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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

EXPERIMENTS WITH COTTON, 1898.

J. F. DUGGAR.

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*Absent on leave.

EXPERIMENTS WITH COTTON, 1898.

By J. F. Duggar.

SUMMARY.

The growing season of 1898 was extremely dry until June 12, which was unfavorable to securing full effects from fertilizers.

Of fourteen varieties of cotton tested in 1898, the largest yield was made by Russell Big Boll, 382 pounds of lint per acre. Next in yield of lint followed Deering, Peterkin and Smith Improved.

Subsoiling late in February failed to increase the yield.

On gray sandy soil all fertilizers yielded a profit; on this soil the yield was profitably increased by application of nitrogen, phosphoric acid and potash, singly or in combination.

The yield was larger when all of the fertilizer was applied in the center furrow than when two-thirds or all of it was applied in the two listing furrows.

In a comparison of rotted cotton seed, cotton seed meal and nitrate of soda the results were inconclusive.

As a means of decreasing black rust, 50 lbs. of nitrate of potash per acre was fully as effective as 200 lbs. of kainit, each material furnishing an equal quantity of potash.

One hundred pounds of kainit per acre reduced the amount of rust; 60 pounds of kainit per acre was less effective in causing the cotton plants to retain their leaves.

The Rainfall During the Growing Season of 1898.

The following is the condensed record of rainfall at Auburn, April to September inclusive, as observed by Dr. J. T. Anderson, of the Chemical Department:

	Rainfall in inches.
April	5.06
May	.26
June	1.18
July	6.79
August	10.13
September	1.93

The longest period of extremely light rainfall was from April 23 to June 12, during which period only six-tenths of an inch of rainfall is recorded.

From April 4 to July 6 no heavy rains fell, only exceedingly light showers; after July 6 the rainfall was abundant.

It should be added that fall frosts occurred in 1898 at an unusually early date.

Varieties.

The number of varieties compared in 1898 was fourteen. The rows were 3½ feet apart. Thinning was done after counting the plants, so as to leave, wherever practicable, an equal number of plants on each of the sixteen-acre plots. With a perfect stand, the distance between plants averaged about 18 inches.

However, the stand on some plots was so poor that we were compelled to conduct the test with inequalities in stand. In all cases the number of plants per acre is given in the following table. Undoubtedly, the deficiencies in stand placed the varieties with small stalks or short limbs at a disadvantage in the instances where such varieties had a poor stand. It is probably for this reason that King, a variety with very small stalk, stood near the foot of the list in 1898. In previous tests, and in an adjoining field in 1898, it was, with a better stand, decidedly productive.

The field used had been employed in 1897 for an experiment to determine the best distance for planting cotton. The details of that test are recorded in Bulletin No. 89 of this station.

The land was flushed before being fertilized and bedded; a complete fertilizer was drilled at the rate of 500 pounds per acre and at a cost of $3.84 per acre.

This consisted of

200 lbs. acid phosphate per acre.
200 " cotton seed meal " "
100 " kainit " "

All plots were planted April 15 and the vacant spaces replanted April 27.

Yield per acre, relative earliness, and percentage of lint of 14 varieties of cotton.

Plot No.	Varieties.	No. of plants per acre.	Yield of seed cotton.	Percentage of total crop of first picking.	Percentage of lint.	Yield of lint per acre.
15	Russell Big Boll	8576	1200	64.	31.9	382
7	Deering	10280	957	54.	35.6	341
11	Peterkin	10280	978	44.	34.7	339
17	Smith Improved	10280	1062	69.	31 9	339
1	Truitt	10280	1010	57.	32.6	330
10	Texas Oak	10280	872	52.	36 5	318
13	Hutchinson's Storm Prolific	10280	941	64.	32 8	309
2	Jones' Re-improved	10280	962	57.	31.8	306
14, 9, 4	Peerless	8096	922	60.	33 5	304
3	Hawkins	7024	866	65.	34.	288
6	Strickland	8144	816	35.	32 1	262
12	Griffin	7296	763	67.	32 8	250
5	King	7728	643	60.	33.5	216
8	*Unknown	560	227	20	30.9	70

* Bought from a seedsman as Welborn. It proved uutrue to name and most seeds were not capable of germination; however, the few plants that appeared, about 1-20 of a stand, were left to mature.

It should be remembered that no single test can be taken as finally determining the relative values of different varieties. Results vary from year to year. The past season was unusual, a fact which detracts from the value of these results.

In addition to the varieties in the test just described, Allen's New Hybrid Long Staple and Culpepper Improved were grown alongside the variety test, but on plots which, in previous years, had been cropped in such a way as to render the results in 1898 not comparable with the results obtained on the plots referred to in the table.

In this separate division where Peerless was grown as a check on the other two varieties, the yield of lint per acre was with Peerless 374, with Allen 357, and with Culpepper 334 pounds. The number of plants per acre was respectively, 10,280, 10,280 and 7,616.

In another field a few of the seed of the Jackson Limbless variety were planted. No difference could be seen between these plants and plants of the Welborn Pet variety as grown at this Station in previous tests. The Georgia Experiment Station had already pointed out the similarity of the two varieties.

The limited number of seed planted and the small area of ground occupied do not allow a statement of the yield per acre. By its appearance it was judged to be a good, but not remarkably productive variety.

SUBSOILING.

This experiment was conducted on red, rather stiff, shallow soil, inclined to bake and sensitive to drought. Flint stones are abundant.

On February 24, 1898, one plot was broken to the usual depth, about 4 inches, with a one-horse turn plow. In this furrow followed a scooter drawn by one mule, which loosened a part of the soil to an additional depth of $3\frac{1}{2}$ or 4 inches. In this way the soil was loosened to a depth of about 8 inches without throwing up to the surface the clay of the subsoil, which is doubtless poorer when first exposed to the air than is the surface soil.

On the same date another plot was broken with a one-horse turn plow in the usual way without the subsoiling scooter. Subsequent treatment,—bedding, fertilizing, and planting,—was identical on both plots.

The fertilizer, applied in the center furrow, and mixed with the soil by the use of a scooter plow, was as follows on both plots:

240	lbs. of	acid phosphate per acre.
100	" "	cotton seed meal " "
48	" "	muriate of potash per acre.
388		lbs., total per acre.

The yield of seed cotton per acre was 992 pounds on the subsoiled plot and 970 pounds on the plot not subsoiled.

The difference in favor of subsoiling is insignificant, being only 22 pounds per acre.

It should not be forgotten that the late date at which the land was broken and the light rainfall up to July constituted conditions highly unfavorable to the growth of crops on subsoiled land, the soil having probably never become sufficiently settled until the late summer rains occurred.

Attention is also called to the fact that the process which here, in accordance with local custom, is spoken of as subsoiling, is quite different from and much less thorough than is subsoiling by means of a specially constructed subsoil plow, which loosens a wider furrow and runs deeper than the scooter plow used in this experiment.

"Light soils would probably not be benefitted by subsoiling. If subsoiling is practiced, it should be done early enough in the winter to allow the rains to moisten and settle the deeply stirred soil before planting time."—*Bul. No. 89, Ala. Exp't. Station.*

Experiments with Fertilizers.

This experiment was conducted on a hilltop where the soil was gray and sandy. The sand was deep and the soil very poor. This field had been planted in cotton in 1896 and in 1897 it was used for a test of varieties of oats. No cowpeas or other renovating plant had grown on this field since 1895. Both the oats and the cotton of preceding years had received moderate quantities of a complete fertilizer mixture.

All fertilizers for the cotton crop of '98 were drilled in the center furrow and mixed by use of a scooter with the soil. April 15 Peerless cotton was planted in all plots. Single plants were left at distances of 15 to 18 inches in the drill, and the rows were 3½ feet apart.

The period up to the time when bolls were formed was very dry and hence very unfavorable to the action of the fertilizers. Black rust was worse on plots having no kainit than on those where kainit was used. The rust-restraining power of kainit explains, at least in part, its favorable effect in this experiment.

Indeed the weather conditions were so decidedly unfavorable that as late as August 6th the plants on the fertilized plots were as large as those on plots where cotton seed meal, acid phosphate, or kainit had been applied singly.

The yield of seed cotton per acre, the increase per acre attributable to fertilizers, the cost of fertilizers per acre, and the profit from fertilizer are given in the table below. In this table allowance is made for the slight difference in yield of the two fertilized plots, and the following prices per ton are assumed for fertilizers: Cotton seed meal, $19; high grade acid phosphate, $12.50; kainit, $13.75. Seed cotton is valued at 1 5-9 cents per pound which is equal to 5 cents per pound of lint and $6.67 per ton of seed.

Results of fertilizer experiments at Auburn, 1898.

Plot No.	Amount per acre.	Fertilizers. Kind.	Per cent of crop at first picking.	Yield seed cotton.	Increase over unfertilized plots.	Value of increase at 1 5-9 cent per pound.	Cost of fertilizers.	Profit from fertilizers.
	Lbs.			*Lbs.*	*Lbs.*			
20	200	Cotton seed meal	70	889	214	$ 3 33	$ 1 90	$ 1.43
21	240	Acid phosphate	77	853	178	2.77	1.50	1.27
22	00	No fertilizer	80	675	.....	.....	.....	.....
23	200	Kainit	71	783	122	1.77	1 38	.39
24	200 240	Cotton seed meal Acid phosphate	74	1013	346	5 36	3 40	1.96
25	200 200	Cotton seed meal Kainit	65	1192	529	8 23	3 28	4.95
26	240 200	Acid phosphate Kainit	66	1145	486	7 56	2.88	4.68
27	00	No fertilizer	76	655	.....	.....	.....	.....
28	200 240 200	Cotton seed meal Acid phosphate Kainit	65	1177	522	8.12	4.78	3.34

Increase of seed cotton per acre where cotton seed meal was added:

To unfertilized plot.......................214 lbs.
To acid phosphate plot...................168 "
To kainit plot..............................407 "
To acid phosphate and kainit plot........36 "

Average increase with cotton seed meal..206 lbs.

Increase of seed cotton per acre where acid phosphate was added:

To unfertilized plot.......................178 lbs.
To cotton seed meal plot.................132 "
To kainit plot..............................364 "
To cotton seed meal and kainit plot.......—7 "

Average increase with acid phosphate.....168 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot....	123 lbs.
To cotton seed meal plot...........	315 "
To acid phosphate plot....................	308 "
To cotton seed meal and acid phos. plot...	176 "
Average increase with kainit............	**230 lbs.**

From the analysis above it is evident that this soil needed all three of the fertilizer ingredients, the nitrogen in cotton seed meal, the phosphoric acid in acid phosphate, and the potash in kainit. In every case the use of fertilizers returned a profit. Doubtless this profit would have been much larger had there been sufficient rainfall in May and June to properly dissolve and distribute the fertilizer. The largest profit resulted from a mixture of cotton seed meal and kainit; this was closely followed in point of profit by a mixture of cotton seed meal, kainit and acid phosphate. Mixtures of two fertilizers, aggregating 400 to 440 pounds per acre, afforded in every case a greater profit than 200 to 240 pounds of a single fertilizer material. Probably the slightly greater effect of cotton seed meal or of kainit as compared with acid phosphate was due to the fact that in preceding years there had been applied more of phosphate than of any other material. This should not be taken to indicate that phosphate is generally less necessary than the other ingredients. On most sandy soils it is certainly equal, if not superior, to the other fertilizers used.

Method of Applying Fertilizers.

The land used for this experiment was a rather stiff loam of light reddish color, and very stoney. The field had been in rye in 1897, followed by broadcast Wonderful cowpeas, which were picked and then grazed by cattle. The land was twice broken, rather to destroy Bermuda grass than as a necessary preparation for cotton. In both of these plowings, scooters were used in preference to turn plows, so as to avoid burying deeply any of the grass.

When ready to plant, a complete fertilizer was applied, as follows :

On two plots the fertilizer was all drilled in the "marking off" or center furrow and mixed by using a scooter ; on two other plots one-half the fertilizer was applied in each "listing" furrow, that is about 8 to 10 inches on each side of the line of drill, making no special provision for incorporating the fertilizer with the soil ; and on two other plots the fertilizer was divided into three equal portions, one part applied in the center furrow without mixing and one portion in each "listing" furrow.

April 25, the same day that fertilizers were applied and beds formed, all plots were planted with King cotton. When the plants were large enough, all plots were so thinned as to leave an equal number of plants on each plot.

The land was apparently uniform.

The fertilizer used on all plots consisted of

240	pounds	acid phosphate	per	acre,
120	"	cotton seed meal	"	"
120	"	kainit	"	"
480	"	Total per acre.		

The rate of application was heavier than usual in order to emphasize any differences that might be due to the methods of applying the fertilizer.

The results are given in the table below:

Fertilizer applied all in center furrow, or in two listing furrows, or in all three furrows.

Plot No.	FERTILIZERS APPLIED	Seed cotton per acre.
		Lbs.
1	{1/3 in center furrow {1/3 in each listing furrow	1371
2	All in center furrow (mixed)	1338
3	1/2 in each listing furrow	1174
4	{1/3 in center furrow {1/3 in each listing furrow	1117
5	All in center furrow (mixed)	1454
6	1/2 in each listing furrow	1166
	Averages.	
1 & 4	{1/3 in center furrow {1/3 in each listing furrow	**1248**
2 & 5	All in center furrow (mixed)	**1396**
3 & 6	1/2 in each listing furrow	**1170**

The highest yield on any single plot, 1,454 pounds of seed cotton, or practically one bale per acre, and the highest average yield, 1,396 pounds per acre, were made on the plots on which all the fertilizer was placed in the center furrow. A single experiment cannot establish a truth, but as far as this test goes, it is decidedly in favor of applying all the fertilizer in the center furrow, thus not only economizing labor, but also securing, under the conditions of this experiment, a larger yield. Apparently the absence of the fertilizer from the immediate vicinity of the plants on Plots 3 and 6 was quite unfavorable to yield.

It should not be inferred that the application of as much as 480 pounds of commercial fertilizer per acre should be applied in the center furrow *without mixing.* When large quantities of fertilizers are used it is important to incorporate the fertilizer with the soil by the use of a scooter or of some corresponding implement. It cannot be stated just what amount of fertilizer makes this mixing imperative, but it is safest to mix thus when 300 pounds or more per acre is the quantity used; with lighter applications, this mixing though doubtless advantageous, may not pay for the extra labor involved.

COTTON SEED VS. COTTON SEED MEAL OR NITRATE OF SODA.

The land used for this experiment was similar to that used for the subsoil experiment previously described. In the recent past all plots had been fertilized and cropped alike.

The crop in 1897 was corn, with a very thin and unsatisfactory stand of peas growing in a drill between the corn rows. On the corn a complete home mixed fertilizer had been used at a moderate rate per acre. The amount of nitrogen left in the soil by the thin growth of peas and by the small amount of residual nitrogen from previous fertization must have been very slight.

The land was flushed and then bedded, applying in the "marking off" or center furrow the fertilizers indicated below.

All plots received

240 pounds acid phosphate per acre and
96 pounds kainit per acre.

Two cotton plots received no nitrogenous fertilizer; two others, 475 ponnds (dry weight) of cotton seed (14 5-6 bushels) per acre, moistened several weeks before being used and in the meantime kept covered with earth to prevent the escape of ammonia.

A third pair of plots received 216 pounds of cotton seed meal, this amount containing the same quality of nitrogen as the 475 pounds of cotton seed. Still another pair of plots received a similar quantity of nitrogen, but in the form of 75 pounds of nitrate of soda.

The variety used was Truitt, the date of planting, April 18, the fertilizers having been applied quite recently.

When the crop was of sufficient size it was so thinned as to leave an equal number of plants (8,800 per acre) on each plot, except on Plot 8, where the original stand was so irregular that only 6,736 plants per acre could be left on that plot. However, a comparison of the yield of this plot with that of its duplicate suggests that the deficient stand was not in this case a disadvantage; hence the figures for Plot 8 are used in the averages in the table below.

Two plots forming a part of this experimeut were planted, the one with Wonderful cowpeas, the other with velvet beans, to be plowed under in the spring of 1899 so as to compare the value of these plants as fertilizers for the cotton crop of 1899 with the commercial fertilizers that will be applied to that cotton crop on the other eight plots.

These plants were fertilized with

240 pounds of acid phosphate per acre and
96 pounds of kainit per acre.

It is interesting to note that the yield of unhulled peas on Plot 1 in 1898 was at the rate of 1641 pounds, or more than 18 bushels per acre; the average yield of two cotton plots fertilized like the peas was 888 pounds of seed cotton per acre.

The yields of seed cotton are given in the following table, in which the mixture of acid phosphate and kainit applied on all plots is for convenience referred to as "mixed minerals."

Fertilizing value of nitrogen from cotton seed, cotton seed meal, and nitrate of soda.

Plot No.	Fertilizers. Am't per acre.	Fertilizers. Kind.	Yield of seed cotton per acre	Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*
3	475	Rotted cotton seed and mixed minerals.......	992	
4	216	Cotton seed meal and mixed minerals.	851	
5	......	No nitrogenous fertilizer; only mixed minerals.	621	
6	75	Nitrate of soda and mixed minerals......	1010	
7	475	Rotted cotton seed and mixed minerals..	1067	
8	216	Cotton seed meal and mixed minerals...... ...	1075	
9	......	No nitrogenous fertilizer; only mixed minerals.	1155	
10	75	Nitrate of soda	1350	
		Averages.		
3 & 7	475	Rotted cotton seed and mixed minerals.	1030	142
4 & 8	216	Cotton seed meal and mixed minerals	963	75
5 & 9		No nitrogenous fertilizer; only mixed minerals.	888	
& 10	75	Nitrate of soda	1180	292

The want of uniformity in the natural fertility of the different plots, which is indicated by the yield, makes it unsafe to draw any positive conclusion as to the relative values of the several fertilizers compared. This question will be further investigated.

However it may properly be noted here that of the large number of comparisons made between cotton seed meal and cotton seed as fertilizers few agree as to the relative values of these two materials. On some soils the nitrogen in cotton seed meal is more effective than is a similar amount of nitrogen in the form of cotton seed. On other soils and in other seasons the opposite result occurs. Cotton seed leave in the soil a larger amount of fertilizer for the following crop than does cotton seed meal.

In 14 experiments conducted under the writer's direction in 1896, on various soils, the average of all results showed that the nitrogen in *crushed* cotton seed was equally as effective as a similar amount of nitrogen in cotton seed meal. The results of the separate tests varied widely. In the tests just alluded to one pound of cotton seed meal was equivalent on the average to 2.06 pounds of *crushed* cotton seed. In a series of tests in South Carolina one pound of cotton seed meal was equivalent to 2.79 pounds of seed. In neither of these series of experiments was any account taken of the residual, or second years, effects of the two fertilizers.

SPECIAL POTASH EXPERIMENT.

In some years and on certain soils large doses of kainit had exercised such a valuable effect in checking black rust or yellow leaf blight of cotton, that an effort was made in 1898 to ascertain the smallest amount of kainit that would serve to restrain rust. Another object of this experiment was to learn whether muriate of potash was equally valuable for this purpose, and a third aim was to note the effects of applying large quantities of relatively insoluble potash in the form of potash feldspar, or pulverized potash-bearing rock.

A poor sandy hilltop, known to be very liable to produce rusted cotton was selected. Only six plots were available, which rendered duplication impossible.

This field grew small grain in 1896 and again in 1897, with drilled cowpeas following the grain on all plots. The peas did not make much growth in either year.

In bedding the land in 1898 all fertilizers were applied in the center furrow and were well mixed with the adjacent soil.

On all plots the following fertilizers, which we shall here speak of as the "basal mixture," were applied April 11:

120 pounds cotton seed meal per acre and 240 pounds acid phosphate per acre.

To this "basal mixture" was added, on one plot, kainit at the rate of 200 pounds per acre; on another, 100 pounds of kainit per acre; on a third, 60 pounds of kainit per acre.

On one plot muriate of potash was used at the rate of 50 pounds per acre, thus furnishing the same amount of potash as 200 pounds of kainit.

Peerless cotton was planted April 19.

On all plots except plots 3 and 4, where the stand was irregular, there remained, after thinning, 8,640 plants per acre.

As early as August 14 rust was noticed on all plots except on those fertilized with 200 pounds of kainit or 50 pounds of muriate of potash per acre. August 16 black rust was general on the plot without potash, on the feldspar plot and on the plot with only 60 pounds of kainit per acre; on the plots having 100 or 200 pounds of kainit or 50 pounds of muriate of potash there was then very little rust.

The following table shows the percentage of the original number of leaves retained, as estimated August 25 and September 23.

