2	2	1.25	16 25
" 17	Soluble Bone	"	"	"	"	200	....	10	3	1	..	13 00
Nov. 28	Corn and Cotton Fert. .	Cincinnati Des. Co	Cincinnati, Ohio	Cincinnati Des.Co.	Cincinnati, Ohio	200	1.85	2	7	1	1	16 48
Dec. 2	Chicora H G. Fertil zer.	Chicora Fert. Co.	Charleston, S.C.	Chicora Fert. Co.	Charleston, S.C.	200	2.06	6	2	2	1	16 21
" 2	Chicora Amo. Dis. Bone	"	"	"	"	200	1.75	7	2	2	2	17 13
" 2	Chicora Soluble Guano...	"	"	"	"	200	1.65	6	2	2	1	14 73
" 2	Chicora Acid Phosphate...	"	"	"	"	200	...	8	2	1	1	11 00
" 2	Chicora Dissolved Bone...	"	"	"	"	200	...	10	2	2	..	12 00
1893 Jan. 5	Chicora H. H. Acid Phos.	"	"	"	"	200	....	10	2	2	1	13 00

Jan. 9	Chesapeake Guano Co	Chesapeake G. Co.	Baltimore, Md.	Chesapeake G. Co.	Baltimore, Md.	200	2.25	4	5.50	2	1	18 38
"	Ammoniated Alkaline Phos	"	"	"	"	200	2	4	4.50	2	1.50	17 00
1892 Nov. 24	W.O.C., Pure Blood Guano	Coweta Fert Co	Newnan, Ga	Coweta Fert. Co	Newnan, Ga	200	2.25	7.50	2.50	1	2	19 88
" 24	Coweta High Grade Fert.	"	"	"	"	200	2	7	2	1	2	18 00
" 24	Aurora Ammoniated Phos.	"	"	"	"	200	1.75	6.50	1.50	1	2	16 13
" 24	Coweta Animal Bone	"	"	"	"	200	1.75	6.50	1.50	1	2	16 13
" 24	A.A P., Acid, Am. & Pot	"	"	"	"	200	1	6.50	1.50	1	1	12 50
" 24	Coweta H. G. Acid Phos	"	"	"	"	200	....	10	2	1	..	12 00
1893 Jan. 23	Coweta Dis. Bone and Pot.	"	"	"	"	200	....	8	2	1	2	12 00
1892 Dec. 31	Cumberland Bone Super	Cumberland Bone & Phos. Co.	Portland, Me.	Cumberland Bone Phosphate Co.	Booth Bay Harbor, Me.	200	1.65	6	2	2	1	14 77
" 21	Magnet Soluble Guano	Davis, Marshall & Co.	Mobile, Ala.	Davis, Marshall & Co.	Mobile, Ala.	200	2 25	4	4	1	1	16 88
" 21	Magnet Acid Phosphate	"	"	A. S. McLemore.	New York, N. Y.	200	.	6	6	1	...	12 00
" 21	Kainit	"	"	Imported from	Germany.	200	.				10	10 00
" 14	Etiwan Guano	Etiwan Phos. Co.	Charleston, S C.	Etiwan Phos. Co.	Charleston, S.C	200	1.75	6	2	2	1 25	15 37
" 14	Etiwan Amd. Superphos	"	"	"	"	200	1 25	5	2	1	.75	12 13
" 14	Etiwan Amd Dis. Bone	"	"	"	"	200	.87	7	2	1	1	13 21
" 14	Etiwan Acid Phosphate	"	"	"	"	200	....	8	3	1	1	12 00
" 14	Etiwan Dissolved Bone	"	"	"	"	200	....	10	1	1	..	11 00
1893 Jan. 2	East Alabama Dis. Bone	East Ala. Fert. Co.	Clayton, Ala	East Ala. Fert. Co.	Clayton, Ala	200	....	10	3.50	1	..	[illegible]

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1893.												
Jan. 2	East Alabama Fertilizer..	East Ala. Fert. Co.	Clayton, Ala....	East Ala. Fert. Co.	Clayton, Ala...	200	2	7.75	1.75	1	2	$18 50
1892. Oct. 6	Edisto Dissolved Bone .	Edisto Phos. Co..	Charleston, S. C.	Edisto Phos. Co..	Charleston, S. C.	200	.....	9	3	1.50	....	12 00
"	Edisto Acid Phosphate .	" ..	"	" ..	"	200	.....	8	2	1	1	11 00
"	Edisto Amo. Dis. Bone...	" ..	"	" ..	"	200	1.64	6	2	1	1	14 74
"	Edisto Soluble Guano...	" ..	"	" ..	"	200	1 64	6	2	1	1	14 74
"	Edisto Amo. Fertilizer....	" ..	"	" ..	"	200	2 06	6	2	1	1	16 21
"	Edisto Amo. Super. Phos.	" .	"	" ..	"	200	1.23	6	2	1	1	13 31
1893. Feb. 2	Wynn's Monarch Guano..	" ..	"	" .	"	200	1.64	6	2	1	1	14 74
"	Wynn's Monarch Dis. Bone.	" .	"	" .	"	200	....	9	3	1 50	...	12 00
"	Wynn's Monarch Ammon. Super. Phosphate.	" .	"	" .	"	200	1 23	6	2	1	1	13 31
"	Farmer's Pride Guano ..	" .	"	" .	"	200	1.64	6	2	1	1	14 74
"	Farmer's Pride Dis. Bone	" .	"	" .	"	200	....	9	3	1.50	...	12 00
1892. Dec. 8	Chas. Ellis' Cumberland Fertilizer.....	Charles Ellis....	Savannah, Ga	Charles Ellis ...	New York and Charleston, S. C.	200	1.45	6.50	1.50	1.75	1.40	14 48

"	Ellis' Pro Bone Sup. Phos.	"	" ..	"	"	200	1.45	6.50	1.50	1.75	1 40	14 48
"	Ellis Soluble Pacific Guano	" ...	" ..	"	"	200	1 45	6 50	1.50	1.75	1 40	14 48
Dec. 16	Goulding's Special Comp.	Goulding Fert. Co. [Ltd.	Pensacola, Fla.	Goulding Fert Co. [Ltd.	Pensacola, Fla.& Dublin, Ireland.	200	1 75	7	2	1	1	16 13
"	Goulding's Bone Comp ..	"	" .	"	"	200	1 75	7	2	1	1	16 13
"	Saint George Fertilizer ..	"	" ..	"	"	200	1	5	2	1	2	12 50
"	Super. Phosphate........	"	" ..	"	"	200	.....	10	2	1	..	12 00
"	Goulding's Seminole Fert.	"	" .	"	"	200	1	5	2	1	2	12 50
1893 Jan. 7	Goulding's High Grade Acid Phosphate....	"	" ..	"	"	200	....	10	2	1		12 00
Jan. 19	Lull & Lancaster High Grade Acid Phosphate	"	" ..	"	"	200	.....	10	2	1	..	12 00
1892. Oct. 15	Mastodon Amo. Sol. Phos	Ga. Chem. Works.	Augusta, Ga ..	Ga. Chem. Works	Augusta, Ga ..	200	2	6.75	2 25	1.50	1	17 00
"	Georgia Formula.	"	" ...	"	" ...	200	1.75	6 75	2.25	1 50	1	16 13
"	Acid Phosphate	"	" ...	"	" ...	200	....	9	1	1	1	11 00
"	Acid Phosphate No. 2....	"	" ...	"	" ..	200	....	10	1	1	....	11 00
Dec. 3	Mastodon Amo. Sol. Phos.	"	" ...	"	" ...	200	2	6.75	2.25	1 50	1	17 00
"	Georgia Formula.	"	" ...	"	" ...	200	1.75	6.75	2.25	1.50	1	16 13
"	Acid Phosphate	"	" ..	"	" ...	200	...	9	3	1	1	13 00
"	Acid Phosphate No. 2 .	"	" ..	"	" ...	200	...	10	3	1	....	13 00
1892. Oct. 8	Anchor Ammon. Fertilizer	Imperial Fert. Co.	Charleston, S. C	Imperial Fert. Co.	Charleston, S. C.	200	2.06	6	2	2	1	16 21
"	XXX C. G. Acid Phos ..	"	"	"	"	200	....	9	2	1.50	1	12 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical.	By Whom Reported.		By Whom Manufactured	Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial value.
		Name.	Address.				Nitrogen.	Phospho. Acid			Potash.	
								Water Soluble.	Citrate Soluble.	Acid Soluble.		
1892												
Oct. 8	XXX Blood & Bone Guano	Imperial Fert. Co.	Charleston, S. C.	Imperial Fert. Co.	Charleston, S.C.	200	1.65	6	2	1.50	1	$14 77
"	Lockwood Acid Phosphate	"	"	"	"	200	....	9	2	1.50	1	12 00
" 8	Lockwood Cotton Grower.	"	"	"	"	200	1.65	6	2	1.50	1	14 77
" 8	Imperial Ammoniated Fert	"	"	"	"	200	2.06	6	2	2	1	16 21
" 8	Anchor Dissolved Bone...	"	"	"	"	200	...	10	2	2	.	12 00
" 8	Anchor Acid Phosphate...	"	"	"	"	200	....	9	2	1.50	1	12 00
" 8	Anchor Amo. Dis. Bone...	"	"	"	"	200	.82	8	2	1.50	1	13 87
" 8	Anchor Soluble Guano ..	"	"	"	"	200	1.65	6	2	1.50	1	14 77
" 8	Imperial Dissolved Bone..	"	"	"	"	200	....	10	2	2	..	12 00
" 8	Imperial Acid Phosphate	"	"	"	"	200	....	9	2	1.50	1	12 00
" 8	Imperial H. G. Bone Ash.	"	"	"	"	200	....	8	2	1.50	2	12 00
" 8	Imperial Amo. Dis. Bone..	"	"	"	"	200	.82	8	2	1.50	1	13 87
" 8	Imperial Soluble Guano...	"	"	"	"	200	1.65	6	2	1.50	1	14 77

Oct. 8	Sterling Acid Phosphate..	Imperial Fert. Co.	Charleston, S. C.	Imperial Fert. Co.	Charleston, S.C.	200	....	9	2	1.50	1	12 00
" 8	Sterling Guano..........	"	"	"	"	200	1.65	6	2	1.50	1	14 77
Nov. 9	Lee Fertilizer...........	Jernigan & Lipscomb..........	Opelika, Ala...	Jernigan & Lipscomb..........	Opelika, Ala...	200	2	8	1	2	2	18 00
" 9	Farmers' Club Guano....	"	"	"	"	200	1.50	6.50	1	2	1	13 75
" 9	Ammoniated Bone........	"	"	"	"	200	1	5	1	2	1	10 50
" 9	J. & L. Dissolved Bone....	"	"	"	"	200	....	11	2	2	...	13 00
" 9	J. & L. Acid Phosphate...	"	"	"	"	200	.....	9	1	2	...	10 00
Dec. 14	Lee Fertilizer...........	"	"	"	"	200	2	8	1	2	2	18 00
" 14	Farmers' Club Guano....	"	"	"	"	200	2	7	1	2	1	16 00
" 14	Ammoniated Bone	"	"	"	"	200	1	5	1	2	1	10 50
" 14	J. & L. Dissolved Bone...	"	"	"	"	200	....	11	2	2	....	13 00
" 14	J. & L. Acid Phosphate..	"	"	"	"	200	....	9	1	2	..	10 00
1893 Jan. 4	J. C. Street's High Grade.	"	"	Lee Fert. Works..	"	200	2	7	1	2	1	16 00
" 4	Ammoniated Dis. Bone..	"	"	"	"	200	2	7	1	2	1	16 00
" 4	English Acid Phos., H. G.	"	"	"	"	200	....	12	1	2	...	13 00
Feb. 14	Old Time Guano	"	"	"	"	200	1.60	8	1.50	2	1	16 10
" 14	Farmers' Club, No. 2...	"	"	"	"	200	1.50	7	1	2	1	14 25
" 14	Ammoniated Dis. Bone...	"	"	"	"	200	1.60	8	1.50	2	1	16 10
Mar. 24	Kennesaw Acid Phosphate	Kennesaw G. Co.	Atlanta, Ga .	Kennesaw G. Co.	Atlanta, Ga....	200	.....	9	3	2	....	12 00

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1893												
Mar. 24	Kennesaw High Gr. Guano	Kennesaw G. Co.	Kennesaw G. Co	Kennesaw G. Co..	Atlanta, Ga....	200	2	6	2	2	1	$16 00
" 24	Blood and Bone Compo'nd	" "	" "	" "	" "...	200	1	6	3	2	1	13 50
1892 Nov. 21	Ammo. Dis. Bone Phos...	Lister's Agricult'l Chem. Works	Newark, N. J...	Lister's Ag. Chemical Works.....	Newark, N. J...	167	2.05	6	2	2	2	17 18
Oct. 11	Planters' Pride Guano....	Marietta Guano Co	Marietta G. Co.	Marietta Guano Co	Atlanta, Ga....	200	1.75	7	2	3	1	16 12
" 11	Solid South Guano........	" "	" "	" "	" "...	200	1.75	7	2	3	1	16 12
" 11	Beef Blood and Bone Compound	" "	" "	" "	" "...	200	1	7	2	3	1	13 50
" 11	M. G. C. Dissolved Bone.	" "	" "	" "	" "...	200	1	7	2	3	1	13 50
" 11	Alliance High Gr. Guano.	" "	" "	" "	" "...	200	1.75	7	2	3	1	16 12
" 11	Piedmont Acid Phosphate.	" "	" "	" "	" "...	200	.....	7	4	3	..	11 00
" 11	Marietta High Grade Acid Phosphate............	" "	" "	" "	" "...	200	......	7	4	3	..	11 00
Dec. 14	Mobile Standard Guano..	Mobile Phos. and Chemical Co...	Mobile Phos. & Chemical Co.	Mobile Phos. and Chemical Co..	Mobile, Ala ...	200	1.86	8	2	2	1	17 51
" 14	Eclipse Soluble Guano....	" "	" "	" "	" "...	200	1.65	4	5	1	1	15 78
" 14	IXL Acid Phosphate.....	" "	" "	" "	" "...	200	.....	12	1.50	2	...	13 50

Mar. 16	Soluble Ammoniated Bone	“ “	“ “	“ “	“ “	200	.85	9	1	1	...	12 98
1892 Oct. 19	Montgomery Blood and Bone Fertilizer........	Montgomery Fertilizer Company.	Montgomery Fertilizer Co..	Montgomery Ft. Co	Montg'mery, Ala	200	2	7	2	1	2	18 00
“ 19	Sea Gull Soluble Guano..	“ “	“ “	“ “	“ “	200	2	7	2	1	2	18 00
“ 19	Capital City Stand. Fert..	“ “	“ “	“ “	“ “	200	1.50	7	2	1	2	16 25
“ 19	Alliance Soluble Guano...	“ “	“ “	“ “	“ “	200	1.50	7	2	1	2	16 25
“ 19	Ammoniated Dis. Bone...	“ “	“ “	“ “	“ “	200	1	7	2	1	1	13 50
“ 19	High Grade Acid Phos ..	“ “	“ “	“ “	“ “	200	....	11	1	1	..	12 00
“ 19	Alkaline Acid Phosphate.	“ “	“ “	“ “	“ “	200	.....	11	1	1	....	12 00
“ 19	High Grade English Acid Phosphate.	“ “	“ “	“ “	“ “	200	.....	11	1	1	..	12 00
Dec. 19	High Grade English Acid Phosphate	“ “	“ “	“ “	“ “	200	.....	10	2	1	...	12 00
“ 19	Schloss & Kahn English Acid Phosphate	“ “	“ “	“ “	“ “	200	.....	11	1	1	...	12 00
“ 19	Greil Bros. & Co., English Acid Phospate...... ..	“ “	“ “	“ “	“ “	200	....	11	1	1	....	12 00
“ 19	High Grade Acid Phos....	“ “	“ “	“ “	“ “	200	.....	11	1	1	...	12 00
“ 19	English Acid Phosphate..	“ “	“ “	“ “	“ “	200	.....	11	1	1	....	12 00
“ 19	Ammoniated Dis. Bone...	“ “	“ “	“ “	“ “	200	1	7	2	1	1	13 50
“ 19	Alliance Soluble Guano ..	“ “	“ “	“ “	“ “	200	1.50	7	2	1	2	16 25
“ 19	Capital City Stand. Guano	“ “	“ “	“ “	“ “	200	1.50	7	2	1	2	16 25
“ 19	Alkaline Acid Phosphate..	“ “	“ “	“ “	“ “	200	......	11	1	1	...	12 00
“ 19	Vandiver's Ammo. Dis. Bone....	“ “	“ “	“ “	“ “	200	1.05	8	1	1	1	13 68

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1892.												
Dec. 19	Vandiver's High Grade Acid Phosphate.......	Montg'y Fert. Co.	Montgom'y, Ala	Montg'y Fert. Co	Montgom'y, Ala	200	....	11	1	1	...	$12 00
"	Vandiver's Eng. Acid Phos. High Grade	"	"	"	"	200	...	11	1	1	....	12 00
"	Hobbie & Teague H. G. Acid Phosphato	"	"	"	"	200	.	11	1	1	....	12 00
"	Sistrunk & Jordan Alkaline Acid Phosphate........	"	"	"	"	200	...	11	1	1	1	13 00
"	Dowling's Alkaline Guano	"	"	"	"	200	1.23	7	1	1	2	14 30
"	Tariff Reform Sol. Guano.	"	"	"	"	200	1 50	7	2	1	2	16 25
"	A. S. & Co. High Grade Acid Phosphate.......	"	"	"	"	200	.....	11	1	1	..	12 00
"	Our Cotton King Guano..	"	"	"	"	200	1	7	2	1	1	13 50
"	Our Cotton Queen Guano	"	"	"	"	200	1	7	2	1	1	13 50
"	Southern Pacific Guano..	"	"	"	"	200	1	7	2	1	1	13 50
"	High Grade English Acid Phosphate.............	"	"	"	"	200	......	11.50	2.50	1	..	14 00
Dec. 30	Winkler's Amo. Dis. Bone.	"	"	"	"	200	2	7	2	1	2	18 00
Oct. 21	Southern States Standard.	C.L.Montague&Co	Savannah, Ga	C.L.Montague&Co	Savannah, Ga..	200	1.65	5	3	1	1	14 78

"	State Alliance Favorite...	"	" ..	"	" ..	200	.82	7	3	1	1	13 89
Dec. 15	Southern States Standard.	"	" ..	"	" ..	200	1 65	6	3	1	1.25	16 03
Dec. 9	Favorite Fertilizer	Marks & Gayle..	Montgom'y, Ala	Ala. Fertilizer Co.	Montgom'y, Ala	200	2	6	2	0	1	16 00
"	Acid Phosphate.........	" ..	"	Edisto Phos. Co..	Charleston, S. C.	206	....	11	2	0	....	13 00
"	Kainit.................	" .	"	Imported from Germany		200	..	..	..	....	13	13 00
"	Muriate Potash.......	" ..	"	"	"	200	....	....	..	....	82	82 00
Nov. 18	Standard Home Mixture Guano	Meridian Fer. Fac.	Meridian, Miss.	Meridian Fer. Fac.	Meridian, Miss.	100-200	1.90	8	2	1 50	1.75	18 40
"	Southern Acid Phosphate.	"	"	"	"	100-200	....	13	1.50	....	. ..	14 50
1893. Jan. 16	Southern Soluble Guano.	"	"	"	"	100-200	1.50	7	2	1	1 50	15 75
Feb. 23	Bone Blood and B	"	"	"	"	100-200	1.65	7.50	2	1	2	17 28
Nov. 10	Farmer's Best Fertilizer..	Mobile R & C Mills	Mobile, Ala ..	Mobile R & C Mills	Mobile, Ala .	200	3.50	1	2.69	3 25	1	16 94
1893. Jan. 4	M. H. & Co. Amo. Dis. Bone	Manley, Hanley & C	Opelika, Ala .	Manley, Hanley & C	Opelika, Ala .	200	2	7	1	2	1	16 00
"	M. H. & Co. XX Acid Phos.	"	" .	"	" ...	200	...	12	1	2	. ..	13 00
1893. Feb. 3	Standard Fertilizer. ...	Miss. Cot Oil Co., Columbus Mills	Columbus, Miss	Miss. Cot. Oil Co., Columbus Mill..	Columbus, Miss.	100	2.45	7 09	3 67	0	3.03	22 37
"	Acid Phosphate	"	"	"	"	100	....	13	....	..	...	13 00
1892. Dec. 5	Perfection Guano..... .	McMillan & Harrison. .	Mobile, Ala	McMillan & Harrison.	Mobile, Ala	200	2	5 90	3	1	2	17 90
"	Acid Phosphate	McMillan & Harrison...	" ..	McMillan & Harrison..... ...	" .	200	.	9	4	2	....	13 00
"	Kainit..............	McMillan & Harrison..... ..	" ..	Imported from Germany		200	....		. .	....	12.50	12 50
1893. Jan. 10	Acid Phosphate	Nat'l Fert. Co ..	Nashville, Tenn.	Nat'l Fert. Co....	Nashville, Tenn.	200	....	10	2	2	....	12 00

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		Name.	Address.				Nitrogen.	Phospho. Acid Water Soluble	Phospho. Acid Citrate Soluble.	Phospho. Acid Acid Soluble.	Potash.	
1893												
Jan. 10	Acid Dissolved Bone ...	National Fert. Co.	Nashville, Tenn.	National Fert. Co.	Nashville, Tenn.	200	1.02	8	2	1	1.25	$14 82
" 10	Rock City Guano.... ...	"	"	"	"	200	1.85	6	2	1	1.25	15 73
" 10	Tennessee Guano........	"	"	"	"	200	1.85	6	2	1	1.25	15 73
" 10	Old Hickory Guano.......	"	"	"	"	200	1.85	6	2	1	1.25	15 73
" 4	N. & T. Amo. Dis. Bone...	Noles & Tenant...	Opelika, Ala..	Noles & Tenant..	Opelika, Ala...	200	2	7	1	2	1	16 00
Feb. 17	Winkler's Amo. Dis. Bone	National Acid Co.	New Orleans, La.	National Acid Co.	New Orleans, La	100-200	1.75	4	4	0	2	16 18
" 17	H. G. Acid Phosphate.....	"	"	"	"	100-200	....	13	2	..	..	15 00
1892												
Dec. 22	Ober's Dis. Bone Phos....	G. Ober & Sons Co.	Baltimore, Md	G. Ober & Sons Co.	Baltimore, Md..	200	....	10.50	1.50	1		12 00
" 22	Ober's Sol. Amo. Su. Lime	"	"	"	"	200	1.80	6.50	1.50	2	1.40	15 70
" 22	Ober's Georgia Cotton Com	"	"	"	"	200	1.80	6.50	1.50	2	1.40	15 70
" 22	Ober's Farmers' Standard Ammoniated Phosphate.	"	"	"	"	200	1.70	6.50	1.50	2	1.40	15 35
" 22	Ober's Amo. Dis. Bone Phosphate..	"	"	"	"	200	1.70	6.50	1.50	2	1.40	15 35
" 22	Ober's Special Amo. Dis Bone..................	"	"	"	"	200	1.65	6.50	1.50	2	1.40	15 18

Oct.	15	Patapsco Amo. Sol. Phos. .	Patapsco G'ano Co	Augusta, Ga . .	Patapsco G'ano Co	Baltimore, Md.	200	2	6.75	2.25	1.50	1	17 00
"	15	Ammoniated Dis. Bone. . .	"	"	"	" .	200	1.75	6.75	2.25	1.50	1	16 13
"	15	Acid Phosphate.	"	"	"	" .	200	. . . .	9	1	1	1	11 00
"	15	Acid Phosphate, No. 2 . . .	"	"	"	" .	200	. . . .	10	1	1	. . .	11 00
Dec.	3	Patapsco Amo. Sol. Phos.	"	Baltimore, Md. .	"	" .	200	2	6.75	2.25	1.50	1	17 00
"	3	Ammoniated Dis. Bone. . .	"	"	"	" .	200	1.75	6.75	2.25	1.50	1	16 13
"	3	Acid Phosphate.	"	"	"	" .	200	. . . .	9	3	1	1	13 00
"	3	Acid Phosphate, No. 2 . . .	"	"	"	" .	200	. . . .	10	3	1	. .	13 00
1893 Jan.	2	Pollard's Pacific Guano . .	Pacific Guano Co. .	Boston, Mass	Pacific Guano Co	Boston, Mass . .	200	1.75	6.50	2	2	1	15 62
1892 Oct.	15	Empire Guano	Rasin Fert. Co. . .	Baltimore, Md	Rasin Fert. Co. . .	Baltimore, Md	200	2.70	4.70	5.70	2.70	1.75	21 60
"	15	Soluble Sea Island Guano	"	"	"	" . .	200	2.70	4.70	5.70	2 70	1.75	21 60
"	15	South American Guano . .	"	"	"	" .	200	2.70	4.70	5.70	2.70	1.75	21 60
"	15	King Guano	"	"	"	" .	200	2 70	4.70	5.70	2.70	1.75	21 60
"	15	Giant Guano.	"	"	"	" .	200	2.70	4.70	5.70	2.70	1 75	21 60
"	15	Acid Phosphate.	"	"	"	" . .	200	. . . .	10	4	1	. .	14 00
"	15	Soluble Specific Guano. . . .	"	"	"	" .	200	3 70	8	2	2	2.50	25 20
"	12	Royal Acid Phosphate. . . .	Royal Fert. Co . .	Charleston, S. C	Royal Fert. Co .	Charleston, S. C	200	. . .	9	2	1 50	1	12 00
"	12	Royal Dissolved Bone. . .	"	"	"	" . .	200	. . . .	10	2	2	. . . .	12 00
"	12	Royal Ammoniated Fert . .	"	"	"	" . .	200	2.06	6	2	2	1	16 21

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		Name.	Address.				Nitrogen.	Phospho. Acid Wtaer Soluble.	Phospho. Acid Citrate Soluble.	Phospho. Acid Acid Soluble.	Potash.	
1892.												
Oct. 12	Royal Soluble Guano....	Rasin Fert. Co..	Baltimore, Md.	Rasin Fertil. Co..	Baltimore, Md..	200	1.65	6	2	1.50	1	$14 78
"	Kainit	"	"	Imported from Germany		200	....	....	..	...	12	12 00
Oct. 8	Reese's Pacific Guano ..	J. S. Reese & Co..	"	J. S. Reese & Co..	Carteret, N. J..	200	1.85	3.50	5	1 20	1 20	16 18
"	Reese's Excellenza Guano	"	"	"	"	200	1.85	3.50	5	1.20	1.20	16 18
Dec. 6	Reese's Pacific Guano ..	"	"	"	"	200	1.85	3.50	5	1.20	1.20	16 18
"	Reese's Excellenza Guano	"	"	"	"	200	1.85	3.50	5	1.20	1.20	16 18
Nov. 19	Leader Acid Phosphate..	Read Fertil. Co...	Charleston, S. C.	Read Fertil. Co...	New York and Charleston, S. C.	200	....	7	3	2	..	10 00
"	Sub Treasury Guano.....	"	"	"	"	200	1 64	6	2	2	1	14 74
"	Matchless Cotton Guano..	"	"	"	"	200	1.64	6	2	2	1	14 74
"	Farmer's Friend Fertilizer.	"	"	"	"	200	2.05	6	2	2	1	16 18
"	High Grade Acid Phos....	"	"	"	"	200	.....	9	4	2	....	13 00
"	Blood and Bone.........	"	"	"	"	200	1.64	6	2	1	1	14 74
Oct. 6	Gossypium Phospho......	G.W.Scott Mfg.Co.	Atlanta, Ga	G.W.Scott Mfg.Co.	Atlanta, Ga....	200	2	6	3	1	1 50	17.50

"	Scott's Animal Amo. Guano	"	"	"	"	200	1 65	6	3	1	1	15 78
"	Hansell's State Standard	"	"	"	"	200	1 65	6	3	1	1	15 78
"	Scott's Potasso Phosphate	"	"	"	"	200	..	9	3	1	2	14 00
"	Scott's High Grade Acid Phosphate..	"	"	"	"	200	...	10	3	1	.	13 00
Oct. 3	Stern's Amo. Raw Bone Super. Phosphate.	Stand. Guano and Chem. Mfg. Co.	NewOrleans, La	Stand. Guano and Chem. Mfg. Co.	NewOrleans, La	100-200	1.75	6	2	.	2	16 13
"	Standard Amo. Sol. Guano	"	"	"	"	100-200	1 75	7	1	..	2	16 13
"	Champion Farmers Choice	"	"	"	"	100-200	1.75	7	1	.	2	16 13
"	Ground Bone...........	"	"	"	"	100-200	3.25	..		21	....	11 38
"	Dissolved Bone..........	"	"	"	"	100-200	..	15	1		..	16 00
"	Acid Phosphate.........	"	"	"	"	100-200		15	1		.	16 00
"	Kainit.................	"	"	Imported from	Germany..... ..	100-200	..	.			12	12 00
"	Fruit Tree Fertilizer	"	"	Stand Guano and Chem. Mfg. Co.	NewOrleans, La	100-200	3.25		..	19	4	15 38
"	Vegetable Fertilizer	"	"	"	"	100-200	3 25	4	2		5	22 38
Oct. 5	Stono Soluble Guano.. ..	Stono Phos. Works	Charleston, S. C.	Stono Phos. Works	Charleston, S. C.	200	2	6	2	2	1	16 00
"	Stono Acid Phosphate ..	"	"	"	"	200	.	8	2	2	1	11 00
"	Stono Dissolved Bone ..	"	"	"	"	200	.	10	2	2	..	12 00
"	Kainit..	"	"	Imported from	Germany	200	....	...	..	.	11	11 00
Dec. 22	Stono Complete Fertilizer	"	"	Stono Phos. Works	Charleston, S. C	200	1.65	6	2	2	1	14 78
Oct. 21	Our Own.	Savan'h Guano Co.	Savannah, Ga	Savan'h Guano Co.	Savannah, Ga..	200	1.65	5	3	1	1	14 78

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		Name.	Address.				Nitrogen.	Phospho. Acid Water Soluble.	Phospho. Acid Citrate Soluble.	Phospho. Acid Acid Soluble.	Potash.	
1892												
Oct. 21	Excelsior	Savannah G. Co	Savannah, Ga .	Sanvannah G. Co.	Savannah, Ga..	200	1.65	5	3	1	1	$14 78
" 21	Diamond Cotton Food....	" "	" " .	" "	" "	200	1 65	5	3	1	1	14 78
21	Alliance Standard	" " ..	" " .	" "	" "	200	1.65	5	3	1	1	14 78
" 21	Standard Bone Guano ..	" "	" " .	" "	" "	200	.82½	7	3	1	1	13 89
" 21	Dis. Bone Acid Phospate..	" " ...	" " .	" "	" "	200	..	8	4	1	..	12 00
21	Eng'h Dis. Bone Acid Phos	" "	" " .	" "	" "	200	.....	8	4	1	..	12 00
" 21	Acid Phosphate with Pot	" " ..	" " ..	" "	" "	200	....	7	4	1	1	12 00
" 21	German Kainit	" " ..	" " .	Imported from	Germany.	200	....	....	...	..	12	12 00
" 21	XX Dis. Bone Acid Phos.	" " ...	" " .	Savannah G. Co..	Savannah, Ga..	200	....	9	5	1	....	14 00
" 21	X X X X Dis. Bone Acid Phosphate	" " ...	" " .	" " .	" "	200	....	11	5	1	...	16 00
Dec. 12	Eng. Dis. Bone Acid Phos.	" " ...	" "	" " ..	" "	200	....	9	4	1	...	13 00
" 12	Dissolved Bone Acid Phos.	" " ..	" " ..	" " ..	" "	200	....	9	4	1	....	13 00
" 12	XX Acid Phosphate	" " ...	" " ..	" " ..	" "	200	....	10	5	1	....	15 00

" 12	XXXX Acid Phosphate..	" " ...	" "	" " ..	" "	200	.....	12	5	1	....	17 00
" 15	Our Own......	" " ...	" " ..	" " ..	" "	200	1.65	6	3	1	1.25	16 03
" 15	Excelsior.	" " ..	" " .	" " ..	" "	200	1 65	6	3	1	1.25	16 03
" 15	Dimond Cotton Food....	" "	" " .	" " ..	" "	200	1.65	6	3	1	1.25	16 03
" 15	Alliance Standard	" " ...	" " .	" " ..	" "	200	1 65	6	3	1	1.25	16 03
Nov. 28	Old Dominion Guano. .	Southern Phos. Co	Atlanta, Ga....	Southern Phos. Co	Atlanta, Ga ..	200	2	7	1 50	2	1.50	17 00
" 28	Southern A. D. Bone.	" "	" ...	"	" "	200	2	7	1	2	1.50	16 50
" 28	Patent Pacific	" "	" ...	"	" " . .	200	2	7	1	2	1.50	16 50
" 28	Etowah Superphosphate	" "	" ...	"	" "	200	0.85	8	2	2	1	13 98
" 28	Southern Acid Phosphate.	" "	" ...	"	" " ..	200	....	10	2	2	...	12 00
1893 Feb. 13	Complete Fertilizer.	Scholze Bros....	Chattanooga, T'n	Scholze Bros....	Chattano'ga, T'n	250	1.70	7	3	1	1.50	17 45
" 24	Baltimore Dissolved Bone.	Slingluff & Co ..	Baltimore, Md.	Slingluff & Co....	Baltimore, Md..	200	1	8	2	1	1	14 50
1892 Oct. 21	Tinsley Standard Fert	Tinsley Fert. Co..	Selma, Ala....	Tinsley Fert. Co..	Selma, Ala....	200	2	8	1	2	1.50	17 50
" 21	Tinsley Stand. Acid Phos	" " .	" ...	"	" ...	200	....	11	3	2	..	14 00
" 25	Troy Perfect Fertilizer ..	Troy Fert. Co....	Troy, Ala.	Troy Fert. Co....	Troy, Ala	200	1 75	7	1	..	1	15 12
" 25	Farmers' Alliance Guano	" " ...	"	"	"	200	1.75	7	1	..	1	15 12
" 25	Dixie Soluble Guano	" " ...	"	"	"	200	1.75	7	1	...	1	15 12
" 25	Troy Acid Phosphate....	" " ...	"	"	"	200	...	10	2	..	...	12 00
" 25	Florida Acid Phosphate...	" "	"	"	"	200	.....	10	1	...	..	11 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical.	By Whom Reported. Name.	By Whom Reported. Address.	By Whom Manufactured	Where Manufactured	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phospho. Acid Water Soluble.	Phospho. Acid Citrate Soluble.	Phospho. Acid Acid Soluble.	Potash.	Relative Commercial value.
1893.												
Jan. 2	Tuscaloosa Guano ..	Tuscaloosa Cotton Seed Oil Co	Tuscaloosa, Ala.	Tuscaloosa Cotton Seed Oil Co ..	Tuscaloosa, Ala.	200	2	8	1	1	1	17 00
"	Tuscaloosa Acid Phos. .	"	"	Meridian Fer. Wks	Meridian, Miss.	200	....	14	1	1	..	15 00
"	German Kainit.....	"	"	Imptd. by Stand. Guano Co.....	NewOrleans, La.	200	...	..	...		12	12 00
1892. Dec. 14	Plow Brand Raw Bone Super. Phosphate.....	Walton&WhannCo	Charleston, S. C	Walton&WhannCo	Charleston, S. C.	200	1 75	6	2	2	1.25	15 38
"	Reliance Amo. Super Phos.	"	"	"	"	200	1.25	5	2	1	.75	12 13
"	W. & W. Co.'s Amo. Dis. Bone............	"	"	"	"	200	87½	7	2	1	1	13 21
"	Diamond Soluble Bone..	"	"	"	"	200	....	10	1	1	.	11 00
"	XX Acid Phosphate	"	"	"	"	200	.....	10	1	1	....	11 00
Oct. 12	Walton Guano ...	Walton Guano Co.	Social Circle, Ga.	Walton Guano Co.	Social Circle, Ga	200	2	7	2	2	1	17 00
"	Walton Acid Phosphate	"	"	"	"	200	....	10	3	2	..	13 00
Dec. 31	Americus Amo. Bone Super Phosphate	Williams & Clark Fertilizer Co	New York, N. Y	Williams & Clark Fertilizer Co...	New York N. Y	200	1.65	6	2	2	1	14 77
Oct. 29	Wando Soluble Guano ..	Wando Phos. Co..	Charleston, S.C.	Wando Phos. Co..	Charleston, S. C	200	1.65	6.50	2	2	1	15 28
"	Wando Amo. Dis, Bone..	"	"	"	"	200	.75	7	3	2	1	13 63

Oct. 29	Wando Acid Phosphate ..	Wando Phos. Co..	Charleston, S. C	Wando Phos. Co..	Charleston, S. C	200	....	10	1	.50	...	11 00
" 29	Wando Acid Phos. No. 2..	" " ..	" "	" " .	" "	200	..	9	1	1	1	11 00
" 29	Wando Dissolved Bone ..	" " .	" "	" " ..	" "	200	.	10	1	.50	.	11 00
1893 Jan. 26	Zell Amo. Bone Super ..	Zell Guano Co ..	Zell Guano Co	Zell Guano Co ..	Baltimore, Md	200	1 87½	6	3	....	1 25	17 56
" 26	Zell Economizer	" "	" "	" "	" "	200	1 87½	6	3		1 25	17 56

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 a 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 Commissioner.*—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 statement 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 ingredients which the fertilizer may contain, which, as well as the preceding, shall be embraced in the guarantee.

SEC. 143. *Fertilizers or 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 specially 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 Commisioner 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 the State, on the trial of any issue involving the merits of such fertilizer or chemical.

*This section is amended by the following:

No. 388.] AN ACT [H. B. 506.

To amend Section 7 of an act entitled an act to establish a department of agriculture for the State of Alabama, approved February 23, 1883.

SECTION 1. *Be it enacted by the General Assembly of Alabama,* That section 7 of an act entitled an act to establish a department of agriculture for the State of Alabama, approved February 23, 1883, be, and the same is hereby amended so as to read as follows: Section 7. Be it further enacted, That it shall be the duty of the auditor to have printed tags of suitable material, with proper fastenings for attaching the same to packages, bags or barrels of fertilizers, and there shall be printed thereon the word "Guaranteed," with the year or season in which they are to be used, which said tags must be signed by the auditor and furnished by him to the commissioner of agriculture, on the commissioner's requisition, to be accounted for by the commissioner in monthly settlements. Said tags shall be furnished to any dealer in or manufacturer of commercial fertilizers who shall have complied with section 142 of the code of Alabama of 1886, upon payment by such dealers or manufacturers to the said commissioner of the sum of twenty-five cents for a sufficient number thereof to tag a ton of such commercial fertilizers. All tags remaining in the hands of the commissioner at the end of the year shall be destroyed in the presence of the governor, secretary of State and attorney-general, and the certificate of these officials shall be the auditor's authority for giving the commissioner credit therefor.

SEC. 2. *Be it further enacted,* That the price of tags as fixed at the sum of twenty-five cents in section 1 of this act shall not take effect until October 1, 1893.

SEC. 3. *Be it further enacted,* That all laws and parts of laws in conflict with the provisions of this act are hereby repealed.

Approved February 21, 1893.

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 tags 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 fertilizer 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 fertilizer.*—Any person who commits a fraud in the manufacture, sale or exchange of any fertilizer, or of any of the ingredients of a fertilizer, must, on conviction, be fined not less than one hundred dollars for each offense.

LICENSES.

The following is a list of all the licenses issued this season to August 1st, with the date when issued, number of license, post-offices, and the counties of the local dealers.