Plot No.	Potash Fertilizer per Plot.	Percentage of leaves retained.	
		Aug. 25.	Sept. 23.
1	200 lbs. kainit	70	5
2	100 " kainit	50	5
3	60 " kainit	40	2
4	No potash	20	½
5	1000 " potash feldspar	20	½
6	50 " murate of potash	70	25

It was perfectly evident from the appearance of the plants that an abundant supply of soluble potash did decrease the amount of rust and did tend to retain the leaves on the plant.

The yieds, however, with one exception, did not show the effects of potash as forcibly as did the appearance of the plants.

The yields follow :

Yield of seed cotton obtained with the use of different forms of potash.

Plot No.	Fertilizers. Am't per acre.	Fertilizers. Kind.	Yield of seed cotton per acre.
	Lbs.		*Lbs.*
1	200	Kainit and basal mixture	556
2	100	Kainit and basal mixture	492
3	60	Kainit and basal mixture	516
4	.....	No potash; only basal mixture	408
5	1000	Potash feldspar and basal mixture	482
6	50	Muriate of potash	*954

* The yield on Plot 6 is so much larger than that on other plots fertilized with potash that we must ascribe it, in part at least, to undetected want of uniformity in the soil.

The reasons were unfavorable for securing the full benefit of fertilizers. Hence, positive conclusions will not be in order until this experiment is repeated. However, one result is so noticeable that it should not be overlooked. A pound of potash in the form of muriate was fully as effective, in restraining rust as a pound of potash in the form of kainit. This experiment, together with others conducted by the writer in 1897 and 1898, suggest that 100 pounds of kainit per acre exerts a marked rust restraining power. It is still an open question what is the least amount of kainit that will produce this effect.

The potash feldspar used in this experiment was furnished by F. M. Dorsey, Hyssop, Ala., who obtained it from a natural deposit in Coosa county. It was pulverized with crude implements and was not in very fine state of division.

WHERE TO GET SEED.

The seed of the varieties grown here is not offered for sale or distribution. Growing on small plots side by side, the varieties naturally cross and become impure. Our stock of seed was obtained from the following parties:

Allen Hybrid L. S., from J. B. Allen, Port Gibson, Miss.
Strickland, from Curry-Arrington Co., Rome, Ga.
Texas Oak, from M. G. Smith, Lightfoot, Ga.
Hutchinson, from J. N. Hutchinson, Salem, Ala.
Russell, from J. T. Russell, Alexander City, Ala.
"Smith Improved," from E. A. Smith, Conyers, Ga.
Culpepper, from J. A. Culpepper, Luthersville, Ga.
Jones' Re-improved, Hawkins, Griffin, and Duncan, from Mark W. Johnson Seed Co., Atlanta, Ga.
Deering and Peterkin, from H. P. Jones, a seed-grower at Herndon, Ga.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON, 1898.

J. F. DUGGAR.

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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, Alabama.

*Absent on leave.

CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1898.

BY

J. F. DUGGAR.

SUMMARY.

Under the direction of the Alabama Experiment Station fertilizer experiments with cotton, or "soil tests," were made in forty-one localities in the State. The object was to learn the best fertilizers for the different classes of soil.

Two hundred pounds per acre of cotton seed meal was used to furnish nitrogen, 240 pounds of acid phosphate to supply phosphoric acid, and both one hundred and two hundred pounds of kainit to afford potash. These fertilizers were applied singly, in pairs, and all three together.

Of these experiments thirty afforded definite indications as to the manurial needs of the soils on which they were made.

Acid phosphate was effective on a greater number of soils than was any other single fertilizing material. The great majority of soils needed a mixture of either acid phosphate and cotton seed meal, or of acid phosphate, cottonseed meal and kainit, that is, a complete fertilizer.

Of two complete fertilizers compared, the one containing 100 pounds of kainit (besides acid phosphate and cotton seed meal) was in most soils more profitable than the complete fertilizer containing 200 pounds of kainit per acre.

Averaging the results of the 30 conclusive tests made in 1898, the largest net profit was afforded by the same fertilizer which was most profitable in the greatest number of localities in 1897. This fertilizer consisted of

200 pounds cotton seed meal per acre.
240 pounds acid phosphate per acre.
100 pounds kainit per acre.

This fertilizer mixture contained 2.59 per cent. of nitrogen, 7.75 per cent. of available phosphoric acid, and 2.93 per cent. of potash.

The average yield of the unfertilized plots in 30 localities was 506 pounds of seed cotton per acre. The average increase in the yield of seed cotton was, for the two complete fertilizers, 392 and 435 pounds; for the phosphate and cotton seed meal mixture the average increase was 339 pounds; the average increase for the five other fertilizers or mixtures ranged between 113 and 287 pounds of seed cotton per acre.

Generally fertilizers were profitable, but in some cases loss occurred when material not needed by the soil was supplied. In a number of localities the most suitable fertilizer mixture afforded a profit of more than $5 per acre.

Soils on adjoining farms, even in the same soil belt, vary greatly. The formulas here given are suggestive only. The history of the land and size of plants may help towards an intelligent guess at the probable needs of the soil, but a local fertilizer experiment is the best means of determining this question.

The lime soils of the Tennessee Valley Region and the reddish lime soils of the narrow valleys of the northeastern part of the state seem to need for cotton little or no potash. For these soils the following formula is tentatively suggested:

160 to 240 pounds acid phosphate per acre.
80 to 120 pounds cotton seed meal per acre.

240 to 360 pounds, total per acre.

This contains about 2.2 per cent. of nitrogen, 8 to 10 per cent. of available phosphoric acid, and ½ per cent. of potash.

In that region in Central and Northwest Alabama lying between the Central Prairie Region and the Table Lands and Coal Fields, the chief need of the soil in most localities where tests have been made has been for phosphate; cotton seed meal was also needed. As a fertilizer for cotton in this region, the above formula is suggested, with the addition of 80 pounds of kainit per acre on the poorest sandy soils and on those where cotton habitually rusts.

For the red clay lands of the central part of East Alabama the above mixture of acid phosphate and cotton seed meal is suggested; for the poorest gray or sandy soils of the same region, it seems advisable to add to this mixture 80 pounds of potash per acre, or to use the formula recommended below for the Southern Long Leaf Pine Region.

In the Southern Long Leaf Pine Region, cotton almost invariably needs phosphate, and to a less extent nitrogen. In some of the soils of this region potash seems to be quite deficient.

The following formula is suggested for cotton on these soils:

60 to 120 pounds cotton seed meal per acre.
120 to 240 pounds acid phosphate per acre.
60 to 120 pounds kainit per acre.

240 to 480 pounds, total per acre.

This fertilizer contains about 1.7 per cent. of nitrogen, 6 to 7.5 per cent. of available phosphoric acid, and 3.5 per cent. of potash.

The lime soils of the Central Prairie Region need drainage and vegetable matter rich in nitrogen rather than the usual commercial fertizers. Melilotus, or tall sweet white clover, used for hay or pasturage and the stubble afterwards plowed under, answers, together with stable manure and cotton seed, the main fertilizer requirement of these soils.

Objects and Methods of the Experiments.

The soils of Alabama differ widely. Hence they require different fertilizers. For most profitable results the fertilizer must be suited to the soil. Misfits are frequent and costly, especially in a State spending several millions of dollars for commercial fertilizers. To decrease such losses is the object of the "soil tests," or local fertilizer experiments conducted under the direction of the Alabama Experiment Station by farmers in different soil belts.

To map the State, even roughly, according to the fertilizer requirements of the prevailing soils, must necessarily be the work of years.

The number of co-operative fertilizer experiments provided for in 1897 was 41, from which 37 reports were received. Thirty of these reports give definite indications, and are discussed at length in this bulletin. The others, deemed inconclusive, are more briefly tabulated.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.

The following is the list of those who made the fertilizer tests in 1898 and reported results :

NAME.	POST OFFICE.	COUNTY.	PAGE.
Autrey, A.	Berneys	Talladega	35 & 50
Anderson, J. P.	Thomaston	Marengo	72 & 75
Beeson, Prof. W. J	Blountsville	Blount	32 & 50
Borland, T. M.	Dothan	Henry	65 & 67
Bevill, W. C.	Bevill	Choctaw	59 & 62
Ballard, J. L.	Jackson	Clarke	48 & 51
Carmichael, D., Jr	Newton	Dale	92 & 94
Collins, D. K	Coosa Valley	St. Clair	68
Conner, G	Brundidge	Pike	92 & 94
Daffin, E. J	Tuscaloosa	Tuscaloosa	53 & 56
Dill, C. C. L	Dillburgh	Pickens	52 & 56
Dykes, J. W	Union Springs	Bullock	73 & 75
Fulton, D. T	Hartford	Geneva	77 & 78
Fulton, W. F	Larimore	DeKalb	31 & 50
Funkey, F	Tuscumbia	Colbert	93 & 94
Harbuck, W. T	Hurtsboro	Russell	38 & 49
Horn, C. D	Coatopa	Sumter	41 & 49
Hayes, E	Cullman	Cullman	76 & 78
Ingram, W. N	Marvyn	Russell	54 & 56
Jackson, J. C	Sulligent	Lamar	33 & 50
Jarrett, R. H	Sterrett	Shelby	57 & 62
Jones, T. K	Greensboro	Hale	70 & 75
Logan, J. A	Gordo	Pickens	45 & 56
Meadows, T. T.	Cusseta	Chambers	37 & 50
McLendon, J. R.	Naftel	Montgomery	63
McIntyre, Prof. P. M.,	Abbeville	Henry	92 & 94
McAlpine, J. A	Boligee	Greene	92 & 94
Purifoy, W. M.	Snow Hill	Wilcox	40 & 49
Robertson, J. T	LeGrand	Montgomery	58 & 62
Sellars, G. O	Lumber Mills	Butler	44 & 48
Slaton, J. P	Tuskegee	Macon	39 & 49
Taylor, Prof. B. A	Wetumpka	Elmore	92 & 94
Terry, J. W	Brewton	Escambia	60 & 62
Thomason, Judge T. J.	Kaylor	Randolph	36 & 50
Watkins, J. C	Burnt Corn	Monroe	42 & 49
Wilcox, J. H.	**Wilson**	**Escambia**	**46 & 48**

The directions sent required each plot to be one-eighth of an acre in area. Rows were $3\frac{1}{2}$ feet apart, and each experimenter was advised to so thin the cotton as to leave the same number of plants on each plot, preferably at distances of 18 inches between plants.

The directions stated that land employed for this test should be level and uniform, not manured in recent years, and not new ground, or subject to overflow, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of treatment for all plots (except as to kinds of fertilizers used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled, ridges afterwards being thrown up above the fertilizers.

The following data, recorded separately for the northern and southern portion of Alabama, are taken from the records of the Alabama Section of the Weather Bureau for 1898:

	Northern.	Southern.
Rainfall for April, inches	4.77	4.11
" " May, "	1.05	.58
" " June, "	3.00	4.19
" " July, "	5.98	6.15
" " Aug., "	5.46	9.40
" " Sept., "	3.22	3.94
" " Oct., "	5.29	3.16
" " Nov., "	4.17	7.02

A severe drought in May and part of June was general throughout the State. In July and August an excess of rain fell. The records show that there was more than the average amount of sunshine in 1898. Frost occurred earlier than usual.

Black rust seems to have occurred in a smaller number of the experiments than in 1897 and to have done less damage where it did occur.

The Fertilizers Used.

The following prices are used, as representing the usual cost of fertilizers delivered in Auburn:

	Per Ton.
Acid phosphate (High grade)	$12 50
Cotton seed meal	19 00
Kainit	13 75

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above. The above prices for high-grade acid phosphate (dissolved bone) and kainit are a little below the usual price in most localities. The phosphate used was from the Edisto Phosphate Company, Charleston, S. C. Most of the kainit was donated by the German Kail Works, New York City.

In each experiment two plots were left unfertilized, these being plots 3 and 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos:

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Mixture contains. Nitrogen.	Mixture contains. †Available phosphoric acid.	Mixture contains. Potash.	Cost of mixture, per ton.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	
1	200	Cotton seed meal.......	13.58	5.76	3.54	
		*In 100 lbs. c. s. meal.**	6.79	2.88	1.77	$ 19.00
2	240	Acid phosphate	......	36.12	....	
		In 100 lbs. acid phos.	....	**15.05**	....	12.50
4	200	Kainit.................	....	....	24.60	
		In 100 lbs. kainit.	....	....	12.30	13.75
5	200	Cotton seed meal	13.58	41.88	3.54	
	240	Acid phosphate				
		In 100 lbs. above mixt.	**3.09**	**9.52**	**.80**	15.45
6	200	Cotton seed meal.....	13.58	5.76	28.14	
	200	Kainit..............				
		In 100 lbs. above mixt.	**3.39**	**1.44**	**7.03**	16.38
7	240	Acid phosphate	....	....	....	
	200	Kainit...............				
		In 100 lbs. above mixt.	....	**8.21**	**5.59**	13.09
9	200	Cotton seed meal.....	13.58	41.88	28.14	
	240	Acid phosphate				
	200	Kainit........... ...				
		In 100 lbs. above mixt.	**2.12**	**6.54**	**4.39**	14.94
10	200	Cotton seed meal	13.58	41.88	15.84	
	240	Acid phosphate				
	100	Kainit...............				
		In 100 lbs. above mixt.	**2.59**	**7.75**	**2.93**	15.11

* Average of many analyses.

† Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by 1 3-14.

Unless explained, the term "profit from fertilizers" as used in the following tables, might be misunderstood.

Profit or loss, as there used, is simply the difference between the value of the increase attributed to the fertilizer (after paying ⅓ cent per pound for picking) and the cost of the fertilizer. To make this more exact, the careful reader may subtract from the apparent profit the cost of applying fertilizers.

The price assumed is 5 cents per pound for lint and $6.67 per ton for seed. This is equal to 1 8-9 cents per pound. Deduct from this the cost of picking, ⅓ cent per pound and we have 1 5-9 cents as the net value per pound of increase of seed cotton; this last figure is used in the following tables.

In determining the increase over the unfertilized plots, the yield of the fertilized plots, Nos. 4, 5, 6 and 7, is compared with both unfertilized plots, lying on either side, giving to each unfertilized plot a weight inversely proportional to its distance from the plot under comparison. This method of comparison tends to compensate for variations in the fertility of the several plots.

It should be remembered that seasons, as well as soils, determine the effects of fertilizers, so that to be absolutely reliable a fertilizer experiment should be repeated for several years on the same kind of soil.

GROUP I. PHOSPHORIC ACID MUCH MORE IMPORTANT THAN POTASH; LATTER NOT NEEDED OR USED AT FINANCIAL LOSS.

Experiment Made by W. F. Fulton, Larimore, DeKalb County.

Dark gray valley soil; subsoil red clay, with lime-rock below.

The field has been in cultivation about seventy-five years. Recent crops were corn in '97, oats in '96, and corn in '95 The original growth was white oak, post oak, red oak, black walnut, hickory, poplar and cedar.

(The reader should consult the tables on pp. 48, 49 & 50 as he reads the report of each experiment.)

Increase of seed cotton per acre when cottonseed meal was added:

To unfertilized plot .... 88 lbs.
To acid phosphate plot ....175 "
To kainit plot............... ....117 "
To acid phosphate and kainit plot ....230 "

Average increase with cotton seed meal ....152 "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ....504 lbs.
To cotton seed meal plot ....591 "
To kainit plot ....324 "
To cotton seed meal and kainit plot.......437 "

Average increase with acid phosphate ....464 "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ....142 lbs.
To cotton seed meal plot ....171 "
To acid phosphate plot ....— 38 "
To cotton seed meal and acid phosphate plot 17 "

Average increase with kainit .... 73 "

Phosphate was much more important than any other material for this soil. It was profitable to add cottonseed meal to phosphate, this combination leading in point of profit, $7.16 per acre, closely followed by acid phosphate alone, with $6.36 per acre. Kainit was not greatly needed.

EXPERIMENT MADE BY PROF. W. J. BEESON, ON FARM OF NINTH DISTRICT AGRICULTURAL SCHOOL, BLOUNTSVILLE, BLOUNT COUNTY.

Dark loam lime soil; subsoil clay.

This field had been used for grass and clover for the two years previous to this test, and in the spring of 1898 was subsoiled. The land had been in cultivation for about twenty-seven years.

Increase of seed cotton per acre when cottonseed meal was added:

To unfertilized plot	328 lbs.
To acid phosphate plot	104 "
To kainit plot	248 "
To acid phosphate and kainit plot	264 "
Average increase with cotton seed meal	**241** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	608 lbs.
To cotton seed meal plot	384 "
To kainit plot	440 "
To cotton seed meal and kainit plot	456 "
Average increase with acid phosphate	**472** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	64 lbs.
To cotton seed meal plot	—16 "
To acid phosphate plot	—110 "
To cotton seed meal and acid phosphate plot	56 "
Average decrease with kainit	**1** "

The main need was for acid phosphate, which used alone afforded a profit of $7.97 per acre.

Cotton seed meal increased the yield to an extent just about sufficient to pay for the meal. Kainit was not needed

Experiment Made by J. E. Jackson, two Miles West of Sulligent, Lamar County.

Gray clayey valley land; subsoil yellowish clay.

The preceding crop was cotton; the crop of 1896 was corn. The original growth of post oak and short leaf pine had been cleared about thirty years before.

Increase of seed cotton per acre when cottonseed meal was added:

To unfertilized plot	72 lbs.
To acid phosphate plot	278 "
To kainit plot	104 "
To acid phosphate and kainit plot	285 "
Average increase with cotton seed meal	**185 "**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	208 lbs.
To cotton seed meal plot	414 "
To kainit plot	80 "
To cotton seed meal and kainit plot	261 "
Average increase with acid phosphate	**241 "**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	19 lbs.
To cotton seed meal plot	51 "
To acid phosphate plot	—109 "
To cotton seed meal and acid phosphate plot	—102 "
Average decrease with kainit	**38 "**

Both acid phosphate and cotton seed meal were important and these two in combination afforded a profit of $4.16 per acre.

Kainit was unnecessary or even harmful.

EXPERIMENT MADE BY A. AUTREY, ¼ MILE EAST OF BERNEYS TALLADEGA COUNTY.

Soil and subsoil stiff red clay.

This field had been in cultivation more than forty years. The original forest growth was oak, hickory and pine.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	192 lbs
To acid phosphate plot	192 "
To kainit plot	296 "
To acid phosphate and kainit plot	168 "
Average increase with cotton seed meal	**212** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.
To cotton seed meal plot	128 "
To kainit plot	416 "
To cotton seed meal and kainit plot	288 "
Average increase with acid phosphate	**240** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—64 lbs.
To cotton seed meal plot	40 "
To acid phosphate plot	104 "
To cotton seed meal and acid phosphate plot	200 "
Average increase with kainit	**70** "

Acid phosphate and cotton seed meal were more effective than kainit, but the largest profit was afforded by a complete fertilizer.

Experiment Made by Judge T. J. Thomason, 2 Miles North of Kaylor, Randolph County, Ala.

Dark gray upland; subsoil below.

This field had been cleared about forty years. The original growth is reported as oak, hickory and long leaf pine.

The preceding crop was wheat; cotton occupied the land in 1895 and 1896.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	312	lbs.
To acid phosphate plot	98	"
To kainit plot	155	"
To acid phosphate and kainit plot	271	"
Average increase with cotton seed meal	**209**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	368	lbs.
To cotton seed meal plot	154	"
To kainit plot	222	"
To cotton seed meal and kainit plot	338	"
Average increase with acid phosphate	**270**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	107	lbs.
To cotton seed meal plot	—50	"
To acid phosphate plot	—39	"
To cotton seed meal and acid phosplate plot	134	"
Average increase with kainit	**38**	"

Acid phosphate and cotton seed meal were both highly beneficial. Kainit was of little or no value except when combined with these other two and was then only of secondary importance.

EXPERIMENT MADE BY T. T. MEADOWS, ½ MILE NORTH OF CUSSETA, CHAMBERS COUNTY, ALA.

Soil and subsoil red with flint stones.

The field was cleared of the origninal growth of oak and hickory about forty or fifty years ago.

The crop of 1896 was corn (whether with or without peas is not stated) and that of 1897 was cotton.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	120	lbs.
To acid phosphate plot	228	"
To kainit plot	115	"
To acid phosphate and kainit plot	—33	"
Average increase with acid phosphate	**107**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152	lbs.
To cotton seed meal plot	260	"
To kainit plot	261	"
To cotton seed meal and kainit plot	117	"
Average increase with acid phosphate	**175**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—8	lbs.
To cotton seed meal plot	—13	"
To acid phosphate plot	107	"
To cotton seed meal and acid phosphate plot	—156	"
Average decrease with kainit	**15**	"

Phosphate was the material chiefly needed. Kainit was of no value. Cotton seed meal was useful.