Date.	NAME.	ADDRESS.	COUNTY.	Number.
1892				
Oct. 7	Ashepoo Phosphate Co.......	Charleston, S. C..	....	549
Oct. 8	Angier, Clarence.............	Atlanta, Ga......	....	556
Oct. 10	Atlanta Guano Co	"	....	558
Oct. 10	Americus Guano Co	Americus, Ga ...	....	559
Oct. 14	Adair, A. D. & McCarty Bros	Atlanta, Ga	....	562
Oct. 17	Atlantic Phosphate Co........	Charleston, S C	....	566
Dec. 8	Albany Ft. and Farm Imp. Co	Albany, Ga......	....	618
Dec. 8	Allen, Sellers & Co...........	Montgomery, Ala	Montgomery..	620
Dec. 9	Alabama Fertilizer Co	" "	"	621
1893				
Jan. 2	Andrews & Martin	Clayton, "	Barbour......	661
Jan. 7	Akin, J. C. & Son	Notasulga, "	Macon	680
Jan. 11	Allen, D. G. & Bro	La Fayette, "	Chambers ...	714
Jan. 11	Andrews, W. T.............	Gold Hill, "	Lee..	716
Jan. 12	Agee, W. P	Perdue Hill, "	Monroe	726
Jan. 14	Arnold, F. M....	Six Mile, "	Bibb.	739
Jan. 16	Allen, R. W. & Co	La Fayette, "	Chambers....	748
Jan. 18	Allen, Joel L	Opelika, "	Lee.........	761
Jan. 27	Ashhurst & DeLoach	Tallassee, "	Elmore	821
Feb. 8	Adams & Pearson	Alexand'r City, "	Tallapoosa ...	905
Feb. 9	Atkins, Owens & Co...... ...	Heflin, "	Cleburne.....	917
Feb. 13	Acre, O. A. C	Newton, "	Dale	939
Feb. 18	Akin, A. L	Thornton, "	Tallapoosa ...	967
Feb. 28	Appling, I. W............	Day's Gap, "	Walker.	1019
Mar. 20	Avant, T. F. and Adcock, W. M	Church Hill, "	Tallapoosa ...	1064
Mar. 28	Anderson, J. L..............	Creswell Sta , "	Shelby.......	1076
1892				
Oct. 6	Berkley Phosphate Co	Charleston, S. C..	....	546
Nov. 12	Bowker Fertilizer Co.........	Savannah, Ga.....	....	578
Nov. 14	Boykin, Carmer & Co	Baltimore, Md....	....	579
Nov. 19	Betts, W. H	Burnt Corn, Ala..	Monroe	586
Nov. 26	Bradley Fertilizer Co	Augusta, Ga	....	589
Dec. 2	" " "	Boston, Mass.. ..	....	607
Dec. 5	Baldwin Fertilizer Co	Savannah, Ga....	....	615
Dec. 24	Brown, David	Albany, Ga......	....	645
Dec. 27	Brake, J. Logan..	Warrior, Ala.	Jefferson.....	647
Dec. 30	Brantley, T. K. & Son	Troy, "	Pike..........	655
Dec. 30	Brantley, T. K. & Son	Brantley, "	Pike.	656
1893				
Jan. 4	Brannen, C. L. & Son	Troy, "	Pike..........	668
Jan. 7	Beeland, J. T. & Bro	Greenville, "	Butler	681
Jan. 7	Beard, J. M	Brantley, "	Pike........ ..	682
Jan. 7	Brantley & Edmonson	Troy, "	Pike..........	683
Jan. 10	Buall, J. W..................	Luverne, "	Crenshaw....	698
Jan. 10	Byers & Robinson...........	Ashville, "	St. Clair.	705

LICENSES—Continued.

Date.		Name.	Address.		County.	Number.
1892						
Jan.	13	Beach, H. M. & Son..........	Columbia,	Ala.	Henry	729
	14	Brown, J. L.......	Five Points,	"	Chambers...	740
	17	Blount, Nicholson & Co	Dothan,	"	Henry	751
	20	Brice, Donehoo & Co	Oneonta,	"	Blount	778
	27	Burns & Wilson.............	Lincoln,	"	Talladega ...	814
	27	Bradley, W. E...............	Abbeville,	"	Henry	818
Feb.	1	Bledsoe, J. W..............	Three Notch,	"	Bullock	845
	2	Burgess, J. A................	Edwardsville,	"	Cleburne	852
	3	Bellenger Bros..	Gadsden,	"	Etowah	864
	6	Brown, Robert B. Oil Co	St. Louis, Mo.	.	... .	881
	7	Burnett, W. A.............. .	Castleberry,	Ala.	Conecuh.....	892
	7	Beard, W. F.................	Troy,	"	Pike.........	894
	7	Burgess, J. L........... ...	Scottsboro,	"	Jackson	897
	8	Brock, F. P..................	LaFayette,	"	Chambers....	901
1893						
Feb.	9	Bartlett, W. H.	Boaz,	"	Marshall....	913
	10	Ballard, Joshua.	Omaha,	"	Randolph	919
	13	Bullington & Co..	Farill,	"	Cherokee. ...	935
	13	Bosworth, Smith & Co	LaFayette,	"	Chambers....	937
	17	Braswell, M. L.	Pleasant Gap,	"	Cherokee....	960
	20	Burnett Bros	Cedar Bluff,	"	Cherokee.....	980
	24	Banks & Owen..............	Hurtsboro,	"	Russell.	995
	25	Bowman, J. J	Heflin,	"	Cleburne.....	1007
	25	Brown, J. A. & Co	Kellyton,	"	Coosa	1009
March	3	Baker, D. W................	Hackneyville,	"	Tallapoosa ...	1029
	4	Burt, R. A	Brandon,	"	DeKalb	1034
	13	Bass, J W., Sr.	Leeds,	"	Jefferson.....	1051
	2	Brown, W. S.	Birmingham,	"	Jefferson.....	1067
	2	Beddingfield, W. T.........	Roperton, Tenn...		.. ..	1072
	29	Bowden, Samuel............	Gordon,	Ala.	Henry	1077
May	4	Baldwin, W. E.	Flint,	"	Morgan	1101
Oct.6,'92		Coweta Fertilizer Co	Newnan, Ga......		....	544
	7	Commercial Guano Co........	Savannah, Ga ..		....	448
	8	Comer, Hull & Co	" " ...		....	553
	11	Crocker Fert. & Chem Co. ..	Buffalo, N. Y ...		....	561
Nov.	26	Cumberland Bone & Phos. Co	Augusta, Ga		....	591
	28	Cincinnati Dessicating Co....	Cincinnati, O....		....	595
	30	Carroll & Murphree.	Troy, Ala.		Pike	599
Dec.	2	Chicora Fertilizer Co.. .	Charleston, S. C.		....	602
	2	Cumberland Bone & Phos. Co.	Boston, Mass.....		. ...	608
	5	Carroll, Major............	Ozark,	Ala.	Dale	611
	8	Comer, William M	Williams' Sta.,	"	Escambia	619
	14	Cody & Newton.	Dothan,	"	Henry........	627
	17	Columbus Fertilizer Co......	Columbus, Ga...		....	630
1893						
Jan.	6	Cosper, Glover & Co.........	Sterrett, Ala ..		Shelby......	677
	7	Crawley & Rouse...	Wetumpka, Ala..		Elmore.	679
	9	Chesapeake Guano Co........	Baltimore, Md....		. .....	696
	10	Cherry, Thomas & Co........	Gold Hill,	Ala.	Lee.....	703
	11	Cordman, F. M...............	Clio,	"	Barbour. .. .	717
	12	Cook, R E. & Co.............	Howard,	"	Henry........	718
	12	Connor, M.	Troy,	"	Pike.........	721
	12	Copeland, J. S..............	Troy,	"	Pike..	723
	12	Chadwick & Brice...........	Snead,	"	Blount..	725
	17	Carpenter, W. O.............	Owens' X R'ds,	"	Madison	754

LICENSES—Continued.

DATE.		NAME.	ADDRESS.	COUNTY.	Number.
1893					
Jan.	19	Crew, Drummon & Co.......	Goodwater, Ala.	Coosa	768
	19	Carlisle, M. W. & Bro........	Roanoke, "	Randolph....	771
	19	Crawford, J. W. & Co........	Abbeville, "	Henry	774
	23	Cherry & Smith.............	Opelika, "	Lee	796
	24	Cleveland, M. L	Randolph, "	Bibb.	800
	25	Cox, L. O	Boaz, "	Marshall.....	803
	27	Cooper, O. W. & Co..........	Oxford, "	Calhoun.	820
	31	Culbreth & Norris............	Columbia, "	Henry	840
	31	Cumpe & Davis...............	Sand Mountain, "	DeKalb ...	843
Feb.	2	Clements, W. N..............	Fort Deposit, "	Lowndes.....	860
	3	Cumbee, J. & Sons...........	Strouds, "	Chambers....	873
	6	Caps, M. V.................	Abbeville, "	Henry	891
	7	Cross & Denson.............	Pelham, "	Shelby.......	893
	8	Crim Brothers	Newton, "	Dale.	904
	10	Clark, W. T. & Co............	Spring Garden, "	Cherokee.....	922
	10	Culver, T. U.................	Inverness, "	Bullock	926
	20	Cameron, J. E. & A. M.......	Notasulga, "	Macon.	971
	24	Chisholm, Wm.	Maple Grove, "	Cherokee	994
Mar.	2	Cooke, J. E	Marietta, "	Walker	1028
	9	Caston Bros	Luverne, "	Crenshaw....	1045
	13	Cox Bros. & Co	Ashville, "	St. Clair....	1052
	20	Chumley, J. P...............	Marcus, "	DeKalb	1066
	25	Cox, G. L	Attalla, "	Etowah	1073
April	4	Crew, Drummon & Co........	Goodwater, "	Coosa	1081
1892					
Dec.	2	Dowling, Jno. W.............	Ozark, "	Dale.	605
	14	Davis, Jno. H	Athens, "	Limestone ...	626
	17	Davis, Marshall & Co........	Mobile, "	Mobile.	631
	28	Davis, W. F.................	Marion, "	Perry	650
1893					
Jan.	5	Dunklin, D. G. & Sons.......	Greenville, "	Butler	669
	9	Dean, Jas. J	Charlton, "	Dale.	693
	23	Dumas, J. T. & Co	Arlington, "	Wilcox.	797
	26	Dennis, P. C................	Coopers, "	Chilton	806
Feb.	1	Dodson, W R	North Port, "	Tuscaloosa...	847
	6	Douglass, F. M..............	Alexander City, "	Tallapoosa..	885
	8	Daniel, J. G. & Co...........	Greenville, "	Butler	903
	8	Donaldson, J. G	Haylesville, "	Winston	910
	11	Dickinson, W. W.	Hurtsboro, "	Russell ...	929
	11	Davenport, N. S. & Co	Valley Head, "	DeKalb ...	930
	15	Dukes & Ward	LaFayette, "	Chambers...	950
	16	Davis, E. R......	Rock Run Sta., "	Cherokee. ..	957
	24	Dawson, W. P. & Son	Ware, "	Elmore ...	992
	25	Dean, W. R	Warrior, "	Jefferson. ..	1012
April	29	Dobbs, S. H	Blanche, "	Cherokee	1099
1892					
Oct.	6	Edisto Phosphate Co	Charleston, S. C..	...	547
Oct.	8	Earle, P. H. & Co	Birmingham, Ala.	Jefferson. ...	552
Nov.	28	Emmons, J. D...............	Williams' Sta., "	Escambia ...	594
Dec.	3	Ellis, Charles	Savannah, Ga ..	....	610
	12	East Alabama Fertilizer Co...	Clayton, Ala. .	Barbour.. ...	624
	14	Etiwan Phosphate Co........	Charleston, S. C.	....	625
1893					
Jan.	2	Evans, H. H. & Co...........	Greensboro, Ala.	Hale	663
	9	Eufaula Oil and Fertilizer Co..	Eufaula, "	Barbour......	695

LICENSES—Continted.

Date.	Name.	Address.	County.	Number.
1893				
Jan. 19	Ester, Thomas J	Day's Gap, Ala.	Walker	769
23	Emmett, L. S	Albertville, "	Marshall	794
28	Elliott, J. A. & Son.	Charthage, "	Hale	827
Feb. 7	Edmonson, R. Q. & Bro	Eufaula, "	Barbour	895
11	Espy, J. R	Gordon, "	Henry	932
Mar. 1	Ethridge, W. B.	Peach Bloom, "	Conecuh	1022
16	Eubanks & Clarke	Piedmont, "	Calhoun	1058
20	Englebert, F. R	Athens, "	Limestone	1063
May 2	Evans, D. H	Hillian's Store, "	Marshall	1100
1892				
Oct. 17	Furman Farm Imp. Co	Atlanta, Ga.		568
Nov. 29	Farley, John C	Opelika, Ala	Lee	597
Dec. 5	Folmar & Sons	Troy, "	Pike	616
1893				
Jan. 5	Folmar, J. & Sons	Luverne, "	Crenshaw	670
6	Faust, J. M	Warrior, "	Jefferson	676
10	Findlay, W. A	Pollard, "	Escambia	706
14	Forrester, B. A	Cowarts, "	Henry	737
19	Fielder, J. B	Loachapoka, "	Lee	773
26	Frohoff, Frank	Hanceville, "	Blount	810
Feb. 6	French, B. D	Sylacauga, "	Talladega	884
8	Finch, L	Evergreen, "	Conecuh	907
15	Formby & Stewart	Spring Garden, "	Cherokee	948
24	Flournoy, W. B	Louisville, "	Barbour	996
April 6	Fields, A. S	Fernbank, "	Lamar	1083
1892				
Oct. 3	Goulding Fertilizer Co	Pensacola, Fla		539
15	Georgia Chemical Works	Augusta, Ga		564
26	Golden Rod Guano Co	Ozark, Ala.	Dale	571
Dec. 2	Garner, William	Ozark, "	Dale	603
1893				
Jan. 7	Green, James R	Waverly, "	Lee	685
21	Griffith, Asa	Hanceville, "	Blount	792
24	Graves, T. P	Eufaula, "	Barbour	899
3	Gilder, G. C	Shady Grove, "	Pike	838
31	Griffith, J. J. & Bro	Hanceville, "	Blount	842
Feb. 1	Guin, J. C	Kennedy, "	Lamar	849
2	Gilbert, R. F	Portersville, "	DeKalb	857
8	Gilder, G. C	Mt. Meigs, "	Montgomery	902
10	Greil Bros. & Co	Montgomery, "	Montgomery	918
14	Gray, William	Dadeville, "	Tallapoosa	944
15	Guest, S. W	Seaborn, "	Etowah	946
15	Gullatte, W. B	Auburn, "	Lee	952
16	Gulledge, F. A	Verbena, "	Chilton	954
20	Gray, Draper & Co	Oxford, "	Calhoun	978
25	Grubbs, Jno. T	Laneville, "	Hale	1002
25	Garner, R. H. & Bro	Oxford, "	Calhoun	1006
Mar. 4	Green, W. B	Merrellton, "	Calhoun	1033
6	Gravlee, W. F. & Co	Jasper, "	Walker	1039
11	Gilbert, John R	Pinckneyville, "	Clay	1048
13	Gilbreath, Emmitt	Guntersville, "	Marshall	1050
16	Galloway, Thomas C	Crudup, "	Etowah	1059
22	Gilliland, M. E	Hill, "	Etowah	1659
23	Goddard, H. O	Clarence, "	Blount	1070
30	Goggans, E. L	Alexander City, "	Tallapoosa	1078

LICENSES--Continued.

Date.	Name.	Address.	County.	Number.
1892				
Nov. 6	Haywood, T. E	Branchville, Ala.	St. Clair	576
Nov. 17	Hudmon Brothers	Opelika, "	Lee	581
Nov. 18	Hodo, A. P	Carrollton, "	Pickens	582
30	Hurt, W. D	Opelika, "	Lee	598
Dec. 1	Henderson & Murphee	Ozark, "	Dale	601
3	Hooper, C. W. & Co	Selma, "	Dallas	609
5	Henderson, J. C	Troy, "	Pike	612
5	Henderson, Fox	Troy, "	Pike	613
5	Henderson & Rainer	Troy, "	Pike	614
7	Hooten & Co	Columbia, "	Henry	617
9	Hanley & Co	Lawrenceville "	Henry	623
20	Harwell & Co	Opelika, "	Lee	634
22	Herring, B. W	Headland, "	Henry	638
22	Hughes, J. E	Floralla, "	Bullock	640
27	Halley, F. M	Lawrenceville "	Henry	646
1893				
Jan. 5	Henderson, W. D. & Chas	Troy, "	Pike	672
5	Henderson, J. M. & Co	Troy, "	Pike	673
6	Hood, W. T	Oneonta, "	Blount	675
7	Hobbie & Teague	Montgomery "	Montgomery	678
7	Haynes, D. P. & Co	Oxford, "	Calhoun	687
11	Humphrey, T. J	Cullman, "	Cullman	708
11	Hunt, L. A. & Co	Clio, "	Barbour	712
12	Henderson, L	Troy, "	Pike	722
13	Hixon, S. D	Perote, "	Bullock	730
14	Hurst & Son	Pratts, "	Barbour	735
14	Hamil Brothers	Troy, "	Pike	736
17	Hardwick, J. M	Notasulga, "	Macon	752
17	Hicks, Lee & Co	Camp Hill, "	Tallapoosa	655
19	Harrell, W. F	Blount Springs "	Blount	767
19	Hill, Jones & Co	Roanoke, "	Randolph	770
20	Hayne, W. H	Loachapoka, "	Lee	776
20	Hudson, H E	Monroeville "	Monroe	781
21	Hutchinson, J. M	Salem, "	Lee	788
23	Hertzler & Anderson	Madison Sta. "	Madison	798
26	Hirsch Brothers	Seale, "	Russell	809
26	Hoffman, Walter P	Waverly, "	Lee	811
27	Hixon, J. F., Jr	Josie, "	Pike	816
27	Howle Brothers	Edwardsville, "	Cleburne	819
28	Hoffman, Paul	Waverly, "	Lee	826
30	Hurt & Greer	Edwardsville, "	Cleburne	830
30	Hicks, W. W. & Co	Dadeville, "	Tallapoosa	832
30	Head, T. L	China Grove, "	Pike	834
Feb. 2	Hayes, J. H	Roxana, "	Lee	856
3	Hartselle Bros. Co	Hartselle, "	Morgan	861
4	Holifield, J. A	Auburn, "	Lee	874
8	Hixon Brothers	Claiborne, "	Monroe	906
9	Henderson, T. J	Mountain Creek "	Chilton	911
13	Henry, Sam & Co	Gadsden, "	Etowah	940
15	Hooper, Jno. F	New Site, "	Tallapoosa	945
16	Hooper, C. S	Blount Springs "	Blount	959
20	Hanserd, M. H	Munford, "	Talladega	970
20	Henry, A. G., Jr	Guntersville, "	Marshall	972
23	Humphreys, L. C	Oxford, "	Calhoun	988
23	Henry, J. L. & Co	Seale, "	Russell	990

LICENSES—Continued.

DATE.		NAME.	ADDRESS.		COUNTY.	Number.
1893						
Feb.	25	Henderson Bros	Fullerton,	Ala.	Cherokee	1001
	27	Houston, J. M	Town Creek,	"	Lawrence	1016
	28	Harrison, J. D	Grafton,	"	Henry	1018
Mar.	3	Hopkins Bros	Bessemer,	"	Jefferson	1030
	10	Hughes, R. F	Piedmont,	"	Calhoun	1046
	11	Hood, David	Clarence,	"	Blount	1047
	25	Hale, J. R. & Bro	Hale,	"	Etowah	1074
April	13	Hudmon Bros	Opelika,	"	Lee	1089
May	4	Hamilton Bros	LaPlace,	"	Macon	1102
	4	Harris, J. D	Tallassee,	"	Elmore	1103
1892						
Oct.	8	Imperial Fertilizer Co	Charleston, S. C.			554
1893						
Jan.	30	Ivey, J. W	Petrey,	Ala.	Crenshaw	836
1892						
Oct.	18	Jernigan & Lipscomb	Opelika,	"	Lee	569
Dec.	22	Johnson, J. J	Geneva,	"	Geneva	639
	31	Jones, V. D	Troy,	"	Pike	658
1893						
Jan.	9	James, P. P	Jamesville,	"	Bibb	688
	13	Jones & Co	Newton,	"	Dale	728
	23	Jordan, H. R. & Son	Collinsville,	"	DeKalb	793
Feb.	7	Jennings, Ben	Seale,	"	Russell	896
	11	Jordan, Manning & Co	Guntersville,	"	Marshall	931
May	18	Johnston, J. G	Tarentum,	"	Pike	1105
1892						
Dec.	2	Kennesaw Guano Co	Atlanta, Ga			604
	21	King, Claude	Leighton,	Ala.	Colbert	637
1893						
Jan.	14	Kirkland, Levi	Cowarts,	"	Henry	738
	18	Kinney, F. H. & P. H	Cullman,	"	Cullman	766
	28	Kyser, J. K	Burnt Corn,	"	Monroe	828
	30	Kennon & Bro	Salem,	"	Lee	831
Feb.	3	Kelley, G. W	Midland City,	"	Dale	866
	4	Kyser, G. W	Burnt Corn,	"	Monroe	879
	9	Koopman & Gerdes	Cullman,	"	Cullman	912
	11	Kingoy, Chas. C	Gordon,	"	Henry	925
	21	Kaylor & Walker	Graham,	"	Randolph	983
	25	Kitchens Bros	Heflin,	"	Cleburne	1008
	27	Killian, W. E	Brandon,	"	DeKalb	1014
	28	Kroll, Geo	Montevallo,	"	Shelby	1021
Mar.	4	Killian, G. W	Portersville,	"	DeKalb	1036
	13	Kelley, D. E. & J. O	Jeff,	"	Madison	1053
April	8	Keener, J. P	Keener,	"	Etowah	1086
	12	Kennedy & Bullin	Taff,	"	Cherokee	1089
1892						
Nov.	21	Lister's Agr. and Chem. Works	Newark, N. J.			588
Dec.	19	Lazenby, Reynolds & Co	Forest Home,	Ala.	Butler	633
1893						
Jan.	13	Leeth Bros	Cullman,	"	Cullman	732
	18	Lancaster, W. L. & Co	Wetumpka,	"	Elmore	764
	21	Lauderdale & Crew	Goodwater,	"	Coosa	790
Feb.	3	Little, C. E	Auburn,	"	Lee	868
	4	Lewis, D. L. & J. A	Sycamore,	"	Talladega	876
	6	Lemle, L	Montgomery,	"	Montgomery	880

LICENSES—Continued.

Date.		Name.	Address.		County.	Number.
1893						
Feb.	9	Landers Bros	Heflin,	Ala.	Cleburne	915
	10	Lowery, R. F.	Perdue Hill,	"	Monroe	921
	18	Lemay, S. I	Hartselle,	"	Morgan	936
	20	Latham, S. A.	Montevallo,	"	Shelby	976
	21	Lester, Mason & Co.	Columbiana,	"	Shelby	984
	25	Lee, Alonzo J	Deadem,	"	Conecuh	1004
	25	Lane & Hobson.	Sylacauga,	"	Talladega	1010
	25	Land & Akin	Camp Hill,	"	Tallapoosa	1013
March	1	Lackey, G. W	Boaz,	"	Marshall	1026
	13	Lemle, I.	Montgomery,	"	Montgomery	1049
	16	Lloyd, Ellison & Co.	Creek Stand,	"	Macon	1057
	22	Lee, Robert A. & Co.	Greenville,	"	Butler	1068
April	25	Lamar, L. & E.	Selma,	"	Dallas	1094
Oct.	8 '92	Marietta Guano Co.	Atlanta, Ga.			557
	26	Montgomery Fertilizer Co	Montgomery,	Ala.	Montgomery	572
Nov.	3	Malone, Collins & Co.	Geneva,	"	Geneva	573
	18	Meridian Fertilizer Factory	Meridian, Miss.			585
	29	Mobile Phos. & Chem. Co.	Mobile,	Ala	Mobile	596
	30	Murphree, Joel D.	Troy,	"	Pike	600
Dec.	9	Marks & Gayle	Montgomery,	"	Montgomery	622
	27	Manley. Hanley & Co.	Roanoke,	"	Randolph	649
	30	Meadows, Smith T. & Co.	Opelika,	"	Lee	654
1893						
Jan.	10	Montgomery, H. B. T.	Opelika,	"	Lee	701
	12	Murphree, C.	Troy,	"	Pike	724
	16	Manasses, J	Clayton,	"	Barbour	742
	20	May. Jas. T	Montgomery,	"	Montgomery	775
	21	Mayfield, Pittman & Co.	Roanoke,	"	Randolph	787
	23	Mills, J B.	Shorterville,	"	Henry	795
	26	Milligan, W. G	Heflin,	"	Cleburne	813
	28	Minter & Mayberry	Waverly,	"	Lee	823
	30	Moreman, J. M.	Waverly,	"	Lee	833
	21	Morris, D. W. & Bro	Chepultepec,	"	Blount	841
Feb.	2	Martin, T. J	Harpersville,	"	Shelby	853
	2	Melton & Co.	Pine Apple,	"	Wilcox.	859
	3	Mississippi Cotton Oil Co.	Columbus,	"		871
	7	Mahon, W. H	Randolph,	"	Bibb	898
	10	Montgomery, W. B.	Lincoln,	"	Talladega	923
	13	Martin & Crocker	Gladstone,	"	Madison.	938
	16	Morgan, J. H. & Co.	Brantley,	"	Crenshaw	956
	20	Middlebrooks & Bro	Elamville,	"	Barbour	975
March	8	Marshall, J. Z	Irondale,	"	Jefferson	1043
	14	Martin, W. J	Abbeville,	"	Henry	1056
April	8	Mobile Grain & Fertilizer Co.	Mobile,	"	Mobile	1085
	15	Morgan & Perryman	Heflin,	"	Cleburne	1090
	27	Miles, T. B	Perote,	"	Bullock	1097
1892						
Oct.	5	McMillan & Harrison	Mobile,	"	Mobile	542
Dec.	22	McGriff & Oakley	Columbia,	"	Henry	641
1893						
Jan.	4	McMillan, J. B. & Co.	Talladega,	"	Talladega	664
	9	McDonald, F. C. & Co.	Luverne,	"	Crenshaw	697
	11	McGehee, Driver & Co.	LaFayette,	"	Chambers	711
	16	McMurray Bros.	Heflin,	"	Cleburne	744
	16	McGiffert, David	Knoxville,	"	Greene	746

LICENSES--Continued.

Date.		Name.	Address.		County.	Number.
1893						
Jan.	17	McElderv, G. T........ ...	Talladega,	Ala.	Talladega ...	753
	17	McEntire & Co	Hanceville,	"	Blount.......	757
	21	McNeil, J. W. & Bro	Patsburg,	"	Crenshaw...	784
	24	McKenzie & Rogers....	Goodwater,	"	Coosa........	801
	31	McKenzie, F. L	Tallassee,	"	Elmore	837
Feb.	2	McBroom, A. M.............	Portersville,	"	DeKalb......	858
	3	McGowan & Holmes	Cuba Station,	"	Sumter.	863
	9	McCleskey & Co	Boaz,	"	Marshall	914
	21	McElhaney, F. G	Auburn,	"	Lee	982
	24	McRea, J. L	Louisville,	"	Barbour......	997
Mar.	3	McLendon, J. C	Bell's Mills,	"	Cleburne. .	1032
	17	McCreary & Co...............	Turnbull,	"	Monroe	1060
	18	McCord, W. T	Albertsville,	"	Marshall.	1062
Apr.	27	McClung, J. A...............	Boats Bend,	"	Etowah..	1098
1892						
Dec.	27	Neece, M. B	Huntsville,	"	Madison	648
1893						
Jan.	2	Nichols & Vernon	Roanoke,	"	Randolph.. .	662
	10	National Fertilizer Co	Nashville, Tenn		....	704
	12	Noles & Tenant.............	Roanoke,	Ala	Randolph. ..	719
	18	Neighbors, T. L.............	Goodwater,	"	Coosa.	763
	25	Nettles, T. A............. ..	Kempville,	"	Monroe	805
	26	Nicholls & Casper	Childersburg,	"	Talladega.....	812
Feb.	8	Nordan, L. W....	Hardwicksb'rgh	"	Henry	908
	13	Nelson, T. M................	Walnut Grove,	"	Etowah	934
	17	National Acid Co...........	New Orleans,	La.	....	961
	18	Newman, Robert............	Abbeville,	Ala.	Henry.	968
	23	Norwood & Hattimer..... ..	Fort Deposit,	"	Lowndes.....	987
	23	Newton, C. A. & Son.........	Bellville,	"	Conecuh.	991
	24	Nixon, W. D.............. ..	Merrellton,	"	Calhoun	999
	25	Nawlin, J. R...............	Gadsden,	"	Etowah..	1005
1892						
Dec.	14	Ozley, J. W	Calera,	"	Shelby.......	628
	21	Ober, G. Sons & Co........	Baltimore, Md ..		....	636
1893						
Jan.	5	O'Neal, W. C	Dothen,	Ala	Henry........	671
	9	Orr, James.	Clayton	"	Barbour.	694
	10	Ogletree, & Jackson	Eastaboga,	"	Talladega....	699
	18	Oliver Brothers.............	Dadeville,	"	Tallapoosa....	762
Feb.	24	Ozbin, W. W...............	Hackleburgh,	"	Monroe	1000
Mch.	3	Oldfield, John M	Hazlegreen,	"	Madison.	1033
1892						
Oct.	15	Patapsco Guano Co.....	Augusta, Ga.. ..		....	565
Nov.	26	Pacific Guano Co.	"		....	590
Dec.	22	Pierce, J. & Co..............	Guin, Ala		Marion.	643
	29	Pacific Guano Co.	Boston, Mass. ...		....	651
1893						
Jan.	2	Ponder, B. F..............	Opelika,	Ala.	Lee	660
	9	Pope, J. F	Wilsonville,	"	Shelby	692
	10	Pinkerton, J. S....	Fail,	"	Choctaw	700
	11	Pickens, J. M..............	Cullman,	"	Cullman. ...	710
	17	Poiner Bros	Newton,	"	Dale.	749
	19	Peebles, W. E	Tallassee,	"	Elmore	772
	27	Polk, M. S	Alexander City,	"	Tallapoosa. ..	815
	28	Prescott & McMurray........	Wedowee,	"	Randolph....	825

LICENSES—Continued.

DATE.		NAME.	ADDRESS.		COUNTY.	Number.
1893						
Feb.	1	Payne, W. H.	Dadeville,	Ala.	Tallapoosa	851
	11	Pearson, Bloodworth & O'Neal	Dadeville,	"	Tallapoosa	927
	15	Perkins, W. W	Springville,	"	St. Clair	953
	17	Phillips, D. T	Elkmont,	"	Limestone	964
	20	Pridgen, J. M	Key,	"	Cherokee	979
	25	Preer, T. C	Opelika,	"	Lee	1011
Mar.	2	Palmer, Hawkins & Stevens	Midland City,	"	Dale	1027
	13	Penny & Hamilton	Hokes' Bluff,	"	Etowah	1054
	20	Prim & Kimball	Jackson,	"	Clarke	1065
	31	Phillips Bros	Gadsden,	"	Etowah	1080
April	5	Payne, J. M	New Market,	"	Madison	1082
	21	Palmer, J. W	Remlap,	"	Blount	1091
	21	Phillips, G. W	Wynneville,	"	Blount	1092
1892						
Oct.	3	Royal Fertilizer Co	Charleston, S. C			540
	7	Russell, M. T. & Co	Grand Bay, Ala		Mobile	550
	8	Reese, Jno. S. & Co	Baltimore,	Md		555
	15	Rosin Fertilizer Co.	Baltimore,	"		563
Nov.	19	Read Fertilizer Co	Charleston, S. C.			587
Dec.	19	Ramer Brothers	Troy,	Ala	Pike	632
	31	Robertson, Frederich & Co.	Opelika,	"	Lee	659
1893						
Jan.	5	Ross, M. J.	Troy,	"	Pike	674
	12	Rainer, F. P. & Bro	Brundidge,	"	Pike	720
	18	Roberts, Geo. W	Collinsville,	"	DeKalb	759
	20	Robinson, B. F.	Jemison,	"	Chilton	777
	20	Riley, T. M.	Riley,	"	Monroe	783
	28	Roberson & Jones	Cropwell,	"	St. Clair	829
Feb.	3	Ray & Robertson	Wilsonville,	"	Shelby	862
	3	Russell, R. A. & Co	Gaylesville,	"	Cherokee	869
	3	Russell, O. L. & Co.	Gaylesville,	"	Cherokee	870
	4	Raspberry, B. T	Strasburg,	"	Chilton	877
	11	Rice, Carter H	New Market,	"	Madison	928
	20	Reynolds, H. C. & W. B.	Montevallo,	"	Shelby	973
	21	Ray, M. F. & Bro	Goodwater,	"	Coosa	985
Mar.	18	Robertson, F. M	Fayette C. H.,	"	Fayette	1061
April	21	Ray, Asa.	Albertsville,	"	Marshall	1093
	27	Rumph, C. W	Perote,	"	Bullock	1096
1892						
Oct.	5	Stono Phosphate Works	Charleston, S. C.			541
	7	Scott Geo. W. Mfg. Co.	Atlanta, Ga			551
Nov.	8	Stand. Guano and Ch. Mfg. Co	New Orleans, La			574
	10	Schloss & Kahn	Montgomery,	Ala	Montgomery	577
	18	Steiner, Joseph & Sons	Greenville,	"	Butler	583
	18	Steiner Bros. & Co	Greenville,	"	Butler	584
	28	Southern Phosphate Co.	Atlanta, Ga			593
1893						
Jan.	4	Simmons, C. M.	Monroeville,	Ala	Monroe	667
	9	Sampey, W. L	Clanton,	"	Chilton	690
	9	Shelton, G. D	Liberty,	"	Blount	691
	10	Schoessler Bros.	LaFayette,	"	Chambers	702
	10	Shefelmeyer, C. A	Cullman,	"	Cullman	707
	11	Snead, Jas. E	Snead,	"	Blount	709
	11	Stodghill, J. T	Fredonia,	"	Chambers	715
	13	Shirley, S. W.	Ansley,	"	Pike	731

LICENSES--Continued.

Date.		Name.	Address.		County.	Number.
1893						
Jan.	13	Sowell & Son..	Monroeville,	Ala.	Monroe	733
	14	Smith, F. C. & Co	Greenville,	"	Butler	734
	16	Sanders & Masterson.........	Leighton,	"	Colbert	747
	17	Schuessler & Co	Roanoke,	"	Randolph	756
	18	Seaman, E. S..........	DeArmanville	"	Calhoun......	760
	20	Sistrunk & Jordan...........	Tallassee,	"	Elmore.......	780
	20	Sanders & Purcell	Columbia,	"	Henry	782
	21	Smith & Black...........	Luverne,	"	Crenshaw	785
	21	Sims, John M...............	Georgiana,	"	Butler........	786
	21	Sibert, W. J................	Gadsden,	"	Etowah	789
	25	Simon, Henry	Montgomery,	"	Montgomery..	804
	26	Savage, L. W................	Evergreen,	"	Conecuh......	808
Feb.	1	Smith, Jasper	Guntersville,	"	Marshall	848
	1	Stephens, T. H. & A. B.......	Keener,	"	Etowah.......	850
	2	Smith Bros..................	Sylacauga,	"	Talladega.....	854
	2	Steward, D. D...............	White Oak Spgs	"	Barbour	855
	3	Smith, Warren F.............	Sylacauga,	"	Talladega	867
	4	Scholze & Bro...............	Chattanooga,	Tenn	....	875
	6	Slaughter, Staffins & Co......	Perdue Hill,	Ala.	Monroe.	887
	6	Savage, Chas. B. & Co.......	Evergreen,	"	Conecuh......	888
	6	Smith, R. H	Collinsville,	"	DeKalb.	889
	10	Sellers & Bro	Montgomery,	"	Montgomery..	924
	14	Smith, G. W. B..............	Childersburg,	"	Talladega	943
	20	Smith, E. S	Argo,	"	Jefferson.....	969
	20	Stewart, B. M. & J. D........	Spring Garden,	"	Cherokee. ...	974
	20	Smith, G. P.................	Centre,	"	Cherokee. ...	977
	22	Schiffman, S. & Co..	Huntsville,	"	Madison. . .	986
	24	Slingluff & Co	Baltimore,	Md.	.. ..	998
	28	Sloan, J. F	Lebanon,	Ala.	DeKalb	1017
March	2	Stevens, John M..	Zoe,	"	Henry. ...	1023
	3	Sturdivant Bros..............	Dadeville,	"	Tallapoosa ...	1024
	4	Simpson, C. M..	Branchville,	"	St. Clair.	1025
	6	Stephens, B. F. & Co........	Louisville,	"	Barbour......	1038
	8	Street, J. C., Exc...........	Goodwater,	"	Coosa	1042
	9	Snodgrass, J. D.	Scottsboro,	"	Jackson. ...	1044
	25	Stumpe, J. M...............	St. Florian,	"	Lauderdale...	1071
	27	Stedham, J. V..............	Williams Sta ,	"	Escambia.....	1075
April	12	Steinhart, A....	Greenville.	"	Butler. ..	1088
	26	Snead, C. E. & Bro.........	Walnut Grove,	"	Etowah..	1095
May	15	Snead, J. H................	Boaz,	"	Marshall	1104
1892						
Oct.	6	Troy Fertilizer Co	Troy,	"	Pike.	545
	21	Tinsley Fertilizer Co	Selma,	"	Dallas........	570
Nov.	17	Tallassee Falls M'f'g. Co.....	Tallassee,	"	Elmore. ..	580
Dec.	23	Tuscaloosa Cotton Seed Oil Co.	Tuscaloosa,	"	Tuscaloosa ...	644
	29	Tillis & O'Neal.	Geneva,	"	Geneva	652
	30	Tucker, Willingham & Co.....	LaFayette,	"	Chambers	653
1893						
Jan.	16	Tuttle, A. G................	Shorters Sta.	"	Macon..	745
	18	Taylor, J. L. B.	Roanoke,	"	Randolph.....	758
	27	Torbert, C. C................	Society Hill,	"	Macon	817
Feb.	6	Thompson Bros.	Fairfield,	"	Covington. ...	886
	9	Thomas, Willis & Salter.......	Alexander City	"	Tallapoosa ...	916
	13	Turner, P. C.................	Walnut Grove,	"	Etowah.......	933
	15	Tidmore & Tidmore..........	Collinsville,	"	DeKalb	949

LICENSES—Continued.