The results for two years agree in indicating that the best fertilizer for this soil was a mixture of acid phosphate and cotton seed meal.

EXPERIMENT MADE BY M. T. HARBUCK, $1\frac{1}{2}$ MILES NORTH EAST OF HURTSBORO, RUSSELL COUNTY.

Light gray soil; yellow retentive subsoil.

The land had been cleared about twenty-five years. The original forest growth was long leaf pine.

The crop in 1897 was corn and peas, in 1896 cotton, 1895 corn and peas.

No rust was noticeable on any of the plots. The season was dry until the 13th of July, after which rain was in excess.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	111	lbs.
To acid phosphate plot	199	"
To kainit plot	63	"
To acid phosphate and kainit plot	131	"
Average increase with cotton seed meal	**126**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	111	lbs.
To cotton seed meal plot	199	"
To kainit plot	99	"
To cotton seed meal plot	167	"
Average increase with acid phosphate	**144**	"

Increase of seed cotton per acre when kainit was added

To unfertilized plot	10	lbs.
To cotton seed meal plot	—38	"
To acid phosphate plot	—2	"
To cotton seed meal and acid phosphate plot	—70	"
Average decrease with kainit	**25**	"

Although phosphate was chiefly needed, no fertilizer was very effective. Potash was not needed. Preceding pea crops reduced the effect of cotton seed meal.

EXPERIMENT MADE BY J. P. SLATON, 7 MILES NORTHEAST OF TUSKEGEE, MACON COUNTY.

Rather compact gray sandy soil; subsoil red clay.

This field was cleared of its original forest growth of oak, hickory, gum, maple, long and short leaf pine about 75 years ago.

The land was pastured in 1896, and planted in corn in 1897; it is not stated whether or not peas were grown between the corn rows. There was very little rust on any of the plots; however plot 5 seemed to be the worst affected.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	292	lbs.
To acid phosphate plot	322	"
To kainit plot	5	"
To acid phosphate and kainit plot	149	"
Average increase with cotton seed meal	**192**	"

Increase of seed cotton per acre when acid phosphate was added.

To unfertilized plot	332	lbs.
To cotton seed meal plot	362	"
To kainit plot	204	"
To cotton seed meal and kainit plot	348	"
Average increase with acid phosphate	**311**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	115 lbs.
To cotton seed meal plot	—172 "
To acid phosphate plot	—13 "
To cotton seed meal and acid phosphate plot	—186 "
Average decrease with kainit	**64 "**

The chief need of this soil was for acid phosphate. Cotton seed meal was also important, but kainit was worse than useless.

The largest profit, $6.77 per acre, followed the use of a mixture of acid phosphate and cotton seed meal.

Experiment Made by W. M. Purifoy, 2 Miles Northeast of Snow Hill, Wilcox County, Ala.

White bald prairie; subsoil white or yellowish rotten limestone at depth of three inches.

The preceding crop was sorghum. Mr. Purifoy notes that this soil was especially liable to rust but that there was none in 1898.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	128 lbs.
To acid phosphate plot	27 "
To kainit plot	227 "
To acid phosphate and kainit plot	141 "
Average increase with cotton seed meal	**131 "**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot...... ....200 lbs.
To cotton seed meal plot................ 99 "
To kainit plot.............................209 "
To cotton seed meal and kainit plot......123 "

Average increase with acid phosphate....158 "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot......................—27 lbs.
To cotton seed meal plot .... 72 "
To acid phosphate plot..................—18 "
To cotton seed meal and acid phosphate plot. .... 96 "

Average increase with kainit............. 41 "

Both phosphate and cotton seed meal increased the yield. Some of the results with kainit are also favorable, especially on plot 10, where with the complete fertilizer containing the smaller amount of kainit there was the largest profit of any plot.

EXPERIMENT MADE BY C. D. HORN, COATOPA, SUMTER COUNTY.

Dark sandy soil; subsoil, red sandy clay.

The field had been cleared about 25 years. The original forest growth was red oak, post oak, black jack, hickory, and short leaf pine.

The land had been in cotton for three years previous to the beginning of the experiment.

Increase of seed cotton per acre where cotton seed meal was added:

To unfertilized plot.......................140 lbs.
To acid phosphate plot.................... 44 "
To kainit plot.............................167 "
To acid phosphate and kainit plot......— 39 "

Average increase with cotton seed meal.. 78 lbs.

Increase of seed cotton per acre where acid phosphate was added:

To unfertilized plot..........................	190 lbs.
To cotton seed meal plot....................	94 "
To kainit plot..	192 "
To cotton seed meal and kainit plot.....	— 30 "
Average increase with acid phosphate.....	**111 lbs.**

Increase of seed cotton per acre when kainit was added

To unfertilized plot....	— 8 lbs.
To cotton seed meal plot..........	30 "
To acid phosphate plot................	— 6 "
To cotton seed meal and acid phos. plot.	— 89 "
Average decrease with kainit............	**18 lbs.**

On every plot there was either a financial loss or only a very small profit. Kainit especially was unnecessary, while acid phosphate and cotton seed meal, used alone, and in most combinations, afforded some increase in yield.

There was no rust in 1898; in 1897, on the other hand, rust was severe and kainit, which checked it, was then the most effective fertilizer.

Experiment Made by J. C. Watkins, 2 Miles North of Burnt Corn, Monroe County.

Gray, sandy and rocky soil; red clay subsoil, 6-8 inches below surface.

The field on which this test was made had been in cultivation about thirty years. The original forest growth is reported as short leaf pine, red and white oak and sweetgum. No note is made of injury from rust.

This field was in cotton in '97, in corn in '95 and '96, and had received little or no fertilizer in recent years. Planting occurred April 28.

The same plots were used for the experiment in 1898 that had been employed in the exactly similar experiment in 1897.

The number of plants per eighth-acre plot was 990. The weather was abnormally dry from planting time until the middle of June; then for two months rains were entirely too frequent and heavy.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	292 lbs.
To acid phosphate plot	6 "
To kainit plot	151 "
To acid phosphate and kainit plot	341 "
Average increase with cotton seed meal	**198 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	344 lbs.
To cotton seed meal plot	158 "
To kainit plot	92 "
To cotton seed meal and kainit plot	282 "
Average increase with acid phosphate	**219 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	— 13 lbs.
To cotton seed meal plot	—154 "
To acid phosphate plot	—265 "
To cotton seed meal and acid phos. plot	70 "
Average decrease with kainit	**90 lbs.**

Both acid phosphate and cotton seed meal were highly important, while kainit was useless.

The largest profit $3.85 per acre was obtained when acid phosphate was used alone.

EXPERIMENT MADE BY G. O. SELLARS, 3½ MILES SOUTHWEST OF LUMBER MILLS, BUTLER COUNTY.

Gray sandy soil 8 in. deep; red clay subsoil.

This field, on which the original growth had been long leaf pine and blackjack oak, had been cleared about ten years. In 1896 the crop was cotton; in 1895 and 1897 corn. The stand was good, 8216 stalks per acre, and there was no rust.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	274 lbs.
To acid phosphate plot	233 "
To kainit plot	227 "
To acid phosphates and kainit plot	250 "
Average increase with cotton seed meal	**245** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	192 lbs.
To cotton seed meal plot	153 "
To kainit plot	228 "
To cotton seed meal and kainit plot	251 "
Average increase with acid phosphate	**206** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	10 lbs.
To cotton seed meal plot	— 35 "
To acid phosphate plot	46 "
To cotton seed meal and acid phos. plot	63 "
Average increase with kainit	**21** "

Cotton seed meal and acid phosphate were decidedly beneficial. Kainit was unnecessary. The largest profit,

$3.10 per acre, was obtained by the use of a mixture of cotton seed meal and acid phosphate. In 1897, when rust prevailed, kainit was of somewhat more value than in 1898 when this disease did not appear.

EXPERIMENT MADE BY J. A. LOGAN, 1½ MILES NORTHWEST OF GORDO, PICKENS COUNTY.

Dark ashy second bottom; subsoil red clay.

The field had been cleared probably thirty years or more.

The original forest growth was oak, mulberry, hickory, and some short leaf pine.

The preceding crops were cotton.

Rust was not present on any of the plots. The season was very dry until June 1, after which time the rainfall was abundant. The stand was reported perfect on all plots.

(See Table, page 56.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	56 lbs.
To acid phosphate plot	78 "
To kainit plot	35 "
To acid phosphate and kainit plot	100 "
Average increase with cotton seed meal	**67** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	360 lbs.
To cotton seed meal plot	382 "
To kainit plot	46 "
To cotton seed meal and kainit plot	110 "
Average increase with acid phosphate	**224** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	59 lbs.
To cotton seed meal plot	38 "
To acid phosphate plot	—255 "
To cotton seed meal and acid phos. plot	—231 "
Average decrease with kainit	**68** "

The chief need of this soil was for acid phosphate. Kainit was not needed. Cotton seed meal was somewhat beneficial, but apparently a much smaller amount of cotton seed meal would have sufficed, say 50 to 100 pounds in combination with 240 pounds of acid phosphate. The largest profit, $4.10 per acre, was obtained by the use of acid phosphate alone. Next in point of profit followed a combination of acid phosphate and cotton seed meal, with a profit of $3.40 per acre.

Experiment Made by J. H. Wilcox, Wilson, Ala.

Clay soil, with some sand and gravel.

1898 was the second year of cultivation, the first crop having been corn. The field was subsoiled before Christmas and planted April 28th.

As a result of unfavorable weather many of the plants on the unfertilized plots and to a less extent on plots 1 and 6, died before fruiting.

(See Table, page 48.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	64 lbs.
To acid phosphate plot	37 "
To kainit plot	45 "
To acid phosphate and kainit plot	134 "
Average increase with cotton seed meal	**70** "

Increase of seed cotton per acre where acid phosphate was added:

To unfertilized plot	256 lbs.
To cotton seed meal plot	229 "
To kainit plot	236 "
To cotton seed meal and kainit plot	325 "
Average increase with acid phosphate....	**261 "**

Increase of seed cotton per acre where kainit was added:

To unfertilized plot	—2 lbs.
To cotton seed meal plot	—21 "
To acid phosphate plot	—22 "
To cotton seed meal and acid phos. plot	75 "
Average increase with kainit..............	**7 "**

Evidently acid phosphate was the chief need of this soil. As usual on new ground, cotton seed meal was of but slight benefit. On this new ground, doubtless still abundantly supplied with potash from the recently burned timber, kainit was not needed.

Wilson, Lumber Mills and Jackson experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Wilson. Yield seed cotton per acre.	Wilson. Increase over unfertilized plots.	Wilson. Profit from Fertilizers.	Lumber Mills. Yield seed cotton per acre.	Lumber Mills. Increase over unfertilized plots.	Lumber Mills. Profit from fertilizers.	Jackson. Yield seed cotton per acre.	Jackson. Increase over unfertilized plots	Jackson. Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	64	64	$—.91	648	272	$ 2.33	1016	8	$—1 78
2	240	Acid phosphate	256	256	2.48	568	192	1.48	1280	272	2.73
3	....	No fertilizer	00	....	....	376	....	....	1008	....	....
4	200	Kainit	00	—2	—1.41	368	10	—1.23	1160	136	.73
5	200 240	Cotton seed meal Acid phosphate	296	293	1.15	766	425	3 10	1464	424	3.08
6	200 200	Cotton seed meal Kainit	48	43	—2.61	560	237	.40	1160	104	—1.67
7	240 200	Acid phosphate Kainit	240	234	.76	544	238	.82	1368	296	1.72
8	....	No fertilizer	8	....	....	288	....	....	1088	....	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	376	368	.94	776	488	2.81	1704	616	5.91
10	200 240 100	Cotton seed meal Acid phosphate Kainit	376	368	1.64	720	432	2.64	1872	784	8.11

Hurtsboro, Tuskegee, Burnt Corn, Snow Hill and Coatopa experiments with cotton.

Plot No.	Fertilizers.		Hurtsboro.			Tuskegee.			Burnt Corn.			Snow Hill.			Coatopa		
	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.*	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.*	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.*	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.*	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.*
	Lbs.		*Lbs.*	*Lbs*		*Lbs.*	*Lbs*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	384	111	$—.18	680	292	$ 2.64	528	292	$ 2.64	200	128	$ .09	458	140	$ .26
2	240	Acid phosphate	384	111	.22	720	332	3.66	680	344	3.85	275	200	1.61	508	190	1.45
3	00	No fertilizer............	273	....	....	388	....	...	336	....	....	72	...	.....	318	....	...
4	200	Kainit..................	280	10	—1.23	508	115	.40	348	—13	—1 50	48	—27	1.80	326	—8	—1.50
5	200 240	Cotton seed meal ...... Acid phosphate	576	310	1.42	1052	654	6.77	736	350	2.04	304	227	.13	584	234	.24
6	200 200	Cotton seed meal ...... Kainit...............	336	73	—2.15	524	120	—1.42	548	138	—1.14	280	200	—.17	542	175	—.56
7	240 200	Acid phosphate. . ..... Kainit...............	368	109	—1.19	728	319	2.07	515	79	—1.65	264	182	— 05	568	184	1.09
8	00	No fertilizer............	256	....	......	414	....	......	460	....	......	88	....	......	416	....	......
9	200 240 200	Cotton seed meal ...... Acid phosphate .... Kainit...............	496	240	—1.05	882	468	2.50	880	420	1.75	408	323	—.24	448	142	2.53
10	200 240 100	Cotton seed meal ...... Acid Phosphate .... Kainit...............	536	280	.27	912	498	3.66	696	236	—.41	624	534	4.28	518	102	—.82

*Seed cotton rated at 1 5-9 cents. This is net price, or price after paying 1/3 cent per lb. for picking; 1 8-9 cents (1 5-9 plus 1/3c.) for seed cotton is equivalent to 5 cents per pound for lint and $6.67 per ton for seed.

Berneys, Sulligent, Blountsville, Larimore, Cusseta and Kaylor experiments with cotton.

	FERTILIZERS.		BERNEYS.			SULLIGENT.			BLOUNTSVILLE.			LARIMORE.			CUSSETA.			KAYLOR.		
Plot No.	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizer.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal...	600	192	$ 1.08	536	72	$—.78	712	328	$ 3.20	544	88	$—.53	416	120	$—.04	664	312	$ 2.95
2	240	Acid phosphate.....	536	128	.49	672	208	1.73	992	608	7.97	960	504	6.34	448	152	.86	720	368	4.23
3	00	No fertilizer	408	......	......	464	......	......	384	......	......	456	......	......	296	......	......	352	......	......
4	200	Kainit..............	336	—64	—2.37	480	19	—1.09	448	62	.42	616	142	1.53	290	—8	—1.52	464	107	.27
5	200 240	Cotton seed meal. Acid phosphate ..	712	320	1.58	952	486	4.16	1096	707	7.59	1160	679	7.16	680	380	2.51	928	466	3.96
6	200 200	Cotton seed meal. Kainit...........	616	232	.32	616	123	1.37	696	305	1.46	768	259	.75	408	107	1.62	728	262	.79
7	240 200	Acid phosphate.. Kainit...........	728	352	2.59	560	99	—1.34	888	494	4.80	992	466	4.37	560	257	1.11	800	329	2.23
8	00	No fertilizer.	368	......	......	448	......	......	396	......	......	544	......	......	304	......	......	376	......	......
9	200 240 200	Cotton seed meal. Acid phosphate .. Kainit...........	888	520	3.31	832	384	1.19	1152	756	6.96	1240	696	6.04	528	224	—1 30	976	600	4.55
10	200 240 100	Cotton seed meal, Acid phosphate .. Kainit...........	792	424	2.51	824	392	2.01	1140	744	7.49	......	......	......	684	380	1.83	960	584	5.00

GROUP II.—PHOSPHORIC ACID MUCH MORE IMPORTANT THAN POTASH; LATTER OF SECONDARY IMPORTANCE, BUT NEEDED.

EXPERIMENT MADE BY J. L. BALLARD FOR SOUTHWEST ALABAMA AGRICULTURAL SCHOOL, JACKSON, CLARKE COUNTY.

Red soil, 5 inches deep; subsoil red clay.

This upland field had been cleared about ten years, the original growth having been long leaf and short leaf pine, oak, sweetgum, dogwood, etc. It was in cotton in 1897 and in corn in 1896, whether with or without cow peas is not stated. (See Table, page 56.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	8 lbs.
To acid phosphate plot	152 "
To kainit plot	—32 "
To acid phosphate and kainit plot	320 "
Average increase with cotton seed meal	**112** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	272 lbs.
To cotton seed meal plot	416 "
To kainit plot	160 "
To cotton seed meal and kainit plot	512 "
Average increase with acid phosphate	**340** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	136 lbs.
To cotton seed meal plot	96 "
To acid phosphate plot	24 "
To cotton seed meal and acid phosphate plot	192 "
Average increase with kainit	**112** "

Phosphate was more important than either of the other fertilizer materials. However it was profitable to add both cotton seed meal and kainit to the phosphate. A complete fertilizer containing only 100 pounds of kainit per acre gave the best results and afforded a profit of $8.11 per acre. The year before cotton seed meal had given best results.

EXPERIMENT MADE BY C. C. L. DILL, DILLBURGH, PICKENS COUNTY, ALA.

Grayish table land; subsoil red clay.

The field had been cleared about 45 years of the original growth of oak, hickory and short leaf pine, but had grown up in old field pines, which were removed in 1890. Corn with cowpeas between the rows constituted the crop in 1897.

See Table, page 56.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	672	lbs.
To acid phosphate plot	83	"
To kainit plot	643	"
To acid phosphate and kainit plot	170	"
Average increase with cotton seed meal	**392**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	736	lbs.
To cotton seed meal plot	147	"
To kainit plot	572	"
To cotton seed meal and kainit plot	99	"
Average increase with acid phosphate	**388**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	298	lbs.
To cotton seed meal plot	269	"
To acid phosphate plot	134	"
To cotton s. meal and acid phosphate plot	221	"
Average increase with kainit	**230**	"

Both phosphate and nitrogen were of prime importance; kainit was also effective, but to a less extent. All fertilizers returned a large profit whether used alone or in combination. The largest yield was obtained by the use of a complete fertilizer.

EXPERIMENT MADE BY E. J. DAFFIN, $2\frac{1}{2}$ MILES EAST OF TUSCALOOSA, TUSCALOOSA COUNTY, ALA.

Red sandy upland soil 3 in. deep; subsoil stiff red clay.

The time since clearing was more than 60 years.

The original growth was short leaf pine, oak, hickory, gum, beech, mulberry, sassafras, persimmon, cherry, poplar, locust, hackberry and ash.

The preceding crop was cotton.

There was no damage from rust.

(See Table, page 56.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	40 lbs.
To acid phosphate plot	253 "
To kainit plot	197 "
To acid phosphate and kainit plot	158 "
Average increase with cotton seed meal	**162** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	136 lbs.
To cotton seed meal plot	349 "
To kainit plot	292 "
To cotton seed meal and kainit plot	253 "
Average increase with acid phosphate	**257** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	62 lbs.
To cotton seed meal plot	219 "
To acid phosphate plot	218 "
To cotton seed meal and acid phos. plot	123 "
Average increase with kainit	**155 "**

Acid phosphate was the chief need of this soil. Cotton seed meal and kainit were also necessary and about equally effective. These results agree with those of 1897. Both years the greatest profit was obtained by the use of a complete fertilizer.

Experiment Made by W. N. Ingram, Marvyn, Russell, County.

Gray sandy soil 6 in. deep; subsoil yellow clay.

This hillside had been cleared 25 or 30 years. The original growth was long leaf pine and oak.

All recent crops consisted of cotton.

Assuming that the yield of Plot 9 was reduced by some inequality in the land or in the number of plants, we have omitted this plot in drawing conclusions.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	352 lbs.
To acid phosphate plot	266 "
To kainit plot	88 "
Average increase with cotton seed meal	**235 "**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	456 lbs.
To cotton seed meal plot	368 "
To kainit plot...........................	450 "
Average increase with acid phosphate....	**425** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot.....................	256 lbs.
To cotton seed meal plot ....—	8 "
To acid phosphate plot...................	152 "
Average increase with kainit.............	**138** "

The chief need of this soil was evidently for acid phosphate. Cotton seed meal was also advantageous.