DATE.		NAME.	ADDRESS.		COUNTY.	Number.
1893						
Feb.	17	Talley, Dyer N.	Trussville,	Ala.	Jefferson	963
	23	Turnipseed & Eichelberg	Oxford,	"	Calhoun	989
Mar.	7	Thornton, R. C.	Three Notch,	"	Bullock	1041
1892						
Oct.	6	Vandiver, W. F. & Co	Montgomery,	"	Montgomery	543
1893						
Jan.	21	Vaughan & Robinson	Heflin,	"	Cleburne	791
Feb.	3	Vinson, E. A	Georgiana,	"	Butler	865
	15	Vinson, T. J	Georgiana,	"	Butler	951
	20	Vermillion, J. H	Ragland,	"	St. Clair	981
	27	Vandegrift, A. B	Birmingham,	"	Jefferson	1015
1892						
Oct.	10	Walton Guano Co	Social Circle, Ga.			560
	17	Wando Phosphate Co	Charleston, S. C.			567
Nov.	9	Winkler, A. G	Greenville,	Ala.	Butler	575
	26	Williams & Clark Fert. Co	New York, N. Y.			592
Dec.	2	Williams & Clark Fert. Co	Boston, Mass			606
	15	Wood, J. P. & Co	Talladega,	Ala.	Talladega	629
	20	Willis, J. J. S	Clayton,	"	Barbour	635
	22	Wright, Henderson & Rainer	Brantley,	"	Crenshaw	642
	31	Whitfield, J. G	Opelika,	"	Lee	657
1893						
Jan.	4	Williams, R. S	Wetumpka,	"	Elmore	665
	4	Weedon & Dent	Eufaula,	"	Barbour	666
	7	Watkins, F. & Co	Opelika,	"	Lee	684
	7	Wright, T. O	Loachapoka,	"	Lee	686
	9	Weil Bros	Opelika,	"	Lee	689
	11	Wood, A. D	Columbia,	"	Henry	713
	12	White & Awbrey	Roanoke,	"	Randolph	727
	16	Williamson, Thos. F	Opelika,	"	Lee	743
	17	Woodall, A. W	Springville,	"	St. Clair	750
	18	Williams, D. C	Collinsville,	"	DeKalb	765
	20	Welden, A. J	Thadeous,	"	Tallapoosa	779
	24	Walker, O. H. & Co	Rutledge,	"	Crenshaw	802
	27	Williams, C. N	Five Points,	"	Chambers	822
	28	Warnock & Son	Oxford,	"	Calhoun	824
	30	Walker, Jas. M	Plevna,	"	Madison	835
	31	Wood, R	Childersburg,	"	Talladega	839
Feb.	1	Ward, H. B	Cuba Station,	"	Sumter	846
	3	Wilson, G. T	Fort Deposit,	"	Madison	872
	4	Williams, J. Matt	Ariosto,	"	Dale	878
	6	Whitman & Co	Boaz,	"	Marshall	882
	6	Webb, Jno. C	Demopolis,	"	Marengo	883
	6	Williams & Turner	Cherokee,	"	Colbert	890
	8	Watkins, Jno. P	Burnt Corn,	"	Monroe	899
	8	Watkins, Jno. P	Burnt Corn,	"	Monroe	900
	8	Wilson & Co	Russellville,	"	Franklin	909
	10	Wells, K	Verbena,	"	Chilton	920
	14	Wilson & Bro	Clanton,	"	Chilton	941
	14	Wright, A. R	Farill,	"	Cherokee	942
	15	Webb Bros	Kelleyton,	"	Coosa	947
	16	Walden, W. M	Trinity Station,	"	Morgan	955
	16	Welden, J. H. & Son	Wilsonville,	"	Shelby	958
	17	Wiggins, W. S. Sr	Monroeville,	"	Monroe	962
	18	White & Griffith	Hokes' Bluff,	"	Etowah	965

LICENSES--CONTINUED.

DATE.		NAME.	ADDRESS.		COUNTY.	Number.
1893						
Feb.	24	White & Neighbors.........	Goodwater	Ala.	Coosa........	993
	25	Williams, R. G	Opelika,	"	Lee	1003
	28	Whaley, J. E	Attalla,	"	Etowah.. ..	1020
Mch.	4	Westmoreland, L. R.........	Florence,	"	Lauderdale...	1035
	4	Wimberly, H. T	Greenville,	"	Butler.	1037
	6	Waters & Russell...........	Alexander City,	"	Tallapoosa ...	1040
	14	Woolf, J. P............	Piedmont,	"	Calhoun......	1055
	31	Williams, R. J	Linwood,	"	Pike.	1079
April	6	Williams, J. H.............	Notasulga,	"	Macon..	1084
Jan.	14	Young, Reuben.............	Snead,	"	Blount.......	741
Feb.	18	Young & Bean.......... .. .	Heflin,	"	Cleburne....	966
Jan.	26	Zell Guano Co.............	Baltimore, Md.		....	807
Feb.	1	Zadek, S	Montgomery,	Ala.	Montgomery .	844
June	29	Moore, M. C.	Alpine,	"	Talladega...	1106
July	3	Johnston, J. G	Tarentum,	"	Pike.........	1107
	3	Watts, B. F. & Co	Caledonia. .	"	Wilcox. ..	1108

Bulletin No. 49, : : October, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

VARIETIES OF WHEAT AND GRASSES.

ALEX. J. BONDURANT, Agriculturist.

JAMES CLAYTON, Assistant Horticulturist.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Commissioner of Agriculture, Montgomery, Alabama, or Agricultural Experiment Station, Auburn, Alabama.

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EXPERIMENTS IN WHEAT AND GRASSES.

BY JAMES CLAYTON, ASSISTANT IN HORTICULTURE.

These experiments in varieties of wheat were begun in 1890, the results of which were published in bulletins 32 and 39, but as further investigation was necessary before definite conclusions could be drawn, the experiments were continued in 1892.

The land used had been planted in vegetables for a succession of years, had been highly fertilized and was in a good state of cultivation.

On the 16th November, 1892, the ground was broken flush, plots each 1-100 of an acre were measured, rows laid off with a scooter and a mixture of 600 lbs. cotton seed meal and acid phosphate, equal parts of each, applied at the rate of 400 lbs. of mixture per acre broad-cast, and 200 lbs. in the drill. A scooter was run in the open furrow after the fertilizers were distributed, to mix them with the soil, and wheat at the rate of 1¼ bushels per acre was planted in the drill and covered with a harrow.

The following is the analysis of the acid phosphate and cotton seed meal, as furnished by Dr. N. T. Lupton, State Chemist, Jan. 21, 1893,

ANALYSIS.

Edisto Acid Phosphate: Water Soluble 9.73, Citrate Soluble 4.83, Acid Soluble 1.41. Total 15.74. Cotton seed meal, Acid soluble 2.73, Nitrogen 6.58, Potash 1.43.

The names of the varieties sown with results, and a brief description, are given below. The Large Red and Large White Wheat were furnished by the U. S. Department of Agriculture, and were first sown on the station in 1890.

The Purple Straw was obtained in the neighborhood of Auburn, and the twelve other varieties were presented by James Carter & Co., High Holborn, London, England.

1. Large White, ripe June 6. Four feet high, some rust; heads from four to seven inches long—not bearded; one to two grains to the mesh; white, plump grains; yield 21 bushels per acre; quality very good.

2. Stand up. Ripe June 12. Three and a half feet high, rusted very badly ; heads smooth two to four inches long; from none to two grains to the mesh; amber color. yield 7 3-10 bushels per acre; grains imperfect; quality very poor.

3. *Bird Proof.* Ripe June 12. 4 ½ feet high; rusted badly; heads smooth, two to three inches long, one to two grains to mesh; color, white; yield 8.16 bushels per acre; grains imperfect; quality very poor.

4. *Anglo Canadian.* Ripe June 8. 4½ feet high; some rust; heads bearded, three to six inches long; one to three grains to the mesh; color, amber; yield 29 bushels per acre; grains medium in size and perfect; quality best.

5. *Holborn's Wonder.* Ripe June 15. 3 feet high; rusted very badly; heads smooth; 3 to 4 inches long; from none to two grains to mesh; color red, grain very small and imperfect. Yield 5.33 bushels per acre; quality poor.

6. *Earliest of All.* Ripe June 6. 4 ft. high; rusted badly; heads smooth 5 to 8 inches long; one to two grains to mesh; color white; grains large, but imperfect; yield 23 bushels per acre; quality very good.

7. *Large Red.* Ripe June 6. 3½ feet high, rusted badly, heads bearded, 3 to 6 inches long, one to two grains to mesh; color red; grains medium size and not perfect; yield 19.3 bushels per acre; quality good.

8. *Pride of the Market.* Ripe June 10. 3 feet high; Rusted very badly; heads smooth; from none to two grains to mesh; color red; grains small and imperfect; yield 7.33 bushels per acre; quality poor.

9. *Queen* Ripe June 10. 3½ feet high; rusted badly; heads smooth, 2 to 3 inches long; one to two grains to mesh; color white; grains small and imperfect; quality poor.

10. *Purple Straw.* An old standard. Ripe May 23. 3½ feet high. Almost free from rust; heads smooth. 2½

to $3\frac{1}{2}$ inches long; two to three grains to mesh; color red; grains small and plump: yield 30.5 bushels per acre ; quality best.

11. *Flour Ball.* Ripe June 15. $3\frac{1}{2}$ feet high; badly affected with rust; heads two to three inches long, one to two grains to mesh; color white; grains small and imperfect; yield 7.83 bushels per acre, quality poor.

12. *Prince of Wales.* Ripe June 12 ; 3 feet high; rusted very badly; heads smooth, 3 to 5 inches long; from none to two grains to mesh; color red; grains very small and imperfect; yield 6.16 bushels per acre; quality very poor.

13. *Hundred Day.* Ripe June 10. 4 feet high; rusted badly. Heads smooth, 2 to 3 inches long; from none to two grains to mesh; color white; grains small and imperfect; yield 10.66 bushels per acre, quality poor.

14. *Miller's Delight.* Ripe June 10. 4 feet high; rusted badly; heads smooth and from 2 to 3 inches long; from none to two grains to mesh: color white; grains small and imperfect; yield 11.66 bushels per acre; quality poor.

15. *White Chaff.* Ripe June 5. 4 feet high; some rust; heads beardless; 3 to 5 inches long; one to two grains to mesh;. color white; grains medium size, plump; yield 30 bushels per acre; quality best.

Only six of the above fifteen varieties can be recommended to the farmers of this State for cultivation, which are given below in the order of their excellence. The other varieties are quite worthless here.

1. Purple straw.
2. White Chaff.
3. Anglo Canadian.
4. Large White.
5. Large Red.
6. Earliest of All.

SPURRY.

This plant was grown here for the first time in 1886, but as no record was kept of the results obtained, it was thought advisable to try it again this year. It is a new plant in

Alabama, and not generally known in the United States, but in some parts of Europe it is highly esteemed as a forage plant for hay and pasturage, and for renovating the soil. It is a vine like, jointed plant, branching out near the ground, and at some of the joints, and at the top; and forming from 25 to 250 seed vessels, according to vigor of plant, each seed vessel containing from 6 to 26 small seeds resembling those of an onion. The average growth of the plant here on our thin sandy land, is from 8 to 12 inches in height.

Further trial is necessary before positive conclusions can be drawn, but from one year's experiment the indications are that it is inferior to either Bermuda or Crab grass, for hay and pasturage, and its meager growth will keep it from competing in the South with clay peas as a renovator of poor soils.

ANALYSIS OF SPURRY, (AIR DRIED.)

Furnished by Dr. James T. Anderson in charge of Chemical Department (August 24th, 1893) of the State Agricultural and Mechanical College :

Moisture	11.05
Ether Extract	6.31
Crude Fiber	16.58
Ash	7.59
Crude Protein	10.28
N. free Extract	48.19
	100 00
Phosphoric Acid	0.90
Potash	1.88
Nitrogen	1.64

The above sample was gathered on June 28th, 1893, sixty days from time of planting.

While this plant does not ripen like wheat, the seed maturing all at the same time, yet at the time of gathering it was sufficiently matured and in a suitable condition for analysis.

The following is a list of Grasses planted on Experiment Station March 20th, 1893:

	Botanical Name.	Common Name.	Seeds from Where.
1	Cynodon Dactylon ..	Bermuda	U. S. Dept. Agr'l
2	. . ..	English Rye	"
3	Lolium Italicum	Italian Rye.	"
4	Poa Pratensis	Kentucky Blue Grass...	"
5	....	Lawn Mixture	"
6	Dactylis Glomerata ..	Orchard Grass	"
7	Agrostis Vulgaris ..	Red Top	"
8	Poa Arachnifera ..	Texas Blue Grass.	"
9	Arundo Festuciodes.	....	Miss. Expt. Station.
10	Bromus Adoensis ...	. . ..	"
11	Bromus Mollis ..	Soft Brome.	"
12	Bromus Unioloides .	Rescue Grass	Ala. "
13	Festuca Heterrophylla	Fescue	Miss. "
14	....	Festuca No. 1	Jas. B. Olcott, Manchester, Conn.
15	Festuca Sylvatica	Forest Fescue	Miss. Expt Station.
16	Poa Compressa. ...	Wire Grass	"
17	Poa Trivialis.	Rough-Stalked Meadow	"
18	Paspalum Platycaule..	Rough Meadow	"
19	Phalaris Coerulencens	Blue Canary	"
20	Desmodium Molle	....	"
21	Sainfoin ..	....	"
22	Trisetum Pubescens .	Downy Oat Grass.	"
23	Aira Flexuosa .	Wood Hair Grass	"
24	Eragrostis Oxylepis	.. ..	"
25	Stipa Tenacissima ..	Tough Feather Grass ...	"
26	Halens Mollis ...	Creeping Soft Grass	"
27	Tetrapoyon Tetrastachys..	....	"
28	Panicum Teneriffe ..	....	"
29	Diplachne Imbricata..	... .	"
30	Chloris Virgata.......	. . . .	"
31	Glyceria Fluitans. ..	Floating Meadow Grass	"
32	Eragrostis Pilosa.....	Slender Meadow	"
33	Melica Altissima	....	"
34	Melica Ciliata	....	"
35	Calamagrostis Avenaria..	....	"
36	Elymus Canadensis	Wild Rye	"
37	Cynosurus Cristatus	Crested Dog-tail	"
38	Millium Effusum	Millet Grass	"
39	Cenchrus Montannus	....	"
40	Themea Membrenacea	.. ..	"
41	Aira Coespitosa. ...	Tufted Hair Grass ...	"
42	Phalaris Paradoxo ..	Bristled Spiked Canary.	"
4	Holcus Lanatus ...	Velvet Grass	"
44	Elymus Arenarius ..	Upright Sea Lyme Grass	"
45	Avena Sterilis	....	"
46	Panicum Frumentaceum	Panic Grass	"
47	Vicia Villosa	Vetch or Tare	"
48	Medicago Sativa	Alfalfa or Lucerne .	"
49	Trifolium Hybridum	Alsike or Sweetish Clover	"
50	Trifolium Incarnatum.	Crimson Clover......	"
51	Lathyrus Silvestris.	Flat Pea	"

Bromus unioloides (Rescue Grass) related to chess or cheat, seed furnished by U. S. Department of Agriculture, and planted on the Experiment Station, 1889.

This grass is said to have been named Rescue Grass by Gen. Iverson of Columbus, Ga., who first brought it to the attention of the planters in 1853. It has been extensively advertised in our State, under the name of "Arctic Grass," seeds of which were procured by the director of this station in 1891, and when compared with the Rescue Grass, were found to be one and the same. In the winter of 1889, a plot of ground was planted in Rescue Grass, which ripened in May. All the seed that could be saved were gathered by hand, although many were shattered-out and thought to be lost. Immediately after harvesting the seed the plot of ground was sown in peas and the same plowed under, and in September following a perfect stand of grass came up.

From the time of the first planting of the seed until now, a perfect stand appears annually in September, which is secured by sowing the ground in peas, and thereby turning under the seeds that fall, as was done in the first instance.

While it has been used only as a soiling crop, yielding two good cuttings in late winter and early Spring, it is also said to be fine for grazing.

Poa arachni (Texas Blue Grass) can be grown from sets or seeds. A plot of land was planted on this station in February, 1889 with sets, 18 by 18 inches apart, requiring careful cultivation the first year. A perfect sod was secured in about two years. It is now growing vigorously and is a valuable winter grass, the greatest objection to it being the amount of cultivation required before the sod is obtained.

Festuca No. 1. Mr. James B. Olcott of New Manchester, Conn., presented this station with some sod of the above named grass in 1890. It is a beautiful and attractive winter grass for yards and lawns, but sun-scalds and dies-out badly during the summer months on our sandy soils.

Some of the grasses mentioned in the foregoing list are promising, viz : Chloris virgata, Panicum teneriffe and Lathyrus silvestris and others, but further trial will be necessary before conclusions can be drawn. Our experience to date is that nothing better has been found for our soil and climate, than rye for winter and Bermuda for summer.

Bulletin No. 50, : November, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

Fruit-Tree Blight in General.

J. M. STEDMAN.

CONTENTS.

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* In charge of Soil Tests.

FRUIT-TREE BLIGHT IN GENERAL.

J. M. STEDMAN.

INTRODUCTION.

Blight is a disease of plants that has of recent years attracted considerable attention, especially to the fruit grower, due to the fact that certain kinds of fruit trees have become affected with this disease, which has spread each year doing increasing harm. With the rapid yearly increase in the number of fruit trees affected, together with the equally rapid increase in the geographical area of distribution of the disease, has come a wide spread interest in this subject throughout the whole country. And this subject is attracting attention more and more; and it has so increased that it is now not confined to the fruit grower, but the farmer and even the general public have come to recognize this disease as a most serious one. The fact that its exact nature is not generally known, and the remedy perhaps even less, has helped to increase the dread of it, and to allow many to neglect their trees and permit them to die in consequence. Hundreds of instances have come under my observation in this state where village people with a few fruit trees, as well as farmers and even fruit growers, allow their trees to go unattended to when the disease appears, and the disease to increase and kill the trees and spread to others unaffected. So great has been this sad neglect of trying to check this disease, due no doubt to a want of information, together with the great yearly financial loss due to it, that this bulletin has been written with the sole purpose of giving to the public, and to the fruit growers and farmers of this state in particular, a general knowledge of what is at the present time known to biologists in regard to the nature and cause of the disease, and of the remedies to be used to combat it and to prevent its spreading to unaffected trees and areas.

The blight is at present more common in the northern part of the State. A fruit grower from that locality who depends almost exclusively upon his fruit trees for a living, states that his apple trees are so badly affected with blight that he has lost nearly his entire crop and a large percentage of the trees. One can readily see what the disease blight means to such a citizen. While attending farmers' institutes in various parts of the state this past summer, I had a good opportunity to observe the effect and extent of this blight; and it was sickening to note the great amount of damage and loss by it, not only of this years' crop, but of the trees themselves; and what is still more, to note the neglect, which must result in the great increase and spread of the disease next year. It is to be hoped that all who read this bulletin will take every precaution themselves and inform their neighbors on this subject; and let all work together to greatly lessen, if not annihilate this, the worst of all plant diseases.

The different kinds of plants that are subject to the attack of the disease--blight--is very great; and it is by no means confined to fruit trees, but even shade and forest trees are subject to it. In some localities in the northern part of this state, I have observed the oak trees affected to such an extent, that with certain species, it was almost impossible to find one perfectly healthy, and as a rule the entire tree was more or less diseased. Fortunately this seems at present to be confined to a few localities only, but one of these is at least five miles in diameter. Should this blight increase as it seems certain to do, we may in a few years have an even greater problem to contend with than that of our fruit trees.

The blight appears in many cases soon after the trees are leaved out, but more often later, and may appear at any time during the summer. Its growth ceases in the Fall at about the time the leaves begin to dry and turn preparatory to shedding, or at the approach of cool weather. The blight makes itself manifest by causing the affected parts, both leaves and stems, and it may be also the fruit, to turn a brown color, which varies from a light brown to a dark tobacco brown, or in some cases an almost black appearance. This coloration of the leaves due to the blight is readily distinguished from the coloration of the leaves due to any other cause, as the partial or total breaking of a stem, or the girdling of the trunk or stems, or an injury of the roots. In the case of coloration by blight the leaves do not appear dried or shriveled as a rule, except in the case of the water oak, but preserve their proper shape; whereas in the coloration due to other causes the leaves appear dried and shriveled and have a lighter brown color. Moreover, the coloration due to blight may not at the time being affect the entire leaf, but may appear on any portion of the leaf or in several places, and cause it to be spotted. Ultimately, however, the entire leaf will become affected unless the growth of the disease be checked by some cause. The disease appears first as a rule at the buds or growing tips of stems or young leaves where the tissues are tender; and from these places it spreads down the stem, involving ultimately all the branches and leaves of the affected limb together with its fruit. As a rule a tree is attacked in several places at once; it may be on many different limbs or on several twigs of the same limb or both; and when a tree is attacked in a great many localities involving a large number of limbs, and this early in the season, the disease will often so increase as to involve the entire tree above the roots and kill it in one summer, if unattended to. It is not an uncommon occurrence, when such a tree has been cut down close to the ground soon after it died, to have new shoots appear from the old roots and grow to be good bearing trees. (Pear.)

Blight always kills the parts of the plant affected. Although the term *blight* is restricted in its true sense to this particular disease of the leaves and stems with their fruit which is often itself affected, due to a spreading of the disease to it from the stem, nevertheless, there are diseases of the fruit itself that do not involve other parts of the tree, which diseases are the result of a cause, the nature of which is like the cause of true blight. When the fruit alone is effected with a *blight* that does not spread to other parts of the plant, we call this disease *Rot* as a rule, although the term rot is also applied to diseases of the fruit, the cause of which is entirely different from that of true blight. There are cases, however, where true blight may begin in the fruit or even blossom before the fruit is formed, and from it spread to the stem and leaves. In this case Waite has demonstrated that insects are the active agents in carrying the disease from one place to another; and that they inoculate the flowers which may have produced minute fruit before the disease increased so as to kill it and spread to the twig, or the disease may have increased so as to prevent the least formation of fruit.

THE NATURE AND CAUSE OF BLIGHT.

The disease known as *blight* is caused by bacteria. Bacteria are plants that are so small that in some cases twenty-five thousand (25,000) of them placed side by side would extend but one inch. Most bacteria, however, are a little larger than this, while many are smaller. They are as a group the smallest of living things, but what they lack in size they make up in numbers. Their power of multiplication is so great that in many cases, when every thing is favorable as regards food and temperature, the result of the growth and multiplication of a single individual plant would be many thousand in one day.

Each plant or bacterium consists of nothing more than a single cell, or to make it more plain to the cultivator, of a single minute sack or mass of living matter. The rapid multiplication of these organisms takes place by a simple division of this single cell into two usually equal parts, each one now constituting a new and independent plant, which repeats the same process of division after a little growth. Bacteria also have another mode of reproduction by what are called spores. These spores are as a rule much smaller than the adult bacteria, and are capable of withstanding greater hardships and live. The adult bacteria themselves can withstand in many cases prolonged drying and a very high or low temperature, but the spores can withstand much more. The spores of many species or kinds of bacteria will withstand boiling for an hour or even more, and some at an even higher temperature, while the spores of *Bacterium anthracis* are stated by Pasteur to remain alive in absolute alcohol.* The spores will also withstand the action of many fungicides and insecticides. This will give the reader some idea of the great vitality of these micro-organisms, and enable one to understand why these creatures can live in the soil, not only during the dry and hot summer weather, but also during the cold of winter. Their minute size will also enable one to readily see how it is that they can float about in the air in great numbers, and be carried from one place to another.

Many bacteria are harmless, since they feed upon only dead or not living tissues or organic substances, and some are even beneficial ; but many are injurious since they feed upon and live within other living organisms, both plant and animal, and in this case may produce disease and death. This death or disease may be the result of the direct action

*Charbon et Septicemie, Compt. Rend. lxxxv. p. 99.

of the bacteria in consuming the tissues, or it may be as a result of the chemical action of the waste products (ptomaines) thrown off during the growth and metabolism of the bacteria. Hence it is observed that there are many species or kinds of bacteria; and they not only act differently and produce different results and diseases, but each species as a rule has its particular animal or plant or substance in which it will grow and multiply and will not do so in any other.

The bacteria that cause the disease in fruit trees known as blight are carried by the wind, or by insects in some cases, from the soil to the buds or leaves of the trees. Here they gain access to the interior of the leaves by means of the stomata or minute openings in the epidermis of the leaf, of which there are in some cases many thousand to a square inch. Once on the tender buds or inside the leaves the bacteria find suitable food and conditions for their growth and multiplication. They feed upon the tissues of the host plant and destroy it, and as they increase in number, they gradually come to infest the entire leaf, and finally the petiole and the twig to the stem and other healthy parts. In this way the disease once started in a single place in the tree, will spread so as to include in time the entire limb or even the entire tree. The disease works down towards the trunk of the tree as well as in all other directions, and since the tissues affected soon die, it follows that if the blight start low down on a branch, it will necessarily kill the entire branch beyond the diseased portion.

The peculiar coloration of the blighted portion does not in reality indicate the entire area affected, since the bacteria are in many cases, especially in the stem, far below or down the branch before the coloration appears there, the coloration not being produced immediately upon the appearance of a few bacteria. Hence in cutting off of a diseased limb it is not sufficient to cut off the portion showing the coloration, since we would leave the stump affected with the bacteria for a considerable distance; and these would continue to multiply and spread, and shortly the disease would again make itself manifest. It is essential then in cutting off the blighted portion of a tree, to cut far below the portion that looks diseased, say from one to three feet according to the size of the limb. It is also safer to cut off the dieased portion just as soon as it appears, and before it has had time to spread to any considerable extent.

In the Fall the leaves that are diseased, as well as the unaffected ones, fall to the ground. Here they decompose and the bacteria are set free, for they do not decay, and are again carried to other localities. In this manner the disease is spread from one tree to another and from one field or locality to another, and thus it is that the blight has and is spreading all over our country. It is then readily understood why it is that, if one neglect to attend to his fruit trees, the blight will ultimately reach those of his neighbors.

During the past summer I made pure cultures of the bacteria causing the blight in the pear, quince, apple, and a coniferous tree. These were made in nutrient gelatine by the usual method of plate and tube culture. In this way the bacteria from each kind of diseased tree were grown in separate tubes of gelatine in which they fed and multiplied, and thus were obtained a large number of individuals of each special kind of bacteria, each tube containing but one kind or species.

Some of the bacteria from the tube containing the ones obtained from the pear tree blight were then inoculated into the healthy leaves of a pear tree by the use of a sterilized needle dipped into the culture, and then pricked through the epidermis of the leaf. Many leaves were thus inoculated in different localities and on different trees, and each inoculated part labeled. In five days every leaf thus inoculated had taken the disease blight, thus proving that these special bacteria were the cause of the disease.

The same method was also followed in regard to the blight of quince and apple trees, and also with the conifera, and in all cases the inoculated leaves took the disease.

I then tried to determine, if possible, whether or not the bacteria causing the blight in the pear tree would, if inoculated into the quince or apple tree, give the blight to those trees; and whether or not the bacterium of the quince tree blight would cause the blight in the pear or apple tree; and also the bacteria of the apple tree blight cause the disease in the pear or quince trees. To determine this I cross inoculated many leaves of the different fruit trees with the blight bacteria from the other kinds of fruit trees, and in no case was I able to produce the blight, except by the inoculation of the bacteria obtained from the blight of the particular kind of tree inoculated. It thus appears that each kind of fruit tree, at least so far as pear, quince and apple are concerned, has its special species of bacteria that produce the blight in that tree, and that this species of bacteria will not produce blight in the other kinds of fruit trees.

It should be mentioned, here, however, that I was able to produce blight in three different species of conifereus trees by the inoculation of the blight bacteria obtained from but one species of tree.

REMEDIES.

From the above it is readily seen that, since the cause of the blight is a minute plant—bacterium—that feeds upon and lives, grows and multiplies within the tissues of its host plant, that we can not reach the micro-organisms that are thus internal parasites, and kill them by the application of any substances to the tree in the form of a spray, as we can do for many fungoid diseases. We would kill the tree before the bacteria could be reached and affected. Hence the only means of combatting this disease *blight* at present known, is the cutting off of the affected portion far below the external signs of the disease. And since we have seen how the germs of this disease remain in the affected parts, as the leaves, that fall to the ground, and how they are eliberated and carried to infest other trees, it is plainly seen that if we cut off the diseased branches and leave them upon the ground, that we are doing no good whatever, for we have killed nothing, but are simply allowing the disease to multiply and spread so much the more, and next year the disease will appear with increased damage. The diseased portion of the trees that are cut off are to be gathered and burned, and especially the leaves, and thus the cause of disease will be destroyed and its spreading prevented.

The simple remedy is then to cut off all blighted portions of the trees far below the parts that appear diseased, and to burn all these cuttings, especially the leaves. The sooner this is done after one discovers the blight in a tree the better.

It is not enough that one thus guard his trees while his neighbors neglect theirs. We must all fight this blight, which is doing more harm already than any other single disease. If every person will thus attend to his fruit trees, we can almost exterminate the disease in a very few years.

I am now experimenting on the application of chemicals to the soilto be taken up with the sap in the Spring to kill or prevent blight, but as yet no definite results have been reached. Little has as yet been done in this line of preventing or curing bacterial diseases of plants, although the field looks promising, since we can in many cases cure bacterial diseases of animals by the internal application of chemicals.

Bulletin No. 51, : October, 1893.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

VEGETABLES.

ALEX. J. BONDURANT, Agriculturist.

JAMES CLAYTON, Assistant Horticulturist.

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All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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* In charge of Soil Tests.

EXPERIMENTS IN VEGETABLES.

By James Clayton, Assistant Horticulturist.

The following results of experiments with a few leading varieties of vegetables on the A. & M. College Experiment Station for 1893, are given in a brief and simple form, hoping that they may be of some practical use to our people. Where conclusions have been drawn, they are based upon the painstaking and careful observation of several year's experiments.

TOMATOES.

Seeds of the varieties named below were mostly furnished by the U. S. Department of Agriculture, Washington, D. C., and only a few packages were purchased from seedsmen.

The seeds were planted on an open bed March 15th and on April 27th, the plants were set in rows 3½ feet apart each way. On August the 10th cuttings about 10 inches in length were made from the "Matchless" and planted, just as plants grown from seed, all of which lived and grew vigorously. At this writing, October 20th, the vines are fruiting heavily and the tomatoes are beginning to ripen.

Especial attention is called to the above method of planting for a fall crop, as much difficulty is experienced in growing plants in the summer months. It is suggested however that the cuttings be planted about the middle of July, instead of in August.

The following is a brief description of the different varieties:

Atlantic Prize—Landreth. Light red, medium size, very wrinkled and flat. Prolific. Ripe July 10th.

Baltimore Prize Taker—Landreth. Light pink, medium to large size, wrinkled and round. Not prolific. Ripe July 12th.

Buckeye State—Dreer. Dark pink, medium to large size, smooth and roundish flat. Not prolific. Ripe July 12th.

Early Bermuda—Landreth. Light red, medium size, very wrinkled and flat. Very prolific. Ripe July 14th.

Extra Early Cluster—Landreth. Light red, medium size, very wrinkled and flat. Prolific. July 12th.

Extra Early Jersey—Landreth. Light red, medium size, very wrinkled and flat. Prolific. Ripe July 10th.

Early Richmond—Landreth. Dark red, medium to large, wrinkled and flat. Not prolific. Ripe July 6th.

Early Ruby—U. S. Department of Agriculture. Yellowish red, small to medium in size, smooth and round. Prolific. Ripe July 8th.

Ignotum—U. S. Department of Agriculture. Pinkish red, medium size, smooth and roundish flat. Prolific. Ripe July 6th.

Livingston's Beauty—U. S. Department of Agriculture. Yellowish red, medium size to large, smooth and roundish flat. Prolific. Ripe July 8th.

Livingston's Favorite—U. S. Department of Agriculture. Yellowish, medium size, smooth roundish flat. Prolific. Ripe July 10th.

Long Keeper—U. S. Department of Agriculture. Red, medium size, smooth and roundish flat. Prolific. Ripe July 10th.

Matchless—W. H. Maule. Light red, medium to very large, smooth and roundish flat. Very prolific. Ripe July 20th. This is one of the handsomest tested.

Paragon—U. S. Department of Agriculture. Yellowish red, medium size, perfectly smooth. Very prolific. Ripe July 12th.

Perfection—U. S. Department of Agriculture. Yellowish red, medium to large size, smooth and roundish flat. Prolific. Ripe July 12th.

Ponderosa—Henderson. Light pink, large to very large size, wrinkled and flat. Not prolific. Ripe July 16th.

Royal Red—Dreer. Red, medium size, wrinkled and roundish flat. Prolific. Ripe July 16th.

Telegraph—U. S. Department of Agriculture. Light red, medium size, wrinkled and flat. Very prolific. Ripe July 14th.

Money Maker—Landreth. Medium size, wrinkled and flat. Very prolific. Ripe July 14th.

Ten Ton—U. S. Department of Agriculture. Yellowish red, small to medium size, smooth and round. Prolific. Ripe July 16th.

The Stone—U. S. Department of Agriculture. Light red, medium to large, smooth and round. Ripe July 14th.

This variety is of recent origin, is a vigorous grower, dark green foliage and the fruit of very good quality.

Turner's Hybrid—U. S. Department of Agriculture. Pink, large to very large, smooth and round. Not prolific. Ripe July 16th. Peculiarly shaped leaves, resembling those of the potato.

Trucker's Favorite—W. H. Maule. Pink, small to medium, smooth and round. Prolific. Ripe July 20th.

Of Livingston's varieties, the following have been grown on this station for several years as a standard of comparison with those of more recent origin, and nothing has been found superior to them, both as to quality and productiveness:

Ignotum, Livingston's Beauty, Livingston's Favorite, Matchless, Paragon and Perfection.

IRISH POTATOES.

The varieties named below were purchased of Henry A. Dreer, Philadelphia, and planted March 16th, 1893.

The land having been thoroughly prepared, was fertilized with compost such as we use for corn, and after the potatoes were planted the plot was covered with pine straw about four inches deep. This was done immediately after the planting was finished. *As soon as the vines began to turn yellow*, the potatoes were harvested, which was from the latter part of June to the first of July, and they were then placed in a cool room, spread out on the floor and sprinkled with slaked lime.

It will be noticed, that, while the Freeman is not so productive as the Early Rose, it is about six days earlier, and being of an excellent quality, is therefore a very desirable variety. The following brief description is given of the varieties planted:

Burbank Seedling.—An old standard which needs no introduction. Long, white skin, free from scab and a good keeper. Prolific. Yield per acre 368 bushels.

Early Essex.—Large and roundish with pink skin, free from scab and knots. Yield per acre 355 bushels.

Early Puritan.—A long roundish variety, very light pink skin, free from scab and knots. Very prolific. Yield per acre 416 bushels.

Early Rose.—Too well known to need comment. A long variety, pink skin, free from scab,—some knots. Prolific. Yield per acre 388 bushels.

King of Roses.—Roundish, pink skin,—some scab and knots. Yield per acre 342 bushels.

Richmond Bell.—Roundish flat, straw colored skin, free from scab and knots. Very prolific. Yield per acre 424 bushels.

Freeman.—A new and beautiful straw colored variety, very early, roundish flat, free from scab and knots. Not very prolific, but about six days earlier than Early Rose. Yield per acre 304 bushels.

CABBAGE.

The following varieties of cabbage seed were sown in open beds March 15th, and transplanted on April 27th to thoroughly prepared land in rows 2½ by 2½ feet:

All Seasons, American Drumhead, Early Summer, Express, Large Late Drumhead, Succession and Surehead.

Preference is given in the order named to Early Summer, Succession and All Seasons, and for later kinds to Large Late Drumhead, and American Drumhead.

EGG PLANT.

A comparison of home raised and bought seed of the New York Improved Purple variety, resulted in no perceptible difference, both being satisfactory. To germinate the seed, place some fresh compost, or any other kind of manure, that will heat easily in a box, filling it from one-half to two-thirds full. Cover this with earth from 4 to 6 inches deep, sow the seed and cover the box with cheese-cloth or muslin, using tacks to confine the edges. The cheese-cloth or muslin is sufficiently thin to admit the warmth of the sun necessary for germinating the seed, and also protects the plants from the ravages of bugs which are very destructive to them while young. It is best to place the box on the southside of a wall, or at some protected place. Keep the soil well watered.

Our best results have been obtained from thin or poor land highly fertilized; and a few plants transplanted and carefully cultivated will supply a family with an abundance of this excellent vegetable.

ONIONS.

To grow onions from seed, sow the seed in open beds in February, and transplant as early as the weather will permit to rows 12 to 15 inches apart, taking pains to have the ground highly fertilized.

Of the fifteen kinds tested on this station, preference is given to the following:

Large Tripoli, Silver King, New Pearl, New Queen, White Barletta, White Maggiajola, Red Wethersfield, which have all produced fair sized onions the first season from pursuing the plan above mentioned.

BUSH LIMA BEANS.

Seeds of Burpee's Bush Lima, Dreer's Bush Lima and Henderson's New Bush Lima, were purchased of Peter Henderson and planted this past season, and in so far, as one year's trial goes, Henderson's New Bush Lima is decidedly in the lead. It is earlier and more prolific than either of the other two.

Beets, Lettuce, Carrots, Salsify and Radishes, all grew to perfection on the station grounds the past season.

CONOVER'S COLOSSAL ASPARAGUS.

Seeds furnished by the U. S. Department of Agriculture, Washington, D. C., were planted, and the plants are now growing vigorously.

A limited supply of these plants, and the following in limited quantities, will be sent free (except postage) to residents of the State making application.

White Velvet Okra Seed, Jones and Sugar Loaf Watermelon, Pine Apple and Nixon Canteloupe seed, and Grape roots of the standard varieties.

Bulletin No. 52, : January, 1894.

Agricultural Experiment Station

—OF THE—

AGRICULTURAL AND MECHANICAL COLEGE,

AUBURN, : : ALABAMA.

CORN AND COTTON.

ALEX. J. BONDURANT, AGRICULTURIST.

CONTENTS.

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VARIETIES OF CORN.

OBJECT OF EXPERIMENT.

(*a*) To ascertain the best yielding variety.
(*b*) To find a good early variety.

The corn was planted on plots 1-40 of an acre large, and in checks 3x5 feet. A fertilizer, composed of 200 lbs. acid phosphate, 66 lbs. muriate potash and 66 lbs. sulphate of ammonia, was applied in the drill before planting, at the rate of 300 lbs. per acre.

Four plots were planted in Experiment Station Yellow. Any difference in the fertility of the soil would be shown by the difference in the yield of those plots. A perfect stand was not secured and this with some inequality of the soil prevents drawing any reliable conclusions as to the best variety.

Cocke's Prolific, Blount's Prolific, Experiment Station Yellow and Pride of America gave best yields in the order named. Cocke's Prolific and Blount's Prolific bear from 2 to 3 small ears to the stalk. With the other varieties named the ears are larger, and two to the stalk an exception.

The best varieties of early corn were Clarke's Early Mastadon (yellow), Early Eclipse (yellow), Gentry's Early Market (white) and Improved Golden Dent.
All varieties were planted April 8th. The shuck on these four was dry August 7th. To the farmer whose corn crib is low ih the Spring, it will be quite a saving to plant one of these early varieties.

By planting early, any one of these would be dry by the first of August.

Plot No.	Names of Varieties.	Weight of corn on ear.	Weight of corn shelled.	Per cent. of cob.	Yield in bus. per Acre.	Date of first tassel.
1	Experiment Station Yellow...	30.7	24.	218	17 1	June 24th
2	Blount's Prolific	30 9	24.3	213	17.3	" 18th
3	Clayton Bread Corn	28 3	20.5	31	14.1	" 24th
4	ocke's Prolific	41 6	32.	231	22 8	" 23rd
5	Clarke's Early Mastadon ..	24 7	19.	23	13 5	" 14th
6	Fxperiment Station Yellow...	30	21 6	28	15 4	"
7	Early Eclipse (Y).........	23.	18.6	191	13.2	June 9th
8	Gentry's Early Market	23 4	18 1	217	12.9	" 16th
9	Giant Broad Grain	26.6	20.1	206	14.3	" 20th
10	Hickory King...............	22 6	17.8	216	12 7	" "
11	Experiment Station Yellow...	22.6	17 7	216	12 6	
12	Improved Golden Dent	21 8	17.7	188	12.6	' 20th
13	Pride of America	24.1	19 9	174	14 2	" 26th
14	Piasa King	21 7	16.9	221	12.	" 23rd
15	Experiment Station Yellow...	22.6	17.	247	12 1	
16	Ross Improved............	24.7	19 5	21	13 9	July 1st
17	Shoe Peg White	21.8	18.	174	12 8	June 24th
18	Virginia Gourd Seed	24 2	18.6	231	13 2	" "

Intercultural Experiments with Fertilizers on Cotton.

The object of this experiment was to ascertain whether it would pay to apply nitrogenous fertilizers interculturally.

Six rows 210 feet long by $3\frac{1}{2}$ feet wide, equal to 1 0 of an acre, were used. Just before planting, the following mixture of fertilizers was applied to each plot, at the rate of 200 pounds per acre: 200 pounds Acid Phosphate; 66 pounds Muriate Potash; 66 pounds Sulphate Ammonia.

As soon as the cotton was up, it was chopped and sided with a heel scrape. About June 1st the stalks of cotton in each row were counted, and then all rows but one thinned to 90 stalks. The 5th row of plot 6 had only 76 stalks. The several numbers of stalks in this row probably accounts for the small yield of that plot.

On June 22nd and July 7th the cotton seed meal and nitrate soda were scattered broadcast and the cotton plowed with a large heel scrape. All the plots were the same size and color up to July 7th and after that date the plots fertilized interculturally became much larger and had better color than the plots which were not fertilized after planting.

CONCLUSIONS.

1st. It pays to apply nitrogenous fertilizers to cotton on sandy land, provided there are good rains following their applications.

2nd. 200 pounds applied in June will be as profitable as 100 pounds in June and 100 pounds in July.

The following table shows the yield per plot and the profit from each plot fertilized after planting.

In calculating profit, the cost of nitrate of soda laid down in Auburn is used, and cotton seed meal is valued at $22 per ton. The seed cotton is valued at .02½ cents per pound.

The following table shows the results of this experiment:

Plot No.	June 22nd Name and quantity of fertilizers applied interculturally.	July 7th Name and quantity of fertilizers applied interculturally.	Pounds yield seed cotton per plot.	Pounds yield seed cotton per Acre.	Value of fertilizers per Acre.	Profit per Acre.
1	100 lbs cotton seed meal	100 lbs cotton seed meal	59.9	898.5	2.20	2.33
2	200 " " "	200 " " "	70.1	1051.5	4.40	3.95
3	Check	....	50.1	751.5	....	.....
4	50 lbs nitrate soda	50 lbs nitrate soda	67.6	1014.	2.82	4.60
5	100 " " "	100 " " "	63.6	954.	5.64	.28
6	Check	....	45.5	682.5	.....	.. .
7	200 lbs cotton seed meal	....	60.9	913.5	2.20	2.71

EXPERIMENTS WITH COTTON, 1893.

A COMPARISON OF VARIETIES.

This experiment consists of a comparison of twenty varieties of cotton. In preparing the land for planting, all the plots were fertilized alike. The rows were laid-off 3½ feet wide, and the cotton planted in checks 3½ feet apart. The culture of every plot, 1–20 of an acre, was the same. The cotton was carefully picked and weighed, and the following tabulated statement shows not only the total yield per acre, but the yield per acre of each variety at every picking, and the date of same. Each variety was kept to itself until the time of ginning, when it was re-weighed and ginned separately.

The following is the table, showing list of varieties:

Plot No.	Names of Varieties.	Yield per acre at different pickings. 1st Picking.	2nd Picking.	3rd Picking.	4th Picking.	Yield of seed cotton per acre when pick'd.	Yield of seed cotton per acre when ginn'd Dec. 8th.	Yield of lint cotton per acre.	Per cent. of lint.	No. of stalks per acre.	No. of stalks per plot.
1	Peerless (seed from C. M. Cory) ...	140	650	340	90	1220	1194	388	32.5	2600	130
2	Coltharps Eureka..	135	600	390	190	1375	1316	416	30.9	2600	130
3	Coltharps Pride..	140	610	340	210	1300	1264	402	31.8	2600	130
4	Dalkeiths Eureka..	85	535	410	230	1260	1236	386	31.2	2600	130
5	Herlong.	75	600	535	100	1305	1278	401	31.6	2600	130
6	Hawkins..	90	580	480	80	1230	1224	424	34.6	2120	106
7	Jones' Long Staple..	140	615	410	170	1335	1338	414	30.9	2600	130
8	Mathews Long Staple	110	590	400	220	1320	1256	384	30.5	2600	130
9	Okra.	275	620	290	50	1235	1196	392	32.8	2600	130
10	Peerless (seed from C. M. Cory)....	130	700	345	70	1245	1172	378	32.2	2480	124
11	Peterkin (M. W. JOhnson Seed Co	60	420	400	120	1060	968	338	34.8	1160	58
12	Peerless (old seed)	190	860	415	90	1455	1492	474	31.7	2600	130
13	Peeler	90	450	390	230	1190	1140	340	29.8	1840	92
14	Petit Gulf	160	710	430	130	1430	1440	456	31.6	2460	123
15	Truitt	100	620	410	110	1240	11·6	380	32.04	1600	80
16	Wonderful	200	840	390	190	1620	1554	460	29.6	2600	130
17	W. A. Cook	205	830	370	190	1615	1554	460	29.6	2600	130
18	Welborn's Pet	340	730	270	50	1390	1388	446	32.1	2600	130
19	Whatley's Improved	230	520	350	130	1230	1208	388	32.1	2600	130
20	Peerless (seed from C. M. Cory)	205	810	350	70	1435	1410	456	32.3	2600	130

The following table shows the classification and grade of each kind of the twenty varieties of cotton as furnished by Mr. C. E. Porter, cotton broker of Opelika, Ala., whose long experience and good judgment guaranteed a correct report. A sample of the lint of each variety was taken and numbered so as to compare with the numbers on our record, sent to Mr. Porter and his report which follows, it is hoped will prove of interest to cotton producers:

Plot No.	Classification.	Length of staple.	Grade.
1	Strict Low Middling	3/4 inch	Very weak
2	" " "	1 5-16 to 1 3/8	Irregular, but strong
3	" " "	1 inch	Regular and fine lint
4	Good Middling	1 3-16 to 1/4	Irregular, moderate strength.
5	Strict Middling	3/4 to 7/8	Very irregular.
6	" Low "	5/8 inch	Very weak, poor staple
7	Strict Middling	1 inch	Moderate strength.
8	" "	1 1-16 inch	Strong and regular
9	Middling	1 inch	Regular and fine lint
10	Strict Middling	1 3/4 to 1 7/8.	Weak lint
11	" "	3/4 to 7/8	Irregular and fine lint.
12	Good Middling	1 1/4 inch	Regular and strong
13	Middling	15-16 to 1 in	Fine lint and irregular
14	Strict Middling	7/8 to 1 inch	Irregular, very fine lint
15	" "	7/8 to 1 inch	Irregular, fair strength
16	Middling	1 1/4 inch	Regular and strong.
17	Good Middling	1 1-16 to 1 1/8	Very irregular, but strong
18	Middling	3/4 inch	Very weak staple
19	Strict Low Middling	1 3-16 inch.	Very weak staple
20	Strict Middling	7/8 inch	Very fine and regular staple

Bulletin No. 53, : January, 1894.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

A New Milk or Water Sterilizer.

C. A. CARY, Veterinarian.

☞ The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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A NEW MILK OR WATER STERILIZER.

BY C. A. CARY.

A cheap and practical milk sterilizer, that will destroy all the disease-producing germs which may be present in milk, has been sought as a means of preserving milk and of protecting the health of little children, and others who use milk as a chief food.

Scientists and medical authorities almost universally agree that tuberculosis (consumption) in animals and in man is caused by the same microbe ; that milk from a tuberculous cow is many times infected with living tubercle baccili ; that when children or grown persons consume such infected milk they may, or do in many instances, contract tuberculosis. Besides this most dreaded germ, there are occasionally other disease-producing microbes in milk, and nearly always numerous septic (decomposition) germs which hasten the process of fermentation (souring) and also interfere with the taste, digestibility and nutritive value of milk.

Milk has been sterilized by heat, by freezing and by passing electrical currents through it. The first of these three methods is the most effectual, practical and the cheapest.

The sterilization of water has been attempted by filtration, by heat, by freezing, by electricity and by the addition of drugs. The filtration method can be relied upon only when every detail is most scrupulously attended to. The value of electricity in sterilizing water has not been sufficiently tested to justify its general use ; furthermore, it is not within reach of people outside of the larger cities. The employment of drugs (antiseptics, etc.,) ruin the taste of water, and in most cases would prevent its use as a food. Also, water sterilization by heat has hitherto caused the water to taste "flat" or insipid, a result of the loss of the absorbed air, oxygen and nitrogen and possibly a little carbonic acid gas, which is usually found in well water. The sterilization of drinking water is a most valuable aid in preventing typhoid fever, cholera, yellow fever, malarial fever and indigestion. The infected water supply was the source of the cholera outbreak at Hamburg in 1892. Infected wells have been the cause of many cases of typhoid fever. It is also very probable that impure water plays an important part in the production of malarial fevers. Moreover, it is almost certain that impure water and non-sterilized milk are the primary cause of "summer complaint" in children, and infectious diarrhea and dysentery in older persons.

It matters not how scrupulously clean and careful the milkmen may be, the milk will become contaminated, more or less, by germs from the air and other sources. Consequently, were the cow perfectly healthy, and the milk to flow from the udder free from microbes, before it reaches the consumer, especially in the cities, it is sufficiently infected with bacteria to interfere with its taste, its digestive and nutritive value.

At present it is an open question as to which is the more healthful for the infant, mother's milk or properly sterilized cow's milk. Recently, in European countries extensive examinations of mother's milk have been made and in the majority of instances women's milk was found to contain microbes. This was more especially true when the mother was not perfectly healthy. Some investigators are inclined to believe that the germs entered the milk from the blood, while others are of the opinion that the microbes came from the skin over the nipple. This question, however, requires further investigation before any relatively true conclusions can be drawn.

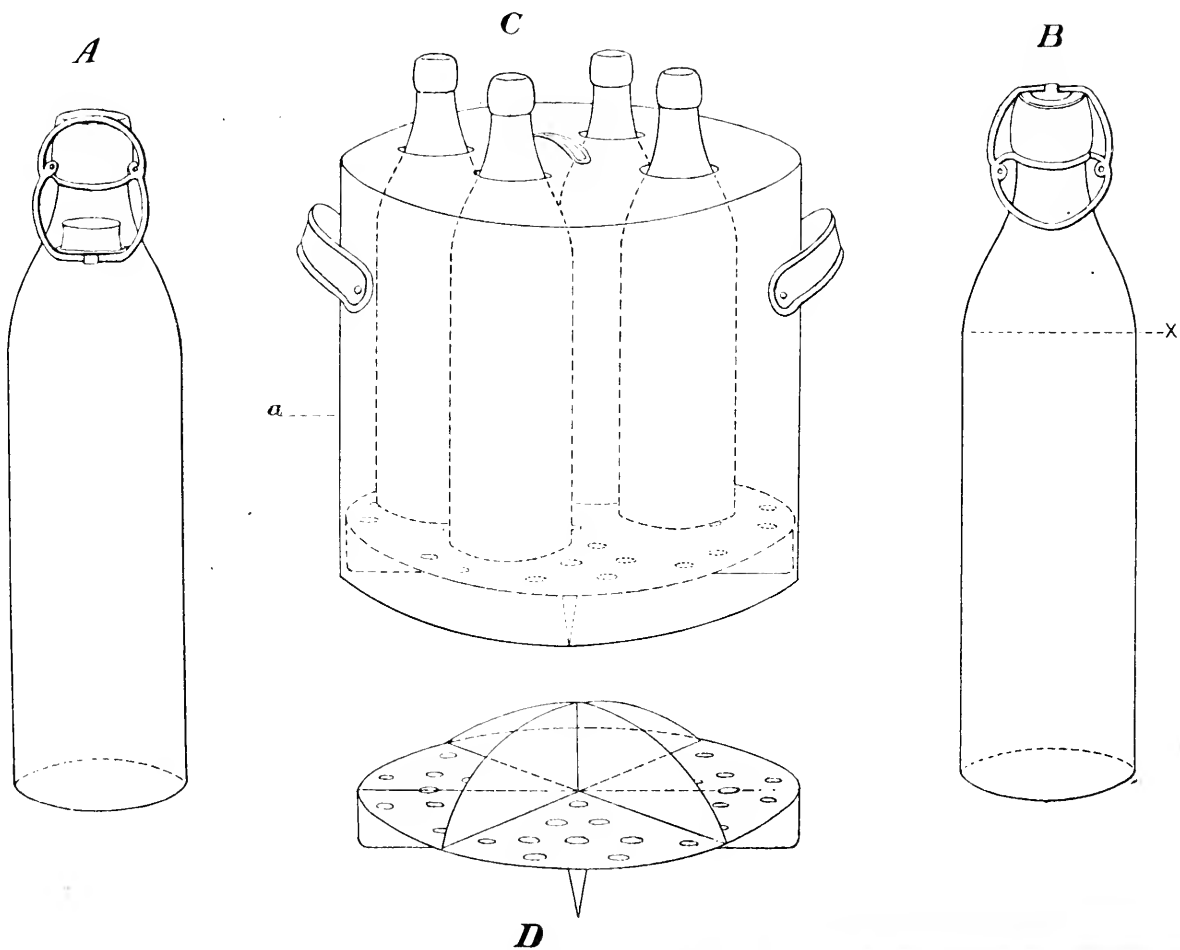
DESCRIPTION OF STERILIZER.

Figure C represents the sterilizing vessel, made of tin, copper or galvanized iron, with the milk or water bottles in position. This vessel, for 4 to 6 bottles, is 9 inches in diameter, and 9 to 12 inches high. The lid has 4 to 6 openings (according to the number of bottles) which are $1\frac{1}{2}$ to 2 inches in diameter. Resting on the flat, true bottom is a false, loose bottom that is raised 1 inch above the true bottom by two strips standing on their edges, running at right angles to each other, and firmly soldered to the inferior surface of the false bottom. This bottom (see figure D) is perforated by several openings, one-half inch in diameter. It, also, has its upper surface divided into as many parts as there are bottles, by pieces that are two to three inches high at the center with their free borders gradually curving towards the circumferance of the false bottom.

The bottles, C and D, with a capacity of $\frac{1}{2}$ pint to 1 pint, are made of heavy thick glass, and are hermetically (air tight) sealed by a rubber stopper, held in position by wires. This stopper is called the "lightning stopper" and is patented. Cork stoppers may be used, but must be held in place by wires or strong cords. The cork should fit tightly and be well secured.

After thoroughly cleansing the bottles, they are filled with milk, not higher than x, figure B. They are now closed and placed in the sterilizing vessel; cold water is poured into the vessel until it rises one-fourth of an inch above the false bottom. The sterilizer is then placed on an oil, a gasoline or a cook stove, and heated until the water in the vessel boils eight to fifteen minutes. As a rule, 11 minutes boiling is sufficient. But should the water in the vessel be heated very rapidly, let it boil 15 minutes. If, however, the water comes to a boil slowly, say 30 minutes after being put upon the stove, allow it to boil 8 to 10 minutes. The vessel must then be taken from the stove, covered with dry cloths, and allowed to stand thus for 30 to 40 minutes. After cooling, the bottles may be put on ice or kept in cool water, and the milk will remain sweet for 24 hours or longer.

The temperature of the milk, under the above conditions, rises to not lower than 150 degrees or higher than 167 degrees, F. According to the best bacteriologists, nearly all growing and adult microbes are killed if heated to 140 de-


A
B
C
D
a
x

grees, F. But physiologists claim that when milk is heated 167 degrees, F., it undergoes a chemical change that impairs its digestibility and nutritive value. By heating milk higher than 167 degrees, F., its starch dissolving ferment is destroyed; a part of the albumin is coagulated, and the caseine will not readily coagulate in the presence of rennet. By prolonged heating of milk at a high temperature, the fat globules separate from the milk and this is said to interfere with the assimilation of the fat. Prolonged heating at a high temperature is said to destroy the milk sugar. But according to the bacteriologists and physiologists, heating milk to 140 167 degrees, F., will kill the adult forms of all kinds of germs, preserve the milk and render it more healthful, without impairing its value, in any way as a food. These comparatively low temperatures will not destroy the spores of many decomposition (septic) germs; consequently the milk "sours" in the course of 24 hours, or as soon as the spores develop into adult microbes. According to Fraenkel, heating cholera bacilli to 122 degrees, typhoid bacilli to 140 degrees, or tubercle bacilli to 158 degrees, F., will destroy them in a short time: this is especially true if the bacilli are in such liquids as milk or water when heated. Furthermore, it is almost absolutely certain that none of these three germs form spores.

If one should desire to keep the milk indefinitely, it must be heated as above directed for three consecutive days. To raise the temperature of the milk to 185 degrees, varying from that up to 205 degrees, F., fill the vessel, C, with cold water, one-third to one-half as high as the level of the milk in the bottles; then boil the water in the vessel 20 to 40 minutes, usually 30 minutes is sufficient to preserve the milk 2 to 4 days, Repeat the process the next day and the milk may be preserved indefinitely. I prefer this method to the preceeding for sterilizing milk in the summer.

To raise the milk or water in the bottles to 206 or 212 degrees, F., fill the sterilizing vessel with cold water as high as the level of the milk or water in the bottles, cover the vessel with a non-perforated lid, or cover the perforated lid with cloths; then allow the water in the vessel to boil 30 to 60 minutes. This will usually keep the milk sweet as long as the bottles are kept closed. During the hot part of last summer I kept milk that had been so sterilized for 6 weeks, and the bottles stood in a window where the sun could shine on them part of the day. As a rule, on account of reasons previously stated, it is not good to sterilize milk at such a high temperature. But drinking water should always be sterilized by this method.

If milk is acid in reaction (slightly sour) before sterilization it will coagulate after sterilization, although it may be free of germs. Sometimes the milk is acid when it comes from the udder and this is said to be due to improper feeding of the cow. In order to determine if the milk is appreciably acid before sterilization, put a small strip of blue litmus paper into the milk; if it turns red the milk is acid, but if this produces no change in the blue paper the milk is neutral or alkaline. If the milk is slightly acid it may be made neutral or slightly alkaline by the addition of a sufficient quantity of a saturated solution of bicarbonate of potassium, or common baking soda, to make the red litmus paper turn blue. This may be done without injuring the milk, if practiced with care.

In sterilizing water, always heat it to 212 degrees, F., for 30 to 60 minutes. After the water in the sterilizing vessel has become partially cooled, the bottles may be placed on ice, put in cold water or transferred to a bucket that may be hung in the well.

The only practical method of using the thermometer, when sterilizing milk, is the one suggested by the Bureau of Animal Industry. It is adjusted in the lid so that the bulb is immersed in the water of the vessel. The vessel is filled with water as high as the level of the milk in the bottles. When the water reaches the desired temperature (160 to 167 degrees, F.,) the vessel is removed from the fire, covered with cloths and allowed to stand 30 to 40 minutes.

CAUTIONS.

Always scrupulously clean the bottles before using. Coarse sand or a bottle brush will remove the dry milk from the inner surface of the bottle. It is best to fill the bottles with water immediately after using the milk.

Never fill the bottles higher than indicated in figure B.

Always keep the bottles closed air tight during and after sterilizing. Never pour cold water into the sterilizer after the water in the sterilizer has commenced to boil.

Never take the bottles from the vessel when they are hot; because cold air or cold water will break them.

Never put cold bottles into boiling water.

A MILK DEALER'S STERILIZER.

This process of sterilization in closed bottles may be employed by dairymen.

A large sterilizing pan could be made after the pattern of a syrup or a sorghum evaporating pan. It may be from 6 to 10 feet long, 2 to 4 feet wide, and 12 to 15 inches deep. The bottom should be made of copper and the sides of plank. The false bottom should be constructed lattice-or slat-like, of wood strips. The bottles should have a capacity of one quart. A tight fitting lid could be constructed of wood, having but one opening, in which a thermometer may be inserted. A heating furnace, something like the one used in evaporating sorghum or cane juice, may be employed, but arranged to suit the different conditions.

After filling the bottles as previously directed, and placing them in the sterilizing pan, it may be filled with cold water as high as the level of the milk in the bottles. Now heat the water to 160 degrees, F., or higher if desired; the temperature will be indicated by the thermometer extending through the lid down into the water. When the water reaches the desired temperature the sterilizing pan, resting on rollers, may be rolled to one side, upon a platform as high as the furnace, and there left undisturbed for 30 to 40 minutes. It is important that the sterilizer remain covered for 30 to 40 minutes after removing it from the fire ; because the milk in the bottles will not reach the same temperature as the water in the sterilizing pan, until 5 or 10 minutes after removal from the fire. When the bottles have partially cooled they may be removed to the ice chest, or to cooling pans. Crates, similar to those used by pop and beer venders, may be employed in delivering the milk.

I claim to have originated this process of sterilizing milk or water in hermetically sealed bottles.

Milk sterilized by this process may be heated to a higher temperature than in open vessels without changing its chemical composition, or interfering with its taste, digestibility or nutritive value.

This closed bottle process is not exposed to infection after sterilization.

As a water sterilizer it does not change the taste of the water ; it leaves the water just as palatable as it was before sterilization. Furthermore, the sterilizer is cheap and may be used by any cook or nurse after a little instruction.

I believe it can be successfully and effectually used by dairymen.

Bulletin No. 54, : February, 1894.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

TOBACCO.

ALEX. J. BONDURANT, AGRICULTURIST.

CONTENTS.

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TOBACCO EXPERIMENT.

I.

OBJECT OF EXPERIMENT.

Experiments in Tobacco, which were commenced on the Station in 1892, and were reported in Bulletin No. 44, were continued the past year with seed from several varieties raised in Virginia, purchased from R. L. Ragland & Co. Hyco, Va., who are raisers of tobacco seed, to supply the agricultural department at Washington, D. C. Seed were also used of the Connecticut Seed Leaf and Havana, furnished by the agricultural department at Washington. Seed furnished by the Florida Agricultural Experiment Station, and seeds procured from Meguiar, Harris & Co., Louisville, Ky., of the Burley tobacco.

These experiments were undertaken to ascertain the kinds of tobacco that seemed best adapted to this climate and soil.

Experiment Station work, conducted in a general way, was more with reference to the growth of the different varieties planted, their qualities, and methods of curing, than to the particulars of fertilizers suitable to the crop in this climate and on this soil.

Methods of raising the plants. These Experiments were commenced on the twenty-sixth of January, and at that time preparation was begun for raising the plants in the Phytopathological, or plant laboratory, in open air beds burnt in the woods and in a hot bed covered with cheese cloth. A brief account of the method followed in each case will be given.

[a] *Phytopathological laboratory.* Rich wood mould, free

from grass seed, was well fertilized with equal parts of nitrate of soda, acid phosphate and kainit. This was placed in boxes to the depth of six inches, the seed were carefully planted in rows a few inches apart, labeled and the soil kept moist by sprinkling late in the evenings when necessary. Very few plants came up from this process. Those that did reach the surface soon died. There are two rational causes for accounting for the failure of these seeds to germinate and grow. The first is, owing to the extreme heat in the Phytopathological, or plant laboratory, which was covered with glass and not protected with awning at that time, thereby destroying the vitality of the seeds. The second cause is, that the boxes containing the mixture of soil and fertilizer were so small that the proportion of fertilizer may have been too large for the quantity of soil used, and hence in this concentrated or caustic form the germinating power of the small seeds was destroyed.

There were two other sowings of the seed in this laboratory, viz: February 28th, and March 29th, with the same results as with the first sowing.

[b] *The woods bed.* This bed was prepared on January 27th, after the plan practiced in the old tobacco States, by burning the ground and then getting the bed in a fine pulverized condition with hoes and rakes. The bed was fertilized after the same method as before mentioned, and the seeds were sown and covered with a light covering of pine straw. These did well, and by the first warm days of March there was an abundance of young plants in sight; yet notwithstanding the covering of pine straw, some were killed by freezing weather, but enough left for use.

About the twentieth of March it was discovered that the flea beetle, which seems as abundant in Alabama as in the old tobacco States, had commenced to attack the young plants, and then by liberal manuring the plants began to grow rapidly, and soon became sufficiently strong to resist the ravages of this pernicious insect, and although they were later than those raised under canvass, yet many good plants were gotten from this bed for replanting the experimental grounds.

From experiments made in raising plants in open beds, we find that they are liable to be destroyed by the flea beetle and other insects; and as a remedy, I would advise spraying the bed with one ounce of Paris Green, mixed with fifteen or twenty gallons of weak soap suds. This same application can also be used after the plants reach the surface. Pyrethum, commonly called insect powder, can be used in the place of Paris Green, either dry or mixed with water, but it is not considered so effective as Paris Green, and besides it is costlier, and more difficult to procure unadulterated.

(c) *Covered Bed.* This bed was prepared on the 4th of February, by making a frame 8 by 16 feet, cased-in with inch plank one and a half feet high on the north side, and one foot high on the south side. The method of fertilizing was the same as that followed with the two before-mentioned beds, seeds being sown in drills a few inches apart. The bed was then covered with cheese cloth sewn together to make a close covering to keep in as much heat as possible and then fastened to the planks with tacks. The bed being near a hydrant, was kept watered with a spraying hose. The plants came up well and grew rapidly, and from this bed most of the plants were gotten for the experiments.

II.

PREPARING FOR PLANTING.

The land upon which these experiments were conducted was bottom branch land, and poor sandy upland. The bottom land, which was in cotton the year before, was the first that was prepared, by breaking it well with a turning plow on April the third, and equal parts of cotton seed meal, kainit and acid phosphate were applied broadcast, at the rate of one thousand pounds per acre, and plowed in with a scooter.

Each plot of two rows each contained one-forty-second of an acre. The rows were laid off with a shovel plow, three pounds of nitrate of soda, six pounds of kainit, and six of acid phosphate mixed, were applied in the shovel furrow, then bedded with Dixie plow and the beds harrowed. Rows were then run cross, three and one-half feet wide, and plants set in checks. April the twentieth the planting commenced, using plants from the canvas bed. April twenty-fifth and May second, all missing hills were replanted, and no more replanting was done on this ground after that time.

The land on which this experiment was made, was sandy and of moderate fertility. A succession of crops, principally cotton, had been grown on it for many years.

The following table shows the results of yield from land known as branch bottom sandy soil. The plants were set in checks 3½ feet each way:

Plot No.	Names of Varieties.	Pounds yield per acre green Tobacco.	Pounds yield per acre cured Tobacco.	Type.
1	Comstock Spanish	6888 0	1029 0	Cigar.
2	Connecticut Seed Leaf	9681 0	1268 4	"
4	Havana Seed Leaf	5607 0	852 6	"
8	Vuelta de Abajo	7014 0	1436 4	"
13	Pure Havana	4179 0	814 8	"

Plot No.	Names of Varieties.	Pounds yield per acre green Tobacco.	Pounds yield per acre cured Tobacco.	Type.
3	Conqueror	5901.0	1163.4	Plug
5	Hester	8366.4	1192.8	"
6	Hyco	8484.0	1247.4	"
7	Long Leaf Gooch	6699.0	1159.2	"
9	Yellow Orinoco	6913.2	1310.4	"
10	White Stem Oraoco	7719.6	1104.6	"
11	Burley	5985.0	1176.0	"
12	Gold Finder	3746.1	688.8	"
14	Yellow Pryor	3234.0	575.4	"

The soil on which the second experiment was made, is upland and known as white sandy soil, very poor without the aid of fertilizers. On this the plants were set, three feet apart on rows three feet wide.

The first application of manure was in shovel furrows laid off three feet apart, stable manure at the rate of five thousand pounds per acre was applied in the drill, then, in the same furrow, at the rate of five hundred pounds per acre, the following fertilizers in this proportion: sixty-six pounds sulphate of ammonia, sixty-six pounds nitrate of soda and two hundred pounds acid phosphate. A scooter furrow was then run in this fertilized furrow, mixing the fertilizer and soil, it was then bedded with the Dixie plow.

The table on next page shows the yield from light sandy soil upland. Rows were three feet apart and plants were set three feet apart:

Plot No.	Names of Varieties.	Pounds yield yer acre green Tobacco.	Pounds yield per acre cured Tobacco.	Type.
1	Comstock Spanish	5382.0	1242.8	Cigar.
2	Connecticut Seed Leaf	5304.0	1505.4	"
4	Havana Seed Leaf	3796 0	881.4	"
8	Vuelta de Abajo	1495.0	439.4	"
13	Pure Havana	*	452.4	"

Plot No.	Names of Varieties.	Pounds yield per acre green Tobacco.	Pounds yield per acre cured Tobacco.	Type.
3	Conqueror	8114.6	1645.8	Plug
5	Hester	7124.0	998.4	"
6	Hyco	8073 0	1591.2	"
7	Long Leaf Gooch	6877.0	1294.8	"
9	Yellow Orinoco	6848.4	1744.6	"
10	White Stem Orinoco	7228 0	1271.4	"
11	Burley	8769.8	1235.0	"
12	Gold Finder	4308.2	720.2	"
14	Yellow Pryor	4630.6	860.6	"

*Green weights of this variety were misplaced and consequently can not be given.

Cultivation. The cultivation was shallow throughout, being done with Terrell heel scrape; on the bottom land the plowing was done both ways, which reduced the expense, as the hoe was not much used.

Harvesting and Curing. The gathering of the crop commenced July the seventeenth, and was continued for every eight or ten days thereafter until the entire crop was gathered, as it required that length of time to make a curing, to bring the tobacco in order, to take it down out of the house and bulk it. The curing was done in a modern tobacco barn, with heating apparatus, as was shown by illustrations in bulletin No. 44, May 1893.

The following is the method of curing that was followed :

CURING TOBACCO.

—FOR YELLOWING OR SWEATING—

Temperature of Barn before firing Stoves, 86 degrees.

July 19, 10 o. c., a. m. Fire started and thermometer kept on average of 90 degrees until 12 o. c. that night. From 12 o. c. at night (July 19th) to

July 20, 9 o. c. An average heat of 95 degrees. All openings, ventilators, &c. closed, temperature not rising much over the average, Twenty-three hours now since fire begun; tobacco yellowed, which is earlier than the rule, thirty hours being usually required to yellow.

SETTING THE COLOR.

July 20, 9 o. c., a. m. Opened ventilators over the Stoves, made two openings in conduits next to door on either side, and half of ventilator on top of Barn. Temperature raised to 100 degrees.

July	20,	10 a. m.	"	"	" 105	"
"	"	11	"	"	" 110	"
"	"	3 p. m.	"	"	" 115	"
"	"	6 "	"	lowered	" 110	"
"	21	3 a. m.	"	raised	" 115	"
"	"	6 "	"	"	" 120	"
"	"	9 "	"	"	" 125	"
"	"	3 p. m.	"	"	" 130	"
"	"	9 "	"	"	" 135	"

CURING TOBACCO, JULY 31, 1893.

Monday, July 31st. Gathered 4 varieties of tobacco and put in Barn and started fire about 3 o. c., p. m. Thermometer raised to 90 degrees and kept at this heat until

Wednesday, Aug. 2nd. 3 o. c., p. m., when temperature was raised to 95 and 100 degrees, using about 4 barrels water in sprinkling floor to prevent drying too rapidly.

Thursday, Aug. 3rd, temperature raised to 130 to 140 degrees: tobacco drying as fast as possible.

Saturday, Aug. 5th, finished drying and wet basement.

Monday, Aug. 7th, took down tobacco and packed away in barn.

Bulking. The tobacco was taken down out of the curing barn as soon as it was cured, and bulked down in the new Agricultural Laboratory, so as to have use of the curing house for more tobacco. In curing tobacco by artificial heat, this barn is an economical method. By commencing to take off the leaves, say the middle of July that are ripe, and continuing to gather the leaves as they ripen until all of the crop is gathered, in this climate with frost delayed until November, as much as eight or ten thousand pounds of tobacco can be cured in a tobacco barn sixteen by twenty feet, from the middle of July to the first of November. Another important advantage in curing by this process is, that a larger per cent. of bright tobacco can be obtained than by curing with open fires.

The tobacco, as it was taken down from the curing house, was in as dry condition as it could be handled without breaking. Unless the stems were thoroughly cured, it would be unsafe to place tobacco in bulk from the curing house as early as was done in this experiment. As all of the tobacco that was cured by this process was thoroughly cured before it was taken from the curing house for bulking in the Agricultural Laboratory, it went through a moderate sweating process, and was found to be all sound and sweet when the bulks were opened about the first of December for assorting and binding into hands.

Assorting. The tobacco was assorted and classified according to the color and quality.

In assorting, three grades were made; *first quality*, which consisted of the largest and best quality of leaf; *second quality*, leaves of smaller size than the first, and *third quality*, or lugs, which were composed of the lowest grade, usually the leaves grown nearest the ground.

After the different qualities were assorted, they were tied in bundles or hands, a thin pliant leaf being used to make the tie. From seven to ten leaves of the best quality were sufficient to make a bundle of a convenient size for handling, from eight to twelve leaves of the second quality were placed in a bundle, and from ten to fourteen of the third quality.

III.

CLASSIFICATION AND VALUATION.

With the view of ascertaining the quality and value of the tobacco raised on the Station, samples of the different varieties were sent for examination to dealers in New York, Richmond, and Danville, Va., Florence, S. C. and New Orleans, La.

At the time of writing this bulletin, reports have been received from the following. As these reports may be of interest to the farmers of this State, and the South, who are interested in this new industry, the essential part of the different reports are given:

REPORT OF H. T. DUFFIELD.

The first report received was from Mr. H. T. Duffield, of the Tobacco Leaf Publishing Co., New York, enclosing the classification of Mr. Wallace, an experienced "judge of tobacco." Mr. Duffield wrote, "the samples you sent are very much like the tobacco grown in the celebrated Owensboro district in Kentucky, this is the opinion of Mr. Wallace; he is a fine judge and never says anything except what he thinks. Mr. Wallace was formerly a member of the firm of Sawyer, Wallace & Co. I have known that house to make one sale of tobacco which amounted to about one million and a half of dollars. I have taken great pleasure in showing the samples, for I am a native of Mississippi, and was reared in Kentucky, and am always glad to do what I can to assist the brethren down South."

OPINION OF MR. WALLACE.

Yellow Pryor. This perhaps is the most serviceable tobacco of the lot. Sample in good condition, shows a very good leaf indeed. If the leaf were a little longer it would be better.

Hester. Brighter than the preceding; better color than it, rather short.

Conqueror. A very nice long leaf; well cured, long enough to be of use to the manufacturers.

Gold Finder. Good brown color; some good leaf and some too thin and papery.

White Stem Orinoco. Green color, with a few leaves of good color, quality uneven.

Long Leaf Gooch. Would never pay to grow, except for the very lowest grades.

Burley. Too green and slazy. If it cannot be grown of better color and more body, it had better be left alone.

Yellow Orinoco. No comparison with the other light colored samples; not nearly so yellow and more green, lifeless.

First Quality Brown. Much larger leaf than second quality brown; a little slazy, color comes more from the growth than from curing. Samples rougher than number two; good body; a good shipping leaf for England; delicious flavor.

Second Quality Brown. Some remarkably good leaf in the sample; rather short—too short for stripping purposes.

First Quality Bright. Shows a very good leaf; well cured; nice small stems.

Second Quality Bright. Shows considerable green and too short to do anything with, except for granulating purposes.

The samples of plug manufacturing leaf, clearly show that the soil and climate are well adapted to the growing of this class of tobacco profitably.

The tobacco, as a rule is too short measuring, that is, the longest sample twenty-one to twenty-two inches, when it should be from twenty-two to twenty-five.

The best varieties are Conqueror, Yellow Prior, and First Quality Brown, in the order named. When compared with the rest, Conqueror seems to justify its name.

Your bright tobaccos are worth just what a man fancies. Some fancy bright wrappers bring fifty cents per pound, while the very commonest bright will fetch six cents or so, on the market now.

REPORT OF MR. FRANK M. ROGERS, FLORENCE, S. C.

I feel sure that the development of the culture of bright tobacco in your State will add materially to the prosperity of the farmers when they give it proper and careful attention.

The industry in this section has become quite a prominent feature in our agriculture, and to those of our farmers who are industrious and attentive, tobacco has proven one of the best paying crops introduced.

There is great prejudice in all the markets of North Carolina and Virginia against all new sections.

They tried in every way to discourage and kill-out the business in this State at first, by paying very low prices for our products; the same prejudice still remains. Owing to our soil, climate and length of season, we can far surpass States north of us in quality of leaf, production per acre and cost of production. They fully realize this, and should the industry spread through two or three of our Southern States, they would practically be unable to compete.

The following is the valuation of the samples, as far as made by Mr. Rogers:

Number one is worth from eight to nine cents per pound.
Number two is worth from seven to eight cents per pound.
Number three is worth from five to six cents per pound.

REPORT OF DIBRELL BROTHERS, DANVILLE, VA.

We have examined the samples carefully, and have put the following valuations on them:

First Quality Brown, we value at	4	cents.
Second " " " " "	$4\frac{1}{2}$	"
First Quality Bright, " " "	10	"
Second " " " " "	8	"
White Stem Orinoco, " " "	4	"
Burley, " " "	$6\frac{1}{3}$	"
Gold Finder, " " "	$4\frac{1}{2}$	"
Hester, " " "	$6\frac{1}{2}$	"
Hyco, " " "	8	"
Yellow Orinoco, " " "	$4\frac{1}{2}$	"
Yellow Pryor, " " "	7	"
Conqueror, " " "	9	"
Long Leaf Gooch, " " "	5	"

We think the Hyco and Conqueror are of better quality and more decided character than any of the others.

REPORT OF S. P. CARR, RICHMOND, VA.

I have carefully examined the samples of tobacco you sent. You have a fine field for the dark tobaccos and a fighting chance with our North Carolina bright varieties, owing to your soil being of similar quality to the North Carolina best tobacco soils.

I think you have at least thirty per cent. advantage in culture—certainly ten per cent. in length of seasons and sunshine, and twenty per cent. in the advantage of a curing season, for unless you are forced to cut through an abnormally wet season, there is no reason why you cannot always have a select time for cutting and curing, which rarely happens in our latitude. In short, we have six weeks margin to cut and cure our tobacco, and you have ten weeks certain.

There was a time in our tobacco industry, dating only a few years back, that no part of our country could raise tobacco worth anything, but North Carolina and Virginia, the home of its first commercial culture; but it has been fully demonstrated that this is a mistake. It is in your power to make the very best type of cigar filler, binder and wrapper, and in these grades you will have a world-wide outlet.

Below find description and comments on your types.

Gold Finder. Coarse leaf, worth eleven to twelve cents per pound.

Conqueror. Very good quality, worth twelve to fourteen cents per pound.

Comstock Spanish. A fair cigar filler, not large enough for wrappers; some of it large enough for binders.

Havana Seed Leaf. Very good binder and common filler, but the laterals or veins too coarse for perfect combustion.

Connecticut Seed Leaf. Too heavy for wrapper, will make fair filler and possibly a binder.

Vuelta de Abajo. A very good filler, but a fraction too rich in body for a mild smoke.

Pure Havana. The best of all the cigar types, only needs a little to make it perfect for wrapper, binder and filler. This is the kind to direct your energies to; you can supplant the genuine Havana in this country, if you will direct your attention to this kind.

Hester. Leaf and texture all right.

Yellow Pryor. Good body, and texture all right.

White Stem Orinoco. Very fair goods.

Long Leaf Gooch. Fair stemmer for the English market.

Yellow Orinoco. A good stemmer for English export, but rather coarse.

Burley. Fair quality, worth from eight to ten cents per pound.

IV.

FACTS FROM STATISTICS OF THE U. S. DEPARTMENT OF AGRICULTURE.