Kainit was less important than the other two materials, but somewhat useful.

The largest profit, $7.80 per acre, resulted from the use of a mixture of cotton seed meal and acid phosphate. This was closely followed by a complete fertilizer containing 100 lbs. of kainit per acre.

Dillburgh, Gordo, Tuscaloosa and Marvyn experiments with cotton.

FERTILIZERS.			DILLBURGH.			GORDO. (Group I.)			TUSCALOOSA.			MARVYN.		
No. Plot	Amount per acre.	KINDS.	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	1360	672	$ 8.55	720	56	$-1.03	944	40	$-1.28	952	352	3.57
2	240	Acid phosphate	1424	736	9.95	1024	360	4.10	1040	136	.61	1054	454	5.56
3	00	No fertilizer	688	..	......	664	...	......	901	...	......	600	....	....
4	200	Kainit	976	298	3.25	724	59	—.47	960	62	—.42	888	256	2.60
5	200 240	Cotton seed meal. Acid phosphate...	1488	819	9.34	1104	438	3.40	1280	389	2.65	1384	720	7.80
6	200 200	Cotton seed meal. Kainit	1600	941	12.47	760	94	—1 82	1144	259	.78	1040	344	2.07
7	240 200	Acid phosphate .. Kainit....	1520	870	10 65	772	105	—1.25	1232	354	2.62	1334	606	6.54
8	00	No fertilizer	640	..	.....	668	...	......	872	...	......	760	...	....
9	200 240 200	Cotton seed meal. Acid phosphate .. Kainit...........	1680	1040	11 38	872	204	—1 61	1384	512	3.18	1200	440	2.05
10	240 240 100	Cotton seed meal. Acid phosphate .. Kainit...........	1600	960	10 85	1000	332	1.08	1280	408	2.26	1480	720	7.12

GROUP III. PHOSPHORIC ACID AND POTASH BOTH IMPORTANT AND ABOUT EQUALLY EFFECTIVE.

EXPERIMENT MADE BY J. W. JARRETT, 1¼ MILES SOUTHEAST OF STERRETT, SHELBY COUNTY.

Gray sandy branch bottom, shallow soil; subsoil yellow.

The field was cleared at least fifty years ago of its growth of oak, hickory and gum. The field was used for cotton in 1897 and for corn in 1895 and 1896.

(See Table, page 62)

Apparently the very large yield on Plot 1, was due to some irregularity in the soil; in the first set of averages below this plot is included, in the second set it is excluded.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	584 lbs.	——
To acid phosphate plot	93 "	93 lbs.
To kainit plot	240 "	240 "
To acid phosphate and kainit plot	114 "	114 "
Average increase with cotton s. meal	**[211]** "	**87** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	392 lbs.	392 lbs.
To cotton seed meal plot	—285 "	
To kainit plot	373 "	373 lbs.
To cotton seed meal and kainit plot	247 "	247 "
Av. increase with acid phosphate	**[182]** "	**337** "

Increase of seed cotton per acre when kainit was added ;

To unfertilized plot............	249	lbs.	249	lbs.
To cotton seed meal plot......	—95			
To acid phosphate plot	230	"	230	"
To cotton seed meal and acid phospate plot.............	437	"	437	"
increase with kainit.	[205]	"	or 305	"

Acid phosphate and kainit were both effective and to about the same extent. The largest profit resulted from the use of a complete fertilizer, containing one hundred pounds of kainit.

It is not stated whether cowpeas were grown between the corn rows in 1895 and 1896 ; if they did this would afford an explanation of the rather slight effect of cotton seed meal.

In 1897 the experiment in this locality was made on fresh land, the main requirement of which was phosphate.

EXPERIMENT MADE BY J. T. ROBERTSON, LEGRAND, MONTGOMERY COUNTY.

Dark gray soil three inches deep; subsoil red clay.

The field had been in cultivation about seventy years. The last three crops were cotton. The original growth was oak, hickory and short leaf pine.

(See Table p. 62.)

Increase of seed cotton per acre when cotton seed meal was added :

To unfertilized plot	240 lbs.
To acid phosphate plot	386 "
To kainit plot	522 "
To acid phosphate and kainit plot	359 "
Average increase with cotton seed meal	**377** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	208 lbs.
To cotton seed meal plot................	354 "
To kainit plot	363 "
To cotton seed meal and kainit plot	202 "
Average increase with acid phosphate........	**382** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	205 lbs.
To cotton seed meal plot	487 "
To acid phosphate plot	360 "
To cotton seed meal and acid phosphate plot.	335 "
Average increase with kainit	**347** "

Cotton seed meal, acid phosphate and kainit were all decidedly beneficial and to about the same extent. The complete fertilizers gave the largest profits, nearly $10 per acre.

EXPERIMENT MADE BY W. C. BEVILL, NINE MILES SOUTHEAST OF BEVILL, CHOCTAW COUNTY.

Dark mulatto table land; subsoil clay.

This field had been cleared fifty years. Long and short leaf pine constituted the principal forest growth.

The two preceding crops were corn.

Rust was present to some extent, especially on Plot 5. The season was extremely dry until June 20th, after which time there was an excess of rainfall. There was a perfect stand of about 1,500 plants to each eighth-acre plot.

(See Table p. 62.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	96	lbs.
To acid phosphate plot	312	"
To kainit plot	224	"
To acid phosphate and kainit plot	296	"
Average increase with cotton seed meal	**232**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	8	lbs.
To cotton seed meal plot	224	"
To kainit plot	44	"
To cotton seed meal and kainit plot	120	"
Average increase with acid phosphate	**124**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	40	lbs.
To cotton seed meal plot	168	"
To acid phosphate plot	80	"
To cotton seed meal and acid phosphate plot	64	"
Average increase with kainit	**88**	"

The most profitable fertilizer was that used on Plot 10, which was a complete fertilizer that contained a half ration of kainit.

Experiment Made by J. W. Terry, 2¼ Miles North of Brewton, Escambia County.

Dark gray soil; subsoil red clay.

The field had been in cultivation about 12 years; the crop in 1896 and in 1897 was corn with cow peas between the rows. The forest growth was long leaf pine.

Increase of seed cotton per acre when cotton seed meal was added :

To unfertilized plot	172	lbs.
To acid phosphate plot	67	"
To kainit plot	116	"
To acid phosphate and kainit plot	166	"
Average increase with cotton seed meal	**130**	

Increase of seed cotton per acre where acid phosphate was added ;

To unfertilized plot	160	lbs.
To cotton seed meal plot	53	"
To kainit plot	133	"
To cotton seed meal and kainit plot	183	"
Average increase with acid phosphate	**132**	"

Increase of seed cotton per acre when kainit was added :

To unfertilized plot	169	lbs.
To cotton seed meal plot	113	"
To acid phosphate plot	142	"
To cotton seed meal and acid phosphate plot	241	"
Average increase with kainit	**166**	"

The results are not entirely conclusive on account of the difference in yield obtained on the two unfertilized plots, and because of unfavorable seasons. Apparently a complete fertilizer was needed, this giving the greatest profit, which was by no means large.

Sterrett, LeGrand, Bevill and Brewton experiments with cotton.

	Fertilizers.		Sterrett.			LeGrand.			Bevill.			Brewton.		
Plot No.	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots	Profit from fertilizers.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	1328	584	$ 7.18	568	240	$ 1.83	544	—96	$—.41	880	172	$ .77
2	240	Acid phosphate	1136	392	4.59	536	208	1.73	456	8	—1.38	768	160	1.00
3	00	No fertilizer	744	.....	.....	328	.....	.....	448	.....	.....	608	.....	.....
4	200	Kainit	992	249	2.49	496	205	1.80	488	40	—.76	744	169	1.25
5	200 240	otton seed meal Acid phosphate	1040	299	1.25	848	594	5 84	768	320	1.58	768	227	.13
6	200 200	Cotton seed meal Kainit	1228	489	4.33	944	727	8.02	712	264	.82	792	285	1.15
7	240 200	Acid phosphate Kainit	1360	622	6.79	848	568	5.95	536	88	1.51	776	302	1.81
8	00	No fertilizer	736	.....	.....	143	....	.....	448	....	.....	440	.....	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1472	736	6.67	1072	929	9.67	832	384	1.16	808	468	2.61
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1374	638	6.95	1048	905	9.99	952	504	3.76	776	336	1.14

GROUP IV. POTASH MORE IMPORTANT THAN PHOSPHORIC ACID; LATTER OF SECONDARY IMPORTANCE, BUT NEEDED.

EXPERIMENT MADE BY J. R. McLENDON, 2 MILES EAST OF NAFTEL, MONTGOMERY COUNTY, ALA.

Light sandy soil 12 inches deep; red clay subsoil.

The field had been in cultivation more than forty years. The original forest growth was short leaf pine, red oak and hickory.

Cotton was the crop in 1896 and in 1897.

Mr. McLendon reports that there was no rust and that the rainfall was sufficient.

Through an oversight the fertilizers were applied upon tenth-acre instead of eighth-acre plots, making the rate of application, and consequently the cost of fertilizers, twenty-five per cent. greater than in any as the other experiments.

(See Table p. 64.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	90	lbs.
To acid phosphate plot	208	"
To kainit plot	168	"
To acid phosphate and kainit plot	274	"
Average increase with cotton seed meal	**185**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	90	lbs.
To cotton seed meal plot	208	"
To kainit plot	2	"
To cotton seed meal and kainit plot	108	"
Average increase with acid phosphate	**102**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot....................184 lbs.
To cotton seed meal plot..................262 "
To acid phosphate plot.................. 96 "
To cotton seed meal and phosphate plot..162 ".

Average increase with kainit................176 "

Naftel experiment with cotton.

	Fertilizers.		Naftel.		
Plot No.	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers.
	Lbs		*Lbs.*	*Lbs.*	
1	250	Cotton seed meal	250	90	$—.97
2	300	Acid phosphate	250	90	—.47
3	00	No fertilizer	160	.....	.....
4	250	Kainit	350	184	1.13
5	250 300	Cotton seed meal Acid phosphate	470	298	.38
6	250 250	Cotton seed meal Kainit	530	352	1.37
7	300 250	Acid phosphate Kainit	370	186	—.74
8	00	No fertilizer	190	.....	.....
9	250 300 250	Cotton seed meal Acid phosphate Kainit	650	460	.18
10	250 300 100	Cotton seed meal Acid phosphate Kainit	590	400	.12

Each of the fertilizers, whether applied singly or in combination increased the yield to a considerable extent.

A complete fertilizer afforded the largest yield. As in 1897, kainit was somewhat more important than either of the other materials. In 1897 when rust prevailed, the favorable effect of kainit was attributed to its rust restraining tendency, but the results obtained in 1898, when there was no rust, indicate plainly that this soil is notably deficient in potash.

No single fertilizer or combination afforded any considerable profit, although each increased the yield.

EXPERIMENT MADE BY T. M. BORLAND, ½ MILE SOUTHWEST OF DOTHAN, HENRY COUNTY.

Dark gray upland; subsoil yellow clay.

This field had been in cultivation for about ten years. The original growth was long leaf pine.

The crop of 1897 was corn, whether with or without peas is not stated.

Cotton was planted April 6. There was no rain until June 2, on which date the experimenter noticed that the plants fertilized with kainit, alone or in combination, had resisted drought better than other plants.

(See Table p. 67.)

Increase of seed cotton per acre where cotton seed meal was added:

To unfertilized plot	32	lbs.
To acid phosphate plot	22	"
To kainit plot	32	"
To acid phosphate and kainit plot	228	"
Average increase with cotton seed meal	**78**	

Increase of seed cotton per acre where acid phosphate was added:

To unfertilized plot	40 lbs.
To cotton seed meal plot	30 "
To kainit plot	20 "
To cotton seed meal and kainit plot	216 "
Average increase with cid phosphate	**76**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	136 lbs.
To cotton seed meal plot	136 "
To acid phosphate plot	116 "
To cotton seed meal and acid phos. plot	322 "
Average increase with kainit	**127**

All fertilizers were needed, kainit giving slightly the best results. No fertilizer afforded much profit, which was doubtless due to the unfavorable season. Mr. Borland writes that 1898 was "the most unfavorable year for cotton that we have had in this country in twenty years. I did not gather more than half the cotton made as the bolls cracked and the cotton rotted." For this reason the experiment is not conclusive.

Dothan experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Dothan. Yield seed cotton per acre.	Dothan. Increase over unfertilized plots.	Dothan. Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*	$
1	250	Cotton seed meal	320	32	—1.41
2	300	Acid phosphate	328	40	— .88
3	00	No fertilizer	288	......	......
4	250	Kainit	416	136	.73
5	250 300	Cotton seed meal Acid phosphate	344	62	—2.43
6	250 250	Cotton seed meal Kainit	432	168	— .67
7	300 250	Acid phosphate Kainit	408	156	.46
8	00	No fertilizer	248	......	......
9	250 300 250	Cotton seed meal Acid phosphate Kainit	632	384	1.19
10	250 300 100	Cotton seed meal Acid phosphate Kainit	616	368	1.64

GROUP V. POTASH MUCH MORE IMPORTANT THAN PHOSPHORIC ACID; LATTER NOT NEEDED OR USED AT FINANCIAL LOSS.

EXPERIMENT MADE BY D. K. COLLINS, $1\frac{1}{2}$ MILES SOUTHEAST OF COOSA VALLEY, ST. CLAIR COUNTY.

Dark sandy second bottom soil; subsoil yellowish clay at depth of five inches.

This river bottom had been in cultivation about twenty years and was considered good cotton land, but with a tendency to rust. The preceding crop was corn; in earlier years corn and cotton alternated.

The original growth was oak, hickory and gum.

Rust appeared and on some plots did great damage, especially on the plot receiving acid phosphate alone, and to a less extent on plot 5.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	64	lbs.
To acid phosphate plot	454	"
To kainit plot	19	"
To acid phosphate and kainit plot	31	"

Average increase with cotton seed meal......142

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—116	lbs.
To cotton seed meal plot	274	"
To kainit plot	—162	"
To cotton seed meal and kainit plot	—150	"

Average decrease with acid phosphate........ 38

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .... 442 lbs.
To cotton seed meal plot................. 398 "
To acid phosphate plot................... 397 "
To cotton seed meal and phosphate plot.— 26 "

Average increase with kainit................ 302

All results of this experiment seem to be governed by the amount of damage from rust, hence kainit, which restrained the rust, was the most effective fertilizer, the other two materials exerting slight effect. There was less rust with the complete fertilizer containing 200 pounds of kainit than with the one containing only 100 pounds of kainit.

The largest profit, $5.51 per acre, was afforded by kainit used alone.

Coosa Valley experiment with cotton.

	Fertilizers.		Coosa Valley.		
Plot No.	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Profit from fertilizers......
	Lbs.		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	1568	64	$ .91
2	240	Acid phosphate	1488	—16	—3.30
3	00	No fertilizer	1504	....	......
4	200	Kainit	1928	443	5.51
5	200 240	Cotton seed meal Acid phosphate	1704	338	1.85
6	200 200	Cotton seed meal Kainit	1808	462	3.90
7	240 200	Acid phosphate Kainit	1608	281	1.49
8	00	No fertilizer	1408	.....	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1720	312	.07
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1584	176	—1.34

GROUP VI. ONLY NITROGEN VERY IMPORTANT; PHOSPHORIC ACID AND POTASH OF SLIGHT OR NO BENEFIT.

EXPERIMENT MADE BY T. K. JONES, 2 MILES SOUTH OF GREENSBORO, HALE COUNTY.

Mulatto, or yellowish, sandy soil.

This land has been in cultivation, chiefly in cotton, for more than forty years. The original growth is reported as hickory, oak and other hard woods. The number of stalks per eighth acre plot was as follows: 681 on plot 1; 941 on plot 2; 1,050 on plot 3; 666 on plot 4; 1,000 on plot 5; 883 on plot 6; 986 on plot 7; 868 on plot 8; 735 on plot 9.

In the following table no corrections have been made for a defective stand, for, judging by the fact that the unfertilized plot with 868 plants yielded more than the unfertilized plot with 1,050 plants, the plots planted thickly had no advantage over other plots. The land was level and apparently very uniform. There was practically no rust on any plot, but on all plots there was heavy loss from shedding of "forms" in June and July.

For at least three years preceding this experiment, the field had grown cotton.

(See Table p. 75.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	304	lbs.
To acid phosphate plot..................	74	"
To kainit plot	49	"
To acid phosphate and kainit plot.......	19	"
Average increase with cotton seed meal...	**112**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	48 lbs.
To cotton seed meal plot	—182 "
To kainit plot	— 82 "
To cotton seed meal and kainit plot	—110 "
Average decrease with acid phosphate	**81** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	29 lbs.
To cotton seed meal plot	—226 "
To acid phosphate plot	—111 "
To cotton seed meal and acid phos. plot	—110 "
Average decrease with kainit	**105** "

Cotton seed meal used by itself afforded the largest yield and the greatest profit. All other fertilizers afforded a financial loss. It is difficult to understand why cotton seed meal gave such poor results when used in combination with other fertilizers, unless we assume that phosphate and kainit, when used with cotton seed meal, exerted a distinctly harmful effect under the rather unusual conditions of this experiment, viz: (1) late planting (May 3), (2) unusually early frost; (3) continued wet weather in July and August, causing great loss from shedding of fruit.

The experiment, though not conclusive, is suggestive of the special need of this soil for nitrogen; in 1897 the experiment on the same farm indicated unmistakably that the main need was for nitrogen.

EXPERIMENT MADE BY J. P. ANDERSON ON FARM OF DR. THOMAS, THOMASTON, MARENGO COUNTY.

Gray, sandy soil, 4 inches deep, with red clay subsoil.

This field had been in cultivation for thirty or forty years. All recent crops consisted of cotton. The original growth was oak, hickory, gum and short leaf pine. There was some rust, chiefly on Plots 5 and 7.

(See Table p. 75.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	426	lbs.
To acid phosphate plot	146	"
To kainit plot	119	"
To acid phosphate and kainit plot	539	"
Average increase with cotton seed meal	**308**	"

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	104	lbs.
To cotton seed meal plot	—176	"
To kainit plot	—142	"
To cotton seed meal and kainit plot	278	"
Average increase with acid phosphate	**16**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	— 9	lbs.
To cotton seed meal plot	—316	"
To acid phosphate plot	—255	"
To cotton seed meal and acid phos. plot	138	"
Average decrease with kainit	**85**	"

The chief need of this soil was for nitrogen. Neither phosphate nor kainit was effective except when combined with cotton seed meal. The largest profit, $4.72 per acre, resulted from the use of cotton seed meal alone.

The experiment seems to have been conducted on the same plots as the test made in 1897. In 1897 kainit was most effective, phosphate fairly effective. The main reason why kainit was decidedly beneficial in 1897, was probably the excessive amount of rust during that year on the plots without kainit. There was less rust in 1898. The appearance of the plants in 1896 suggested the need for a complete fertilizer and seemed to show, as in 1898, the special importance of cotton seed meal.

EXPERIMENT MADE BY J. W. DYKES, 3½ MILES WEST OF UNION SPRINGS, BULLOCK COUNTY.

Dark sandy soil just above overflow; subsoil yellow clay.

This field, which had a soil about eight inches deep and inclined to be wet, was cleared about 13 years ago. The original growth was short leaf pine, dogwood, gum, hickory and oak.

The preceding crop was corn.

(See Table p. 75.)

Increase of seed cotton per acre when cottonseed meal was added:

To unfertilized plot	336 lbs.
To acid phosphate plot	189 "
To kainit plot	169 "
To acid phosphate and kainit plot	170 "
Average increase with cotton seed meal......	**216 "**

Increase of cotton seed per acre when acid phosphate was added:

To unfertilized plot	160	lbs.
To cotton seed meal plot	64	"
To kainit plot	12	"
To cotton seed meal and kainit plot	113	"
Average increase with acid phosphate	**87**	"

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	118	lbs.
To cotton seed meal plot	—49	"
To acid phosphate plot	—30	"
To cotton seed meal and acid phosphate plot	51	"
Average increase with kainit	**22**	"

The largest yield and the greatest profit, $3.88 per acre, was afforded by a complete fertilizer containing 100 pounds of kainit.

In most combinations cotton seed meal was more affective than acid phosphate.

Greensboro, Thomaston, and Union Springs experiments with cotton.