From the report of the U. S. Department of Agriculture on the crops for the year 1893, the estimate placed on the crop of tobacco raised in sixteen States, all that are reported as having raised tobacco, is 483,023,963 pounds from 702.952 acres, and valued at $39,155.442. This will give an average of $55.70.1 per acre for the sixteen States that cultivated tobacco in 1893. The last estimate made by the Department of Agriculture of the acreage, production and valuation of tobacco, prior to those given above, appeared in the annual report of the Department for 1889, being the estimate of the crop for 1888. The acreage as estimated for 1888 was 747,326, producing 565,795,000 pounds of tobacco, at a total value of $43,666.665. The crop the following year, 1889, was returned by the U. S. Census at 488,255,896 pounds, the product of 692,990 acres, with a total valuation of $34, 844.449.

From a comparison of the estimates of 1888 with the Census figures of 1889, it would seem that the former were considerably too high. These discrepancies have been eliminated in the Department Report for the year 1893. The figures of acreage for the whole, vary little from year to year, there being an increase of about 10,000 acres over the Census figures. The yield, on the contrary, varies greatly; and for 1893 was below the average. This is shown by the total production being 5,000,000 pounds less than for the Census year, despite the increased acreage. The average yield of tobacco for the year 1893 in the sixteen tobacco States amounted to 687 pounds per acre.

The final estimates of the average farm price of tobacco, December 1st, 1893, for the sixteen States that produced tobacco, are as follows:

Massachusetts,	16.0	cents per pound.
Connecticut,	14.0	" " "
New York,	15.2	" " "
Pennsylvania,	13.5	" " "
Maryland,	7.6	" " "
Virginia,	6.2	" " "
North Carolina,	8.0	" " "
Arkansas,	10.0	" " "
Tennessee,	8.8	" " "
West Virginia,	10.2	" " "
Kentucky,	7.6	" " "
Ohio,	6.5	" " "
Indiana,	7.3	" " "
Illinois,	7.0	" " "
Wisconsin,	6.3	" " "
Missouri,	7.6	" " "

This report makes no allusion to tobacco raised in the Southern States. It is well known that Florida and Southern Georgia produce good cigar tobacco, and South Carolina good plug and smoking, and all of these States have tobacco manufactories for cigars, plug and smoking tobacco.

The report of the government for cotton for the year 1893 for acreage and yield is not at hand, only the prices of the staple from eleven States that cultivated cotton are given. From the report of 1888, which gave the essential features of the cotton crop for that year, it appears that the average yield per acre for cotton that year, for all the cotton States, was one hundred and eighty pounds, and the average price at that time was eight and one half cents per pound, which would amount to fifteen dollars and thirty cents per acre. Since that time the average production may not have decreased, but it is certain that the price of the staple has declined, and it is reasonable to conclude from the following table that the farmers in the cotton States did not average gross, over $ 12.61 per acre for their cotton, for the year 1893.

The average farm price for cotton for 1893, in the eleven States that raised cotton, is as follows :

Virginia,	7.1	cents	per	pound.
North Carolina,	7.2	"	"	"
South Carolina,	7.1	"	"	"
Georgia,	7.3	"	"	"
Florida,	7.3	"	"	"
Alabama,	7.0	"	"	"
Mississippi,	7.0	"	"	"
Louisiana,	7.0	"	"	"
Texas,	6.9	"	"	"
Arkansas,	6.8	"	"	"
Tennessee,	6.5	"	"	"

As far as Experiments have progressed on the Station, the indications are that tobacco, of good quality, particularly for manufacturing plug, for pipe smoking and cigarettes, and possibly for cigars, can be raised in this part of Alabama at a profit. From samples sent to the Station for examination, from different parts of the State, it is fair to conclude that in that portion of the State bordering on the Gulf coast, that tobacco of good quality, fine flavor for wrappers, binders and fillers for cigars, can be produced. Some of this kind was received this season from Dr. John Gordon, Healing Springs, Washington county, which apparently possessed all the requisite qualities for making cigars of excellent quality, after being put through the proper process. Samples of tobacco were also received from Mr. Z. T. Stroud, Aberfoil, Bullock county. These samples were in a badly damaged condition, owing to the fact that they were very wet. After the samples were dried-out, they were examined and found to be a leaf of good size and color—good flavor in smoking, free from pungency, a decided cigar flavor, burning well and leaving a pearl ash.

Some good samples were received from Mr. R. D. Martin, Florence, Ala., suitable for making plug and smoking. The variety which Mr. Martin calls the Brazil Gold Leaf, has been grown by him for several years, and he writes that he has sold all he has for sale at thirty cents per pound. He reports that he has gotten three crops a year from this variety on the same ground, by planting early.

One of the most important things to be done to make the tobacco industry a success in this State, is the establishment of home manufactories. The freight charges on tobacco from Auburn to Florence, S. C., or Danville, Va., are $1.05 per 100 pounds, which reduces the profit too much in this age of sharp competition.

The cotton crop of this State brings annually $30,000,000 to $35,000,000, and from the best information that has been gotten, as much as one-fourth or one-fifth of the amount that the cotton crop sells for is spent in tobacco raised in other States. If our own people raised and manufactured enough tobacco for their own consumption, a large amount of money that is now sent out of our State annually for an article that we could produce at home, would be kept in our own State.

The Station saved seed from last years crop of all of the varieties planted, and will distribute a limited quantity to the farmers of the State on application.

Bulletin No. 55, : : April, 1894.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

A NEW DISEASE OF COTTON.

COTTON BOLL-ROT.

J. M. STEDMAN, BIOLOGIST.

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☞ The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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COTTON-BOLL ROT.

A New Bacterial Disease of Cotton Affecting the Seeds, Lint and Bolls.

BY J. M. STEDMAN.

During the middle of August, 1893, I received from the Department of Agriculture, Montgomery, Ala., some samples of cotton-bolls supposed to be suffering from the attack of insects. The cotton-bolls were accompanied by a note stating that they had been received from Mr. A. W. Bryant, Stockton, Baldwin county, Alabama, and asked for the name and habits of the insect affecting them, and for the remedies to be used to combat or destroy the same. On the 13th of September, I received a box of diseased cotton-bolls from Mr. W. A. Bryant himself.

A short examination of the bolls and of the numerous insects in them was sufficient to convince me of the fact that the insects were not the direct cause of the disease, but that on the contrary, they were present in order to eat of the already dead and decaying vegetable matter. The insects were Coleoptera (beetles) of the family Nitidulidæ (Sap-suckers), and were present in all stages of development. The larvæ, one of which is represented in figure 7, and the adult beetles, represented in figure 5 and 6, were very numerous, while their pupæ were not uncommon. The larvæ are about one-fourth of an inch in length and are nearly white in color. Figure 7 represents one magnified about five diameters.

A closer examination revealed the presence of two species of adult beetles both of which are about one-eighth of an inch long. Figure 5 represents one of these sap-beetles, *Epuræa æstiva*, magnified six diameters, while figure 6 shows the other species, *Carpophilus mutilatus*, equally magnified. Both of these beetles are well known among fruit growers in the Southern States, Mexico, and Central and South America. They are widely distributed throughout the south, feeding both in the larval and adult condition upon decaying or injured fruit of all kinds, and are sometimes found sucking the sap from wounded portions of trees. They are common in cotton-bolls that have been injured by the boll-worm, and in decaying heaps of cotton seed. Neither the adult beetles nor the larvæ are known to eat or attack healthy fruit or living vegetable tissue. The presence of these insects, then, in the diseased and decaying cotton-bolls is not surprising, and their presence can have at least only a secondary connection with the true disease in that they may, by their burrows cause, perhaps, a more rapid spreading of the disease.

Neither the beetles nor their larvæ were to be found in all the disease cotton-bolls, but only in such as were greatly damaged by the disease having spread so as to involve nearly the entire contents of the boll and to have caused the tips of the corpels to open slightly. In such bolls I also observed several species of ordinary saprophytic fungi, and in a few cases the fungus, *Colletotrichum Gossypii*, Southworth, that produces the disease in cotton-bolls known as anthracnose.* But no fungi were observed in the bolls that were only slightly diseased or decayed inside.

The presence of fungi and insects in those cotton-bolls only that were greatly diseased and decayed inside, and that had either the tips of the carpels opened or the disease had spread so as to involve a portion of the outer surface of the bolls, together with the entire absence of insects and fungi in all cases where the disease was confined to the contents of the boll, led me to suspect the bacterial nature of the disease in question. Accordingly, pure cultures of the bacteria from the disease inside the closed cotton-bolls were then made by the usual plate culture method, and the inoculations made in both tubes of nutrient gelatine and of agar-

*See Bull. No. 41, On Some Diseases of Cotton, by G. F. Atkinson, p. 40.

agar by means of a sterilized platinum needle. In four days the growth of the bacteria in the gelatine tubes had become very profuse, and had clouded the entire mass of gelatine, giving it a slight greenish hue. The growth of the bacteria in the agar-agar tubes was different. Here the bacteria spread out as a milky cloud around the entire length of the path of the inoculating needle through the agar, and also over the surface of the agar as a more or less white, semi-transparent and glossy growth. See figure 3, which represents the growth as it appears in agar-agar tubes.

That this difference in the growth of the bacteria in the agar-agar and gelatine tubes was not due to a difference in the kind of bacteria in each was proven by the numerous cross inoculations that were made. Fresh agar-agar tubes were inoculated with the bacteria from a gelatine tube culture, and fresh gelatine tubes inoculated with the bacteria from an agar-agar tube culture, in all cases by means of a sterilized platinum needle; and in no case was there any signs of a deviation in the method of growth or apperance of the cultures peculiar to either the agar or to the gelatine as above stated.

In order to determine whether or not the bacteria of which I had made pure cultures were the cause of the disease in the cotton-bolls, I selected ten healthy cotton plants, and with a sterilized needle, I made two punctures into four healthy cotton-bolls on each of the plants, numbers 1, 3, 5, 7, 9, and labeled each boll. Then by means of the same needle, sterilized and then infected with the bacteria from the pure tube culture, I made two punctures into four healthy cotton-bolls on each of the plants, numbers 2, 4, 6, 8, 10, and labeled each boll. In twelve days all the cotton-bolls inoculated with the bacteria from the tube cultures had taken the disease in varying degrees, and in twenty days they were entirely destroyed; the entire contents of the bolls having rotted, and the outer surface to a more or less extent. On the contrary, the four bolls used as a control experiment on each of the other five plants were perfectly healthy and showed no signs of a disease, except one that had been attacked by a fungus at the place where the needle had caused an injury, thus enabling the fungus to develop there; but this boll was not affected with the disease in question.

Hence it is demonstrated that this specific bacterium was and is the cause of the disease in question.

From one of the original bolls some diseased tissue including seed was hardened in increasing strengths of alcohol, infiltrated with paraffine in the usual manner, cut into sections which were fastened to the slide by clove-oil-collodion, stained with gentian violet or with carbofuchsin, and mounted in balsam. On examination with a high power (1-24 inch Hom. Imm. Obj. of Winkel) of the microscope, most of the cells in the diseased region of the tissues were found to contain bacteria in abundance. Figure 4 represents a portion of a section of such a tissue as seen under the microscope, and is magnified 800 diameters.

Several cover-glass preparations from the pure cultures of bacteria in both agar-agar and gelatine were made and stained with either gentian violet or with carbafuchsin, and examined with the 1-24 inch Hom. Imm. The appearance of these bacteria as seen under such a high power of the microscope is shown in figure 1, which represents them as magnified 1500 diameters. When magnified equally, the bacteria in the sections of diseased tissue will be seen to be identical in appearance with those from the culture tubes.

Not being able to identify this species of bacteria with any heretofore described, I have named it

BACILLUS GOSSYPINA.

Obtained by Stedman (1893) from the inside of diseased cotton-bolls suffering from a rot of the seed and lint.

Morphology.—Short, straight bacilli, truncate with slightly rounded corners, 1.5 micron long and 0.75 micron broad; usually solitary, sometimes in pairs, and occasionally in chains of from three to four.

Stains readily with the usual aniline colors.

Biological characters.—An aërobic, non liquefying (slight liquefaction in old gelatine cultures), motile bacillus. Forms spores. Grows at the room temperature in the usual culture media, but more rapidly at 25° to 35° C. In gelatine tube cultures, the growth in three days gives a milky appearance, which spreads from the line of puncture of the inoculating needle, until in five days the entire gelatine becomes milky and assumes a slight greenish color. In agar-agar the growth on the surface appears as a smooth, semi-transparent, milky layer; while the development along the line of the puncture of the inoculating needle through the agar takes place as a cloudy, more or less even growth, gradually becoming thinner at the periphery.

Pathogenic.—Inoculated into healthy cotton-bolls, a disease resulting in a rotting or decaying of the seed and lint is produced in from one to two weeks, which soon involves the carpels, and thus destroyes the entire cotton-boll.

This new rot disease of the cotton-boll is readily distinguished from the only disease likely to be confounded with it, namely anthracnose, by the fact that the anthracnose first makes its appearance as small, reddish brown spots on the surface of the boll, which spots enlarge and become dark, gray or pink according to circumstances. Finally, when the spots have attained a considerable size, they will be found to consist of a pink centre surrounded by a dark band, and this in turn surrounded by a dull, reddish brown band. The anthracnose is caused by a fungus, *colletotrichum Gossypii, Southworth** which originates on, and is usually confined to, the carpels of the boll, and only occasionally infects the lint.

The new rot disease of the cotton-boll, on the contrary, originates within the boll, and does not make itself visible, as a rule, until the entire or nearly entire contents of the boll has become involved and decayed, when the carpels may become affected and show signs of decay in places. The cotton-boll rot is caused by a bacterium, *Bacillus gossypina, Stedman,* and first appears as a small black or dark brown area on some of the young and developing seed and lint inside the boll near the petiole. This area gradually enlarges and causes the affected parts of the seed and

* See Bull. No. 41, On "Some Diseases of Cotton," by G. F. Atkinson p. 40.

lint to decay or rot, and ultimately spreads so as to involve all the seed and lint within the boll, and may then even affect portions of the carpels. Figure 2 shows a diseased boll cut open, the seed and lint being affected. If the boll becomes diseased early in its growth, say four weeks before it is ripe, the disease will cause the entire boll to rot before the carpels can open at all. If, however, the disease appears later, when the boll is full size or nearly so, and the seed and lint nearly developed, the carpels may open or separate slightly at the tips, and thus admit the small sap-beetles that will enter and feed upon and breed in the decaying contents of the boll, and thus help to disentegrate it. Saprophytic and other fungi finding here a suitable pabulum may now appear and infest the decaying boll. Of course these diseased bolls can never mature lint or seed.

Should the disease appear still later when the boll has partially opened, or is nearly ready to open, the rot may affect only a few seed and a small portion of the lint before the boll opens and dries. In this case the boll would appear nearly normal and a large portion of the lint and seed would be perfect, especially that exposed to view, while that nearest the petiole would be affected. This is really the most serious condition so far as the cotton growers at large are concerned, since it is probably here that the great danger of spreading the disease to unaffected areas is to be found. In the other cases the contents of the boll is either wholly or more or less destroyed, and the boll fails to mature or develop lint; and if it opens it is but slight, and the boll is known to be diseased or imperfect and is never picked. But when the disease is so slight as to allow picking, the effected seed and lint is mixed unconsciously and taken to the gin, where the seed becomes mixed with seed from unaffected district; and thus all the seed that passes through the gin is liable to be infested with the germs of the rot disease, and finally to become distributed to distant parts of the country. Too great a precaution in regard to this method of spreading the disease can not be taken. The cause of the disease has been shown to be a micro-organism (bacteria) of extreme minuteness, and one that is found in innumerable numbers in the diseased tissues; and since the presence of a single one of these bacteria may cause the disease, we should guard against dangers of contamination.

Although it has never been demonstrated, yet it seems probable that the bacteria present in the diseased seed, lint and carpels, after they fall to the ground and become disentegrated, are eliberated and find their way to the roots of the cotton plant which they enter, and pass up through the plant to the bolls, inside of which they find conditions suitable for their development. Or the seed may be unaffected but the lint left attached to it may contain the bacteria which would thus be in close connection with the young cotton plant when it germinates, and then could find its way into the roots. And it also seems very probable that those seed which are affected with the bacteria, but not in sufficient quantities to prevent their germination, may produce young plants with the rot bacteria already within their tissues (seed leaves), and thus these bacteria may then easily find their way into the bolls when they appear. But it seems to me even more probable that the bacteria are carried by the wind or insects from the soil to the flowers, where they remain attached to the moist and viscid stigma or in the nectar; and that they not only thus readily find their way into the young and developing bolls, but that they even multiply in the nectar or on the stigma; and that the insects which visit the flowers are thus contaminated and inoculate other flowers. This seems even more probable since we know of certain other bacterial diseases of plants, as pear blight, that is thus carried from one tree to another, and from one flower to another on the same tree. This explanation of the spread of the disease helps us over one difficulty, namely, the fact that the disease is principally confined to the middle and top crop. For if the bacteria are in the young cotton plant before the bolls are formed, one would expect the first or lower crop to be equally affected. If the bacteria enter by way of the flowers, we could explain the scarcity of the disease in the lower or first crop of bolls by the supposition, that the insect which carries the disease from one flower to another does not appear until the flowers of the middle crop are beginning to open. The lower crop would have simply the wind to introduce the disease, while the middle and top crop would have in addition the greater agency, insects. An effort will be made this summer to determine whether or not the bacteria do normally enter the bolls through the flower, and also to determine the insects which carry the disease from one flower to another. Experiments are now being conducted to determine the truth of the other four supposed methods of the distribution and entrance of the bacteria into the interior of the cotton-bolls.

So far as my observations and experiments are concerned, I have never been able to induce the rot bacteria to develop the disease or cause pathological disturbances in any part of the cotton plant other than the interior of the bolls, although they will live and even multiply to a slight extent within the tissues of the other parts of the plant.

All the facts in the case go to show that the cotton plants naturally become affected either by the rot bacteria entering the roots from the soil, or that the plants begin their existence as affected ones by the bacteria having entered the cotyledons (seed leaves) of the seed while still within the boll, or that the bacteria are carried by the wind or insects from the soil to the flowers, and from one flower to another, and enter the bolls in this way. It hardly seems probable that the bacteria could be blown by the wind or carried by other agencies upon the surface of the cotton-bolls and enter by that route, since the rot disease always makes its first appearance as a small diseased area of the seed and lint inside the boll near the petiole, and only later involves the carpels, and makes itself apparent on the exterior. Nevertheless, the bacteria may enter in this way and migrate to the seeds, for we have no definite proof to the contrary.

The rot disease seems to be principally confined to the middle and top crop, and makes itself manifest to the ordinary observer about the first of August. It is usually pretty evenly distributed over a field, and as yet is not as troublesome to river plantations as to high lands. That this rot disease is a very important one can be seen from the fact that it is damaging the cotton crop to the extent of 35% in certain parts of the State, and is on the increase and spreading. Mr. A. W. Bryant writes me that he has counted as many as nineteen diseased bolls on one stalk, and there were no doubt many more that were not diseased enough to appear on the exterior.

As regards the remedies and precautions to be taken in fighting this disease, it will be readily understood from the nature of the disease as above described, that the remedy must be a preventive one; and that we can not resort to any thing like spraying the plants with a fungicide or other chemicals, since we would kill the plants before the seat of the disease could be reached. We can then do nothing towards curing a boll once diseased, but we may help the cotton plant as a whole, and lessen the chances of having other bolls diseased, if we will remove the diseased bolls. But since the bacteria in the diseased tissues are not readily killed by such natural means as cold of winter or heat of summer, drying or becoming wet, nor by the decaying of the tissues in which they are found, but are simply eliberated and thus allowed to work through the soil to infest other cotton plants, we must, therefore, carefully preserve the diseased bolls and burn them, and not allow one to fall to the ground and remain there. If the diseased bolls are not picked and burned, but are simply allowed to remain on the cotton plant, they will sooner or later fall to the ground, and thus distribute millions of new bacteria in the soil, and rapidly increase the chances of having diseased bolls next season. It will not answer to leave the diseased bolls on the stalk after the cotton is picked, since the rain will wash the decayed and affected interior of the bolls out, and distribute it upon the soil. The diseased cotton-bolls should all be picked off and burned just as soon as discovered, or at least during the first picking of the lint, and ever afterwards as discovered.

It is a simple matter to carry a second bag in connection with the one used in picking lint, and to place in the second bag all diseased bolls as discovered, and to put them into small heaps and burn them. By this means the rot disease can be greatly lessened. Of course all cotton that appears to be imperfect in the boll should be glanced at, to see that it is not diseased farther in the boll, before it is placed with the good lint, otherwise diseased seeds will find their way to the gin and be distributed and planted.

When the cotton field is badly affected with the cotton-boll rot disease, it would be advisable to plant some other crop there for two years, and to use other fields previously occupied by a different crop for the raising of cotton. In this way the bacteria in question might be gotton rid of.

We may sum up briefly as follows :

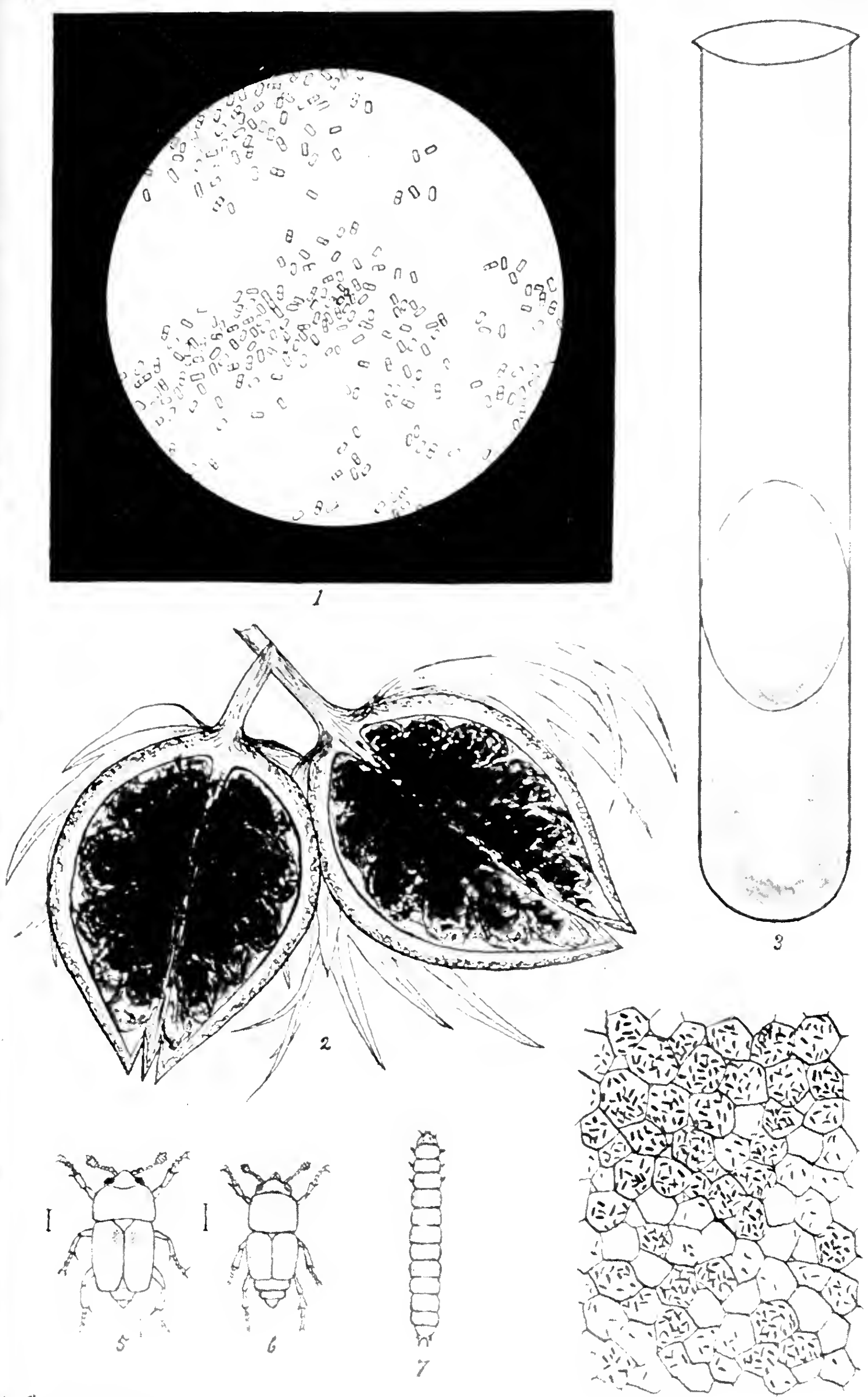
a. The *cotton-boll rot disease* is caused by a bacterium (*Bacillus gossypina, Stedman*) which works within the boll, causing its contents (seed and lint) to decay And since the bacteria are inside the tissues, it would be unless to spray the plant with any chemicals at present known, since we would kill the plant before the diseased region could be reached.

b. The disease is multiplied in and carried from one crop of cotton to another, and also to unaffected areas, by means of the diseased tissues, with probably the help of the wind and insects.

c. The bacteria may possibly enter the cotton plant from the soil, through the roots, although it is possible they may enter through the epidermis of the boll; but more probably they were already in the seed-leaves of the seed, or enter the bolls from the flower.

d. All diseased cotton-bolls should be picked off and *burned* just as soon as discovered, or at least while the lint is being gathered, and the field gone over again immediately after the last picking of the lint.

e. Cotton seed coming from a gin known to have ginned cotton from an affected district should not be planted in unaffected districts.



J. M. Stedman Del.

Bulletin No. 56, : : May, 1894.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

Experiments in Crossing for the Purpose of Improving the Cotton Fiber.

P. H. MELL, BOTANIST.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

All communications should be addressed to

EXPERIMENT STATION, AUBURN, ALA.

Published by order of the Board of Direction.

BROWN PRINTING CO., STATE PRINTERS, MONTGOMERY, ALA.

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INTRODUCTION.

In as much as this bulletin is prepared largely for the benefit of the farmer, who is but little versed in botanical literature, scientific terms have been carefully avoided where simple language will intelligibly convey the information desired without destroying scientific accuracy.

There are also some remarks presented on the subject of plant growth, with which all botanists are familiar; but it is deemed best to submit them in this connection in order to make the topic under discussion more clear to the farmer, and, therefore, no other apology is necessary for reprinting these well known principles of botanical knowledge.

The author of this bulletin makes no claim to new discoveries; and, although problems have been presented for solution, little more than an introduction to future investigations on the subject under consideration, has been attempted. The effort has been made to give an intelligent account of how the cotton plant might be developed so as to force it to yield the planter the greatest remuneration for his labor. Nature has been carefully followed, as far as her works have been understood, and all theories have been eliminated. The bulletin is intended to be one of facts and not of theories.

The conclusions submitted are based on the results of investigations extending over a period of three years. Several hundred crosses were successfully made, and the developments from year to year carefully watched and studied. A large amount of microscopic work was required to determine the transformation of the fiber.

The following represent the so-called varieties used in the experiments:

Allen's long staple, Bailey, Barnett, Cherry's cluster, W. A. Cook, J. C. Cook, Dixon, Gold Dust, Hawkins' improved, Herlong, Hunnicutt, Jones' improved, Jones' long staple, Keith, T. J. King, Okra leaf, Peeler, Peerless, Peterkin, Petit Gulf, Rameses, Rust proof, Storm proof, Southern Hope, Truitt, Welborn's Pet, Wonderful, Zellner.

The following species, included in the table of results, were also planted the past season to acclimate them for future experiments:

Two Egyptian types, "*Mit-Afifi*," and "*Bamieh;*" *Nankin; Sea Island.* The name, "Mit-Afifi," is derived from a village in Egypt, near which place a Greek merchant first discovered this variety of cotton. The form closely resembles the Sea Island in many particulars, although it is distinct enough to be determined a separate species. This cotton is very highly thought of by the Egyptian planters and is extensively cultivated by them. The staple has a light brown tinge and is long and moderately strong. The seed are black, and, with the exception of a bluish tuft at the extremity, they are smooth. The plants grew on the college farm at Auburn, Alabama, to the height of twelve feet. The leaves are large, three to five lobed and dark green in color. The stem is more or less branched with three or four bolls at each joint of the branch. The bolls are small, slender and pointed, and divided into three cells or carpels. The flowers are bright yellow with a red spot at the base of each of the five petals. This plant seems to be a variety of *Gossypium Braziliense.* The "Bamieh" is about as valuable as the Afifi in the development and strength of the fiber. The plant is tall, reaching a height of ten feet. The leaves are dark green with red veins, very large and five lobed. The bolls grow on slender stalks, six inches in length, attached to the main stem. There are no limbs. The divisions of the bolls are three, and, in some cases, four in number. The involucre is very prominent, almost covering the boll. The flowers are bright yellow with a red spot at the base of each of the five petals. Cotton caterpillars refuse to attack these plants, although all the ordinary plants around them were stripped of their leaves.

THE PLAN OF THE COTTON FLOWER AND THE METHOD ADOPTED BY NATURE FOR MATURING THE SEED.

In entering upon the prosecution of any work we must first have an adequate conception of the nature of the object upon which we propose to experiment. Few people, who cultivate the cotton, can give an intelligent description of the plant and the methods used by it for maturing its seeds. Not many persons understand that the fiber consists of elongated cells growing from the outer surface of the seed-coat. Yet these very parties are amazed when they fail to make the plant accomplish what is so readily secured under the management of a more intelligent and careful agriculturist—the farmer who studies all the peculiarities of the plant, watching each development as it is unfolded under the guidance of natural laws. To the observant man it may be unnecessary to say that the best developed flower on the healthiest plant will produce the best staple. It is not the fast growing plant, greatly multiplied in leaf and wood surface, that is apt to produce the best matured flowers and bolls. The food necessary for all the demands of a healthy flower must come to it unstinted. If it is diverted from its flow by the demands of rapidly growing leaves and wood the generative organs must suffer, and this deficiency of food may cause the flower to wither and fall off—at least it will dwarf the organs and result in immature bolls.

Before proceeding to discuss the results of the experiments secured in the cross-fertilization of the cotton it may be best to describe the construction of the flower for the benefit of some of my readers who are not well acquainted with the working of this organ. This knowledge is necessary to a correct understanding of the experiments, the results of which are given in this bulletin. The flower consists of five separate sets of organs. 1. An outside green circle of three leaves, called *involucre* (see *a* fig. 1), the leaflets of which are united and heartshaped at the base, deeply incised, and remain in contact with the boll during its entire growth. The peculiar shape of these forms gives the name "square" to the young buds. 2. An inner circle of cup shaped leaves, obtusely five toothed, called *calyx*, the divisions of which are termed *sepals*. These forms are not visible in the fig. 3. Just inside the calyx cup is another circle of leaves called *corolla*, divided into five *petals* (see *b* fig. 1). The petals are generally of a delicate cream color when they first unfold from the bud, but in a few hours they change to deep red, after which they wither and fall off. These outside circles of leaves are termed the *non-essential* organs, because they simply serve a secondary purpose in the development of the seed—they are in fact the *protecting* organs for the delicate germ. 4. The next set of organs is called *stamens;* they are found crowded in large numbers around, and growing upon, the *pistil* (see *a* fig. 2). These stamens produce the male function, called *pollen*, which has the appearance, to the unassisted eye, of a mass of fine yellow powder. A grain has been greatly enlarged in fig. 3. Without the presence of

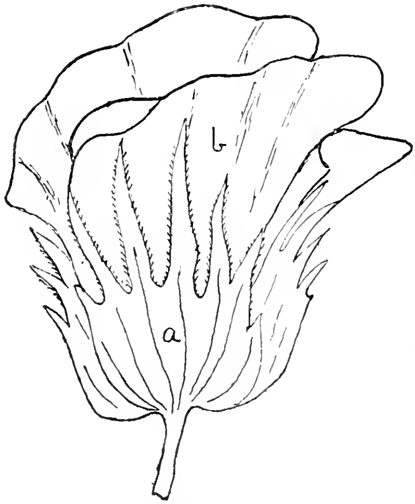

Fig 1

P. H. Mell Del.

this pollen the seed cannot be produced. 5. The *pistil* (bd fig. 2), is the female organ, and there are three to five in each flower, united and twisted around each other. The pistil consists of three parts: (1) *stigma b*, to which the pollen is first attached after it leaves the stamens; (2) the *style*, a slender shaft separating the stigma from the (3) *ovary d*. The ovary, after fertilization with pollen, forms the boll in which the seed and fiber are found.

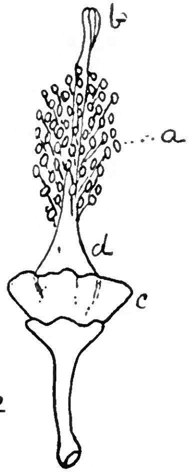

Fig 2

Sea Island Pistil.
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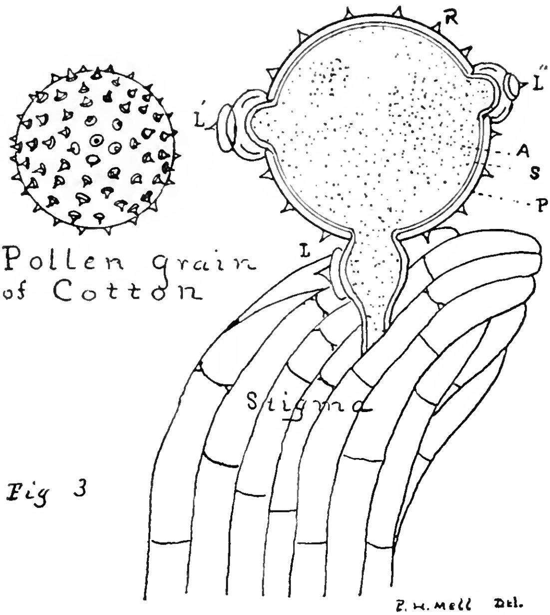
Now a few words as to the action of the pollen grains after they find lodgment on the stigma or female organ. A cotton pollen grain is a sphere covered with two coatings, or thin membranes, inside of which is a mass of matter (A fig. 3), that carries the male principle. The coat, P, has



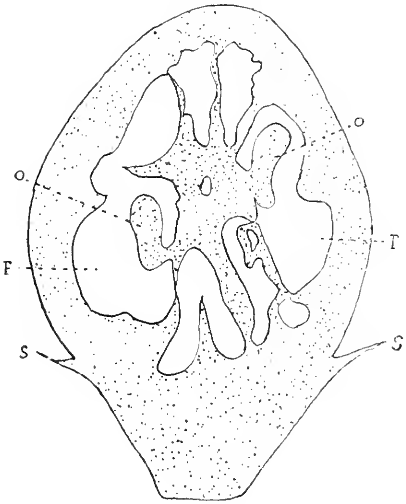
Pollen grain of Cotton

Fig 3

P. H. Mell Del.

a number of circular openings closed by lids, L, L', L'', R, underneath which the inner membrane, S, is thickened. When the flower opens in early morning the pistil exudes a quantity of sticky fluid on and about the numerous fine hairs growing on the stigma, by means of which the pollen grains are caught when transported by the wind and insects. Very soon after the pollen lodges on the pistil, the lid, L fig. 3, is thrown aside by the growing of the inner membrane coat, S, into a tube. This tube pushes its way between the tissues of the stigma down the style and into the ovary at d fig. 2, where the end of the tube opens and the female germ becomes fertilized, thus producing the seed. The most remarkable fact in regard to this matter is the rapid growth of the pollen tube in such a short time, because the work must be accomplished in twenty-four hours.

Shortly after the fertilization has taken place in the ovary, the petals, stamens and the upper portions of the pistil wither and fall off, leaving the ovary and its surrounding involucre leaves. This ovary, as has been already stated, is the young boll containing the rapidly growing seeds with their fiber coatings. A section of a half grown boll is given in fig. 4. This is a longitudinal section showing seeds at oo, and the cells (or *carpels*) FF which will be filled with the staple when the boll is complete in its growth. SS represent the calyx. The involucre is not shown in the drawing.

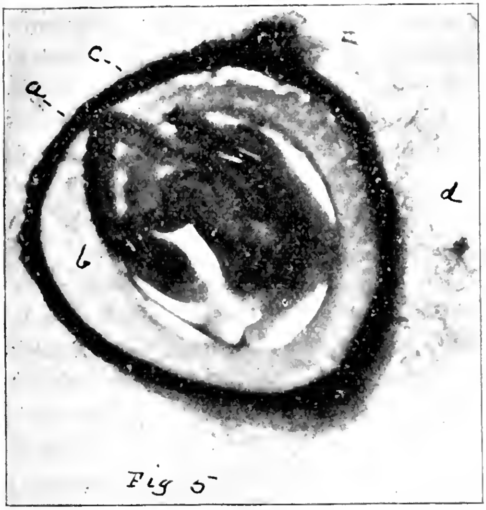


Section of Ovary.

Fig 4

P. H. Mell Del.

Fig. 5 is a cross section of the seed exhibiting the young germ or plant at *a*: the food stored up for its use at *b*; and the fiber *d* growing from the outer surface of the seed coat *e*. When the germ *a* begins to enlarge under the influence of the moisture of the soil and the invigorating power of the sun's rays, it breaks the coat or "hull" *e* and starts with its leaves towards the light. In this young stage of its growth it lives upon the delicate food prepared and stored up by its parent plant at *b*. When this food is exhausted the young plant is old enough to take care of itself and drink in through its roots and assimilate the food materials from the soil in which it is growing.



It will be readily understood from the foregoing how important it is to have pollen grains of the best character and a well developed pistil, if we expect to secure high grade fiber. Inferior plants cannot produce healthy organs and superior seed, any more than inferior grades of stock can produce fine blooded cows and horses. So little attention is paid to this subject by planters generally no comparative estimate can be made on the results after the seed are planted. The farmer does not know whether the seed came from first-class plants or not; whether they are good, bad or indifferent. No attempt is made to select the seed, but good, bad and worthless are planted in the drill together. When the plants are ready to bloom the inferior as well as the superior individuals are permitted to grow side by side, while the insects and winds are busy blending the two together by means of the transmitted pollen, and, of course, the healthy plants suffer to the advantage of the inferior forms. The seed thus produced become greatly deteriorated in the course of a few years, and the farmer is ready to heap denunciations on the head of the man from whom he bought the improved seed a few years before, at a high price. It does not pay to cultivate inferior grades of cotton in the neighboring fields where improved cotton is growing. Insects will soon transmit pollen from one grade to the other so as to cause the fine seed to greatly lose its vitality and superior qualities, and soon cause it to retrograde to the original inferior stock from which it had been improved. An intelligent, observant man, standing in a cotton field during a bright, warm morning, in July or August, will notice humming birds and many insects busy flying from flower to flower sucking the nectar for food. A close examination of the bodies of these insects will disclose the fact that over them is scattered quantities of pollen. When the insect crowds down into the corolla cup to reach the nectar at its base, the pollen on its body is attached to the stigma and fertilization is accomplished. Now if the insect has visited the flowers of inferior grades of cotton before reaching the improved flower, the inferior pollen will have a chance to put in its effects on the germ of the improved cotton. *All seed should be carefully selected each season; and inferior plants noted in the field should be rooted out before they begin to bloom.*

With these facts concerning the development of the flower well understood we are prepared to enter upon the discussion of the results secured from the experiments in crossing.

METHODS ADOPTED IN THE FIELD FOR PRODUCING THE CROSSING.

The term "crossing" in botany signifies the blending of two varieties of the same species by transmitting the pollen of the flower of one form to the pistil of the other. In this manner the peculiar properties of both varieties are united in a new offspring, and results of special advantage are often secured.

In the experiments conducted at Auburn the "W. A. Cook" and "Peerless" varieties were selected to carry the female function, because these plants had distinctive and desirable features which were strongly marked; and a stable basis was thus offered upon which to develop the future improved bolls.