Plot No.	Amount per acre	FERTILIZERS. Kind.	GREENSBORO. Yield seed cotton per acre.	GREENSBORO. Increase over unfertilized plots.	GREENSBORO. Profit from fertilizers.	THOMASTON. Yield seed cotton per acre.	THOMASTON. Increase over unfertilized plots.	THOMASTON. Profit from fertilizers.	UNION SPRINGS. Yield seed cotton per acre.	UNION SPRINGS. Increase over unfertilized plots.	UNION SPRINGS. Profit from fertilizers.
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	760	304	$ 2.83	1466	426	$ 4.72	856	336	$ 3.33
2	240	Acid phosphate	504	48	—.76	1144	104	.11	680	160	.99
3	00	No fertilizer	456	.....	.....	1040	.....	.....	520	.....	.....
4	200	Kainit	504	29	—.91	1064	—9	—1.52	640	118	.45
5	200 240	Cotton seed meal Acid phosphate	616	122	—1.51	1356	250	.48	872	349	2.03
6	200 200	Cotton seed meal Kainit	592	78	—2.07	1248	110	1.57	712	287	1.19
7	240 200	Acid phosphate Kainit	480	—53	—3.70	1020	—151	— .53	656	130	— .86
8	00	No fertilizer	552	.....	.....	1204	.....	.....	528	....	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	520	—32	—5.27	1592	388	1.25	928	400	1.44
10	200 240 100	Cotton seed meal Acid phosphate Kainit	......	......	.....	1560	356	1.46	1040	512	3.88

GROUP VII. NO FERTILIZER VERY EFFECTIVE.

EXPERIMENT MADE BY E. HAYS, ONE MILE WEST OF CULLMAN, CULLMAN COUNTY, ALA.

Sandy upland; recently cleared.

The original growth was oak and pine. Apparently the land had been in cultivation only one year before the test was begun.

On this "new ground" no fertilizers were decidedly beneficial.

(See Table, p. 78.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	152 lbs.
To acid phosphate plot	—86 "
To kainit plot	—31 "
To acid phosphate and kainit plot	213 "
Average increase with cotton seed meal	**62** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	112 lbs.
To cotton seed meal plot.	—126 "
To kainit plot	—170 "
To cotton seed meal and kainit plot	74 "
Average decrease with acid phosphate	**27** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot......................	45 lbs.
To cotton seed meal plot...............	—138 "
To acid phosphate plot.....	—237 "
To cotton seed meal and acid phosphate plot	62 "
Average decrease with kainit	**67** "

Experiment Made by D. T. Fulton, Hartford, Geneva County.

Gray sandy loam; subsoil yellow sandy clay.

The field had been cleared only three years and had produced but two crops, one of cowpeas and one of corn. The forest growth was long leaf pine with a few oaks.

No fertilizer increased the yield to any great extent, a result ascribed chiefly to the unfavorable year. "Much of the cotton rotted in the field."

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	128 lbs.
To acid phosphate plot	32 "
To kainit plot	32 "
To acid phosphate and kainit plot	40 "
Average increase with cotton seed meal	**58** "

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	112 lbs.
To cotton seed meal plot	16 "
To kainit plot	48 "
To cotton seed meal and kainit plot	56 "
Average increase with acid phosphate	**58** "

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	152 lbs.
To cotton seed meal plot	56 "
To acid phosphate plot	88 "
To cotton seed meal and acid phosphate plot	56 "
Average increase with kainit	**88** "

Hartford and Cullman experiment with cotton.

Plot No	Fertilizers. Amount per acre.	Fertilizers. Kind.	Hartford. Yield seed cotton per acre.	Hartford. Increase over unfertilized plots	Hartford. Profit from fertilizers.	Cullman. Yield seed cotton per acre	Cullman. Increase over unfertilized plots	Cullman. Profit from fertilizers
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	352	128	$ 0 09	880	152	$0.46
2	240	Acid phosphate	336	112	.24	840	112	.24
3	00	No fertilizer	224	....	......	728	....	......
4	200	Kainit	376	155	1 03	800	45	—68
5	200 240	Cotton seed meal Acid phosphate	368	150	—1.07	808	26	—3.00
6	200 200	Cotton seed meal Kainit	408	194	— .27	824	14	—3.07
7	240 200	Acid phosphate Kainit	424	213	.43	712	-125	—4.82
8	00	No fertilizer	208	....	......	864	....	......
9	200 240 200	Cotton seed meal Acid phosphate Kainit	464	256	— 80	952	88	—3.41
10	200 240 100	Cotton seed meal Acid phosphate Kainit	480	272	.15	912	48	—3.33

Do Fertilizers pay at Present Prices of Cotton?

We may in part answer this question by showing the average amount of increase in yield of seed cotton attributable to the different fertilizers. The following table gives the *average* results for 22 co-operative tests in 1897, and for 30 in 1898. The price assumed for a pound of seed cotton, 1 5-9 cents, is the *net* price of increase, or value of the seed cotton after paying 33 cents per 100 pounds for picking, and is equivalent to 5 cents per pound for lint and $6.67 per ton for seed.

Average increase over unfertilized plots in 1897 and 1898.

Fertilizers.				Average 22 tests in 1897.		Average 30 tests in 1898.	
Plot No.	Amount per acre.	Kind.	Cost of fertilizers.	Increase over unfertilized plots.	Profit from fertilizers.	Increase over unfertilized plots.	Profit from fertilizers.
	Lbs.			*Lbs.*		*Lbs.*	
1	200	Cotton seed meal	$ 1.90	**113**	$—.15	**205**	$ 1.29
2	240	Acid phosphate	1.50	**194**	1.51	**230**	2.08
3	00	No fertilizer	.....	.....	.....	.....	.....
4	200	Kainit	1.38	**144**	.86	**97**	.13
5	200 240	Cotton seed meal Acid phosphate	3.40	**339**	1.87	**375**	2.43
6	200 240	Cotton seed meal Kainit	3.28	**282**	1.10	**258**	.73
7	200 200	Acid phosphate Kainit	2.88	**287**	1.58	**283**	.88
8	00	No fertilizer	.....	.....	.....	.....	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	4.78	**419**	1.73	**392**	1.32
10	200 240 100	Cotton seed meal Acid phosphate Kainit	4.08	**372**	1.70	**435**	2.84

This table shows that fertilizers, even when used indiscriminately, or without any attempt to suit the fertilizer to the soil, were, as judged by *average* results, moderately profitable.

Averages however do not do full justice to the amount of increase which fertilizers afford when selected with special reference to their suitability for the soil on which they are to be applied. The several tables on preceding pages which give the yield and profits in each locality show that in a number of localities, the complete fertilizer, the meal and phospate mixture, or even the phosphate applied by itself afford profits of more than $5 per acre after paying for cost of picking the increased yield due to the fertilizer.

The absolute necessity for using fertilizers in the regions where they are now in general use can also be inferred from the small yields obtained in most tests on the plots that received no fertilizer. In our conclusive tests in 1897 and 1898, the average yields *without fertilizers* were respectively 474 and 506 pounds of seed cotton per acre. Excluding all tests where the unfertilized plots produced 500 pounds or more of seed cotton per acre, we find that 11 soils in 1897 averaged without fertilizers only 281 pounds, and 17 soils in 1898 averaged, when unfertilized, only 299 pounds of seed cotton per acre, the entire product, including seed, being worth less than $6 per acre.

General Suggestions about Suiting the Fertilizer to the Soil.

There are no positive indications or signs by which the farmer can tell whether his soil needs chiefly phosphate or potash. He can often decide whether nitrogenous fertilizers are needed. As a rule on soils with the proper supply of moisture, and properly cultivated, a very small cotton stalk suggests a need of nitrogenous fertilizers. A very large cotton stalk, too much "run to weed," indicates that an ample supply of nitrogen is present, and if such a large plant is poorly fruited, and late in maturing, a need for phosphate is suggested, (except possibly in the Central Prairie Region). A light shade of green on the leaves, instead dark, deep luxuriant green, may indicate a need of either of phosphate or nitrogen, or both. But color of foliage is not to be relied on, for few have an accurate eye for color, the subject has not been sufficiently studied, and the supply of moisture or the presence of leaf disease is apt to determine or obscure the color of the foliage.

A black or dark soil usually contains an abundance of vegetable matter and hence of nitrogen, but lime soils may be dark colored and still need additional nitrogen. Next to size of stalks, the history of the field affords the best indication as to whether or not the soil needs nitrogen. For example, recently cleared land contains much vegetable matter and cotton on "new ground" seldom responds profitably to nitrogenous fertilizers. The ashes left in burning the brush, especially if the growth is hardwood, usually make potash fertilizers unnecessary on recently cleared land. When "new ground" needs any fertilizer at all it is usually acid phosphate alone.

Cotton following cow peas, needs little if any cotton seed or cotton seed meal if the peas the preceding year occupied all the space. If the peas were grown between the corn rows and made but slight growth of vines, a small amount of nitrogenous fertilizer may be needed.

We are able to give no indication by which to determine the need for potash. Where black rust is prevalent kainit is often needed.

The best solution of the fertilizer question is for the farmer to obtain the necessary supplies of high priced nitrogen from the air instead of from fertilizers. This can be done by practicing such a rotation as will require a large area of cow peas (and of vetch and *crimson* clover, when the farmer has learned from the bulletins of this Station how to "inoculate" them and thus to grow successfully these two soil-improving plants. Inoculation consists in sowing with the clover seed some of the soil from a field where clover has been successfully grown; or in sowing with vetch seed soil from an old vetch field, and so on.

For example, the following three-year rotation will furnish to the soil sufficient nitrogen trapped from the air by the restorative plants to dispense almost or quite entirely with purchased nitrogen, which now in ammoniated guanos or cotton seed meal costs 12 to 15 cents per pound:

First year corn, with cow peas between.

Second year fall oats, followed by cow peas.

Third year cotton as usual, or followed by a "catch crop" of crimson clover or vetch.

If half instead of one-third of the farm is needed for cotton, the above rotation is easily changed to a four-year rotation by causing another cotton crop to follow the cotton crop of the third year, thus allowing cotton to occupy one-half the cultivated land.

The growth of the renovating plants does not diminish the necessity for buying phosphate, and, where needed, potash, both of which, however, cost per pound only about half as much as nitrogen. Moreover, the adoption of a rotation embracing a large proportion of leguminous or soil-improving crops would not at once, but only after several years, render the purchase of nitrogenous fertilizers unnecessary.

This plan, especially if further perfected by growing a larger amount of livestock, will greatly decrease the farmer's expenditure for fertilizers, without reducing the amount of his sales.

Means of Determining the Needs of a Soil.

While the size of stalks, history of land, color of soil, and even color of foliage are helpful in making an intelligent guess as to the needs of a soil, the only certain means of learning the best fertilizer for a given soil is by an actual test of fertilizers.

This Station is able to furnish material for only 30 to 40 such tests each year. A much larger number of tests is needed if we are speedily to arrive at a knowledge of the fertilizer needs of the numerous varieties of soil in Alabama. It will pay farmers to make similar experiments or simpler tests at their own expense.

If a farmer is willing to take sufficient pains to make a complete test on 10 eighth-acre plots, it would be well for him to follow exactly the plan of the tests described in this bulletin.

However, a simpler test on three plots will throw some light on the needs of his soil. Thus on 3 plots he can determine whether his soil needs potash, and how much increase or profit he gets from a complete fertilizer and from a mixture of acid phosphate and cotton seed meal. The three plots should be either one-eighth or one-fourth acre in area. The middle plot should have no fertilizer; one plot should receive per acre 80 pounds of cotton seed meal and 160 pounds of kainit; the third plot should receive 80 pounds of cotton seed meal, 160 pounds of acid phosphate and 80 pounds of kainit. Any parties agreeing to make this test at their own expense will, on application, be furnished with a detailed plan suggesting dimensions of plots, forms for keeping records, etc.

This simple test can scarcely fail to be profitable to the party making it, and if reports are sent to Auburn and edited, these supplementary tests may serve to confirm or modify the fertilizer formulas suggested in this bulletin for the different soils of the State, and the tests may thus be made useful to many farmers.

This is an opportunity for farmers to help each other, and surely sufficient public spirit will not be wanting to make these simpler tests, involving as they do no unusual expense and only a very small amount of extra labor and pains.

The names of parties volunteering to give information about local soils, forest growth, and fertilizers in most general use in their neighborhoods, will be gladly enrolled. In time we shall probably be able to furnish such observers with blank forms on which to record information of this kind.

Wherever, in the following pages, a formula is recommended which contains cotton seed meal, cotton seed may be substituted, using at least two and one-half times as much seed as the amount of meal recommended.

The suggestions in the next few pages are based on experiments extending over a number of years but are in no sense intended as final nor as universally applicable.

Fertilizers for Red Lime Soils of the Tennessee Valley Region.

Although commercial fertilizers are not generally used in this region the soil responds freely to fertilizers containing nitrogen and phosphoric acid. There is ample data to sustain this conclusion. Experiments made at Town Creek, Athens, Trinity and for several years at Madison show that acid phosphate greatly increases the yield of cotton and that the use of potash is not profitable. As in all other parts of the State, nitrogen, preferably in cotton seed or cotton seed meal, is advantageous on the upland fields that have been cultivated continuously in cotton for many years. To obtain best results, cotton seed meal or cotton seed on these soils should be applied, not alone, but in combination with acid phosphate.

The remarks above are not intended to apply to overflowed land.

Doubtless the following formula will give profitable results on cotton on these soils :

Acid phosphate,	160 to 240 pounds per acre.
Cotton seed meal,	80 to 120 pounds per acre.
Total,	240 to 360 pounds per acre.

This formula contains 2.2 per cent. nitrogen, about 8 to 10 per cent. available phosphoric acid and a little over ½ per cent. of potash.

Where the cotton stalks grow large enough the cotton seed meal may be reduced or even omitted. If much cotton seed meal is used, the rows should probably be wider than is usual on the uplands in this region. In a region so well adapted to cow peas, clover, etc., these crops should enter the rotation so often as to make it unnecessary to purchase nitrogenous fertilizers.

Fertilizers for Calcareous Valley Soils of Northeast Alabama.

The above designation is here tentatively used to include the valley soils, rich in lime, such as occur at Blountsville, Blount County, and Larimore, DeKalb County. In both localities in 1898 phosphate was greatly needed, as was also nitrogen, (in cotton seed meal) when combined with phosphates. Potash was apparently not needed.

It is notable that numerous other experiments on reddish land in Northeast Alabama give similar results. For example, on mulatto land *with red clay subsoil*, apparently calcareous, at Creswell Station, Shelby County, a test extending over two years indicated a decided need for acid phosphate and no necessity for kainit. The same was true in a two-year test at Remlap, Blount County, on soil described as red sandy land, with clay subsoil. At Attalla, Etowah County, on red loam, with red clay subsoil, results for three years indicated that little or no potash was needed, but that the need for phosphoric acid was imperative.

For the soils of this class the writer would suggest the use of the formula mentioned as suitable for the Tennessee Valley Region.

Fertilizers for Oak and Hickory Uplands with Short Leaf Pine.

Following the agricultural map of Alabama published by Dr. E. A. Smith, State Geologist, this designation is applied to an area in the northwestern part of Alabama lying between the Central Prairie Region on one side and the Table Lands and Coal Fields on the other, and extending northward from Tuscaloosa and Pickens counties.

For this region we have no large amount of data. The experiment at Sulligent, Lamar county, in 1898, on gray valley land shows plainly that phosphate was important and potash unnecessary. The same was true at Gordo, on "dark ashy second bottom."

At Dillburgh, Pickens county, in 1898, on high grayish table land, with red clay subsoil, and at Davis Creek, Fayette county, in 1891, on "whitish" soil, phosphate was highly important, and potash was beneficial, but to a less extent.

Doubtless on most of the better upland soils of this region where fertilizers are needed at all, a combination of two parts acid phosphate and one part cotton seed meal will be sufficient. (See formula for Tennessee Valley soils.) The thinner, sandier upland soils may be benefitted by the addition to the above of 80 pounds of kainit per acre, especially if cotton on these soils inclines to rust.

Fertilizers for Gravelly Hills Region with Long Leaf Pine.

The term used above is not intended to convey an idea that the soils embraced in this region are uniform. They vary widely. This region, as laid down in Dr. Smith's map, embraces the larger part of Tuscaloosa county, a small part of Pickens, the northern parts of Hale, Perry, Montgomery, Macon and Russell, most of Bibb, Chilton and Autauga and the southern parts of Elmore and Lee.

Numerous tests has been made in this region. The great majority of them agree in showing a decided need for phosphates. This is particularly true in the experiments several times repeated at Tuscaloosa, Clanton, (Chilton County), and Randolph, (Bibb County), and also in tests made at Robinson Springs, (Elmore County), Marvyn, (Russell County), and between Tuskegee and Notasulga, (Macon County.) In a few tests in other localities in this region nitrogen has been most effective, but in no case has potash been the principal material needed.

Most of these tests have indicated that potash fertilizers were unprofitable in the rather large amounts employed in these experiments. In other tests potash has been useful, but always less important than acid phosphate. In nearly all these tests nitrogenous fertilizers have been beneficial, but in most of these counties of less importance than phosphates. The following fertilizer formula is tentatively suggested for those soils in this region where cotton does not usually suffer severely from black rust and where the stalks are not notably undersized:

80 to 120	pounds	cotton seed meal per acre.
160 to 240	"	acid phosphate.
240 to 360	"	total per acre.

On soils inclined to rust it will probably pay to add to the above 80 pounds of kainit per acre.

Fertilizers for Gray Isinglass and Red Clay Lands of East Alabama.

This triangular area extends along the Georgia line from Russell into Cleburne county. Its eastern angle or apex is near Verbena, in Chilton county, on the Louisville and Nashville Railroad.

The soils vary from deep red clay to light gray sand of considerable depth. At Cusseta, on red land, a test continued for two years indicated that phosphate was chiefly in demand, that nitrogen was necessary but less effective, and that potash was not profitable. At Kaylor, Randolph County, on lighter soil, the results on the whole have been but little more favorable to kainit. Experiments repeated for several years on gray sandy soil at Dadeville agree with those just cited in showing the pre-eminent need for phosphates and afford a somewhat more favorable showing for potash fertilizers, which, however, are, as in all the co-operative tests in this region, less effective than either cotton seed meal or acid phosphate.

At Roanoke, Randolph County, on sandy loam soil, phosphate was the chief need of the soil, nitrogen of secondary importance, and kainit of still less advantage, although somewhat beneficial.

Without attempting a complete analysis of the numerous experiments at Auburn, which lies in the southern edge of this district, it may be said briefly that on the Experiment Station farm potash fertilizers have been less essential than phosphate and nitrogenous fertilizers on the stiffer, reddish soil, but that potash has been beneficial when combined with the other materials and applied to the lighter soils of this farm. In at least one instance potash was also decidedly beneficial on stiffer, reddish loam, this favorable result occurring in a season when black rust was very destructive.

It appears to the writer that the farmers of this region can dispense with kainit or other potash fertilizer on red land not very subject to rust. A mixture of two-thirds acid phosphate and one-third cotton seed meal is probably the correct proportion for most of the red lands of this region.

For example I would suggest

Cotton seed meal per acre...	80 to 120 pounds	
Acid phosphate per acre....	160 to 240 "	
Total.....................	240 to 360 "	per acre.

This proportion should be modified according to the size of cotton stalks usually produced, according to recent cropping of the land, etc., increasing the proportion of cotton seed meal where the cotton stalks are usually too small and decreasing the proportion of meal on fields on which a thrifty crop of cowpeas has recently grown, and omitting the meal entirely on fresh land.

On the gray soils of this region where the sand is deep or where rust frequently occurs, 80 pounds of kainit per acre will often prove profitable.

The formula given above and containing no kainit, would analyze about 2.2 per cent. nitrogen, or 2.6 per cent. ammonia, about 8 or 10 per cent. of available phosphoric acid, and about ½ per cent. of potash. If kainit constituted one-fourth of the fertilizer analysis would show about 1.7 per cent. of nitrogen, 6 to 7½ per cent. of available phosphoric acid and 3.5 per cent. of potash.

Fertilizers for Southern Long Leaf Pine Region.

As here used, this term is applied to the long leaf pine lands of the southern third of the State, or to the greater part of the land region south of the Central Prairie Region.

It is usually sub-divided, and embraces a variety of soils. While many fertilizer tests have been made in this portion of the State, many of the results cannot be considered in detail here because of uncertainty as to the kind of soil and vegetation of the localities where many of the tests were made.

Deferring a detailed analysis of the results in the southern part of the State until further data is available and until more is learned about the localities in which the earlier tests were made, it may be said that there is a general need for phosphoric acid in these soils and that nitrogen is also important, especially when combined with acid phosphate.

As to potash, the results vary widely. There seems to be a more general need for potash than in the cotton-growing regions north of the Central Prairie Region.

In most localities potash, while decidedly useful, is not equally as important as phosphoric acid, and should doubtless constitute a smaller portion of the fertilizer than should phosphoric acid. In some tests potash was not needed, especially where a red clay subsoil was present.

The following formula is tentatively suggested for the soils of this region:

60 to 120	lbs.	cotton seed meal	per acre.
120 to 240	"	acid phosphate	" "
60 to 120	"	kainit	" "
240 to 480	"	Total per acre.	

On fresh land the cotton seed meal and kainit may be omitted; on the stiffer soils, especially where the forest growth is largely hard woods, it is probable that the potash in the above formula may be omitted if rust is not feared.

The formula given above contains about 1.7 per cent. of nitogen, 6 to 7.5 per cent. of available phosphoric acid, and 3.5 per cent. of potash.

Fertilizers for the Central Prairie Region.

In this region there is considerable variation in soils. Leaving out of consideration all the soils within this belt that contain any considerable percentage of sand, we have to deal with soils all rich in lime. These lime soils represent every gradation in color and fertility between white or bald prairie and deep black soils, rich in vegetable matter, and indeed in all elements of plant food.

There is a widely accepted opinion that commercial fertilizers do not pay on these lime lands. However the majority of these lime soils are greatly improved by the addition of vegetable matter. The better class of soils need drainage and vegetable matter in order that the physical condition may be improved. The poorer grades all need vegetable matter rich in nitrogen. Cotton seed is here generally preferable to cotton seed meal, by reason of the greater effect of the former in lightening the soil, but on some of the thin uplands small quantities of cotton seed meal can be used to advantage.

However, the fertilizer most effective on the lime soils of the Central Prairie Region is a crop of melilotus, or tall sweet white clover. After a field has been occupied for two years by this plant and again put in cultivation, the yield is often nearly double what it was before this restorative crop was grown. This benefit to the soil accrues even though the melilotus may have been almost continuously grazed or frequently mowed during its second year of growth.

Fertilizers for Other Regions.

The data at hand are not sufficient to permit a discussion of the needs of the soils of the Table Lands and Coal Fields in North Alabama. For the numerous narrow soil belts in the northeastern part of the State, lying between the Coal Fields and the Gray Gneissic (Isinglass) and Red Clay lands we have considerable data, which however is unavailable for lack of accurate information as to the soil and vegetation of the localities in which the tests were made.

Another region not discussed in this bulletin is a region of short leaf pines and hard woods fringing the central prairies. Information regarding the boundaries and soils of this region, and indeed of any soil, is invited from readers of this bulletin.

In this discussion no reference has been made to soils needing lime, although tests of lime have been made for this Station in several localities. Soils which when moistened and brought into contact with blue litmus paper, cause the paper to turn red, need lime. Paper for this test will be supplied free to parties applying to the writer and promising to report the results of their tests.

INCONCLUSIVE EXPERIMENTS.

The experiment near Abbeville, Henry county, was started on the farm of the Southeast Alabama Agricultural School, by Prof. S. T. Slaton, and concluded by Prof. P. M. McIntyre.

The soil was a brown loam.

The land had been in cultivation about fifty years. The original forest growth was oak and hickory.

The experiment near Newton, Dale county, was made by Mr. D. Carmichael, Jr.

The land had been in cultivation about ten years and consisted of a light, gray surface soil, with a red clay subsoil. The original forest growth was long leaf pine.

The experiment at Wetumpka, Elmore county, was made upon the farm of the Fifth District Agricultural School, by Prof. B. A. Taylor.

The land was dark gray in color, with a yellowish red subsoil.

The original forest growth was pine, both long and short leaf, the short leaf however predominating.

The land was infested with nut grass, which obscured the effect of the fertilizers on cotton.

The experiment near Brundidge, Pike county, was made by Mr. G. Conner, on land that had been in cultivation about sixty years and which was apparently not uniform, the yields of the two unfertilized plots varying widely.

The surface soil was gray with a yellow subsoil.

The original forest growth was oak, hickory, gum and short leaf pine.

The experiment at Boligee, Greene county, was made by Mr. J. P. McAlpine, on land that had been cleared about fifty years.

The soil was dark yellow, with a yellow subsoil.

The original forest growth was short and long leaf pine, chestnut, oak, hickory, mulberry and persimmon.

The experiment at Tuscumbia, Colbert county, was made by Mr. F. Funkey upon land that had been cleared and cultivated about forty years.

The land was red with a red clay subsoil.

Inconclusive experiments with cotton.

Plot No.	Amount per acre	FERTILIZERS. Kind.	ABBEVILLE. Yield of seed cotton per acre.	ABBEVILLE. Increase over unfertilized plots	NEWTON. Yield of seed cotton per acre.	NEWTON. Increase over unfertilized plots	WETUMPKA. Yield of seed cotton per acre.	WETUMPKA. Increase over unfertilized plots	BRUNDIDGE. Yield of seed cotton per acre.	BRUNDIDGE. Increase over unfertilized plots	BOLIGEE. Yield of seed cotton per acre.	BOLIGEE. Increase over unfertilized plots	TUSCUMBIA. Yield of seed cotton per acre.	TUSCUMBIA. Increase over unfertilized plots
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal..	720	208	400	—32	624	216	512	136	720	152	1220	532
2	240	Acid phosphate....	440	—72	416	—16	648	240	480	104	560	—8	976	288
3	00	No fertilizer.....	512	......	432	......	408	....	376	....	568	......	688	.....
4	200	Kainit.........................	640	146	400	—10	416	......	520	114	642	95	888	206
5	200 240	Cotton seed meal............ Acid phosphate..............	600	123	576	189	616	192	696	259	976	450	1192	517
6	200 200	Cotton seed meal............ Kainit	440	—19	464	99	456	24	736	269	632	126	872	203
7	240 200	Acid phosphate.............. Kainit......................	648	206	408	66	416	—24	576	78	440	—45	744	82
8	00	No fertilizer..................	......	......	320	......	448	......	528	......	464	......	656	.....
9	200 240 200	Cotton seed meal. .... Acid phosphate. .... Kainit......................	424	......	424	104	584	136	760	232	408	—.56	832	176
10	200 240 100	Cotton seed meal .... Acid phosphate.............. Kainit......................	......	......	392	70	704	256	808	280	440	—24	720	64

BULLETIN No. 103. MARCH, 1899

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

EXPERIMENTS IN SYRUP MAKING.

B. B. ROSS, Chemist.

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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, Alabama.

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EXPERIMENTS IN SYRUP MAKING.

Several years since a bulletin (No. 66) was issued by the Experiment Station, with reference to the making of syrup from sugar cane upon a small scale, and in this bulletin were embodied the results of experiments conducted by the chemist of the Station up to that time. Since that date numerous inquiries have been addressed to this department, asking for additional information on the subject, and it is deemed advisable to present at this time a report of the results of further experiments in the clarification and manufacture of syrup on a small scale.

This subject is one that should be of especial practical interest at this time on account of the very low price of our chief staple crop, and the consequent tendency of the farmers to diversify their crops to a greater extent than heretofore. As noted in a previous bulletin, the supply of home manufactured syrup only meets a portion of the demand for the article during a very small part of the year, and the remainder of the product is obtained from without the State.

While the purchaser of the home made article can rest assured that his goods are free from adulteration, the consumer of the imported syrup cannot be at all certain as to its quality and composition, owing to the extent to which the addition of adulterants is carried. A large proportion of the syrups obtained from outside markets contain considerable admixtures, of corn glucose, and some are obtained by the reboiling of syrups and molasses which have undergone partial fermentation, while still other syrups may have been produced from dark colored and low grade molasses which have been brightened by chemical treatment.

Some years since the writer ascertained by personal investigation that in some of the chief syrup markets of the country, dark colored plantation molasses was being bleached by the dealers by means of chemical processes, bi-sulphite of soda and pulverized zinc being the chief chemical agents employed.

With the exercise of proper care in the clarification and preservation of the genuine cane syrup, the imported or, at least, the adulterated article, should soon be excluded from the market, and the consumer can then be assured of the purity and good quality of the goods which he purchases. As stated in the previous belletin, but little attention has been given, as a rule, to the clarification or defecation of syrups in this State, and in many cases a considerable proportion of the scums and suspended impurities are boiled down with the syrup, darkening its color, affecting its taste and making its preservation more difficult. A satisfactory clarification of the juice not only brightens the product very materially, but also effects the removal of a large proportion of the albuminous matters, whose presence favors the growth and action of ferments.

It is also of the greatest importance that more attention be given to the density to which the syrup has been cooked, since in most cases the syrup boiler determines by the eye and in a very crude way the point at which the syrup should be drawn off.

In many cases the syrup is cooked to too thick a consistency, and as a consequence, a crystallization and deposition of sugar takes place, while on the other hand, if the syrup is not boiled to the proper density, fermentation is likely to ensue and the preservation of the syrup becomes a more difficult problem.

When the ordinary form of evaporator is at hand, the actual process of evaporation can be conducted in the usual manner, but the crude preliminary system of clarification now in general use can be much improved by resorting to the sulphuring process outlined in Bulletin No. 66.

In this process, the juice fresh from the mill is allowed to run slowly through a sulphuring box containing a number of inclined shelves, and, as the juice trickles slowly down from shelf to shelf, it meets with an ascending current of sulphur fumes which are produced by burning brimstone or roll sulphur in a roughly constructed brick furnace.

In this way the juice is at once rendered lighter in color, and when heated in the evaporator, the separation of albuminous matters and other impurities is effected much more readily and rapidly. After the heating of the juice is commenced, the addition of a small amount of milk of lime is frequently found to facilitate the clarification and renders the separation of scums more easy.

Where the above process of clarification is employed, the resulting syrup is much clearer and brighter, and at the same time, it can be preserved much more readily. If it is desired to preserve the syrup for a considerable period of time, the hot liquid, concentrated to the proper strength, is run into a bottle or a well glazed jug of from half gallon to one gallon capacity, which has been rinsed out with hot water. The vessel is filled almost up to the mouth with the hot syrup and is then securely sealed and stored away for future use.

By this process, syrup has been successfully preserved at the laboratory for from one to four years, and crystallization of sugar can also be prevented if care is taken to avoid cooking the syrup to too great a density.

In Bulletin 66 reference was made to the composition of syrup put up in sealed vessels in the fall of 1894, as compared with the composition of the same syrup in the fall of 1895. The syrup in question was put up in bottles of three quarts capacity each, and one of these bottles was kept in a sealed condition until quite recently. After a lapse of more than four years no perceptible fermentation had taken place, nor had there been any crystallization of sugar. The syrup possessed a fresh and quite natural taste and the subjoined analysis will show, had undergone very little change in composition as compared with the previous analysis. This bottle was opened accidentally several weeks in advance of the analysis and the increase in glucose and decrease in sucrose is no doubt largely due to this fact.

	ORIGINAL SAMPLE.	PRESERVED SAMPLE.
Total solids....	71.2 per cent.	71.2 per cent.
Cane Sugar....	46.7	43.6
Glucose........	22.4	26.8

Well glazed jugs of from one half to one gallon capacity can be employed instead of bottles, and tin cans, with small screw top, can also be used advantageously.

When it is once known that syrup of good quality and high purity and possessing the fresh taste of the original article can be obtained any month in the year, it will be quite easy to build up a market for such goods and the demand will necessitate an increase in the supply of the article.

The Baume hydrometer or saccharometer, described in Bulletin No. 66, can be employed to good advantage in determining the point at which the syrup becomes sufficiently dense to be drawn off, and when the spindle immersed in the hot liquid, reads 34 to 35 degrees, the liquid can then be run out of the evaporator. Farmers who have used the Baume spindle report good results from its employment and state that by means of its use no difficulty is experienced in boiling the syrup to a uniform density.

In the employment of the common evaporators, heated by direct contact of flame, over an ordinary furnace, great trouble is generally experienced in the proper regulation of the temperature and of the rate of evaporation, and on this account, scums and suspended impurities are frequently boiled down with the syrup. If the temperature of the furnace becomes too high, the evaporation becomes too rapid for the satisfactory clarification of the juice and the syrup is scorched or darkened in color by reason of the high heat to which the thin layers of liquid are subjected.

In order to secure the best results in clarification and evaporation, the heat should be easily and quickly controlled so that evaporation can be accelerated or retarded at will, or, if necessary, suspended instantaneously.

The employment of steam for heating purposes is the only sure means of attaining these ends, and during the past two or three seasons steam clarifiers and evaporators have been employed in the experiments conducted at the Station. Since the evaporation of juices and syrups is carried out in the sugar factories and refineries upon such a large scale, it was impossible to secure upon the market evaporation apparatus adapted to syrup making upon a small scale, and hence two small evaporators were especially constructed for experimental purposes, the smaller of the two being improvised from an ordinary open-fire evaporator already on hand.

This evaporator was about 4½ feet long, three feet wide and about six inches deep, while the large evaporator had a length of about five feet, a width of about three feet and a depth of ten inches.

The sides of the evaporators were of wood as usual, and the bottoms were constructed of sheet copper, but no partitions were employed as in the ordinary evaporators.

A series of pipes, connected at the ends by return bends, were placed in the bottom of each evaporator, almost the whole surface of the bottom being thus covered, with the exception of a space about four or five inches in width which was reserved for the collection of the scums from the boiling juice. This unoccupied space should be on the side of the evaporator opposite to the point at which the steam is admitted, and this side should also be slightly lower than the other in order to facilitate the removal of the scums. The piping employed was galvanized iron, three-fourths inch inside diameter, and valves were provided for the proper regulation of the steam used in the evaporation, while another set of valves enabled the operator to prevent the too rapid escape of waste steam from the coil.

The juice, after sulphuring, is first run into the small evaporator or clarifier, steam is turned on, and the contents of the clarifier brought gradually to a boil.

The scums and impurities come to the surface quite rapidly, the greater portion of them collecting over the space not occupied by the pipes, where they can be easily removed.

The clarifier is somewhat more elevated than evaporator, and when the juice has been well skimmed, it is at once run into the larger evaporator and the steam is immediately turned on.

Fresh quantities of juice are now run into the clarifier, boiled, skimmed and then run into the evaporator, the evaporation of the juice being conducted all the while.

Any scums which form in the evaporator can be removed in the usual way, and when the syrup has reached the proper density, the steam is shut off and the evaporator is emptied through the usual outlet.

By the employment of the steam heat, the temperature and the rate of evaporation can be regulated with great exactness, and a much more thorough clarification and satisfactory evaporation is secured than by the employment of the ordinary evaporators, where a large proportion of the scums are frequently boiled down with the syrup, darkening its color and rendering its preservation difficult.

The best results in clarification were found to be secured by boiling the juice in the clarifier at a very gentle heat, especial care being taken to prevent excessive foaming and frothing in the early stages of the operation, while a brisker rate of evaporation can be employed in the larger evaporator.

An important fact to be noted in this connection also is that steam gins and mills are frequently found located closely adjacent to lands well adapted to cane culture, and any surplus steam at their disposal could be easily utilized in the operation of evaporators of moderate size, and if desired, the cane mill could also be operated by steam power. By the cultivation of a good variety of sorghum as well as of sugar cane, the syrup making period could be lengthened somewhat, and the product could be correspondingly increased without any additional cost for evaporating apparatus.

Any one who has already at hand a steam boiler of proper capacity will find the employment of small steam evaporators very satisfactory, and a much brighter and clearer syrup can be obtained with little trouble and small cost.

Clarifying Agents.

The process for clarifying with sulphur fumes, as before stated, was described in detail in Bulletin 66, and essentially the same process and apparatus have been employed during the past two or three seasons with excellent resnlts. As a rule, the juice after passing through the sulphuring box has been mixed with an equal bulk of fresh juice, thus securing the clarification of the additional juice without any increased consumption of sulphur, and an excessive absorption of sulphur dioxide gas is thus avoided.

Sulphur has been used as a clarifier, both with and without the use of lime, care being taken in the former case to add the lime in the form of a thin milk, in small quantities, to the slightly heated juice, and then bringing the liquid to a brisk boil. In the manufacture of syrup, the best results with lime have been secured where that substance is added just in sufficient proportions to leave the juice faintly acid, as indicated by a piece of blue litmus paper immersed in the liquid.

During the preceding season, the Provident Chemical Works, of St. Louis, kindly placed at the disposal of the laboratory about a gallon of the liquid clarifying agent manufactured and sold by them under the name of "Clariphos." This preparation is a strong solution of acid phosphate of lime and has very active clarifying and defecating properties. Some small lots of juice, treated with this agent, brightened very perceptibly in color, and on standing, quite a considerable amount of precipitated impurities settled. This suspended matter was separated by filtering through a coarse cloth, and the clear liquid was evaporated down to a bright syrup. "Clariphos" has been employed very successfully in the sugar houses in Louisiana and is undoubtedly a valuable clarifying agent, but the increased amount of manipulation required in the way of settling, filtering, etc., interferes materially with its adaptability to syrup making upon a small scale.

In the present season, a small quantity of bi-sulphite of lime solution was purchased for use as a substitute for sulphurous acid, gas in clarifying juices. A severe freeze damaged the cane selected for experimental purposes and before the experiments in syrup making could be carried out, fermentation had set in, causing still further injury to the cane, as was indicated by the low sucrose and the high glucose content. A sample of the juice of the cane taken when the experiments were in progress showed 16.1 per cent. Total Solids, 8.8 per cent. Sucrose, and 5.0 per cent. Glucose.

A small lot of fresh cane gave quite a satisfactory syrup by the use of bi-sulphite of lime, but some of the products of fermentation of the larger lot of cane made the process of clarification much more difficult than in the case of the fresh cane. The bi-sulphite was employed on a neighboring plantation with fairly good results, and it is believed that under normal conditions it can be used to advantage as a substitute for the sulphurous acid gas. About one quart of the bi-sulphite was added to fifty gallons of juice, the clarification and removal of scums being conducted as before described. If settling vessels of sufficient capacity are at hand, it is best to allow the juice to stand for some time after the addition of the bi-sulphite of lime in order to secure the full clarifying effect of the latter.

The syrup produced in the experiments with the damaged cane was found on analysis to exhibit the following composition: Total solids, 71.9 per cent., Sucrose, 44.7 per cent., Glucose, 26.4 per cent. These figures show practically no loss from inversion on evaporation and with a good quality of fresh cane, a much better grade of syrup would have been produced.

Further experiments with clarifying agents and with steam evaporators will be conducted during the next season and it is hoped that additional information of value on this subject will be secured.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

VELVET BEANS.

J. F. DUGGAR.

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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, Alabama.

*Absent on leave.

THE VELVET BEAN.

By J. F. Duggar.

INTRODUCTORY.

Among the plants recently introduced to the public, few have received so much notice in the Gulf States as the velvet bean. In Florida within the last few years it has come into extensive use and has found general favor, especially as a plant for use as a fertilizer in orange groves. Although Alabama has no orange groves, the farmers of this State also have uses for the velvet bean, which matures seed in the southern part of Alabama and makes a luxuriant growth of vines in every part of the State.

The velvet bean (*Mucuna utilis*) is a plant which, in general appearance of leaves and stems, is nearly similar to the running varieties of cow peas. The vines attain great lengths, a growth of twenty feet being usually made and much greater lengths being sometimes attained. The beans are larger than cowpeas and usually 3 or 4 are found in each pod. The pods are short and stout, nearly black in color and covered with a coat of velvety hairs.

The velvet bean belongs to the same family as the cowpea. It is a legume or leguminous plant, and like the cowpea, the velvet bean is a renovating plant, having the power to enrich the land on which it grows. The velvet bean, cowpeas, vetch, clover, lespedeza, beggar weed, and indeed all the commonly-cultivated leguminous plants, have the advantage over other cultivated plants of being able to obtain a large proportion of their nitrogen from the air. Nitrogen, if purchased in cotton seed meal or commercial fertilizers, costs 12 to 15 cents per pound. Nitrogen is several times more expensive than an equal weight of phosphoric acid or potash, the other two constituents that make fertilizers useful and costly.

The farmer who plants a fair proportion of his land with cowpeas, velvet beans, or other legumes, can dispense with high priced nitrogenous fertilizers or ammoniated guanos, not only with the legumes themselves, but he can also dispense with them in fertilizing the cotton, corn, or small grain which follows on the land where the restorative crop grew the preceding year.

Most of the soils of this State are deficient in vegetable matter and nitrogen. This deficiency can be made good by the growth of luguminous plants. A large proportion of the energies of the Agricultural Department at this Station are given to the endeavor to learn which of these plants is most effective as a fertilizer and best adapted to use as a means of restoring the fertility of the soil.