Having succeeded in raising strong and healthy plants of all the varieties mentioned in another part of this bulletin, a number of flowers on the best plants of the W. A. Cook and Peerless were prepared in the following manner, on an evening just before sundown, when there was no indication of rain for at least forty-eight hours:

The buds on the most mature limbs were selected, the petals of which would fully expand during the early hours of the next morning, and by means of small scissors these petals (*b* fig. 1) were cut off just above their bases, thus exposing the stamens and pistils fully to view. The stamens (*a* fig. 2) were then carefully removed by means of a pair of forceps, without bruising the pistil. Thus denuded of all male organs the pistil was covered with a thin paper bag, as a protection against the wind and insects, and left until next morning by which time it was fully developed with all its functions ready for the reception of the pollen. A healthy flower from a plant of another variety was plucked next morning and carried to the flower prepared the afternoon before, and, by means of a small soft brush, the pollen was dusted on the stigma (*b* fig. 2) of the pistil. The bag was replaced and carefully fastened around the limb so as to prevent any possibility of pollen from any other source being introduced upon the pistil. A tag, properly labeled, was suspended at the base of the flower for future reference. After two or three days this bag was taken off and the new boll left to grow under the influence of the sun's rays. Many hundreds of these bolls were grown, the fiber gathered and the seed carefully selected and planted the following season. The seeds were again gathered, carefully selected and planted the third season. The fiber of the last planting was then subjected to the most rigid examination under the microscope and submitted to severe tests to determine its valuable and weak properties.

The strands of fiber, as already stated, are elongated tubes growing from the outer surface of the seed coat. In their young state they are filled with a fluid, but as maturity advances this fluid disappears, the walls of the tube collapse, and a twisted form is assumed which is more and more complete as the development of the tube approaches perfection. The value of the staple is largely controlled by the degree of this twist; and this property also enables the spinner to manipulate the fiber to the best advantage.

Now, in as much as the fiber is a portion of the seed coat, the full and perfect maturity of the seed will also produce in the staple a complete twist and maximum degree of strength. The plant, therefore, in all its stages should be closely watched and carefully studied in order to fully understand its peculiar properties—what characteristics are desirable and what are objectionable. Two varieties of the same species, well understood, should be blended, in the manner already indicated, so as to intensify the desirable traits and greatly diminish the inferior qualities. For instance, if the male organ on one plant matures fine grades of pollen, and the female organ is healthy and well developed on the other, the blending of the two will tend to improve the resulting form. A careful selection of the seed, planting only the best, will still further aid in producing superior results.

In conducting the experiments at Auburn special importance has been placed on eliminating all objectionable and weak forms, as progress is made, and in intensifying the strong features until the best types are firmly established. The fact has been borne in mind at all times that no satisfactory results could be secured from this work unless the plants under investigation were cultivated far removed from inferior grades of cotton.

SOME OF THE PROBLEMS TO BE SOLVED.

1. Are all the so-called "varieties" of cotton grown in the South entitled to separate names?

2. How many species of the *Gossypium* are cultivated in the cotton-belt? Are the upland forms—so-called "Upland Cotton"—true species or are they hybrids, the product of blending two or more distinct species during the long period of years in which the cotton has been cultivated in the South?

3. In "improving" the cotton plant is the fiber strengthened and developed, or is there simply an increase in the size of the plant to the detriment of the fiber? Is it not often the case that the fiber is weakened and damaged by forcing the plant, as we sometimes notice is the case when certain forms of fruits are forced to ripen earlier than the usual period, causing the outside coating to mature before the inferior is thoroughly developed?

4. At what stage of growth of the boll does the fiber attain its full development?

5. What are the properties of a well formed cotton fiber?

Some of these problems are not yet fully answered by the results so far secured, but valuable information has been obtained on all the questions propounded, and, in some instances, decided answers will be rendered.

1. Are all the "so-called" varieties entitled to separate names?

This question seems to be answered in the following classification of these "varieties."

(1) Short staple forms, under 1.2 inches:

Bailey, Barnett, Cherry's cluster, J. C. Cook, Dixon, Gold dust, Hawkins' improved, Herlong, Hunnicutt, Jones' improved, Keith, King, Okra leaf, Peeler, Peerless, Peterkin, Petit gulf, Rust proof, Rameses, Southern hope, Storm proof, Truitt, Welborn's pet, Zellner.

(2) Long staple, 1.3 inches and above:

Allen's long staple, W. A. Cook, Jones' long staple, Wonderful.

(3) Prolific forms:

Allen's long staple, Bailey, Barnett, Cherry's cluster, W. A. Cook, Dixon, Gold dust, Hawkins' improved, Herlong, Hunnicutt, Jones' improved, Keith, King, Okra leaf, Peerless, Truitt, Welborn's pet, Wonderful.

(4) Non-prolific:

J. C. Cook, Jones' long staple, Peeler, Peterkin, Petit gulf, Storm proof, Southern hope, Zellner.

(5) Those forms which have leaves alike:

Allen's long staple, Cherry's cluster, Dixon, Jones' improved, Jones' long staple, Gold dust, Hunnicutt, Keith, King, Peeler, Truitt, Wonderful, Zellner. (Three to five lobed leaves.)

W. A. Cook, Hawkins' improved, Peerless, Petit gulf, Southern hope, Storm proof, Welborn's pet. (Four to five lobed leaves.)

(6) Long limbed forms:

Allen's long staple, J. C. Cook, Gold dust, Herlong, Hunnicutt, Jones' long staple, King, Peeler, Peerless, Peterkin, Petit gulf, Rameses, Southern hope, Truitt, Wonderful, Zellner.

(7) Short limbed forms:

Bailey, Barnett, Cherry's cluster, W. A. Cook, Dixon, Hawkins' improved, Jones' improved, Keith, Okra leaf, Storm proof, Welborn's pet.

(8) Clustered varieties:

Cherry's cluster, Herlong, Peerless, Welborn's pet.

(9) Large boll varieties:

Allen's long staple, W. A. Cook, Hawkins' improved, Hunnicutt, Jones' long staple, Wonderful.

(10) Medium and small varieties:

Bailey, Barnett, Cherry's cluster, J. C. Cook, Dixon, Gold dust, Herlong, Jones' improved, Keith, King, Okra leaf, Peeler, Peerless, Peterkin, Petit gulf, Rameses, Southern hope, Storm proof, Truitt, Welborn's pet, Zellner.

(11) The dark, smooth seed forms:
Bailey.
(12) The furry, dark and small seed forms:
J. C. Cook, Petit gulf.
(13) The large light brown, furry seed forms:
Allen's long staple, W. A. Cook, Gold dust, Hawkins' improved, Hunnicutt, Jones' long staple, Keith, King, Peeler, Peerless, Peterkin, Rameses, Southern hope, Storm proof, Truitt, Welborn's pet, Wonderful, Zellner.
(14) The small, light brown, furry seed forms:
Barnett, Cherry's cluster, Dixon, Herlong, Jones' improved, Okra leaf.

Selecting from the above classification those forms which have features alike, we may rearrange our plants into the following seven groups:

1. Allen's long staple, W. A. Cook, Hunnicutt, Jones' long staple, Wonderful.
2. Bailey, Okra leaf.
3. Cherry's cluster, Herlong, Peerless, Welborn's pet.
4. J. C. Cook.
5. Barnett, Dixon, Hawkins' improved, Jones' improved, Keith, King, Rameses, Truitt.
6. Gold dust.
7. Peterkin, Peeler, Petit gulf, Storm proof, Southern hope, Zellner.

It may not be far wrong to assert that each of the many so-called varieties now on the market belong to one of these groups; and, in a number of instances, coming under the observation of the writer, the "new cotton" has no right to a new name, but is only an improved production of seed under an excellent system of cultivation and selection from year to year.

The second problem in our investigations, viz.: How many species of the gossypium are cultivated in the cotton belt, &c., is quite difficult to solve with the present data at hand. We may say, however, that indications point to the presence of the following species at least:

Gossypium herbaceum, L.: *gossypium roseum*, Tod: *gossypium nankin*, Mey: *gossypium Mexicanum*, Tod: *gossypium maritimum*, Tod: *gossypium hirsutum*, Mill: *gossypium barbadense*, Linn.

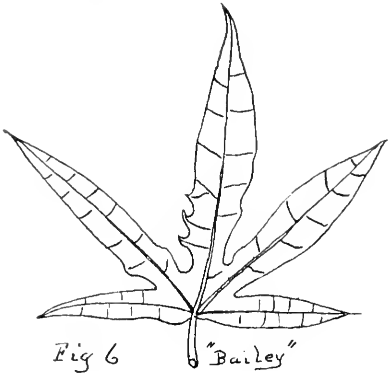


Fig 6 "Bailey"

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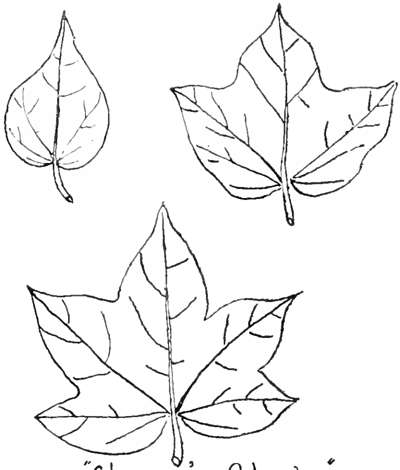
Some of these have been blended and intercrossed to such a degree as to almost conceal the distinctive features of each species. There is strong reason to suppose that the "upland cotton" is a hybrid produced by blending the properties of several species, under the cultivation of a long series of years. For instance the Bailey and Okra leaf varieties seem to be the offsprings from the *gossypium maritimum Tod*, and *g. roseum Tod.* They have the Sea Island properties in the small black, smooth seed, the long fiber and the deep lobing of the leaves. Cherry's cluster, and other forms like it, have properties resembling *gossypium Wightianum* Tod, *g. Mexicanum* Tod, and *g. maritimum* Tod. Cotton has been cultivated in the South for such a long period, and seed from so many different sources have been planted in such near localities to each other, every opportu-



"Cherry's Cluster"
Fig 7

P. H. Mell Del

nity has been presented for favorable hybridizing, and in the repeated replanting of these seed year after year, the types have been well established. It becomes, therefore, a difficult problem to determine from what kind of species the individuals are derived. Investigations will be continued on this line and it is hoped that future results will warrant a more decided answer to the problem.

Fig 8

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Figures 6, 7, 8, and 9, show the forms of the leaves grown on the plants cultivated at Auburn for our experiments, and they also represent the number of species. It may not be far wrong to say that they also give us the majority, if not all, the types grown in the South. If this position is correct these leaves will be of some interest in enabling us to answer the problem concerning the number of species now found in the cotton belt.

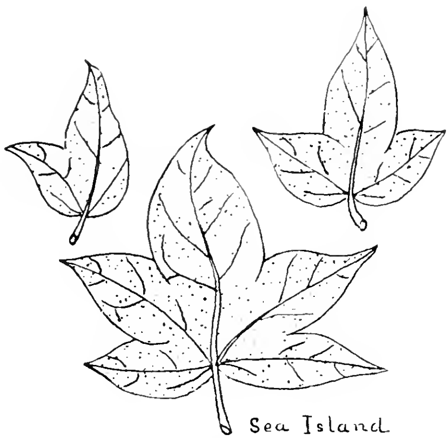


Fig 9

R. H. Mell Del

In a future bulletin this subject of the identification of the cotton will be more fully and definitely treated.

3. *In improving the cotton plant is the fiber strengthened and developed, or is there simply an increase in the size of the plant to the detriment of the fiber?*

The experiments seem to give an unmistakable answer to this question. It was only on those plants which were large, strong and healthy that the best condition of the fiber was secured. But, this being true, it was noticed on the other hand, that on those plants where there was a very rapid growth of wood-limbs and leaves there was a diminution in the number of flowers. This was caused, no doubt, by the great draft on the supply of sap to satisfy the demand of these growing parts. All things being equal, therefore, it is safe to say that the best condition of the fiber will be secured by a steady, constant growth of the plant in all its parts. It should not be stunted or retarded for lack of proper fertilization and cultivation, but every demand should be met so that a vigorous growth will be secured in all the functions of the plant. Nature often needs assistance to enable her to do her best work, particularly in her attempt to accomplish healthy results in the poor soils so prevalent throughout the cotton belt. The plant must be fed with the same judicious care that the stockman bestows upon animals under his intelligent management. It must be equally fed for wood-making, leaf development and seed maturity. And these ends can only be reached through painstaking care and observation of all stages of the plant growth and development.

The experiments conducted at Auburn give conclusive evidence that the improvement of the cotton plant under the influence of the crossing processes does not deteriorate the fiber, but tends greatly towards making it superior in its properties. There was no effort made to force the plant in its growth, but every inducement was offered it to perfect itself in all its functions. In the careful examinations made of the cotton stalk in the field it was noticed that on those plants which were strong and vigorous from the start and grew slowly to large, well developed stalks the flowers were larger, brighter in color and the bolls were also well formed and healthy in looks. The resulting fiber, of course, under such conditions, was possessed of the best qualities. The twenty-eight best forms given in another part of this bulletin (page 21) were large, finely developed plants that were well fruited, and in all respects healthy and vigorous.

The experiments are not yet far enough advanced to answer the fourth question, and it will, therefore, be deferred until progress will warrant the printing of another bulletin on this subject.

5. *What are the properties of a well formed cotton fiber? and how near do the crossed forms in this bulletin approach the perfect condition?*

Experience has proven that the perfect staple must have—

(1) Complete maturity throughout the entire length.
(2) Uniform twist from end to end.
(3) Uniform width in all parts.
(4) Maximum length.
(5) Purity in color.

The table of results show that the crosses, in nearly every instance, have improved the condition of the cotton, and, in some individuals, remarkably so. The length of the fiber has been increased in numerous cases, and the strength almost doubled. It is true that the percentage of fiber is not as great as we would desire, but this is due to the increased size of the seed. Both female forms on which the crosses were made, are large seed varieties and the resulting cross would naturally tend towards an increased size in the portion of the plant. Experiments may enable us to raise the percentage of the fiber after the seed-coat has been evolved into a stable, healthy condition. It may be noticed, however, that although the percentage of fiber in the crossed plants is smaller than that produced by the originals, still, the actual weight of the former is frequently nearly double that of the latter.

After a careful study of the tables in this bulletin the following plants have been selected because they seem to sustain in great measure the best traits of superior grades of fiber, viz., strength, maturity, length, twist and purity of color. These are named in the order of their superiority, and, in some cases, they show a remarkable degree of development from the original forms. For instance, the cross resulting from blending Barnett and Peerless, the first mentioned in the list following, shows certain decided improvements that are interesting. The number of seed to each boll increased from 27 in Barnett and 42 in Peerless (or an average of 34.5) to 38 in the crossed plant. The increase in weight of seed is from 3.115 grammes in Barnett, 3.217 grammes in Peerless to 4.866 grammes in the crossed plant, or a gain of 1.700 over the average results of the two originals. In the case of the fiber the weight has increased over the original forms in the following manner: Barnett, 1.737 grammes; Peerless, 1.751 grammes, and the crossed plant, 2.244 grammes, or an increase of 0.500 of a gramme over the average results of the originals. These facts are quite interesting, because they show the possibility of wonderful results if the experiments of crossing are continued far enough to established these tendencies towards perfected forms of development. If nothing else is gained than simply an increased length in the fiber with maturity in twist the results of the investigations will more than repay the amount of work and time expended.

The table on pages 22 and 23 was prepared to show more strikingly the decided improvement secured over the original varieties, and some most remarkable and interesting facts are shown in this comparison. The marked improvement in every instance establishes beyond doubt the importance of the experiments, the results of which are submitted in this bulletin.

TABLE I.

Twenty-eight of the best forms of cotton produced by the crossing process. Named in order of superiority.

No.*	Names.	Strength.†	Maturity.	Length.‡	Twist.
12	Barnett on Peerless	14.57	Excellent	1.6	Excellent.
70	Truitt on Peerless	14.14	Very good	1.1	Excellent.
14	Cherry's Cluster on Cook	13.08	Very good	1.3	Excellent.
56	Petit Gulf on Peerless	13.04	Good	0.9	Good.
43	King on Cook	12.79	Good	1.0	Excellent.
58	Rust Proof on Peerless	12.58	Very good	1.0	Very good.
54	Peterkin on Peerless	12.46	Excellent	1.1	Excellent.
76	Wonderful on Peerless	12.44	Excellent	1.2	Excellent.
55	Petit Gulf on Cook	11.96	Good	0.9	Good.
2	Allens long staple on Peerless	11.95	Good	1.3	Very good.
79	Wonderful on Peerless	10.79	Very Good	1.2	Very good.
74	Welborns pet on Peerless	10.75	Excellent	0.9	Excellent.
38	Jones' long staple on Peerless	11.71	Good	1.2	Good.
51	Peerless on Cook	11.56	Very good	1.4	Good.
83	Zellner on Cook	11.56	Very good	1.4	Very good.
46	Okra leaf on Peerless	11.32	Good	1.1	Very good.
77	Wonderful on Peerless	11.28	Excellent	1.0	Excellent.
3	Allen's long staple on Peerless	11.04	Good	1.3	Good.
49	Peeler on Peerless	10.97	Good	1.2	Good.
33	Hawkins' improved on Peerless	10.89	Very good	1.2	Excellent.
71	Truitt on Cook	10.78	Excellent	1.2	Excellent.
19	J. C. Cook on Peerless	10.55	Good	1.4	Good.
15	Cherry's cluster on Cook	10.51	Excellent	1.2	Excellent.
37	Jones' improved on Peerless	10.39	Very good	1.2	Good.
7	Bailey on Cook	10.27	Good	1.2	Good.
11	Barnett on Cook	10.21	Good	1.4	Good.
50	Peeler on Cook	10.06	Very good	1.4	Very good.
47	Peeler on Peerless	10.05	Good	1.4	Very good.

* The numbers in this column are the same found in Table IV—first column. † The measurements of strength are in grammes (a gramme is equivalent to 15.4 grains). ‡ The length is determined in inches.

TABLE II.

Comparison between the Original Plants and 25 of the Best Improved Forms.

Numbers (Table IV.)	Name of Plant.	Number Seed.	Wt. Seed in grammes	Wt. Lint in grammes.	Per cent. Seed.	Per cent. Lint.	Length of Fiber in inches.	Diameter of Fiber in millimeters.	Character of Twist.	Max. strain for breaking one strand in grammes.	Min. strain for breaking one strand in grammes.
12	**Barnett on Peerless**	**38**	**4.866**	**2.244**	**68.4**	**31.6**	**1.10**	**0.022**	Excellent	**14.99**	**13.95**
	Peerless	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**34.5**	**3.166**	**1.744**	**64.5**	**35.5**	**0.94**	**0.020**			
	Barnett	27	3.115	1.737	64.2	35.8	1.00	0.020	Fair.		
70	**Truitt on Peerless**	**37**	**5.197**	**2.580**	**68.1**	**31.9**	**1.10**	**0.021**	Excellent	**15.38**	**12.79**
	Peerless	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**37.5**	**4.122**	**2.085**	**66.2**	**33.8**	**0.89**	**0.017**			
	Truitt	33	5.027	2.419	67.6	32.4	0.90	0.015	Poor.		
14	**Cherry's Cluster on Cook**	**36**	**4.326**	**1.979**	**68.6**	**31.4**	**1.30**	**0.020**	Excellent	**14.20**	**12.31**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**42**	**4.796**	**2.465**	**65.5**	**34.6**	**1.20**	**0.018**			
	Cherry's Cluster	42	3.917	2.190	63.5	36.5	0.90	0.017	Fair.		
56	**Petit Gulf on Peerless**	**44**	**4.276**	**3.214**	**57.1**	**42.9**	**0.90**	**0.018**	Good.	**13.71**	**11.75**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42**	**4.557**	**2.251**	**66.5**	**33.5**	**0.94**	**0.020**			
	Petit Gulf	42	5.897	2.751	68.2	31.8	1.00	0.020	Very good		
43	**King on Cook**	**38**	**4.656**	**2.007**	**69.7**	**30.1**	**1.00**	**0.018**	Excellent	**14.47**	**10.81**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**43.5**	**4.082**	**2.135**	**64.4**	**35.6**	**1.10**	**0.019**			
	King,	45	2.470	1.530	61.4	38.6	0.70	0.018	Fair.		
58	**Rust Proof on Peerless**	**33**	**4.608**	**2.396**	**65.8**	**34.2**	**1.00**	**0.022**	Very good	**13.10**	**12.10**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**41.5**	**4.279**	**2.229**	**65.6**	**34.0**		**0.017**			
	Rust Proof,	41	5.340	2.706	66.3	32.7		0.014	Fair.		
54	**Peterkin on Peerless**	**43**	**4.945**	**2.630**	**65.3**	**34.7**	**1.10**	**0.022**	Excellent	**14.40**	**10.43**

	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**43.5**	**3.522**	**2.125**	**62.6**	**37.5**	**0.94**	**0.020**			
	Peterkin,	45	3.826	2.499	60.3	39.7	1.00	0.020	Fair.		
76	**Wonderful on Peerless**	**34**	**5.010**	**2.575**	**64.7**	**35.3**	**1.20**	**0.020**	Excellent	**14.48**	**11.22**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42**	**4.316**	**2.087**	**66.9**	**33.1**	**1.11**	**0.019**			
	Wonderful,	42	5.415	2.423	69.0	31.0	1.35	0.018	Very fair.		
55	**Petit Gulf on Cook**	**43**	**4.216**	**2.507**	**62.7**	**37.3**	**0.90**	**0.016**	Good.	**15.30**	**9.25**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**42**	**5.786**	**2.746**	**66.8**	**32.2**	**1.25**	**0.020**			
	Petit Gulf,	42	5.897	2.751	68.2	31.8	1.00	0.020	Very good		
2	**Allen's Long Staple on Peerless**	**34**	**4.540**	**2.194**	**67.4**	**32.6**	**1.30**	**0.020**	Very good	**12.25**	**11.77**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**43.5**	**3.469**	**1.893**	**64.8**	**35.2**	**1.09**	**0.020**			
	Allen's Long Staple,	45	3.722	2.035	64.7	35.3	1.30	0.020	Fair.		
79	**Wonderful on Peerless**	**40**	**5.154**	**2.490**	**67.4**	**32.6**	**1.20**	**0.017**	Very good	**11.34**	**9.78**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42**	**4.316**	**2.087**	**66.9**	**33.1**	**1.11**	**0.019**			
	Wonderful,	42	5.415	2.423	69.0	31.0	1.35	0.018	Very fair.		
74	**Welborn's Pet on Peerless**	**38**	**4.123**	**1.394**	**74.7**	**25.3**	**0.90**	**0.037**	Excellent	**12.98**	**10.32**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**38**	**2.265**	**1.320**	**62.2**	**37.8**	**0.89**	**0.017**			
	Welborn's Pet,	34	1.312	0.890	59.6	40.4	0.90	0.014	Good.		
38	**Jones' Long Staple on Peerless**	**43**	**6.337**	**2.500**	**71.7**	**28.3**	**1.20**	**0.020**	Good.	**16.76**	**8.24**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42**	**4.329**	**2.156**	**66.4**	**33.6**	**1.06**	**0.020**			
	Jones' Long Staple,	42	5.440	2.560	68.0	32.0	1.5	0.020	Very poor		
51	**Peerless on Cook**	**33**	**4.607**	**1.941**	**70.4**	**29.6**	**1.40**	**0.020**	Good.	**15.20**	**8.85**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**42**	**4.446**	**2.246**	**66.1**	**33.9**	**1.19**	**0.020**			
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
83	**Zellner on Cook**	**41**	**4.916**	**1.653**	**74.8**	**25.2**	**1.40**	**0.021**	Very good	**14.88**	**10.50**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Very good		
	Average	**37.5**	**5.345**	**2.289**	**70.6**	**29.7**	**1.20**	**0.020**			
	Zellner,	33	5.015	1.837	73.8	26.8	0.90	0.020	Fair.		

TABLE II—Continued.

Comparison between the Original Plants and 25 of the Best Improved Forms—Continued.

Numbers (Table IV).	Name of Plant.	Number of Seed.	Wt. Seed in grammes.	Wt. Lint in grammes.	Per cent. of Seed.	Per cent. of Lint.	Length of Fiber in inches.	Diameter of Fiber in millimeters.	Character of Twist.	Max. strain for breaking one strand in grammes.	Min. strain for breaking one strand in grammes.
46	**Okra Leaf on Peerless**	**37**	**4.933**	**2.630**	**65.3**	**34.7**	**1.10**	**0.020**	Very good	**14.84**	**9.27**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**36.5**	**3.035**	**1.804**	**62.7**	**37.3**	**1.04**	**0.021**			
	Okra Leaf,	31	2.852	1.857	60.6	39.4	1.20	0.022	Very fair.		
77	**Wonderful on Peerless**	**38**	**5.344**	**2.660**	**66.8**	**33.2**	**1.00**	**0.022**	Excellent	**13.77**	**9.25**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42**	**4.316**	**2.087**	**66.9**	**33.1**	**1.11**	**0.019**			
	Wonderful,	42	5.415	2.423	69.0	31.0	1.35	0.018	Very fair.		
49	**Peeler on Peerless**	**39**	**4.988**	**2.216**	**69.2**	**30.8**	**1.20**	**0.022**	Good.	**14.42**	**9.10**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**42.5**	**4.039**	**2.037**	**66.7**	**33.8**	**1.04**	**0.017**			
	Peeler,	43	4.860	2.322	67.6	32.4	1.20	0.014	Fair.		
33	**Hawkins' Improved on Peerless**	**43**	**5.260**	**2.346**	**69.2**	**30.8**	**1.20**	**0.020**	Excellent	**16.78**	**7.38**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**41.5**	**2.444**	**1.424**	**62.6**	**37.5**	**0.87**	**0.020**			
	Hawkins' Improved	41	1.670	1.096	60.3	39.7	0.87	0.020	Fair.		
71	**Truitt on Cook**	**43**	**5.670**	**2.554**	**68.9**	**31.1**	**1.20**	**0.014**	Excellent	**12.35**	**9.68**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**37.5**	**5.352**	**2.580**	**67.5**	**32.5**	**1.20**	**0.017**			
	Truitt,	33	5.029	2.419	67.6	32.4	0.90	0.014	Poor.		
19	**J. C. Cook on Peerless**	**35**	**4.363**	**1.793**	**70.9**	**29.1**	**1.40**	**0.021**	Good.	**13.87**	**7.87**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average										
	J. C. Cook,										
15	**Cherry's Cluster on Cook**	**44**	**4.840**	**2.545**	**65.5**	**34.5**	**1.20**	**0.022**	Excellent	**12.08**	**8.61**

	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**42**	**4.796**	**2.465**	**65.5**	**34.6**	**1.20**	**0.018**			
	Cherry's Cluster,	42	3.917	2.190	63.5	36.5	0.90	0.017	Fair.		
37	**Jones' Improved on Peerless**	**42**	**5.240**	**2.490**	**67.8**	**32.2**	**1.20**	**0.020**	Good.	**11.00**	**9.75**
	Peerless,	42	3.217	1.751	64.8	35.2	0.87	0.020	Very good		
	Average	**36**	**3.894**	**2.246**	**63.8**	**36.3**	**0.89**	**0.017**			
	Jones' Improved,	30	4.570	2.740	62.8	37.4	0.90	0.014	Good.		
11	**Barnett on Cook**	**35**	**5.175**	**2.090**	**71.2**	**28.8**	**1.40**	**0.020**	Good.	**11.01**	**8.85**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**34.5**	**4.395**	**2.239**	**65.8**	**34.2**	**1.25**	**0.020**			
	Barnett,	27	3.115	1.737	64.2	35.8	1.00	0.020	Fair.		
50	**Peeler on Cook**	**40**	**6.382**	**2.252**	**73.9**	**26.1**	**1.40**	**0.018**	Very good	**11.16**	**8.54**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	1.50	0.020	Good.		
	Average	**42.5**	**5.263**	**2.531**	**67.5**	**32.5**	**1.35**	**0.017**			
	Peeler,	43	4.860	2.322	67.6	32.4	1.20	0.014	Fair.		

TABLE III.

CHARACTERISTIC FEATURES OF ORIGINAL

Name of Cotton.	Length of Branches.	Height of Stalk in feet	Number of lobes to leaves	Number of bolls to each limb.	Size of bolls.	Shape of bolls.
Allen's L'g St'ple	Long.	5 6	3.	....	Large........	Pointed.......
on Cook...	Long...	5.6	3 5	4-6	Medium....	Pointed. .....
on Peerless	Medium	5.6	3.	6-7	Large........	Pointed .....
Bailey..........	Medium	3	5	....	Small.........	Round..... ..
on Cook...	Medium.	4.5	3.4.5	6-7	Medium......	Pointed .....
on Peerless	Long...	5.	3 4 5	6-7	Large........	Pointed. .....
Barnett...	Short...	Tall	.....	....	Medium	Round. ......
on Cook...	Medium	4.5	3.	5-8	Medium	Pointed. .....
on Peerless	Medium	4.	3.4.5	4-6-7	Medium......	Round. ......
Cherry's Cluster	Medium	4.	3.5	....	Small.........	Round. ......
on Cook.	Long...	6.7	3.	5-9	Small....... ..	Pointed.......
on Peerless	Long..	7.	3.	6-7	Medium......	Pointed.....
W. A. Cook.....	Short...	Tall..	5.	....	Large........	Tapering. ....
J. C. Cook*.....	Long.	4	.....	....	Small..	Round. ......
on W.A.Cook*	Long...	4 6	3.5	3-6	Large........	Tapering. ....
on Peerless .	Short...	4.5	3 5	8-10	Small.......	Round. ......
Dixon	Short...	Short.	3.5	Scatt'rd	Small........	Round........
on Cook...	Long...	6.	3.5	7-12	Small.......	Tapering.....
on Peerless	Medium	4 5	3 5	4	Small	Round. .....
Gold Dust......	Long..	Short.	3.5	... .	Small........	Round ....
on Cook...	Long...	5.6	3.	7-8	Medium......	Tapr'ng round
on Peerless	Long.	4 5	3 5	5-7	Medium	Round. ......
Herlong........	Long...	4.	3 4	....	Medium......	Round. ......
on Cook...	Long..	5.6	3.	4	Long.........	Tapering. ....
on Peerless	Short...	4.	3.5	6-8	Small	Tapering. ....
Hawkins' Imp.	Short.	Tall..	3.4.5	....	Large.......	Round. ......
on Cook..	Long...	5.6	3.5	5-6	Large........	Tapering. ....
on Peerless	Long.	4.5	3.	7	Small........	Round. ......
Hunnicutt......	Long...	Tall..	3.5	....	Large........	Pointed ......
on Cook...	Long..	6.7	3.5	5	Medium	Tapering. ....
on Peerless	Long...	4.6	3.5	3-4	Large........	Pointed......
Jones' Improved	Short...	3.	3 5	....	Medium......	Round. ......
on Cook..	Long...	3.4	3.	5-8	Small........	Round. ......
on Peerless	Long...	4.5	3.5	5-7	Small........	Round . .....
Jones' L'g Staple	Long...	Tall..	3.	....	Large.	Pointed......
on Cook...	....	......	....	....	....	....
on Peerless	Long...	4.5	3 5	5-6	Medium......	Tapering.....
Keith..........	Short...	5.	3.5	....	Medium......	Round ......
on Cook...	Long...	6.8	3.5	8-10	Large.......	Tapr'ng round
on Peerless	Long...	3.4	3.	3	Small........	Round. ......
T. J. King......	Long...	3	3.5	....	Small........	Round. ......
on Cook...	Long...	3.4	3.	3-4	Small........	Tapering. ....
on Peerless	Long...	5.6	3.	5-6	Medium......	Tapering. ....
Okra Leaf......	Medium	4.	3.5	5-7	Small........	Tapering. ....
on Cook...	....	......	....	....	....	....
on Peerless	Long...	6.	3 5	5-7	Small........	Round. ......
Peeler..........	Long...	Tall..	3 5	....	Medium......	Tapering. ....
on Cook...	Average	4.5	3.	3-4	Small........	Tapering. ....
on Peerless	Long...	6.7	3.4.5	5	Large	Tapering. ....
Peerless.	Long..	4.	4.5	....	Small........	Round. ......
on Cook...	....	4.6	3.5	3-5	Large & small	Tapr'ng round

* This type is probably a hybrid from a blending of the *G. nanking* or *sanguineum* on the upland types. The color of stalk and smooth, black seed indicate *G. nanking or sanguineum* and shape of leaves, bolls, etc., the upland type.

†Fiber adheres tenaciously to the boll rendering it troublesome to pick.

TABLE III—Continued.

PLANTS AND THE CROSSES PRODUCED.

Prolific or Non-prolific.	Color of Seed.	Length of Staple.	Time of maturity.	Remarks.
Prolific....	Light brown	Long.	Medium	Seed large, furry.
Prolific...	Light brown	Long.	Medium	Seed large, furry.
Prolific	Light brown	Long.	Medium	Seed large, furry.
Prolific...	Black......	Med.	Early .	Seed small, smooth.
Prolific ...	Light brown	Long.	Medium	Seed large, furry.
Prolific...	Light brown	Long.	Early .	Seed large, furry.
Prolific ...	Light brown	Med .	Late ..	Seed medium, furry—limbs scarce.
Prolific...	Light brown	Long	Medium	Seed medium, furry—limbs numerous.
Prolific ...	Dark brown	Short.	Medium	Seed small, furry—limbs numerous.
Prolific....	Light brown	Short.	Early .	Seed med., furry—resembles Peerless clust'd.
Prolific...	Light brown	Long	Early ..	Clustered Seed med., furry—limbs num'ous.
Prolific ...	Light brown	Short.	Early .	Seed medium, furry—limbs numerous.
Prolific...	Light brown	Long.	Late . .	Seed large, furry.
Non-prolific	Dark brown	Short.	V'ry late	Purple stem—Seed small, furry.
Average..	Dark brown	Long	Medium	Seed medium, furry—limbs numerous.
Prolific ...	Dark brown	Long	Medium	Seed medium, furry—limbs numerous.
Prolific....	Brown...	Short.	Early	Seed medium, furry.
Prolific ...	Brown...	Long	Early .	Seed medium, furry—limbs numerous.
Non-prolific	Brown..	Short.	Early ..	Seed medium, furry—limbs numerous.
Mod. Pr'lific	Brown ..	Short.	Early ..	Seed large, furry—limbs few—very yel. pol'n.
Prolific...	Light brown	Long.	Early .	Seed large, furry—limbs numerous.
Prolific	Light brown	Short.	Early .	Seed large, furry—limbs numerous.
Prolific ...	Green	Short.	Early .	Seed medium, furry—clustered.
Non-prolific	Light brown	Long.	Early .	Seed large, furry—limbs numerous.
Prolific....	Dark Green	Short.	Early ..	Seed medium, furry—limbs numerous.
Prolific	Light brown	Short.	Medium	Seed large, furry.
Prolific....	Light brown	Short.	Medium	Seed small, furry—limbs numerous.
Prolific	Light brown	Short.	Medium	Seed small, furry—limbs numerous.
Prolific...	Light brown	Short.	Late.	Seed large, furry—limbs numerous.
Mod. Pr'lific	Light brown	Long.	Medium	Seed large, furry—limbs numerous.
Non-prolific	Light brown	Short.	Medium	Seed large, furry—limbs numerous.
Moderate ..	Light brown	Short.	Early ..	Seed medium, furry—limbs drooping.
Prolific....	Light brown	Short.	Early ..	Seed large, furry—limbs numerous.
Prolific	Light brown	Short.	Early ..	Seed large, furry—limbs numerous.
Non-prolific	Light brown	Long.	Late. ..	Seed large, furry—limbs straggling.
....	Light brown	......	....	Cross failed.
Prolific .	Light brown	Short.	......	Seed large, furry—limbs numerous.
Prolific....	Light brown	Short.	Early .	Seed large, furry—limbs few.
Prolific	Light brown	Long.	Early ..	Seed medium, furry—limbs numerous.
Non-prolific	Light brown	Long	Early .	Seed medium, furry—limbs numerous.
Prolific....	Brown.....	Short.	Early ..	Seed large, furry—limbs few.
Non-prolific	Brown....	Short.	Early ..	Seed medium, furry.
Prolific....	Dark Brown	Short.	Early ..	Seed medium, furry.
Prolific	Light brown	Med..	Early ..	Seed medium, furry.
....	....	......	......	Cross failed.
Prolific	Light brown	Short.	Early ..	Seed large, furry—limbs numerous.
Non-prolific	Brown.....	Long	Late...	Seed large, furry—limbs straggling.
Non-prolific	Brown.....	Long.	Medium	Seed large, furry.
Non-prolific	Brown....	Long.	Medium	Seed large, furry—limbs numerous.
Prolific....	Light brown	Short.	Early ..	Two bolls at joints—seed large, furry, clust'd.
Non-prolific	Brown.....	Long.	....	Seed medium, furry.

TABLE III—Continued.

CHARACTERISTIC FEATURES OF ORIGINAL

Name of Cotton.	Length of Branches.	Height of Stalk in feet	Number of lobes to leaves	Number of bolls to each limb.	Size of bolls.	Shape of bolls.
Peterkin Imp'd.	Long..	Tall.	......	....	Small........	Round.......
on Cook.	Long...	3.4	3.	2-3	Small.......	Tapering....
on Peerless	....	5.6	3.4.5	5-6	Large.......	Tapering.....
Petit Gulf	Long...	Tall..	5.	. ...	Medium......	Tapering.....
on Cook...	Long...	4.	3.	3	Medium......	Tapering ....
on Peerless	Long...	6.	3.	4	Small........	Round.......
Rameses........	Long...	4.	......	.....	Medium......	Round.......
on Cook...	Long...	4.5	5.	5-6	Small........	Round.......
on Peerless	....	4.	3.	4-5	Small........	Tapering....
Storm Proof † ..	Medium	Tall..	3.4.5	....	Medium......	Pointed......
on Cook...	Long...	4.5	3.	2-3	M dium	Pointed......
on Peerless	Long ..	4.5	3.5	4-6	Medium......	Pointed.... .
Southern Hope.	Long...	Tall..	4.5	....	Medium......	Pointed......
on Cook...	Long...	4.5	3.	3-5	Large & small	Pointed round
on Peerless	....	5.	3.	6-7	Small...... ..	Round.......
Sea Island.....	....	6.	5.	5-6	Small........	Pointed .....
Bamieh ‡	No limb	10.	5.	2-3	Long........	Pointed .....
Afifi ‡...........	Short...	12.	3.5	3-4	Small........	Pointed.....
Truitt..........	Long...	Av'ge	3.5	....	Small........	Round.......
on Cook...	Very l'g	3.4	3.5	3	Small.......	Tapering.....
on Peerless	Long...	4.5	3.5	5-7	Small........	Round.......
Welborn's Pet .	Short...	Tall..	4.5	....	Medium	Round.......
on Cook...	Medium	6.	3.5	3-4	Large........	Pointed......
on Peerless	Long...	4.6	3.5	3-5	Small........	Round.......
Wonderful.	Long...	Tall..	3 5	....	Large........	Pointed......
on Cook...	Long...	4.6	3.	2-3	Large.......	Pointed......
on Peerless	Long...	6.7	3.5	5-7	Large........	Pointed......
Zellner.........	Long..	4.	3 5	....	Medium......	Round.......
on Cook...	Long...	5.6	5.	3	Small.......	Pointed .....
on Peerless	Long...	3.4	3.5	3-4	Small.......	Round.......

‡ The cotton worm passed these plants by even after all other plants had been stripped of leaves.