During each of the past three years velvet beans have been grown on the farm of the Alabama Experiment Station. Most of our experiments have had as their object the determination of the value of the velvet bean as a fertilizer, for which use it seems even better fitted than for forage.

Our first seed was bought in the spring of 1896 from J. W. Thorburn & Co., New York City, under the name of banana field pea, or velvet bean.

USES OF VELVET BEANS.

Apparently the first use made of velvet beans was as ornamental climbing plants. Planted around porches with proper trellises they make a dense shade. Doubtless for this purpose the shade could be obtained earlier in the season by planting the seed in very small flower pots and transplanting after danger of frost is passed.

The first recognition of the value of velvet beans as renovating plants seems to have been made in Florida, where they are now planted in orange groves as a means of enriching the soil.

As a rule the luguminous plants prized for soil improvement are also excellent for feeding animals, their large percentage of nitrogen making them especially nutritious. Both vines and seed of the velvet bean are used as food for domestic animals, and some slight use has been made of the seed as food for mankind. Another use for velvet beans is as means of crowding or shading troublesome weeds. In the velvet bean we probably have a means of fighting Bermuda and nut grass, and perhaps also Johnson grass.

VELVET BEANS FOR SOIL IMPROVEMENT.

Soil improvement as measured by increased yield of sorghum Hay.—At Auburn, on poor sandy soil, velvet beans were planted May 13, 1896, to note the character of growth and the effect in enriching the soil. For comparison a similar plot of land was planted on the same day with Wonderful or Unknown cowpeas. Both crops were fertilized alike, as was also an adjacent plot which produced no crop during 1896. Both velvet beans and cowpeas were planted in drills about two feet apart. Velvet beans were sown at the rate of 80 pounds and cowpeas at the rate of 60 pounds per acre. The cowpeas ripened a fair crop of seed; these were not picked, but left to be turned under as fertilizer the following spring. The velvet beans formed pods but matured no seed.

In March, 1897, the cowpeas and velvet beans were plowed under, and April 23 early amber sorghum was sown broadcast at a uniform rate on all three plots, and fertilized with 240 pounds per acre of acid phospate, and 64 pounds of muriate of potash. The cowpeas and velvet beans were depended upon to supply sufficient nitrogen for the successful growth of sorghum.

The weights in pounds per acre of cured sorghum hay obtained in 1897 on each plot, were as follows:

	Yield of sorghum hay.	Increase due to legumes.
	Lbs.	*Lbs.*
Sorghum, on plot not cropped in 1896	3792	....
Sorghum after cowpeas, plowed under	7008	3216
Sorghum after velvet beans, plowed under	7064	3272

In this case the crop of sorghum in 1897 was nearly doubled as the result of plowing under a crop of velvet beans or of cowpeas. The increase in the yield of sorghum hay which we must attribute to the favorable effects of the preceding leguminous crops is more than 1½ tons per acre. The value of the increase is more than $12, if we value sorghum hay at $8 per ton.

The yield of sorghum was practically the same on the plot where velvet beans had been grown as on the plot where cowpeas had been turned under. The two plants stand then, under these conditions, on an equality, as measured by the increase in the yield of the crop following immediately after the legumes. Probably both velvet beans and cowpeas afforded sufficient nitrogen for a much larger crop of sorghum, the yield of which was lowered by extremely dry weather.

Soil improvement as measured by increased yield of oats.—A somewhat similar experiment was begun May 14, 1897, when two plots were planted with velvet beans at the rate of three pecks per acre, two with Wonderful cowpeas at the rate of one bushel per acre, and a fifth plot with German millet. A sixth plot was plowed and fertilized like the other five, that is with 264 pounds of phosphate and 66 pounds of muriate of potash per acre, but was not planted, being left to grow up in crab grass and poverty weed. The soil was poor and sandy and similar to that in the experiment described above.

At the proper stage the millet, one plot of cowpeas, and one of velvet beans were cut for hay. The dates on which these plants reached the proper stage of maturity were July 16, Sept. 10, and Sept. 21, respectively.

The weights in pounds per acre, were as follows:

	Green forage. Lbs.	Cured hay. Lbs.
German millet	2,732	994
Velvet beans	11,550	3872
Cowpeas	13,750	2420

The yield of both cowpeas and velvet beans was several times greater than that of German millet. This is partly due to the longer period of growth of the velvet beans and cowpeas, but it is also due to the fact that these two legumes had the power to draw a large part of their nitrogenous food from the air, while the millet could obtain only the small amount of nitrogen which a poor soil afforded.

The stand of velvet beans was not quite thick enough in the drill. The drills were two feet apart. When weighed the velvet bean hay contained perceptibly more moisture than the cowpea hay; hence we can not conclude from the above figures that the yield of dry matter (food) was greater with the velvet beans than with the cowpeas. The velvet bean plants on the remaining plot were left to continue their growth until the time should arrive for plowing them under. The peas on the remaining plot were picked October 6, and yielded at the rate of eleven bushels per acre. Velvet beans did not mature seed.

October 25, 1897, oats were plowed in on all six plots with a one-horse turn plow, turning under on one plot the growth of crabgrass and poverty weed, on a second the stubble of millet, on another the stubble of cowpeas, on a fourth the stubble of velvet beans, on another the vines of cowpeas (after being picked), and on still another the entire growth of velvet beans, including the half-grown seed. The plowing was poorly done on the plot containing velvet beans, a large proportion of the vines being left on the surface. This could have been remedied by the use of a rolling coulter attached to the plowbeam.

The oats were fertilized with acid phosphate and muriate of potash. No nitrogenous fertilizer was applied to any plot.

The yields of oats, as influenced by the preceding crop of legumes, are recorded in Bulletin 95, published last summer, and the results are quoted here.

Yield per acre of oats grown after stubble or vines of cowpeas, velvet beans, etc.

Plot No.		YIELD PER ACRE.	
		Grain.	Straw.
		Bus.	*Lbs.*
1	Oats after velvet bean vines	28.6	1206
6	Oats after velvet bean stubble	38.7	1672
	Average after velvet bean vines and stubble.	**33.6**	**1439**
4	Oats after cowpea vines	28 8	1463
3	Oats after cowpea stubble	34 4	2013
	Average after cowp a vines and stubble	**31.6**	**1738**
2	Oats after crab grass and weeds	7 1	231
5	Oats after German millet	9.7	361
	Average, after non-leguminous plants	**8.4**	**296**

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble or vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass.

May 18, 1898, oats on all plots were cut.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab-grass, weeds and German millet).

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous or soil-improving plants, instead of non-leguminous plants, during the preceding season.

The figures in the above table measure the improvement in the soil which, under favorable conditions, velvet beans may effect. Here again cowpeas and velvet beans seem to stand nearly on an equality as renovating plants. Doubtless both furnished sufficient nitrogen for a much larger crop of oats than was produced, which excess was useless in a dry season.

It will be noticed that the oat crop following velvet bean stubble was larger than that obtained where the effort was was made to plow under the entire plant. This should not be taken as indicating that the stubble and roots contain most of the fertilizing material of the plant. It indicates rather that they contained sufficient nitrogen for as large a crop as the moisture conditions of the soil and the unfavorable season permitted to be grown. It is certainly more profitable to cut and feed most legumes, saving the resulting manure and plowing under the stubble, than to use the entire plant as fertilizer. There are, however, conditions under which it is desirable to plow under the entire velvet bean plant, as on fruit farms or on other farms where there is an insufficiency of live stock.

If velvet beans are cut for hay it should be remembered that the removal of the hay takes from the land a large amount of nitrogen, phosphoric acid, and potash. According to analyses made at the Louisiana Station (Bul. 55, p. 121) a little more than one-third of the nitrogen of the entire velvet bean plant is found in the roots and fallen leaves.

Two other experiments are now in progress here to determine the amount of increase in the cotton crop which may be effected by turning under the stubble alone or the entire velvet bean plant.

Nitrogen in velvet beans growing on one acre.—A field of velvet beans grown here on verv poor land in 1898 and fertilized with 240 pounds of acid phosphate and 48 pounds of muriate of potash per acre yielded 19,040 pounds of green material per acre. The weight of hay after five days curing was 8,240 pounds per acre. These beans were planted April 20 in rows 3½ feet apart and at the rate of 110 pounds per acre. They were not cut until October 12, when the stems had become too hard to make first class hay.

October 8, 1898, samples were taken from this field for analysis. The roots found in the upper six inches of one square yard were carefully taken up, and the weights of the fresh roots and vines recorded. After drying 11 days the weights of roots and vines were again taken, and samples sent to the chemical laboratory for analysis. The roots and stubble from one square yard, on which six plants were growing, weighed when dry 0.26 pound, which is at the rate of 1,258 pounds per acre.

Dr. J. T. Anderson, Associate Chemist of the Station, determined the percentages of nitrogen and of moisture in both vines and roots, with the following results:

The nitrogen in the air-dry roots and stubble was 1 per cent., and in the air-dry vines, including partially grown pods, it was 2.29 per cent.; the moisture was 6.72 and 9.52 per cent., respectively. On the basis of the yield of hay as determined by cutting and curing a sixteenth-acre plot, the nitrogen in the crop of velvet bean plants on one acre was as follows:

	Lbs. nitrogen per acre.
In 1258 lbs. roots and stubble, excluding fallen leaves	12.5
In 8240 lbs. cured, coarse, hay	188.7
In entire plants	201.2

These figures indicate that the amount of nitrogen contained in the entire growth of velvet beans on an acre was equal to that contained in about 2,800 pounds of cotton seed meal. As the soil was very poor, the greater part of this nitrogen must have been obtained from the air. The yield of hay on this field was unusually large, but even if half this amount be taken as an average yield, we have still a most impressive lesson as to the value of leguminous plants for storing up nitrogenous fertilizing material for the enrichment of the soil.

It is evident that there will be no need to apply cotton seed meal to any crop following immediately after a crop of velvet beans, plowed under, and it is probable that on this land the mass of rich vegetable matter will render it unnecessary to use cotton seed meal for several years.

The above table does not do justice to the fertilizing value of velvet bean stubble, inasmuch as the dead fallen leaves, which are abundant and very rich in nitrogen, were not included with the roots and stubble in the sample analyzed. The roots and stubble alone contained only 12.5 pounds of nitrogen per acre, or about as much as is contained in 175 pounds of cotton seed meal. If the fallen leaves had been included, the value of the stubble would probably have been doubled. Our field experiments suggest that the usual stubble left after cutting the vines for hay contains sufficient nitrogen for the needs of the crop following immediately after the velvet beans.

These results showing the great value of the velvet bean as a fertilizer do not stand alone. They agree very closely with results obtained at Calhoun, Louisiana, by Dr. C. W. Stubbs and C. E. Mooers, and reported in Bulletin No. 55 of the Louisiana Experiment Station. The results of both investigations are brought together in the following table:

Yield of vines, roots and nitrogen in crop of velvet beans on one acre.

	ALABAMA.	LOUISIANA.
Yield green vines and fallen leaves per acre	19,040	22,919
Yield cured vines	8,240	7,495
We ght air-dried roots....................	1,258	173*
Lbs. nitrogen in entire plants on 1 acre...	201	191
Per cent. nitrogen in cured vines	2.29	2.27
Per cent. nitrogen in air-dry roots.	1.00	1.54

*It is not stated in Louisiana Bulletin 55 that any of the stem or stubble was included with the roots; in our tests stubble of about 3 inches in length was included with the roots; hence, probably the wide difference in the amount of roots in the two experiments.

ADVANTAGES AND DISADVANTAGES OF VELVET BEANS.

In any comparison of velvet beans with cowpeas as a renovating crop, there is one point in which velvet beans are conspicuously superior. When frost comes the vines and leaves settle down together in such a way that the force of falling rain is broken and the network of vines is so complete that the leaves, the most valuable portion, cannot be blown or washed away. With cowpeas the case is somewhat different, the bare stems standing erect and affording no means of retaining the leaves in place.

On the other hand better implements are required to turn under vines of the velvet beans than to plow under cowpea vines. The work of burying velvet bean vines is, however, easily done with a rolling coulter attached to the turn plow, or by the use of the disk plow, which latter implement is not likely to come into general use on the light sandy soils where the velvet bean is most valuable. One orange grower writes of running a cutaway disk harrow across the vines in two directions before plowing. This dispenses with the necessity for a coulter.

An Alabamian who planted velvet beans in his young orchard concluded that they were undesirable there on account of their habit of climbing into the trees, which he thought were thereby injured. This objection might perhaps be overcome by planting velvet beans at some distance from the trees and by occasionally cutting off the vines growing towards the trees, by the use of a plow run shallow, with rolling coulter attached, or even by moving the vines with the hands before they obtained firm hold upon the trees. Our experiments at Auburn show that velvet beans should not be planted, like cowpeas, between rows of corn, as the tangle of vines will cause the corn to rot and make it difficult to gather the crop.

THE VELVET BEAN FOR FORAGE.

As before stated both the vine and the pod are used as food for live stock.

However, the seed ordinarily mature only in the southern part of Alabama, while the vine thrives at least as far north as the northern boundary of this State.

Velvet bean vines can be used either for pasturage, for cutting and feeding green, soiling, or for hay.

The writer has preserved velvet bean vines in the silo alone and mixed with corn silage. In some portions of the silo the velvet beans made good silage, in other portions they spoiled. Further experiments are required before we can say that this plant is well adapted for use in the silo.

As a forage plant velvet beans must be judged by (1) quality, (2) quantity (yield), and (3) cost of production.

Quality of velvet bean hay.—In the absence of chemical analysis, showing the per centages of starch, fat, etc., in velvet bean vines or hay, we cannot form an accurate idea of the value of the velvet bean plant as a forage. Both the green material and the hay are readily eaten by most farm animals. We know from the fertilizer analysis of the plant that it is rich in nitrogen and hence in muscle making material. The large proportion of leaves also suggests that the hay is highly nutritious.

Until analyses are made and accurate experiments conducted to determine directly the digestibility and nutritive value of this forage plant, we may assume that for purposes of food the velvet bean is probably identical with its near relative, the cowpea.

Yield of velvet bean hay.—The quantity of hay yielded by velvet beans is satisfactory. On this farm the yield of velvet bean hay has never been less than one and one-fourth tons per acre, and has in one instance amounted to over four tons per acre. On poor land one can safely count on a larger yield of velvet beans than of millet, sorghum, or most other non-leguminous forage crops.

It is a more difficult matter to reach a correct judgment as to the relative yields of velvet bean and cowpea hay. In the table below are brought together the results of all the experiments conducted here in which direct comparisons were made between the yield of hay from velvet beans and from the "Wonderful" variety of cowpeas, which variety is one of the most luxuriant growers.

Yield of velvet bean hay as compared with hay from Wonderful cowpeas at Alabama Experiment Station.

SOIL AND METHOD OF PLANTING.	Velvet beans		Wonderful cowpeas.	
	Seed sown per acre.	Hay per acre.	Seed sown per acre	Hay per acre.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
Sandy soil, 1897; in 2 ft drills	46	3872*	64	2420
Sandy soil, small plots, 1897; in 2 ft. drills, cultivated..................	.....	7300	.....	8930
Fair reddish loam soil, 1898; broadcast..................................	120	5360	60	6400
Fair sandy soil, 1898; broadcast...	128	4200	96	4160
Average 4 experiments.........	.....	5183	.....	5477

* Apparently this sample of velvet bean hay was not so well cured and contained more water than the corresponding sample of cowpea hay.

The average yield of velvet bean hay as shown in the above table was 5,183 pounds, and of cowpea hay 5,477 pounds per acre. The difference in yield is so slight that we may regard the average yields as practically identical.

Harvesting velvet bean hay.—If thus far equal areas of velvet beans and cowpeas have seemed to be practically equal to each other, whether regarded as fertilizer or as forage, the cost of growing the two is by no means the same in regions where seed must be purchased.

Our experience suggests that it is desirable to use at least one bushel of seed per acre. The price paid for shelled beans in 1899 was $1.00 per bushel, plus the freight from Florida. Our supply in 1898 was brought from M. S. Moreman, Switzerland, Fla., and in 1899 from H. K. Fuller, Apopka, Fla. Assuming the cost of purchased velvet bean seed at $1.40 per bushel, we have an expense somewhat greater than the usual cost of the seed necessary for planting an acre of cowpeas. Again we have found that when using a grass blade a laborer can cut a larger area of cowpeas than of velvet beans in a day. If it should be found practicable here to cut velvet beans several times each season or before they become badly tangled, thus allowing the use of the mower, this difficulty of harvesting would be overcome. It is stated that velvet beans are in Florida cut several times during one season. It has yet to be learned whether in our climate, with irregular summer rainfall, velvet beans will make a luxuriant second growth after being cut. If practicable, this method of cutting velvet beans several times during the season will remove the chief disadvantage of this plant for hay making. If only one cutting is made, it should occur when the plants are in bloom.

It has been suggested that the velvet bean may be induced to mature seed further north than is now done by planting thinly in locations where the vines may climb up on trees, fences, etc., thus exposing the pods to air and sunshine more completely than when the pods lie near the ground. In this way they may perhaps be gradually acclimatized and made to ripen seed at least as far north as the central portion of Alabama. To encourage the maturing of seed, planting should be done as early as practicable, or at least as early as the earliest planting of cotton. A few dozen plants intended especially for seed production might be given even an earlier start, by planting a month earlier under glass and transplanting with a ball of adhering earth when danger of frost is past.

AMOUNT OF SEED REQUIRED.

A count made by the writer showed that a bushel of 60 pounds of velvet beans contained a little over 32,000 beans. In three feet rows this would plant an acre, provided two seed were dropped every 11 inches in the drill.

One correspondent writes that less than one peck of seed will plant an acre if two beans are dropped in hills five by three feet apart. This is evidently too thin for best results. Three experienced Florida growers of velvet beans, consulted on this point, reply in substance as follows: (1). "I never use less than one bushel per acre. I plant in 4-foot rows, dropping three or four beans in hills two feet apart, in every fourth furrow while breaking the land;" (2). "I plant in hills three feet apart each way, two to three beans in a hill;" (3). "I get best results by planting quite thick, not less than one bushel per acre, or even two."

In a test made at Auburn in 1898, velvet beans sown broadcast at the rate of 128 pounds, which is more than two bushels per acre, yielded 4,160 pounds of hay per acre as against only 2,880 pounds when only 64 pounds of beans were sown. In a parallel experiment with drilled velvet beans the results were inconclusive. The amounts of seed used in some of our experiments are given in the table on page 120.

It is probably best to plant in drills and to use about one bushel of seed per acre. On poor land acid phosphate and potash fertilizer, as kainit, muriate of potash, or ashes, will be desirable. Cultivate shallow until the vines interfere with cultivation.

USES OF THE BEANS (FRUIT).

Velvet beans as human food.—The shelled beans have been used as food for cattle, hogs and chickens and even as a table vegetable. The writer has up to this time made no experiments to determine the suitability of the beans for feeding to different classes of livestock.

Inasmuch as there is on record one well authenticated case of injury following the use of green, immature, shelled velvet beans as a table vegetable, caution is advised in using the beans for human food. This case of apparent poisoning or acute indigestion following the eating of green velvet beans, boiled, was carefully investigated by Mr. V. K. Chestnut, of the U. S. Department of Agriculture. He has kindly permitted the writer to examine his correspondence with Mr. J. S. Sergeant, of Florida, who reported the only case on record where velvet beans proved decidedly harmful. With him green boiled velvet beans proved injurious, not only to men, but also to the poultry. Mr. Sargeant writes as follows concerning velvet beans as a substitute for coffee:

"We have since used them as coffee two and three times a day for three or four months continually without observing any deleterious effect. If properly ground they make a very pleasant drink. The least bit of burning makes the beverage too bitter, and on the other hand, too little browning leaves them with an unpleasant taste and odor." Four Floridians who have had extensive experience with velvet beans were consulted on the suitability of velvet beans for food of man and beast. All hold the opinion that they contain no poisonous principles, but three of these four correspondents agree that the velvet bean is not a desirable table vegetable. The fourth, Mr. E. J. Johnson, Leesbury, Fla., writes thus: "For human food they are by all odds the richest and best vegetable I have ever tasted. If eaten in large quantities they will nauseate the stomach, not from poison, but from richness. They should be soaked in water over night. This separates the inside hull from the bean. They should then be parboiled in at least two waters. Then cook them as you do any other beans."