TABLE III—Continued.

PLANTS AND THE CROSSES PRODUCED.—Continued.

Prolific or Non-prolific.	Color of Seed.	Length of Staple.	Time of maturity.	Remarks.
Non-prolific	Brown	Med.	Late..	Seed medium, furry—plant straggling.
Non-prolific	Brown...	Long	Early	Seed medium, furry.
Prolific....	Brown	Short	Average	Seed medium, furry.
Non-prolific	Dark brown	Med..	Late.	Seed medium, furry—plant straggling.
Non-prolific	Dark brown	Short	Late.	Seed medium, furry.
Non-prolific	Dark brown	Short.	Late..	Seed medium, furry.
Prolific....	Brown....	Short	Early..	Seed large, furry.
Prolific	Brown	Short.	Early.	Seed medium, furry.
Mod. Pr'lific	Brown....	Short.	Early.	Seed medium, furry.
Non-prolific	Brown	Med.	Late ...	Seed large, furry.
Non-prolific	Brown....	....	Late ..	Seed large, furry.
Mod. Pr'lific	Brown	Long	Average	Seed large, furry—very little rust present.
Non-prolific	Brown....	Long	Late..	Seed large, furry—plant straggling.
Mod. Pr'lific	Brown	Short.	Average	Seed medium, furry.
Prolific...	Brown.....	Long.	Average	Seed medium, furry.
Prolific ...	Black	Long	Late..	S'd sm'l, sm'h-lvs larg-b'ls 3 lob.—st'lks red'h.
Non-prolific	Black......	Long	Late ...	S'd sm'l, sm'h-leaves larg'-bolls on main stem.
Non-prolific	Black	Long	Late.	Leaves large—seed small, smooth.
Prolific	Brown.....	Short	Average	Seed large, furry.
Non-prolific	Brown.....	Long.	Average	Seed medium, furry—limbs numerous.
Prolific....	Brown	Short.	Average	Seed large, furry—limbs numerous.
Prolific	Brown	Short.	Early ..	Seed large, furry—clustered.
Non-prolific	Brown.....	Long	Early ..	Seed large, furry.
Non-prolific	Brown.....	Short.	Early.	Seed large, furry—limbs numerous.
Prolific..	Light brown	Long.	Late...	Seed large, furry.
Non-prolific	Light brown	Long	Average	Seed medium, furry.
Prolific.	Light brown	Long	Average	Seed large, furry—limbs numerous.
Non-prolific	Brown.....	Short.	Early ..	Seed large, furry.
Non-prolific	Brown	Long	Early ..	Seed small, furry.
Non-prolific	Brown.....	Long	Early ..	Seed small, furry—limbs numerous.

TABLE IV.

Number.	Name of Varieties containing male flowers supplying pollen.	Name of variety with female organ.	Length of bolls original varieties in inches.	Circumference of bolls original varieties in inches.	Number of carpels to boll—original varieties.	Length of boll on crossed plant—inches.	Circumference of boll on crossed plant—inches.
1	Mit Afifi				3		
2	Allen's Long Staple	Peerless	2.5	4.8	4		
3	Allen's Long Staple	Peerless					
4	Allen's Long Staple	Cook, W A					
5	Allen's Long Staple	Cook, W A				2.3	4.4
6	Bailey	Cook, W A	2.0	5.0	5	2.5	5.0
7	Bailey	Cook, W A					
8	Bailey	Peerless				2.5	4 5
9	Bailey	Peerless					
10	Barnett	Cook, W A	3 3	4.4	3	2.3	4.5
11	Barnett	Cook, W A				2.5	5.0
12	Barnett	Peerless					
13	Bamieh				3 4		
14	Cherry's Cluster	Cook, W A	2.1	4.3	5	2.5	4.8
15	Cherry's Cluster	Cook, W A					
16	Cherry's Cluster	Peerless				2.2	4.1
	Cook, W A		2.1	4 8	5		
17	Cook, J C	Cook, W A	2.1	4.3		2.4	4.8
18	Cook, J C	Cook, W A				2.4	4.9
19	Cook, J C	Peerless				2.1	4 0
20	Dixon	Cook, W A	2.1	4.5	5	2.5	5.0
21	Dixon	Cook, W A					
22	Dixon	Peerless				2 0	4 0
23	Gold dust	Cook, W A	2.0	4.1	5		
24	Gold dust	Cook, W A				2.4	5 2
25	Gold dust	Peerless					
26	Gold dust	Peerless					
28	Herlong	Cook, W A	2.3	4.7	5	2.4	4 7
29	Herlong	Cook, W A				2.5	4.9
30	Herlong	Peerless					
31	Herlong	Peerless					
32	Hawkins' Improved	Cook, W A	2 5	5 1	4	2.8	5 5
33	Hawkins' Improved	Peerless				2.3	3.7
34	Hunnicutt	Cook, W A	2 5	4.6	5		
35	Hunnicutt	Peerless				2 5	5 0
36	Jones' improved	Cook, W A	2.4	4.8	5	2.5	5.3
37	Jones' improved	Peerless				2.1	4.4
38	Jones' long staple	Peerless	2.3	4.8	5	2.1	4.3
39	Jones' long staple	Peerless				2.4	4.6
40	Keith	Cook, W A	2.0	4 3	4		
41	Keith	Cook, W A				2.3	4.5
42	Keith	Peerless				2.3	4.3
43	King, T J	Cook, W A	2.4	4 5	5	2.4	4.3
44	King, T J	Peerless				2 3	4.7
45	Nankin				3 4		

TABLE IV—Continued.

Number of carpels to boll on crossed plants.	Number of seed to boll—original variety.	Number of seed to boll—crossed plants.	Weight of seed original plants per boll—grammes.*	Weight of seed per boll crossed plants—grammes.*	Weight of fiber per boll original plants—grammes.*	Weight of fiber per boll crossed plants—grammes.*	Per cent of seed per boll original plants.	Per cent of seed per boll—crossed plants.	Per cent fiber per boll—original plants.
......	20	......	3.096	......	1.582	......	66.6	......	33.8
4	45	34	3.722	4.540	2.035	2.194	64.7	67.4	35.3
5	......	40	......	5.147	......	2.309	......	69.0	......
5	......	43	......	4.283	......	2.210	......	66	......
5	......	39	......	6.430	......	3.160	......	67.2	......
5	35	41	4.2578	6.132	2.4860	2.639	74.6	70.0	25.4
5	......	39	......	6.104	......	2.706	......	69.3	......
5	......	45	......	5.702	......	3.058	......	65.4	......
5	......	42	......	5.707	......	2.704	......	67.8	......
5	27	42	3.115	4.779	1.737	2.859	64.2	67.9	35.8
4	......	35	......	5.175	......	2.090	......	71.2	......
5	......	38	......	4.866	......	2.244	......	68.4	......
......	21	......	3.158	......	1.429	......	68.8	......	31.2
4	42	36	3.917	4.326	2.190	1.979	63.5	68.6	36.5
5	......	44	......	4.840	......	2.545	......	65.5	......
4	......	36	......	4.090	......	1.950	......	67.7	......
5	42	......	5.675	......	2.740	......	67.4	......	32.6
5	......	44	......	4.556	......	2.993	65.5	60.4	34.5
5	......	44	......	4.866	......	2.399	......	66.9	......
4	......	35	......	4.363	......	1.793	......	70.9	......
5	44	35	5.1068	4.976	2.5456	2.363	66.8	67.8	33.2
5	......	40	......	5.817	......	2.421	......	70.6	......
5	......	37	......	3.860	......	1.907	......	66.3	......
5	39	39	4.5850	4.841	2.1200	2.655	69.9	64.6	30.1
4	......	31	......	4.079	......	1.944	......	67.7	......
5	......	45	......	4.873	......	2.140	......	69.5	......
5	......	44	......	5.038	......	2.819	......	64.1	......
5	45	44	4.7900	5.892	2.4670	2.512	67.9	60.6	32.1
4	......	36	......	5.222	......	2.578	......	66.9	......
4	......	38	......	4.430	......	1.778	......	71.3	......
4	......	40	......	4.686	......	2.093	......	69.1	......
5	41	43	1.670	7.020	1.096	3.557	60.3	66.3	39.7
5	......	43	......	5.260	......	2.346	......	69.2	......
4	42	34	5.4136	4.940	2.4518	2.120	69.2	69.8	30.8
5	......	47	......	6.471	......	2.846	......	69.5	......
5	30	41	4.570	5.340	2.470	2.289	62.6	70.0	37.4
5	......	42	......	5.240	......	2.490	......	67.8	......
5	42	43	5.440	6.337	2.560	2.50[illegible]	68.0	71.7	32.0
4	......	34	......	3.927	......	1.992	......	66.2	......
4	35	34	4.1076	4.675	1.6756	2.0[illegible]2	69.9	69.4	30.1
5	......	40	......	4.984	......	1.870	......	72.7	......
5	......	42	......	6.766	......	3.376	......	66.7	......
5	45	38	2.490	4.656	1.530	2.007	61.4	69.7	38.6
5	......	34	......	4.724	......	2.228	......	67.9	......
......	......	36	4.067	......	1.838	......	68.9	......	31.1

TABLE IV—Continued.

Number.	Name of varieties containing male flowers supplying pollen.	Name of variety with female organ.	Per cent. fiber per boll—crossed plants.	Length fiber original plants expressed in inches—4 tests.	Diameter of fiber original plants in millim's—av.6 str'nd†	Length of fiber cros'd plants in inches—av. 6 strand.
1	Mit Afifi			1 30	0.013	
2	Allen's Long Staple	Peerless	32 6	1.30	0.020	1.3
3	Allen's Long Staple	Peerless	31.0			1.3
4	Allen's Long Staple	Cook, W. A.	34.0			1 4
5	Allen's Long Staple	Cook, W. A.	32 8			1.3
6	Bailey	Cook, W. A.	30.0	1.10	0.016	1.5
7	Bailey	Cook, W. A.	30.7			1.2
8	Bailey	Peerless	34.6			1.2
9	Bailey	Peerless	32.2			1.4
10	Barnett	Cook, W. A.	32.1	1.00	0.020	1.6
11	Barnett	Cook, W. A.	28.8			1.4
12	Barnett	Peerless	31.6			1 1
13	Bamieh			2 50 1.70	0.017	
14	Cherry's Cluster	Cook, W. A	31.4	0 090	0.017	1 3
15	Cherry's Cluster	Cook, W. A	34.5			1.2
16	Cherry's Cluster	Peerless	32.3			1 0
	Cook, W. A.			1 50	0 020	
17	Cook, J. C	Cook, W. A	39 6	0.75	0.020	1 5
18	Cook, J. C	Cook, W. A.	33.1			1 2
19	Cook, J. C	Peerless	29.1			1.4
20	Dixon	Cook, W. A	32.2	0 75	0.020	1.4
21	Dixon	Cook, W. A.	29.4			1.3
22	Dixon	Peerless	33.7			0 9
23	Gold dust	Cooh, W. A.	35.4	0.75	0.014	1.2
24	Gold dust	Cook, W. A	32.3			1.3
25	Gold dust	Peerless	30.5			0 9
26	Gold dust	Peerless	35.9			1.0
28	Herlong.	Cook, W. A	39.4	0.75	0.022	1.2
29	Herlong.	Cook, W. A.	33 1			1.2
30	Herlong.	Peerless	28.7			1.1
31	Herlong.	Peerless	30.9			0.9
32	Hawkins' Improved	Cook, W. A.	33.7	0.87	0.020	1.1
33	Hawkins' Improved	Peerless	30.8			1.2
34	Hunnicutt.	Cook, W. A.	30.2	1.00	0.020	1.4
35	Hunnicutt	Peerless	30 5			1.1
36	Jones' Improved	Cook, W. A.	30.0	0 90	0.014	1.1
37	Jones' Improved	Peerless	32.2			1.2
38	Jones' Long Staple.	Peerless	28.3	1.25	0 020	1 2
39	Jones' Long Staple.	Peerless	33.8			1.1
40	Keith.	Cook, W. A.	30.6	1.00	0.020	1 2
41	Keith	Cook, W. A	27.3			1.3
42	Keith.	Peerless	33.3			1.4
43	King, T. J	Cook, W. A.	30.1	0.70	0.018	1.0
44	King, T. J	Peerless	32.1			0.9
45	Nankin				0.018	0.9

TABLE IV—Continued.

Diameter of fiber crossed plants in millim's–av.6 str'nd†	Condition of twist original plants.	Condition of twist crossed plants.	Strength of fiber original plants—grammes.‡	Strength of fiber crossed plants—grammes.‡	Degree of maturity of fiber—crossed variety.	Degree of maturity of fiber—original variety.
......	Fair.		14.2			Fair.
0.020	Fair	Very good	8.92	11.95	Good	Fair.
0.018		Good		11.04	Good	
0.018		Good		8.42	Good	
0.020		Fair		10.37	Good	
0.021	Fair.	Excellent	8.10	8.15	Very good	Fair.
0.019		Good		10.25	Good	
0.018		Poor.		8.19	Poor.	
0.018		Fair		8.45	Fair	
0.020	Fair.	Excellent	5.57	6.95	Excellent	Good.
0.020		Good		10.21	Good	
0.022		Excellent		14.57	Excellent	
......	Fair.		15.17			Fair.
0.020	Fair.	Excellent	14.75	13.08	Very good	Fair.
0.022		Excellent		10.51	Excellent	
0.020		Fair.		13.23	Good.	
......	Good.		7.59			Good.
0.013	Good	Fair	11.67	11.88	Good.	Good.
0.013		Fair		12.45	Good.	
0.021		Good	9.85	10.55	Good.	
0.018	Fair	Excellent	10.24	8.58	Excellent	Good.
0.014		Poor.		9.37	Poor.	
0.020		Fair.		9.23	Fair	
0.016	Fair	Fair.	10.74	13.04	Fair	Fair.
0.018		Poor.		13.03	Poor.	
0.020		Good		6.47	Good.	
0.016		Poor		13.83	Very poor	
0.021	Poor.	Fair	8.85	13.00	Good.	Fair.
0.016		Fair.		9.94	Fair.	
0.018		Fair.		8.42	Fair.	
0.017		Poor.		9.04	Poor.	
0.018	Fair	Poor.	4.31	9.75	Poor	Fair.
0.020		Excellent		10.89	Very good	
0.017	Very good	Good	7.89	7.86	Good	Very good
0.021		Good		6.16	Very good	
0.018	Good	Poor.	9.75	6.57	Good.	Good.
0.020		Good		10.39	Very good	
0.020	Very poor	Good	7.55	11.71	Good.	Good.
0.020		Fair.		11.05	Fair	
0.020	Very fair.	Very good	7.12	7.08	Excellent	Good.
0.017		Fair.		8.89	Good.	
0.020		Very good		7.72	Good.	
0.018	Fair	Excellent	7.91	12.79	Good.	Fair.
0.014		Fair.		11.28	Fair	
......	Very fair.		8.88			Good.

TABLE IV—Continued.

Number.	Name of Varieties containing male flowers supplying pollen.	Name of variety with female organ.	Length of bolls original varieties inches.	Circumference of bolls original varieties inches.	Number of carpels to boll—original varieties.	Length of boll on crossed plant—inches.
46	Okra leaf	Peerless	2.1	4.4	5	2 3
47	Peeler	Peerless	2.4	4.5	5	
48	Peeler	Peerless				
49	Peeler	Peerless				
50	Peeler	Cook, W A				2.5
51	Peerless	Cook, W A	2 3	4.8	5	2.3
52	Peerless	Cook, W A				2.6
53	Peterkin	Cook, W A	2.5	4.8	5	2.5
54	Peterkin	Peerless				
55	Petit gulf	Cook, W A	2.4	4 8	5	
56	Petit gulf	Peerless				2.4
57	Rust proof	Cook, W A	2.5	4.5		2 5
58	Rust proof	Peerless				
59	Rameses	Cook, W A	2 3	4 4		
60	Rameses	Cook, W A				
61	Rameses	Peerless				
62	Storm proof	Peerless				
64	Sea Island				4 3	
65	Southern hope	Peerless	2.6	4.8	5	2.0
66	Southern hope	Cook, W A				2 8
67	Southern hope	Cook, W A				2 4
68	Truitt	Peerless	2 4	4 8	5	2 5
69	Truitt	Peerless				2.5
70	Truitt	Peerless				
71	Truitt	Cook, W A				2 6
72	Welborn's pet	Cook, W A	2 1	4.5	5	2 4
73	Welborn's pet	Peerless				
74	Welborn's pet	Peerless				2 0
75	Wonderful	Peerless	2.5	4 3	5	2 0
76	Wonderful	Peerless				
77	Wonderful	Peerless				
78	Wonderful	Peerless				
79	Wonderful	Peerless				
80	Wonderful	Cook, W A				2 3
81	Zellner	Peerless	2 3	4 8	5	
82	Zellner	Peerless				2 0
83	Zellner	Cook, W A				2 5

TABLE IV—Continued.

Circumference of boll on crossed plant—inches.	Number of carpels to boll on crossed plants.	Number of seed to boll—original variety.	Number of seed to boll—crossed plants.	Weight of seed original plants per boll—grammes.*	Weight of seed per boll crossed plants—grammes.*	Weight of fiber per boll original plants—grammes.*	Weight of fiber per boll crossed plants—grammes.*	Per cent. of seed per boll original plants.	Per cent. of seed per boll crossed plants.	Per cent. fiber per boll—original plants.
4.8	4	31	37	2 852	4.933	1.857	2.630	60.6	65.3	39.4
......	5	43	44	4.860	6.443	2.322	2.784	67 6	69.9	32.4
......	5	......	41	......	5 939	......	2.297	......	72.1	......
......	4	......	39	......	4.988	......	2.216	......	69.2	......
4 9	5	......	40	......	6 382	......	2.252	......	73.9	......
4.4	4	42	33	3 217	4.607	1.751	1.941	64 8	70 4	35.2
4.8	5	......	41	......	5 245	......	2.765	......	65.5	......
4.4	4	45	39	3.826	4.944	2.499	2.159	60.3	69.7	39.7
......	5	......	43	......	4.945	......	2 630	......	65.3	......
......	5	42	43	5 897	4.216	2.751	2 507	68 2	62.7	31.8
4.8	5	......	44	......	4 276	......	3 214	......	57.1	......
5.1	4	41	33	5.340	5.026	2.706	2.076	66.3	70.8	32.7
......	4	......	33	......	4.608	......	2.396	......	65.8	......
......	5	34	43	2.417	4.910	1.029	2.460	70.2	66 6	29.8
......	5	......	44	......	5.610	......	2.755	......	67.1	......
......	4	......	32	......	4.129	......	1.802	......	69.6	......
......	5	45	48	5.8028	7 314	2.8880	3.237	68.9	69 3	31.1
......	......	15	......	2 023	......	0.658	......	......	......	29 3
4 4	4	40	36	4 975	4 068	2.239	1 838	68 9	73 4	31.1
5 2	4	......	37	......	4 070	......	1 612	......	71 6	......
4 8	5	......	44	......	6 149	......	2 842	......	68 4	......
4 3	4	33	36	5.029	5 439	2.419	2 258	67 6	70 7	32 4
4 1	4	......	35	......	5.183	......	2 3.5	......	68.8	......
......	5	......	37	......	5 197	......	2.580	......	68 1	......
4 6	5	......	43	......	5 670	......	2 454	......	68 9	......
5.0	4	34	35	1 312	5 193	0.890	1 926	59 6	73 1	40 4
......	5	......	43	......	5.238	......	2 316	......	68 5	......
4 4	4	......	38	......	4 123	......	1 394	......	74 7	......
4 2	4	42	33	5 415	5 624	2.423	2.320	69 0	71 8	31 4
......	4	......	34	......	5 010	......	2 575	......	64 7	......
......	4	......	38	......	5 344	......	2 660	......	66 8	......
......	4	......	34	......	5 397	......	2 338	......	68 6	......
......	5	......	40	......	5 154	......	2 490	......	67 4	......
5.0	4	......	33	......	4 574	......	2 118	......	68 3	......
......	5	33	42	5 015	5 349	1 837	1 900	73 8	73 8	26.8
4 3	5	......	47	......	5 294	......	2.610	......	66 4	......
5 1	5	......	41	......	4 916	......	1 653	......	74 8	......

TABLE IV—Continued.

Number.	Name of varieties containing male flowers supplying pollen.	Name of variety with female organ.	Per cent. fiber per boll—crossed plants.	Length fiber origi'al plants expressed in inches—4 tests.	Diameter of fiber original plants in millim's-av.6 str'nd†	Length of fiber cros'd plants in inches—av. 6 strand.
46	Okra leaf	Peerless	34.7	1.20	0.022	1.1
47	Peeler	Peerless	30.1	1.20	0.014	1.4
48	Peeler	Peerless	27.9	......	......	1.1
49	Peeler	Peerless	30.8	......	......	1.2
50	Peeler	Cook, W. A	26.1	......	......	1.4
51	Peerless	Cook, W. A	29.6	0.87	0.020	1.4
52	Peerless	Cook, W. A	34.5	......	......	1.3
53	Peterkin	Cook, W. A	30.3	1.00	0.020	1.4
54	Peterkin	Peerless	34.7	......	......	1.1
55	Petit gulf	Cook, W. A	37.3	1.00	0.020	0.9
56	Petit gulf	Peerless	42.9	......	......	0.9
57	Rust proof	Cook, W. A	29.2	......	0.014	1.1
58	Rust proof	Peerless	34.2	......	......	1.0
59	Rameses	Cook, W. A	33.4	0.87	0.025	1.2
60	Rameses	Cook, W. A	32.9	......	......	0.8
61	Rameses	Peerless	30.4	......	......	1.2
62	Storm proof	Peerless	30.7	1.00	0.020	1.4
64	Sea Island		......	1.50	0.017	......
65	Southern hope	Peerless	26.6	1.20	0.018	1.3
66	Southern hope	Cook, W. A	28.4	......	......	1.1
67	Southern hope	Cook, W. A	31.6	......	......	1.3
68	Truitt	Peerless	29.3	0.90	0.014	1.0
69	Truitt	Peerless	31.2	......	......	1.1
70	Truitt	Peerless	31.9	......	......	1.1
71	Truitt	Cook, W. A	31.1	......	......	1.2
72	Welborn's pet	Cook, W. A	26.9	0.90	0.014	1.4
73	Welborn's pet	Peerless	31.5	......	......	1.2
74	Welborn's pet	Peerless	25.3	......	......	0.9
75	Wonderful	Peerless	25.3	1.35	0.018	1.0
76	Wonderful	Peerless	35.3	......	......	1.2
77	Wonderful	Peerless	33.2	......	......	1.0
78	Wonderful	Peerless	31.4	......	......	1.2
79	Wonderful	Peerless	32.6	......	......	1.2
80	Wonderful	Cook, W. A	31.7	......	......	1.2
81	Zellner	Peerless	26.2	0.90	0.020	1.2
82	Zellner	Peerless	33.6	......	......	1.2
83	Zellner	Cook, W. A	25.2	......	......	1.4

TABLE IV—Continued.

Diameter of fiber crossed plants millim's-av.6 str'nd†	Condition of twist original plants.	Condition of twist crossed plants.	Strength of fiber original plants—grammes.*	Strength of fiber crossed plants—grammes.*	Degree of maturity of fiber—crossed variety.	Degree of maturity of fiber—original variety.
0.020	Very fair.....	Very good...	7.12	11.32	Good	Fair. ....
0.017	Fair	Very good...	8.53	10.05	Good	Fair ....
0.017	....	Fair	......	8.43	Fair.	
0.022	....	Good	......	10.97	Good ...	
0.018	....	Very good...	......	10.06	Very good	
0.020	Very good ..	Good	10.42	11.56	Very good	Very good
0.017	....	Excellent ...	.....	6.52	Very good	
0.020	Fair	Very good...	7.33	9.24	Very good	Fair .....
0.022	....	Excellent ...	.....	12.46	Excellent	
0.016	Very good..	Good	7.77	11.96	Good ..	Very good
0.018	....	Good	......	13.04	Good ...	
0.020	Fair	Very good..	11.02	7.90	Very good	Fair ..
0.022	....	Very good...	.....	12.58	Very good	
0.013	Fair	Fair	13.08	12.12	Fair	Good ...
0.018	....	Very fair...	.....	9.67	Very good	
0.016	....	Poor	.....	6.96	Poor	
0.018	Very good...	Very good...	7.48	9.25	Very good	Good ...
.....	Very good...	....	8.51	12.70‡	....	Very good
0.011	Very fair	Fair	10.26	12.05	Good	Good ....
0.017	....	Excellent	......	8.61	Excellent	
0.017	....	Very good....	.....	7.26	Good	
0.018	Poor.	Fair	15.16	13.05	Fair	Poor ....
0.022	....	Fair	......	12.63	Fair	
0.021	....	Excellent	......	14.14	Very good	
0.014	....	Excellent	......	10.78	Excellent	
0.013	Good........	Poor	7.34	7.03	Poor.....	Good ....
0.025	....	Fair	......	6.86	Fair.	
0.037	....	Excellent	......	10.75	Excellent	
0.021	Very fair....	Good	......	8.52	Good	Fair. ....
0.020	....	Excellent	9.61	12.44	Excellent	
0.022	....	Excellent	......	11.28	Excellent	
0.014	....	Very good....	......	9.31	Good	
0.017	....	Very good. ..	......	10.79	Very good	
0.018	....	Good	......	8.26	Good	
0.016	Fair	Fair	12.43	16.12	Fair	Good ....
0.020	....	Good	......	9.65	Good	
0.021	....	Very good....	......	11.56	Very good	

* A gramme is equivolent to 15.4 grains.
† A millimeter is equivalent to 0.03937 of an inch.
‡ Results of cultivation at Auburn.

MICRO-PHOTOGRAPH, FIG. 10.

1. Afifi.
2. Bamieh.
3. Sea Island.
4. Nankin.
5. Bailey.
6. Okra Leaf.

These strands were taken at randum from the bolls, but rather indicate the average condition of the fiber in each instance. In the case of the Sea Island and Okra leaf, and the Bailey the character of the twist is excellent. The Afifi and Bamieh are not so well twisted, but the degree of strength to resist rupture compares very favorably with the others. With the exception of Nankin these are long staple cottons.

MICRO-PHOTOGRAPH, FIG. 11.

The figures in brackets () correspond to those found in first column in table on pages 30–37.

1. Hawkins' improved, *original form.*
2. Hawkins' improved crossed on W. A. Cook (32).
3. Hawkins' improved crossed on Peerless (33).
4. Hunnicutt, *original form.*
5. Hunnicutt crossed on W. A. Cook (34).
6. Hunnicutt crossed on Peerless (35).
7. Jones' improved, *original form.*
8. Jones' improved crossed on W. A. Cook (36).
9. Jones' improved crossed on Peerless (37).
10. Jones' long staple, *original form.*
11. Jones' long staple crossed on Peerless (38).
12. Jones' long staple crossed on Peerless (39).
13. Keith, *original form.*
14. Keith crossed on W. A. Cook (40).
15. Keith crossed on Peerless (42).
16. King, *original form.*
17. King crossed on W. A. Cook (43).
18. King crossed on Peerless (44).

Some of these strands have been untwisted to show more clearly the comparative widths and degree of maturity.

Micro-Photograph, Fig. 12.

These figures in brackets () correspond to those found in first column in table on pages 30–37.

1. Herlong, *original.*
2. Herlong crossed on W. A. Cook (28).
3. Herlong crossed on Peerless (31).
4. Gold dust, *original.*
5. Gold dust crossed on W. A. Cook (23).
6. Gold dust crossed on Peerless (26).
7. Dixon, *original.*
8. Dixon crossed on W. A. Cook (21).
9. Dixon crossed on Peerless (22).
10. Cherry's cluster, *original.*
11. Cherry's cluster crossed on W. A. Cook (14).
12. Cherry's cluster crossed on Peerless (16).
13. Bailey, *original.*
14. Bailey crossed on W. A. Cook (7).
15. Bailey crossed on Peerless (8).
16. Allen's long staple, *original.*
17. Allen's long staple crossed on Peerless (3).
18. Allen's long staple crossed on W. A. Cook (4).

Micro-Photograph, Fig. 13.

The figures in brackets () correspond to those found in first column in table on pages 30–37.

1. Southern hope, *original.*
2. Southern hope crossed on Peerless (65).
3. Southern hope crossed on W. A. Cook (67).
4. Truitt, *original.*
5. Truitt crossed on Peerless (68).
6. Truitt crossed on W. A. Cook (71).
7. Welborn's pet, *original.*
8. Welborn's pet crossed on W. A. Cook (72).
9. Welborn's pet crossed on Peerless (73).
10. Wonderful, *original.*
11. Wonderful crossed on Peerless (77).
12. Wonderful crossed on W. A. Cook (80).
13. Zellner, *original.*
14. Zellner crossed on Peerless (82).
15. Zellner crossed on W. A. Cook (83).

FIG. 14.

Size and shapes of bolls secured from the plants developed by the crossing experiments:

*1.	Afifi	1%
2.	Allen's long staple on W. A. Cook	4
3.	Allen's long staple on W. A. Cook	4
4.	Allen's long staple on Peerless	2
5.	Allen's long staple on Peerless	2
6.	Allen's long staple on W. A. Cook	5
7.	Allen's long staple on W. A. Cook	5
8.	Allen's long staple on Peerless	3
9.	Allen's long staple on Peerless	3
10.	Bailey on W. A. Cook	6
11.	Bailey on W. A. Cook	6
12.	Bailey on W. A. Cook	7
13.	Bailey on W. A. Cook	7
14.	Bailey on W. A. Cook	7
15.	Bailey on Peerless	8
16.	Bailey on Peerless	8
17.	Bailey on Peerless	9
18.	Bailey on Peerless	9
19.	Barnett on W. A. Cook	10
20.	Barnett on W. A. Cook	10
21.	Barnett on W. A. Cook	11
22.	Barnett on W. A. Cook	11
23.	Barnett on Peerless	12
24.	Barnett on Peerless	12
25.	Bamieh	13
26.	Bamieh	13
27.	Cherry's cluster on W. A. Cook	14
28.	Cherry's cluster on W. A. Cook	14
29.	Cherry's cluster on Peerless	16
30.	Cherry's cluster on Peerless	16
31.	Cherry's cluster on Peerless	16
32.	Cherry's cluster on Peerless	16
33.	Cherry's cluster on W. A. Cook	15
34.	Cherry's cluster on W. A. Cook	15
35.	J. C. Cook on Peerless	19
36.	J. C. Cook on Peerless	19
37.	J. C. Cook on W. A. Cook	18
38.	J. C. Cook on W. A. Cook	18
39.	J. C. Cook on W. A. Cook	17
40.	Dixon on W. A. Cook	20

129. Truitt on Peerless 68
130. Truitt on W. A. Cook ....
131. Truitt on W. A. Cook ....
132. Truitt on Peerless 69
133. Truitt on Peerless 69
134. Truitt on Peerless 70
135. Truitt on Peerless 70
136. Welborn's pet on W. A. Cook 72
137. Welborn's pet on W. A. Cook 72
138. Welborn's pet on Peerless 73
139. Welborn's pet on Peerless 73
140. Wonderful on Peerless 75
141. Wonderful on Peerless 75
142. Wonderful on W. A. Cook 80
143. Wonderful on W. A. Cook 80
144. Wonderful on Peerless 76
145. Wonderful on Peerless 76
146. Wonderful on Peerless 79
147. Wonderful on Peerless 79
148. Wonderful on Peerless 78
149. Wonderful on Peerless 78
150. Wonderful on Peerless 77
151. Wonderful on Peerless 77
152. Wonderful on Peerless 77
153. Zellner on Peerless 81
154. Zellner on Peerless 81
155. Zellner on W. A. Cook 83
156. Zellner on W. A. Cook 83
157. Zellner on Peerless 82
158. Zellner on Peerless 82

* Numbers found on the plate.
% Numbers found on the table, pages 30–37, first column.

Plate 15.

Open bolls with the fiber protruding in a condition to be picked for the gin. These bolls show distinctly the improvement resulting from crossing. In most instances the size has been perceptibly increased. The numbers over each boll correspond to those in column one in table on pages 30–37.

1. Afifi.
2. Allen's long staple on Peerless.

3. Allen's long staple on Peerless.
4. Allen's long staple on W. A. Cook.
5. Allen's long staple on W. A. Cook.
6. Bailey on W. A. Cook.
7. Bailey on W. A. Cook.
8. Bailey on Peerless.
9. Bailey on Peerless.
10. Barnett on W. A. Cook.
11. Barnett on W. A. Cook.
12. Barnett on Peerless.
13. Bamieh.
14. Cherry's cluster on W. A. Cook.
15. Cherry's cluster on W. A. Cook.
16. Cherry's cluster on Peerless.
17. J. C. Cook on W. A. Cook.
18. J. C. Cook on W. A. Cook.
19. J. C. Cook on Peerless.
20. Dixon on W. A. Cook.
21. Dixon on W. A. Cook.
22. Dixon on Peerless.
23. Gold dust on W. A. Cook.
24. Gold dust on W. A. Cook.
25. Gold dust on Peerless.
26. Gold dust on Peerless.
27. Green fiber.
28. Herlong on W. A. Cook.
29. Herlong on W. A. Cook.
30. Herlong on Peerless.
31. Herlong on Peerless.
32. Hawkins' improved on W. A. Cook.
33. Hawkins' improved on Peerless.
34. Hunnicutt on W. A. Cook.
35. Hunnicutt on Peerless.
36. Jones' improved on W. A. Cook.
37. Jones' improved on Peerless.
38. Jones' long staple on Peerless.
39. Jones' long staple on Peerless.
40. Keith on W. A. Cook.
41. Keith on W. A. Cook.
42. Keith on Peerless.
43. King on W. A. Cook.
44. King on Peerless.
45. Nankin.
46. Okra leaf on Peerless.
47. Peeler on Peerless.

48. Peeler on Peerless.
49. Peeler on Peerless.
50. Peeler on W. A. Cook.
51. Peerless on W. A. Cook.
52. Peerless on W. A. Cook.
53. Peterkin on W. A. Cook.
54. Peterkin on Peerless.
55. Petit gulf on W. A. Cook.
56. Petit gulf on Peerless.
57. Rust proof on W. A. Cook.
58. Rust proof on Peerless.
59. Rameses on W. A. Cook.
60. Rameses on W. A. Cook.
61. Rameses on Peerless.
62. Storm proof on Peerless.
63. "Scrub" on Peerless.
64. Sea Island.
65. Southern hope on Peerless.
66. Southern hope on W. A. Cook.
67. Southern hope on W. A. Cook.
68. Truitt on Peerless.
69. Truitt on Peerless.
70. Truitt on Peerless.
71. Truitt on W. A. Cook.
72. Welborn's pet on W. A. Cook.
73. Welborn's pet on Peerless.
74. Welborn's pet on Peerless.
75. Wonderful on Peerless.
76. Wonderful on Peerless.
77. Wonderful on Peerless.
78. Wonderful on Peerless.
79. Wonderful on Peerless.
80. Wonderful on W. A. Cook.
81. Zellner on Peerless.
82. Zellner on Peerless.
83. Zellner on W. A. Cook.

Plate 16.

This plate represents a seed from each boll with its fiber adhering, but spread out so as to exhibit the relative length of each specimen. The figures correspond to those found in table on pages 30–37, first column:

1. Afifi.
2. Allen's long staple on Peerless.

3. Allen's long staple on Peerless.
4. Allen's long staple on W. A. Cook.
5. Allen's long staple on W. A. Cook.
6. Bailey on W. A. Cook.
7. Bailey on W. A. Cook.
8. Bailey on Peerless.
9. Bailey on Peerless.
10. Barnett on W. A. Cook.
11. Barnett on W. A. Cook.
12. Barnett on Peerless.
13. Bamieh.
14. Cherry's cluster on W. A. Cook.
15. Cherry's cluster on W. A. Cook.
16. Cherry's cluster on Peerless.
17. J. C. Cook on W. A. Cook.
18. J. C. Cook on W. A. Cook.
19. J. C. Cook on Peerless.
20. Dixon on W. A. Cook.
21. Dixon on W. A. Cook.
22. Dixon on Peerless.
23. Gold dust on W. A. Cook.
24. Gold dust on W. A. Cook.
25. Gold dust on Peerless.
26. Gold dust on Peerless.
27. Green fiber.
28. Herlong on W. A. Cook.
29. Herlong on W. A. Cook.
30. Herlong on Peerless.
31. Herlong on Peerless.
32. Hawkins' improved on W. A. Cook.
33. Hawkins' improved on Peerless.
34. Hunnicutt on W. A. Cook.
35. Hunnicutt on Peerless.
36. Jones' improved on W. A. Cook.
37. Jones' improved on Peerless.
38. Jones' long staple on Peerless.
39. Jones' long staple on Peerless.
40. Keith on W. A. Cook.
41. Keith on W. A. Cook.
42. Keith on Peerless.
43. King on W. A. Cook.
44. King on Peerless.
45. Nankin.
46. Okra leaf on Peerless.
47. Peeler on Peerless.

48. Peeler on Peerless.
49. Peeler on Peerless.
50. Peeler on W. A. Cook.
51. Peerless on W. A. Cook.
52. Peerless on W. A. Cook.
53. Peterkin on W. A. Cook.
54. Peterkin on Peerless.
55. Petit gulf on W. A. Cook.
56. Petit gulf on Peerless.
57. Rust proof on W. A. Cook.
58. Rust proof on Peerless.
59. Rameses on W. A. Cook.
60. Rameses on W. A. Cook.
61. Rameses on Peerless.
62. Storm proof on Peerless.
63. "Scrub" on Peerless.
64. Sea Island.
65. Southern hope on Peerless.
66. Southern hope on W. A. Cook.
67. Southern hope on W. A. Cook.
68. Truitt on Peerless.
69. Truitt on Peerless.
70. Truitt on Peerless.
71. Truitt on Peerless.
72. Welborn's pet on W. A. Cook.
73. Welborn's pet on Peerless.
74. Welborn's pet on Peerless.
75. Wonderful on Peerless.
76. Wonderful on Peerless.
77. Wonderful on Peerless.
78. Wonderful on Peerless.
79. Wonderful on Peerless.
80. Wonderful on W. A. Cook.
81. Zellner on Peerless.
82. Zellner on Peerless.
83. Zellner on W. A. Cook.
84. W. A. Cook.
85. Peerless.

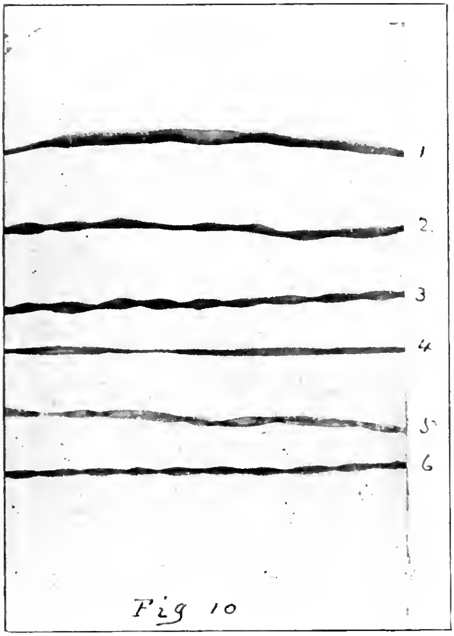


Fig 10

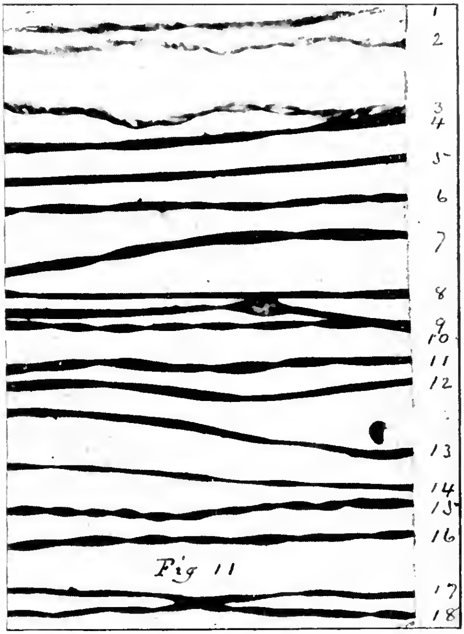


Fig 11

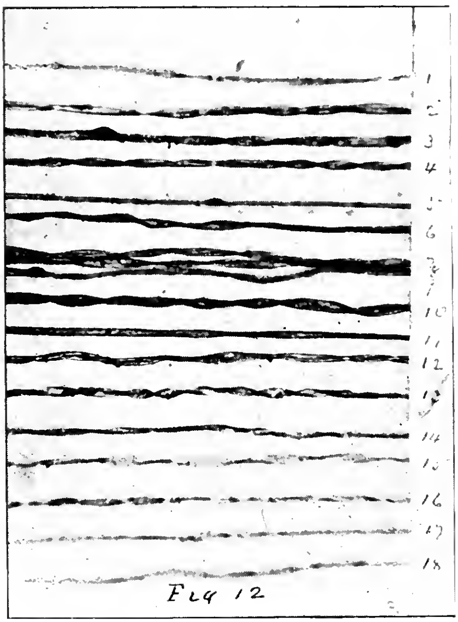


Fig 12

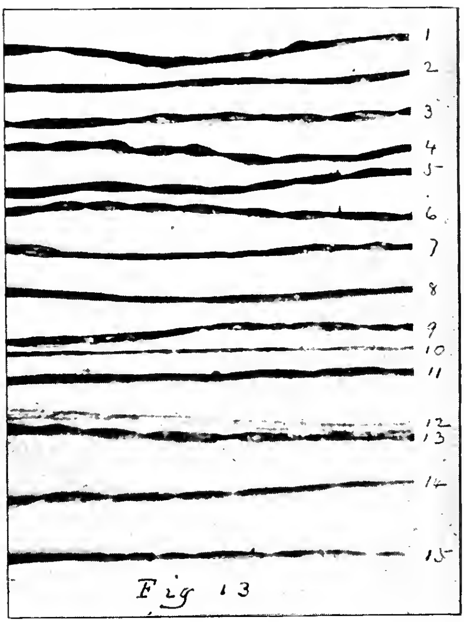


Fig 13

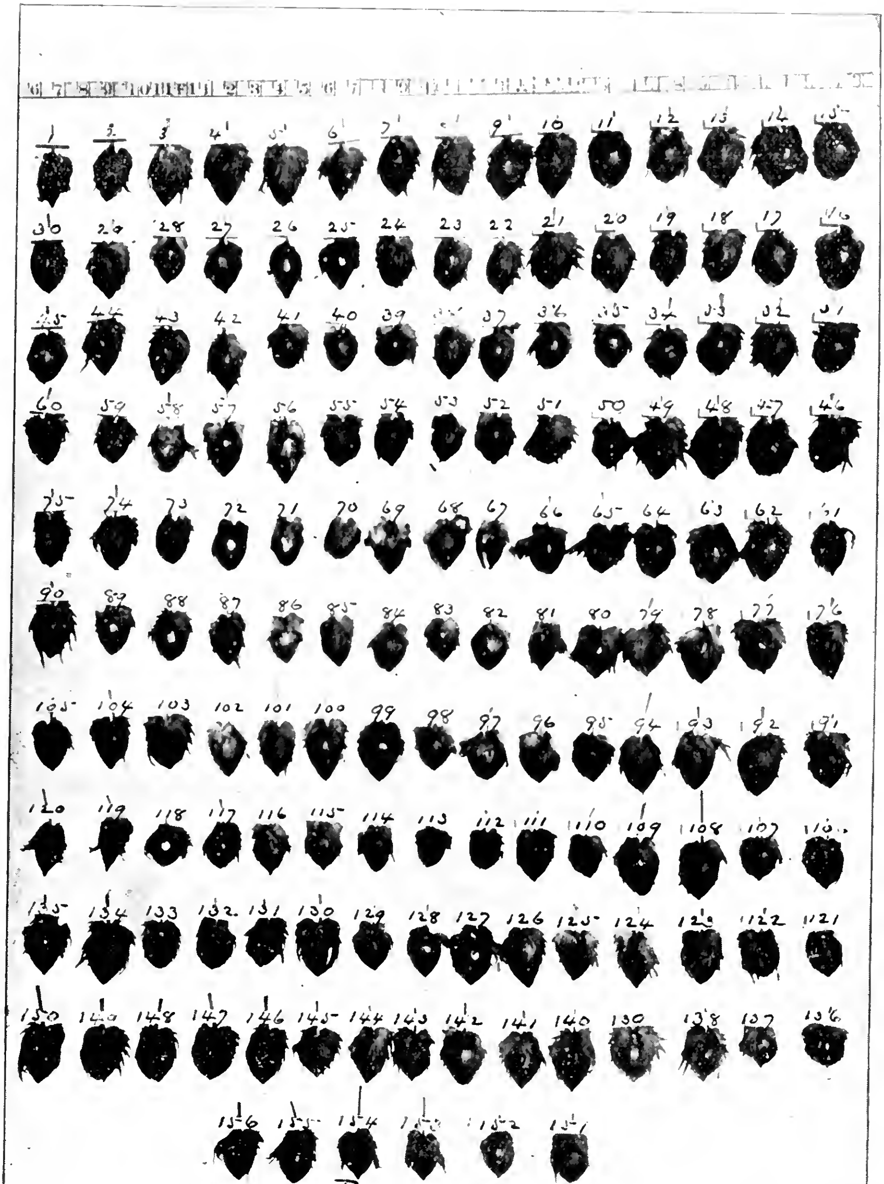
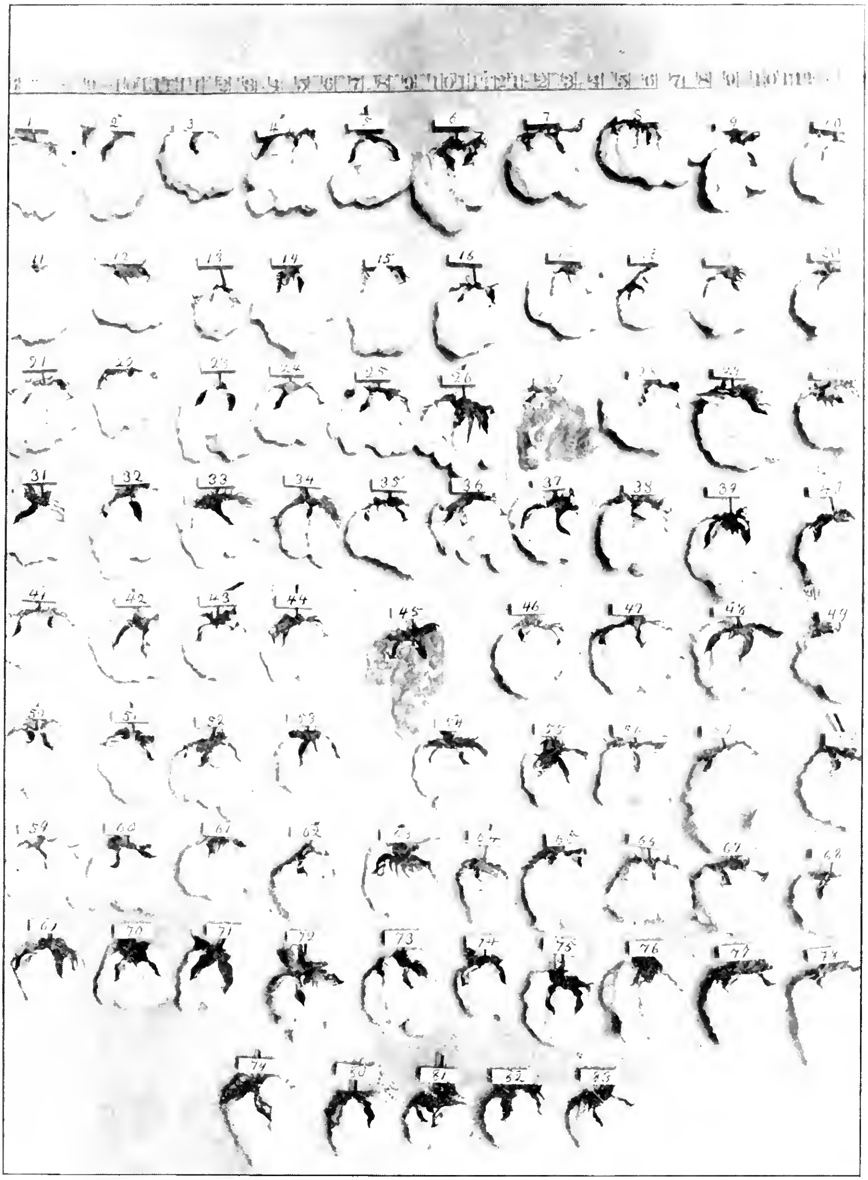
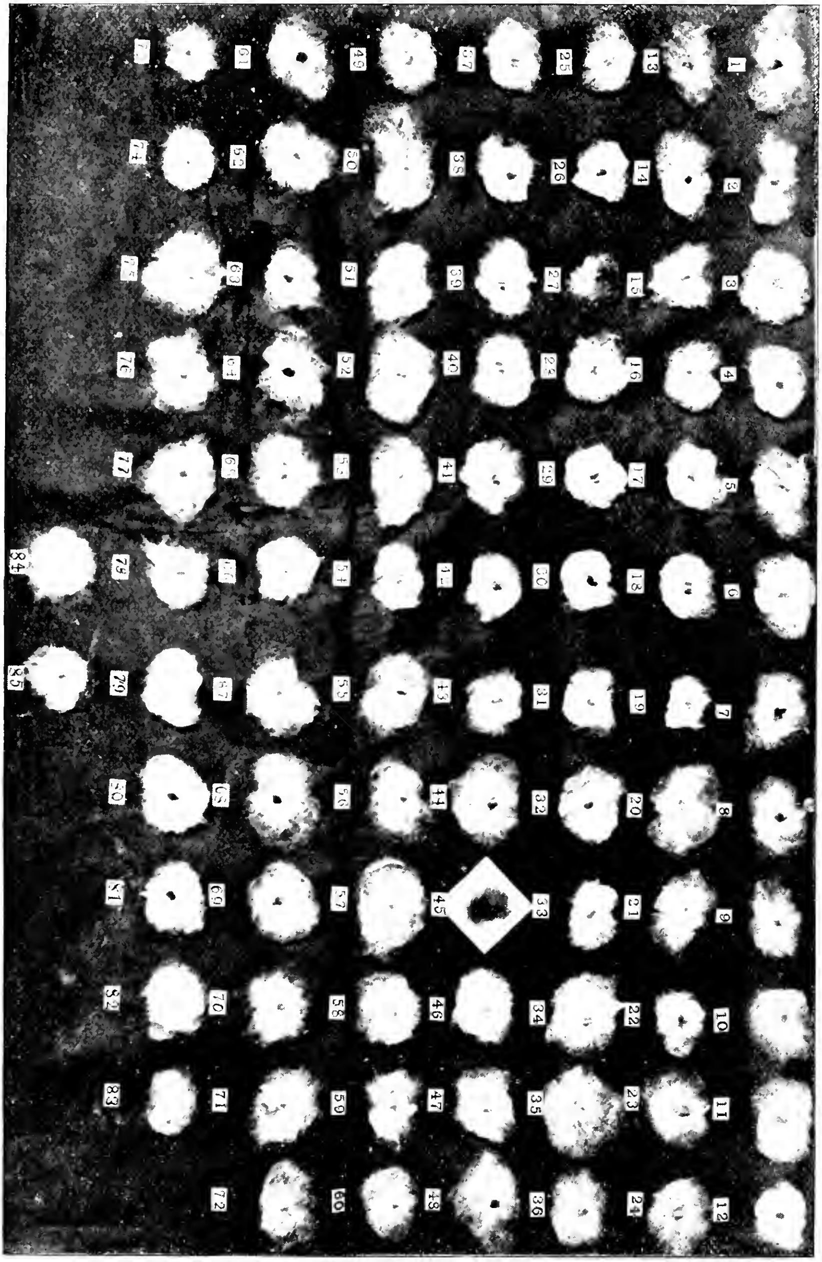


Fig 14





Bulletin No. 57, : : May, 1894.

Agricultural Experiment Station

—OF THE—

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

Fertilizers Required by Cotton as Determined by the Analysis of the Plant.

J. T. ANDERSON.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

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FERTILIZER REQUIREMENTS OF COTTON.

AS DETERMINED BY THE ANALYSIS OF THE PLANT.

No question, perhaps, so nearly concerns the grower of cotton as that of fertilization. The small margin for profit in its cultivation makes it imperative that the southern farmer, who chooses to depend well nigh exclusively on the great staple for his livelihood, should cultivate it at the smallest possible cost. An indiscriminate and unintelligent use of fertilizers must be discarded, then, as early as possible, and the farmer should seek to inform himself as to what his soil needs in order to make it highly productive. Much that is valuable has been published on this subject, and many reliable experiments performed which seem to solve the question pretty effectually as far as the particular soils under consideration are concerned. By the application of various fertilizers in varying proportions the experimenter has been able to say that his soil needs this and that constituent in this and that amount, but he solves the question with any great degree of certainty *only* with reference to his own soil and those which resemble it in kind and climatic conditions. What is needed in South Carolina or Texas, for instance, may not be needed in Alabama, and what an east Alabama soil may be deficient in, may be found in sufficiency in a western Alabama soil. The great desideratum, therefore, is to find some method of determining soil requirements which admits of general application, or which may be readily and cheaply applied in individual cases. With the hope of being able, if possible, to make some small contribution toward the solution of this great problem, the work detailed in this bulletin was undertaken.

For the purposes of the experiments herein described two plots of ground were selected, whose soils are of the same general type, but are widely different in point of fertility. The soil of the Drake field is too poor for the profitable culture of cotton, while that of the Station garden has, by proper management, been brought into a high state of cultivation. The field plot stood idle the previous year, while the garden produced two crops. The last crop was a winter grass which was harvested just prior to breaking the soil for these experiments. In the preparation of this land all the stubble and roots, as far as possible, were removed by the rake after the ground was thoroughly broken up. Each piece of ground was divided into ten small plots, each 10x10 feet, and lying end to end. The garden strip was so located that there was a slight drainage in a transverse direction. In the Drake field, however, the peculiar conditions of the surface were such that, to secure uniformity of soil, the strip had to be so located that the drainage would be lengthwise, plot 1 being the higher. In all cases a space four feet wide was left between the plots. Three of the plots in each strip were left unfertilized, while to the other seven the three fertilizing constituents were applied, singly and in combination, as is set forth in Table I. In the final preparation of the soil and in the planting and cultivation of the cotton, all plots were treated alike.

The first set of samples for analysis were taken during the first week in June, when the plants were in the early flowering stage. The second set were drawn about the 1st of September, when the last blossoms were falling off, and the early bolls were beginning to open. The entire stalk above ground was taken, air dried, and prepared for analysis in the usual way.

It is proper to state here that all the field work for these experiments was done for the writer under the supervision of Mr. James Clayton, formerly assistant horticulturist of the station, to whom acknowledgments are due for valuable and painstaking services.

In Table I will be found the percentages of potash, phosphoric acid, and nitrogen in the plant in the flowering stage. The figures given are the means of a number of determinations, and are calculated to the dry substance, the moisture of each sample having been carefully determined in the usual way, by separated heatings and weighings until no further loss of weight occurred. In the same Table will be found the weight in ounces of the seed cotton gathered from each plot.

To make the results comparable the number of stalks in each plot were counted and the actual weights obtained were reduced to a uniform stand. It should be stated further that the stalks were not as thick in the plots as is usual, and none of them were located near the edge of the plots. the purpose being to allow the roots to have the full benefit of the fertilizers used.

TABLE I.

COTTON PLANT IN FLOWERING STAGE.

A glance at the figures in Table No. 1 will reveal several noteworthy facts. In the first place it will be observed that there is considerable divergence between the maximum and minimum percentages of two of the constituents. That the composition of the cotton plant, therefore, in relation to these ingredients at least, is subject to perceptible variation, cannot be doubted. For instance, the maximum percentage of potash in the Drake field is 50.8 % higher, and in the garden, 21.1 % higher, than the minimum in the same soil ; while the maximum in the garden exceeds the minimum in the field by 98 %. The maximum of nitrogen in the field is 17 %, and in the garden 25.8%, higher than the minimum in the same soil ; and the maximum in the garden, 28.2 %

Table I.

COTTON PLANT IN FLOWERING STAGE.

Plots.	FERTILIZERS USED.	Drake Field. Per cent. Potash.	Drake Field. Per cent. Phosphoric Acid.	Drake Field. Per cent. Nitrogen.	Drake Field. Oz. Seed Cotton.	Station Garden. Per cent. Potash.	Station Garden. Per cent. Phosphoric Acid.	Station Garden. Per cent. Nitrogen.	Station Garden. Oz. Seed Cotton.
1	None	2.154	0.839	3.390	3.75	3.444	0.861	3.455	35.63
2	Nitrate Soda		0.863	3.906	10.	3.287	0.829	3.976	73.43
3	Kainit	2.751		3.382	11.88	3.320	0.958	3.717	117.14
4	Acid Phosphate		0.781	3.837	34.	3.227	0.914	3.896	124.29
5	None	2.034	0.934	3.488	9.29	3.178	0.862	3.825	130.83
6	Nitrate Soda and Kainit	2.137	0.627	3.855	30.	2.981	0.805	3.831	120.
7	Nitrate Soda and Acid Phosphate	1.823	0.699	3.685	23.21	3.199	0.854	4.225	96.25
8	Kainit and Acid Phosphate	1.997	0.919	3.967	29.17	3.102	0.797	3.873	132.86
9	Nitrate Soda, Kainit, Acid Phosp.	2.547	0.830	3.645	37.50	3.611	0.860	4.347	145.34
10	None	2.238	0.886	3.645	12.50	3.106	0.805	4.149	141.25

higher than the minimum in the field. The *relative* variations between the extremes of phosphoric acid are greater than those in the case of nitrogen, but the absolute variations are small, and may possibly be traceable to accidental causes. It may not be amiss to state just here that a great deal of time and care were spent in the analytical work, that no errors might creep in to vitiate the results, and hence it can be confidently affirmed that the results given may be relied on. It is believed, however, that some individual stalks have exhibited peculiarities of composition, and such peculiarities might have been eliminated, perhaps, had a larger number of plants from each plot been available for analysis.

In the second place, we note that the character of the soil exercises a perceptible influence on the composition of the plant, at least as far as potash and nitrogen are concerned. Taking the means of the percentages of potash in the three unfertilized plots of each soil separately, we find that this mean in the garden soil is 51.4 % higher than the corresponding mean in the field soil. Making the same estimates for nitrogen, we find that the garden soil exceeds the field soil in this ingredient by 8.6 %. Here, as before, we cannot affirm any positive rule concerning phosphoric acid.

The original purpose of these investigations was to find out what effect, if any, the addition of fertilizing constituents to the soil would have on the relative proportions of these constituents in the plants themselves. With this purpose before us let us examine Table I in detail. In the results from the Drake field soil, we see that the highest percentage of potash is in plot 3, and the next highest in plot 9, to both of which plots potash was added. On the other hand, the second lowest percentage is in plot 8, which also was fertilized with potash. It will be noticed that this plot seems eccentric in another particular—in that it contains the highest percentage of nitrogen, when no nitrogen was applied to it. With this exception, the highest percentage of nitrogen is found in plot 3 which has nitrogen fertilization, and the lowest percentage where nitrogen was used, is higher than the average of those where no nitrogen was added, even when the high percentage of plot 8 is included in the estimate. As has already been noted, the variation in phosphoric acid seems to obey no rule, the percentages in the two soils being practically the same.

In the beginning of this discussion it was stated that the garden soil was in a high state of cultivation to begin with, and it was to be expected, that the influence of fertilizers here, both on the composition of the plant and on the yield of seed cotton, would be less strongly marked than in the poorer soil. While this is the case, it is, also, true that by fertilization with potash and nitrogen the percentages of these constituents even here are increased. This is notably true in plot 9, where all three fertilizers were applied and where are found the highest percentages of these ingredients.

The average effect of fertilization on the percentages of the fertilizing constituents in the plants may best be seen by reference to Table II. By the term "fertilization" in this table is to be understood the use of the particular ingredient in question, without reference to the other ingredients. Thus when percentages of potash are considered, fertilization with potash without reference to phosphoric acid or nitrogen is solely considered.

Table II.

GENERAL SUMMARY.

	Drake Field.			Station Garden.		
	Fertilization.			Fertilization.		
	Without	With	% Increase by	Without	With	% Increase by
Potash	2.062	2.356	14.25	3.240	3.254	0.43
Phosphoric Acid	.828	.807	—2.53	.853	.856	0.35
Nitrogen	3.618	3.773	4.28	3.819	4.095	7.23

It will thus be seen that by fertilization with potash, the average percentage of that constituent in each soil is increased. This increase is large in the poor soil and small in the rich. Fertilization with nitrogen, also, has a well marked influence on the percentages of that constituent, as the above table shows.

The results that we have hitherto been considering were obtained from the analysis of the plant in the early flowering stage. It was deemed expedient to analyze the plant in a later stage, also, and so about three months after the first samples were taken, when the plant was full of unopened bolls, the second lot were drawn. One of the purposes of this investigation was to see if the percentages of potash, phosphoric acid, and nitrogen in the plant did not increase with the yield of cotton. This could hardly be otherwise, if the seed were ground up with the stalk, inasmuch as the seed are a reservoir, so to speak, in which these constituents accumulate. Hence it was thought best not to include the young, inmature seed in the sample for analysis, and they were accordingly rejected. The results of the analysis are given in Table III following, which is constructed after the model of Table I. Here, as in the other, the results are calculated to the dry substance.

Table III.

ANALYSIS OF PLANT IN THE BOLLING STAGE.

Plots.	FERTILIZERS USED.	Drake Field.				Station Garden.			
		Per cent. Potash.	Per cent. Phosphoric Acid.	Per cent. Nitrogen.	Oz. Seed Cotton.	Per cent. Potash.	Per cent. Phosphoric Acid.	Per cent. Nitrogen.	Oz. Seed Cotton.
5	None	1.256	.788	1.883	9.29	2.538	.758	2.352	130.83
6	Nitrate Soda and Kainit	2.123	.345	1.969	30.	2.026	.741	2.436	120.
7	Nitrate Soda and Phosphoric Acid.	1.051	.537	1.883	23.21	1.494	.688	2.064	96.25
8	Kainit and Phosphoric Acid	2.119	.488	1.841	29.17	2.751	.900	2.442	132.86
9	Nitrate Soda, Kainit, Phosp. Acid	2.562	.557	1.833	37.50	3.054	.696	2.339	145.34
10	None	......	......	......	12.50	2.683	.724	2.273	141.25

A conspicuous fact observable in the above table is that the figures here are smaller than the corresponding figures in the first table. This was to be expected. The plant at this stage of growth is nearing maturity, and the three important constituents are being rapidly stored up in the seed.

Studying the table in detail, we find that in the Drake field the lowest percentages of potash are in 5 and 7, where there was no potash fertilization, while the highest is in 9, where there is complete fertilization and where there is, also, the highest yield of cotton. As we shall see a little later, the average of the percentages of potash in plots in the field which have potash fertilization, is about the same as that in the richer soil of the garden. Singularly enough we have in 9 one of the lowest percentages of nitrogen, but the other two nitrogen-fertilized plots bring up the average, and with this constituent, as with potash, we have an increase of percentages due to fertilization. We must observe, however, the small variation between the maximum and minimum in this column.

Coming now to the garden plot we find that the average effect of potash fertilization is to increase the percentages of potash, while, on the other hand, nitrogen fertilization does not seem to have a like effect on the percentages of nitrogen. This would seem to indicate that the garden soil contains a deficiency of potash, but a sufficiency of nitrogen.

The results on phosphoric acid are worthy of special attention. With a single exception the percentages of this constituent in the Drake field in the bolling stage, are decidedly lower than the corresponding ones in the flowering stage, while no such marked change is observable in the garden percentages. It would seem, therefore, that there is a deficiency of available phosphoric acid in the Drake field, which was not shown by the analysis at the earlier stage, and further, that there is no such deficiency in the garden soil. The exceptional case referred to is in 5, where the percentage of phosphoric acid is only a little smaller than the average found in the earlier stage. This fact, taken in connection with that of a high percentage of nitrogen and a low yield ot cotton, might suggest the possibility of a case of arrested development. It will be observed that with rare exceptions the percentages of all the constituents are higher in the garden than they are in the field, and from this the conclusion may be drawn that there is a deficiency of potash, phosphoric acid, and nitrogen in the field. The smaller yield of cotton in the field strengthens this conclusion.

Table IV following, gives the summary of results contained in Table III, and is submitted without comment.

Table IV.

GENERAL SUMMARY.

	Drake Field			Station Garden.		
	Fertilization.			Fertilization.		
	With out	With	% Increase by	Without	With	% Increase by
Potash	1.154	2.268	96.53	2.238	2.610	16.62
Phosphoric Acid	5.66	.527	—6.89	.741	.761	2.70
Nitrogen	1.862	1.895	1.77	2.356	2.280	—3.22

For convenience of comparison and study, it has been thought advisable to present Table V following, which is a consolidation of Tables I and III.

It will be seen from this table that the percentages of the constituents in the bolling stage are smaller in most instances than the corresponding percentages in the flowering stage. It will be convenient to refer to this decrease in values in per cents of those of the earlier stage. In the Drake field we find the decrease in potash in No. 6 to be 0.7 %, and in Nos. 8 and 9, there is an increase ot 6.1% and 0.6 % respectively; while in the other two plots the decrease is 38.2 % and 42.3 %. It will be observed, also, that the largest yields of cotton are in plots 6, 8, and 9. From this it would seem that in the potash-fertilized plots there is a sufficiency of that constituent under the circumstances here existing. On the other hand, comparing the field and garden, we find that while the latter has much higher percentages of potash to begin with, it has at the same time larger per cents of decrease than the potash-fertilized plots in the field, ranging from 11.3 % in plot 8 to 53 % in plot 7. In other words, with a larger supply there is a smaller excess of potash over the demands for that constituent. Little can be learned from the figures relating to phosphoric acid. The decrease ranges from 0.8 % in plot 6 in the garden to 46.9 % in plot 8 in the field. The decrease in the values of nitrogen is uniformly high, showing the great demand for that valuable constituent. In the field the range is from 46 % in plot 5 to 53.6 % in plot 8, while in the garden it runs from 36.4 % in 6 to 51.1 % in 7.

A few words with reference to the yield of cotton in passing. A reference to Table I will show that in the unfertilized plots 1, 5, and 10 in each soil the yield is not the same, but is lowest in 1 and highest in 10. This suggest that all the plots are not uniformly fertile, but increase in fertility from 1 to 10. This lack of uniformity in natural fertility, will, of course, effect the results obtained by artificial fertilization, but the effect of the latter on the yield is noticeable, just as it was on the composition of the plant. By a study of Table V we find that where we have high percentages of two or more constituents in the flowering stage, and a relatively low decrease of those percentages in passing to the bolling stage, we have, generally speaking, a large yield. On the other hand, low, or even average, percentages in the early, and a large decrease of the same in the later stage, showing an insufficient supply from the soil, means a relatively low yield. The application of this rule,

Table V.

Plot	FERTILIZERS USED.	Drake Field. Potash Flower-ing	Drake Field. Potash Bolling	Drake Field. Phosphoric Acid Flower-ing	Drake Field. Phosphoric Acid Bolling	Drake Field. Nitrogen Flower-ing	Drake Field. Nitrogen Bolling	Drake Field. Seed cott'n	Station Garden. Potash Flower-ing	Station Garden. Potash Bolling	Station Garden. Phosphoric Acid Flower-ing	Station Garden. Phosphoric Acid Bolling	Station Garden. Nitrogen Flower-ing	Station Garden. Nitrogen Bolling	Station Garden. Seed cott'n
5	None	2.034	1.256	0.934	0.788	3.488	1.883	9.29	3.178	2.538	0.862	0.758	3.825	2.352	130.8
6	Nitrate and Kainit	2.137	2.123	0.627	0.345	3.855	1.969	30.	2.981	2.026	0.805	0.741	3.831	2.436	120.
7	Nitrate and Phos. Acid	1.823	1.051	0.699	0.537	3.685	1.883	23.21	3.199	1.494	0.854	0.688	4.225	2.064	96.3
8	Kainit and Phos. Acid	1.997	2.119	0.919	0.488	3.967	1.841	29.17	3.102	2.751	0.797	0.900	3.873	2.442	132.9
9	Nitrate, Kainit, Phos. Acid	2.547	2.562	0.830	0.557	3.645	1.833	37.50	3.611	3.054	0.860	0.696	4.347	2.339	145.3
10	None	......	......	......	......	......	......	......	3.106	2.683	0.805	0.724	4.149	2.273	141.3

if it be a rule, to plot 5 Drake field may explain the low yield of cotton there, a deficiency both of potash and of nitrogen being manifest. Likewise in plot 7, Station garden, we find a large decrease in the percentages of all three constituents, although two of them have been added to the soil, and here, also, we find a relatively low yield.

In connection with this work, it has been thought well to make a complete analysis of the two soils. In view of the fact of their similarity geologically, both being classed as light sandy soils, and the additional fact that one is very poor and the other rich, a comparison of their chemical composition will be interesting.

CHEMICAL ANALYSIS OF SOILS.

	DRAKE FIELD.	STATION GARDEN.
Moisture	.650	.825
Insoluble Silica	94.790	93.097
Soluble Silica	.532	.560
Alumina	1.153	1.873
Oxide Iron	.850	1.093
Lime	.185	.260
Magnesia	.158	.122
Soda	.268	.315
Potash	.098	.087
Phosphoric Acid	.087	.064
Nitrogen	.069	.086
Organic Matter	1.550	2.195
Humus	.580	.863
Available Inorg. Matter	.647	.946
Humus Silica	.253	.353
Humus Phosphoric Acid	.020	.035

As will be observed, both soils have a high percentage of insoluble silica, that of the field exceeding that of the garden nearly two per cent. Oxide of iron in the hydrated condition is believed by some to increase in soils the absorptive power of gases, and particularly, of moisture. Both of our soils are low in this constituent, with the advantage in favor of the garden. Estimated in terms of the poorer soil, the garden soil is 28.6 % higher in oxide of iron than the other. If the minimum limit assigned to lime in light sandy soils by writers on this subject be correct, both of these have a sufficiency of this valuable constituent, the garden having 40.5 % more than the field. In both potash and phosphoric acid, on the other hand, the garden soil is poorer, about 1 % in the former and 26.4 % in latter. What has just been said applies to *total* phosphoric acid. The humus phosphoric acid, all of which is believed to be readily available to the plant, is 75 % higher in the garden than in the field. In total available inorganic matter—that which dissolves out with the humus—the garden soil is 46 % richer than the field soil.

It will thus be seen that the garden soil in the main is richer in the important inorganic constituents than the other soil; but it is believed that its superior fertility is chiefly due to its larger proportion of organic matter. In total organic matter it is 41.6 %; in humus, 48.8 %; and in total nitrogen, 24.8 % richer than the other.

CONCLUSIONS.

It is not safe to base conclusions on a single series of experiments. Further investigations may make it necessary to alter some of the opinions suggested in this paper, and some of these conclusions here may have to be withdrawn, but it is believed that the broadest conservatism will sanction the following conclusions from the results herein presented:

1. That the composition of the cotton plant in respect to potash, phosphoric acid, and nitrogen, is subject to decided variations under varying conditions.
2. That the nature of the soil exerts a considerable influence on the composition of the plant, a rich soil giving higher percentages of the three important constituents than a poor soil.
3. By fertilizing with either of the three constituents in soils not already containing a sufficiency of the same, it is possible to increase the percentage of that constituent in the cotton plant which is grown on such soil.
4. That humus in the soil is of great value, not only in supplying organic constituents, but, also, in holding inorganic constituents in most available conditions.

It is not claimed that the results herein described *demonstrate* the utility of this method as a means of determining soil requirements for cotton, but it is claimed that they are highly suggestive. If the normal composition of the healthy, thrifty plant under given soil conditions be known, we believe it possible to determine when a deficiency of any of the three constituents exists in a given soil. Systematic determinations, therefore, of the composition of the cotton plant under normal healthy conditions, together with determinations of the chemical composition and the physical properties of the producing soil, will furnish a basis, it is believed, for the establishment of a plan of investigation which will prove of great value to the agricultural interests of the South.

Bulletin No. 58, : : August, 1894.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN, : : ALABAMA.

Paris Green; Composition and Adulterations.

B. B. ROSS, State Chemist.

☞The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

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INSECTICIDES.

Composition and Adulteration.

The employment of insecticides in combating and checking the ravages of the cotton worm, has been generally practiced in the cotton growing sections of the South for many years, and where proper precautions have been observed, with undoubted success.

The materials which are almost exclusively utilized by the cotton planter as insect poisons are Paris Green, and London Purple, though the consumption of the former far exceeds that of the latter.

While these substances have been so generally employed for such a long period of time, but little attention has been paid to the quality and purity of the materials purchased for use as insecticides, and it is not at all surprising that frauds and adulterations are occasionally found upon the market.

With a view to determining whether or not such adulterations or falsifications had been practiced upon goods of this class for sale in this State, an attempt was made to secure samples of Paris Green and London Purple from all sections of the State. A large number of circular letters, calling for samples of these insecticides, were sent out to parties in all portions of the State, and it was expected that quite a number of specimens would be obtained in this way. But few replies, and still fewer samples were received, however, and the investigation has consequently been more limited in scope than was originally intended.

With one exception, the samples came from the "black belt," where the employment of Paris Green, has been much more extensive than on the hill lands ; in fact in some of the hill counties, it has been found impossible to secure Paris Green in the market. Not a single sample of London Purple, could be obtained, a circumstance that indicated that this insecticide was even less in demand than was the case several years since.

Commissioner H. D. Lane, through Maj. T. J. Key, very kindly co-operated in securing additional samples of Paris Green, and these with the samples already on hand enabled the formation of a fair estimate of the character and quality of the insecticides on the market in Alabama.

The substance sold under the name "Paris Green" is, chemically considered, an aceto-arsenite of copper, and is known in the arts and to the trade under quite a variety of names, such as, "Emerald Green," "Mitis Green," "French Green," "Schweinfurt Green," etc.

The last named term (derived from the place of it's first manufacture) is the designation most frequently given to it in Europe, it being there used largely as a pigment on account of it's brightness of color.

Scheele's green, the simple arsenite of copper, is frequently confounded with Paris Green, but it is distinguished from the latter by its duller color and the entire absence of acetic acid, which is a characteristic constituent of a genuine Paris Green.

One of the methods formerly employed in the preparation of Paris or Schweinfurt Green involved the simple treatment of the crude and freshly precipitated Scheele's green (copper arsenite) with wood vinegar, from which source the acetic acid of the final product was derived.

The process as first devised by Russ & Sattler in 1814, was kept secret for a long period, but after the investigation of its composition by Liebig, its manufacture became more extended.

In the method generally adopted for the preparation of this substance, arsenious acid (white arsenic) and acetate of copper (verdigris) are employed; both are dissolved separately in hot water, and the boiling solutions are mixed together, the precipitated coloring matter being allowed to settle.

Paris Green is normally a bright crystalline powder, insoluble in water, but changing in color when boiled with water for some time. According to Ehrmann, the composition of pure Paris Green is as follows:

Copper oxide	31.29
Arsenious acid	58.65
Acetic acid	10.06

The purest grades of Paris Green, however, show at least slight variations from the proportions given above, and it is quite difficult to fix an absolute standard for the composition of products of this character.

Paris Green, which is intended for use as an insecticide, however, should contain at least 50 per cent. of combined arsenious acid, and any purchasers of this article who are in doubt as to its purity or quality can have the same tested by forwarding a sample to this Laboratory.

The following is the result of the examination of the samples of Paris Green received at this Laboratory:

		Arsenious acid.
No. 1.	From Hale Co., forwarded by Mr. B. L. Garber	55.42
No. 2.	From Wilcox Co., forwarded by Mr. S. M. Cathcart	55.01
No. 3.	From Montgomery, forwarded by Dept. of Agriculture	59.71
No. 4.	From Montgomery, forwarded by Dept. of Agriculture	53.13
No. 5.	From Montgomery, forwarded by Dept. of Agriculture	57.38
No. 6.	From Eimer & Amend, New York	54.15
No. 7.	From Tallapoosa county	none.

Samples one to six inclusive, possessed the bright green color characteristic of a genuine Paris Green, and their mechanical condition was all that could be desired.

The proportions of arsenious acid are also well above the limit previously referred to (50%), and no traces of adulteration or attempts at adulteration were detected.

Sample No. 7, although of nearly the same shade of color as a normal Paris Green, was nevertheless so lacking in the brightness of tint which characterizes the genuine article that it was at once regarded with suspicion. A qualitative examination, carefully conducted, showed an entire absence of both copper and arsenic, not the least trace of the latter being discoverable by the employment of the most delicate tests. Quite a number of tests were next made for all the green coloring agents of importance, but with negative results, and it was then decided that the color of the material was due to a combination of blue and yellow coloring matters.

A further examination revealed the presence of Prussian Blue and chrome yellow, intimately mixed with each other, and well incorporated with a large quantity of inert materials, such as clay, chalk, etc.

On taking a small portion each of Prussian Blue and Chrome Yellow and mixing with a large quantity of clay or chalk, it was found that a product corresponding almost precisely in color to the material examined, could be produced, and it was found quite easy to imitate the normal shade of color of Paris Green, though, as before stated, the brightness of tint, would be lacking. It was estimated that a material of this character could be manufactured at a cost not exceeding one cent per pound, while a high grade Paris Green frequently costs above twenty cents per pound, the fraudulent manufacturer being thus able to dispose of his product at an enormous profit.

Of course, such a preparation as this is entirely worthless as an insecticide, and planters using such an article, and not being aware of its character, would probably be thereafter prejudiced against the use of insect poisons in any shape or form.

As before stated, the true character and quality of an insecticide can be readily ascertained by analysis, and the

Station Laboratory will cheerfully test any samples forwarded for examination by planters from any section of the State.

Any fraudulent goods of this character can thus be readily driven from the market, and the planter can then be assured as to the absolute purity of the insecticides which he may purchase.

METHOD OF ANALYSIS.

The following is the process adopted in the Laboratory for the determination of arsenious acid in Paris Green:

Weigh one gram of the material, and place in a medium size beaker or flask; add about 30 cubic centimetres of strong hydrochloric acid and digest on a water bath, at a temperature somewhat below the boiling point, adding at frequent intervals, small quantities of finely powdered potassium chlorate. Continue the heating until the odor of free chlorine has almost disappeared; dilute with water, and filter, if necessary. Add ammonia in slight excess, cool and add magnesia mixture gradually, stirring vigorously all the while. Allow to stand 12 hours, filter and wash precipitate with ammonia water.

Dry filter and contents: detach precipitate from filter as completely as possible; ignite filter, using ammonium nitrate solution to facilitate ignition. Transfer the precipitate to a porcelain crucible, and heat for a while on an iron plate, and finally with the direct flame. Add filter ash to the precipitate and weigh as magnesium pyro-arsenate.

(Note.—Of course, this method is only applicable in the absence of phosphates and arsenates.)