Velvet beans for live stock.—Here are some results of long experience in feeding the beans to live stock:

Mr. E. J. Johnson writes: "I fed them ground and dry to chickens, cows, and horses. Others cook them. I have a neighbor who fattened 60 hogs by turning them into the field and allowing them to help themselves."

Mr. H. K. Fuller, Apopka, Fla., writes thus:

"I have fed the beans ground with hulls to my milk cows with the best of results; I think them equally as good as cotton seed meal. Some of my neighbors have tried cooking them. They claim that stock eat them readily and thrive as well as when the beans are ground into meal. * * I fattened 4 very fine hogs this year on cleaned beans ground fine and mixed with equal parts of wheat bran. The meat was very sweet and juicy. I also feed my poultry with the same mixture with the best results."

The statement of Mr. A. P. Newheart, Ocoee, Fla., is as follows: "All stock and poultry are exceedingly fond of them in the green stage, but I have never persuaded a horse to eat them when ripe, neither whole, ground, nor cooked * * When the beans are too hard, I have them ground with the hulls and feed of this about 4 quarts at a meal with a little salt and find them equally as good milk producers as cotton seed, though in warm weather the butter is oily. Pigs eat them and it is said that the pork is deliciously sweet."

Mr. C. L. Smith, of Pomona, Fla., writes thus: "Ground in the hull they are fine feed for horses, cows and hogs. Feed with a little wheat bran at first and at no time feed too much. Boiled (in pod) or carefully ground velvet beans are good for chickens. You can turn hogs into [a field of velvet beans] in November and the hogs will grow fat by the middle of January. Then you can turn the vines under for corn."

From the experience of these men and others it seems that there is no danger in the judicious feeding of velvet beans (fruit) to cattle, hogs, and poultry. The air-dry shelled beans analyzed by Prof. H. H. Persons, (Fla. Bul. No. 35), contained 6.29 per cent. of fat, 53.5 per cent. of nitrogen-free extract (starch, etc.,) and the very large amount of 18.81 per cent. of protein or muscle-forming material. This indicates that the beans are even richer in food materials than the cowpea, which ranks especially high as a foodstuff.

From the large number of pods formed on velvet bean vines grown at Auburn, it is evident that the yield of seed would be very large, if they should mature. In Florida 18 to 20 bushels of beans per acre are reported as the usual crop.

Unfortunately it is only the farmers of the southern third, or at most, of the southern half of Alabama who can grow the velvet bean with the expectation of getting a crop of seed, and in the seed a very nutritious concentrated foodstuff. For the deep sandy soils of the southern part of the State the velvet bean promises to be extremely useful, both as fertilizer and as food for animals.

CO-OPERATIVE TESTS OF VELVET BEANS IN ALABAMA.

In 1898, co-operative experiments were made with velvet beans for this Station by farmers in 14 localities in Alabama. In reporting results the great majority of experimenters reported a more luxuriant growth made by velvet beans than by cowpeas. Almost invariably the yield of hay as *judged by the eye* was estimated as much greater than the yield of cowpea hay. However our work here has convinced us that it is easy to over-estimate the yield of velvet bean hay, for the growing vines present an imposing appearance and the hay is loose and bulky.

Giving due weight to these reports of results based merely on appearance and to our accurate experiments at Auburn, where the product of large plots was weighed, it appears probable that on good land the cowpea and velvet bean afford practically equal yields of hay, while on poor, deep sandy land the velvet bean may afford a larger yield.

BULLETIN No 105. AUGUST, 1899.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

WINTER PASTURAGE, HAY AND FERTILITY AFFORDED BY HAIRY VETCH.

By

J. F. DUGGAR.

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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, Alabama.

WINTER PASTURAGE, HAY AND FERTILITY AFFORDED BY HAIRY VETCH.

By J. F. Duggar.

SUMMARY.

Hairy vetch (*Vicia villosa*), sown in September or October, alone or with oats, affords nutritious pasturage during the following February, March, April and May. If not grazed too late it affords a cutting of hay from April 20 to May 10. Hairy vetch is disposed of as pasturage, hay or green manure in time for quick-growing summer crops, as cowpeas, sorghum, late corn, etc. It grows only from seed, but can be so managed as to reseed the ground continously.

Hairy vetch was cut for hay at four different stages; the yield of hay increased up to the time of full bloom, when the maximum yield of 5,789 pounds of hay per acre was obtained; chemical analysis showed that, at whatever stage this plant was cut, the hay was nutritious. Considering both quality and quantity of hay, it was concluded that the best time to cut vetch (growing alone) was three or four days before the period of full bloom.

Hairy vetch rapidly enriches the soil in nitrogen, if the plant is plowed in for green manure. It is able to draw this nitrogen from the air and add it the soil only when the roots of the vetch plant are supplied with enlargements of definite character, and known as root nodules or tubercles.

When sown in the usual way on most poor soils in Alabama the vetch plant does not have these "bumps" or nodules on the roots. If devoid of tubercles, hairy vetch does not enrich the soil, and fails completely if the land is poor.

Such soils can be made to produce vetch plants containing tubercles by sowing, along with the vetch seed, some of

the earth from a place where the English pea or the wild vetch has been grown for several years.

The process of employing suitable soil or other material containing definite kinds of tubercle-producing germs is called inoculation. Full directions for the inoculation and culture of hairy vetch are given in this bulletin.

With hairy vetch natural inoculation occurred during the second year that the plant was grown on the same land. Artificial inoculation, as described in this bulletin, caused the success of the first crop of vetch, whereas reliance on natural inoculation involved the failure of the first crop of vetch, or else the use of expensive nitrogenous fertilizers.

In order to have available for use in future years a supply of valuable inoculation material, it is important that prospective vetch growers should sow at least a small area of vetch this fall; the soil from this plot may be used for inoculating larger areas in subsequent years.

A very luxuriant crop of hairy vetch, in full bloom, contained in the roots, stubble, and vines growing on one acre, fully as much nitrogen as is contained in 1¼ tons of cotton seed meal. A large proportion of this came from the air.

By far the greater portion (at least four-fifths) of the fertilizing material in the vetch plant is in the top, or part cut for hay. However, there is considerable nitrogen in the stubble and roots, as shown here both by chemical analysis and by the satisfactory growth of corn on land where vetch stubble had been plowed in.

Our tests indicated a larger profit from feeding the vetch hay, plowing in only roots and stubble, than from turning under the entire plant for green manure.

Hairy vetch can be advantageously introduced as a "catch crop" into the ordinary rotations of the cotton farm, without reducing the usual area of cotton, corn, or small grain. Hairy vetch, if properly inoculated, is a profitable crop even if the farmer fails to utilize its food value and grows it only for soil improvement, which end it rapidly effects through prevention of leaching from the soil in winter and through the stores of nitrogen and vegetable matter added to the soil.

WHAT IS HAIRY VETCH?

In two previous bulletins (No. 87 and No. 96) of the Alabama Experiment Station, the writer has pointed out the great value of hairy vetch as a forage plant and as a means of improving the soil. As the editions of these bulletins are exhausted and as we have recently conducted other experiments with this plant, the present bulletin is issued with the hope of inducing many farmers to test hairy vetch, which we may safely say is one of the most promising plants for those who desire winter pastures, nutritious hay, or soil improvement.

Hairy vetch (*Vicia villosa*) is an annual plant. This implies that its growth is made in less than twelve months and that the plant does not spring from the roots, but that seed must be planted every year, or that the plants must be allowed to ripen sufficient seed for a "volunteer" crop the next season.

The introduction of hairy vetch into Central Europe is comparatively recent, while in the United States few tests of this plant were made before the present decade.

The plant forms numerous slender branches, which in thrifty plants are usually three to six feet long. These branches are too fine and slender to stand erect.

The leaflets are small. The entire plant is covered with a coat of fine hairs, hence the name hairy vetch. This plant is also called sand vetch. The flowers, which appear in dense clusters in April, are purplish, and a field of vetch in full bloom presents a beautiful appearance. The seed, of which several are borne in each pod, are black and about the size of okra seed. The seed pods readily burst open, throwing the seed to some distance. This makes it easy for the plant to reseed itself if not grazed too closely when the seeds are forming.

SPECIAL VALUE OF LEGUMINOUS PLANTS.

Hairy vetch, like the clovers, cowpeas, etc., belongs to the large order of plants known to the botanists as *Leguminosœ*. Hence we speak of members of this order as leguminous plants or legumes.

All the legumes with which we are concered might also properly be called soil-improving, or renovating, plants. They deserve this name because they have the power, not possessed by most other plants, to obtain *from the air* a large proportion of the fertilizing material that they need; and the nitrogen which they thus obtain, if given to the land by plowing in the legume, makes the soil rich in this valuable fertilizing material. Since nitrogen, if purchased in the form of cotton seed meal costs 10 or 12 cents per pound, the fertilizing value of legumes is self-evident.

The great value of legumes as soil improvers may be better realized by considering the figures which show the amount of nitrogen in the tops and roots of hairy vetch grown on this station in 1898-'9.

Analysis of samples of the vines and roots of hairy vetch cut May 2, 1899, when in full bloom, showed that the crop on one acre contained:

	Lbs. nitrogen per acre.
In the 5789 pounds of hay....................	159.2
In the 1052 pounds of roots and stubble.......	20.8
In the entire growth on one acre............	180

This 180 pounds of nitrogen is equal to that contained in more than 2,500 pounds of cotton seed meal. Or, pricing the nitrogen at 10 cents per pound, a luxuriant growth of vetch on an acre represents nitrogen the market price of which is $18. Some of this comes from the soil, a large proportion from the air. If we assume that only half the nitrogen was obtained from the air, the soil would gain, by plowing in the entire vetch crop, nitrogen to the value of $9. Granting that some of this will be washed out from the soil before a succeeding crop can appropriate it, there is to counterbalance this the mechanical improvement of the soil, due to the incorporation of about three tons of vegetable matter per acre.

On poorer, sandier soil samples of hairy vetch taken May 7, '98, showed that the ton and a half of hay growing on an acre contained 85½ pounds of nitrogen, and the roots and stubble 20 pounds, a total of 104½ pounds of nitrogen per acre. Numerous other figures obtained in experiments here might be given, all showing the superior value of hairy vetch and other legumes as fertilizers. For example, in this experiment just alluded to, rye, growing alongside the vetch, on similar soil and with identical fertilization, was able to obtain only one-fifth as much nitrogen as vetch, because the rye plant was limited to the supply of nitrogen in the soil, while the vetch plant drew from the unlimited store of nitrogen in the air as well as from the scant supply in the soil.

THE FUNCTION OF ROOT NODULES OR TUBERCLES.

The above figures and the experience of every observing farmer should raise the question, "Why can vetches, cow-peas, and other legumes, obtain nitrogen from the air while non-leguminous plants cannot?" Let us compare the roots of the cow-pea, or other legume with the roots of rye, corn, or other grass-like plant, and we will discover the essential point of difference between soil-improving and soil-exhausting plants. The legumes, or soil improvers, if thrifty and if examined at the proper time, say just before blooming, will be found to have little bumps or enlargements on the roots, slightly attached on the surface of the root. The soil exhausting plants—those which have not the power to take nitrogen from the air—have no such en-enlargements on the roots. These enlargements, root nodules, or tubercles, found on all normally developed soil-improving plants, are the means by which these plants are enabled to assimilate the gaseous nitrogen of the air. They are filled with minute vegetable organisms, germs, or bacteria, which convert the gaseous nitrogen into a form suitable for the use of the flowering plant.

In one sense, each tubercle or nodule is a fertilizer factory, peopled with great numbers of industrious vegetable operatives, working constantly and manufacturing nitrogenous fertilizer, which is floated off in the sap of the host plant to be utilized in building up the stem, roots, and leaves of the higher plant.

WINTER-GROWING PLANTS.

Hairy vetch begins its growth in September or October and occupies the ground during the winter months. It thus prevents in a large degree the leaching out in the winter rains of the nitrogen already in the soil. It retains what nitrogen is already in the soil by taking up through its roots the soluble soil nitrogen, which, if not thus utilized, would to a large extent be washed out and carried off in the drainage water, and thus utterly wasted. The nitrogen thus appropriated is restored to the soil when the plant, or its stubble, is incorporated with the soil a few months after winter ends. Soils of medium fertility in the South (as also rich soils) are more injured by leaching if left without growing vegetation during winter than they are by the fertilizing material removed in the crop. The richer the soil, the greater this loss. Leaching even occurs, in smaller measure, on the poorest of soils left bare of green vegetation in winter.

Hairy vetch checks leaching, but it is not alone in this valuable function. Rye, wheat, barley, and winter oats, in fact any crop filling the soil during winter with a tangle of live roots ready to take up the soluble nitrogen before it can escape in the drainage water, will serve to retain what fertility the soil already possesses. Often these crops, especially on rich land, save more than enough fertility in this way to pay cost of seed and labor expended in sowing them. Remember that nitrogen is worth 10 to 12 cents per pound, and that many pounds may be drained from an acre of bare soil each winter. The winter-growing small grain crops conserve present fertility, but they do not add to the supply of plant food, for when plowed in, they restore only what fertilizing materials they have obtained from the soil.

It is reserved for the winter-growing legumes to perform the double service of preventing leaching and of largely increasing the supply of nitrogen in the soil. They are both conservers and accumulators of fertility, and for this reason are preferable to non-leguminous plants. Among these winter growing legumes, none promise greater usefulness to the cotton farmers of Alabama and to those who are turning their attention to live stock than hairy vetch. It requires the use of the land for only the cooler portion of the year, furnishes winter pasturage, nutritions hay, and a cheap fertilizer. The culture of hairy vetch is simple and the plant has adaptability to a wide class of soils, provided the farmer utilizes the results of recent discoveries relating to leguminous plants.

INCREASING THE YIELD OF RARELY-GROWN SOIL-IMPROVING PLANTS BY MEANS OF INOCULATION.

When a root nodule or tubercle decays the germs which it contain are left in the soil and distributed by cultivation and by the movement of drainage water. Hence the soil on which vetch has grown for several years has an abundant supply of that kind of germ found in the root nodules of the vetch plant. These germs are not dead but have the power of growing and of multiplying should they again come in contact with a succulent vetch root. If one of these germs becomes thus attached, a nodule is formed on the vetch root, and by the rapid multiplication of the original germ this tubercle becomes stocked with a multitude of nitrogen-storing bacteria, thus making available to the higher plant the great store of atmospheric nitrogen.

By an extension of the figure used in a preceding paragraph, we may say that a single one of these operatives (nodule bacteria) is able to organize a new fertilizer factory (nodule or tubercle) and in a few weeks or months to people it with the descendents of the founder. However, a germ from a vetch tubercle would be unable to cause the growth of a tubercle on any of the clovers, cowpeas, etc. In other words, nearly every kind (genus) of soil-improving legumes has its own exclusive variety of nodule-forming bacteria, which can cause the growth of tubercles only on this particular genus, or closely related genera, ot plants.

As stated above, the growth of any given legume, say cowpeas, stocks the soil with myriads of germs able to cause tubercles to develop on the next year's crop of cowpeas. The soil, thus germ laden, is blown about by the winds, stocking with the cowpea germs fields where cowpeas have never grown. Hence, we count on most Southern soils having a full supply of cowpea germs, because the cowpea has been so widely grown in the South. So in the North there is probably an ample supply of clover germs, distributed from the clover fields, which are so generally to be seen. Likewise in the West, where alfalfa fields are common, the supply of alfalfa germs, doubtless carried by winds and by irrigation water, seems ample.

But a very different condition prevails over large areas of the South as regards the supply of germs able to produce tubercles on clover, alfalfa, or vetch. Take vetch, for example. In Alabama there are comparatively few fields of either common or hairy vetch. Hence, even if all these fields were abundantly stocked with tubercles and vetch bacteria, there could be no general and adequate distribution of the germs.

Absence of "vetch germs" in many Alabama soils.—As a matter of fact, the writer has found, in examination of vetch plants from dozens of localities in Alabama, that when first grown, vetch fails to produce tubercles, or else has so few tubercles that they are inadequate for soil improvement. Hence we infer the absence or inadequate supply of vetch germs from the majority of soils of the extreme South.

This fact has a very practical bearing. For a vetch or other leguminous plant without tubercles is cut off from the store of atmospheric nitrogen, cannot improve the soil, and cannot make a luxuriant growth except on rich land or by the use of high priced nitrogenous fertilizers. Moreover, the absence of tubercles lowers the quality of the forage, decreasing the valuable nitrogenous food materials, as well as greatly diminishing the yield. (See Ala. Expt. Sta. Bul. No. 96, p. 206).

Leguminous plants have no proper place on the farm unless their roots are well supplied with tubercles. Yet such rarely-grown legumes as vetch, clover and alfalfa on many Southern soils fail to form tubercles the first year. It is the farmer's business to make them form tubercles. He can do this by supplying to his field where he wishes to sow clover, alfalfa, or vetch, the appropriate germ. This process of supplying the requisite germ is called *inoculation.*

Inoculation by use of suitable earth.—For instance, the farmer wishing to grow vetch, should, if a patch of hairy vetch or of common vetch growing wild is to be had in his vicinity, examine these vetch plants. If they have tubercles, he should obtain some of the soil from the upper three inches of this old vetch field, taking the soil from near the roots of the old vetch plants or from spots where there was a thick stand of vetch.

However, as not many will be able to find a vetch field from which to get soil, a substitute can be had in the soil from a portion of the garden where English peas grew last season, *and where they developed an abundant growth of tubercles.*

Having the soil from the old vetch field or gard en spot proceed as follows :

If the supply of inoculating soil is limited in proportion to the area to be sown with vetch, place the soil in a bucket, tub or tight barrel and add such an amount of water as will thoroughly saturate the soil and in addition will leave, after the settling of the soil, sufficient water to wet the amount of vetch seed to be sown. After adding the water, stir soil and water together very thoroughly. Then allow settling to occur and pour off the water on the vetch seed, stirring the seed to make sure that every seed becomes wet. Sow the seed promptly after this treatment, avoiding as far as practicable exposure to light. Cover the seed promptly.

A more thorough inoculation can be secured, when there is available sufficient inoculating soil, by proceeding as above, and in addition, sowing broadcast one or two tons per acre of the unmoistened inoculating soil, harrowing it in promptly and repeatedly, so as to thoroughly distribute the inoculating earth through the soil.*

Commercial germ fertilizer, or Nitragin.—There is a prepared inoculating material, called germ fertilizer, or Nitragin, imported from Germany by Victor Koechl & Co., 79 Murray St., New York. There is a different brand for clover, alfalfa, vetch, etc. All brands cost about $1.25 per bottle (sufficient for ⅝ acre), the cost with express, amounting to about $2.25 per acre. Directions for use accompany each bottle.

The following extract from Bulletin No. 93 of this station indicates that there are practical limitations to the *extensive* use of Nitragin, its best use being as a "starter" for inoculating a small area; the soil from this small plot, may, in future years, be used to inoculate extensive areas:

"The greatest obstacle to the general use of Nitragin in certain 'cloverless' regions is the fact that this valuable material is perishable. It loses its inoculating property if long exposed to light, or if subjected to much heat, or if kept for more than two or three months. It endures longer in a cool than in a warm temperature. Nitragin shipped from Germany early enough to reach the Southern farmer in time for use on fall-sown seed runs great risk of being exposed to a temperature sufficiently high to cause fermentation, and consequent death, of the germs which it contains.

"So many bottles of Nitragin ordered in time for use in our fall experiments have reached us in a worthless or dead condition that we would advise those who may wish to obtain a few bottles of Nitragin as a "starter," to order the shipment made from Germany about the first of February, so that the Nitragin will arrive in time for use on seed sown in March. While we have found to be dead some of the Nitragin imported in winter, the losses have been less at this season than with importations in the early fall."

---

* As inoculation material for crimson clover, earth from roots of vetch or English peas will not answer. For this purpose use earth from about the roots of the little white clovers often found in spring in old pastures and lawns or from the roots of any of the true clovers (*Trifolium*)

NATURAL INOCULATION.

As stated above there are two means of artificial inoculation, (1) by use of soil from a field on which has been grown for several years, *with abundant supply of tubercles*, the same kind of legume that it is desired to inoculate, and (2) by the use of Nitragin or germ fertilizer, a concentrated commercial preparation, which is exceedingly perishable.

Artificial inoculation pays, but it is not absolutely necessary to final success with vetch and similar rarely-grown legumes. Nature may do the work of inoculation, if given time enough. Artificial inoculation, with material sufficiently stocked with the proper germs, practically insures immediate success, or the success of the crop the first year. To wait for nature to so modify the germs now in the soil of "vetchless" regions as to cause nodule formation on the vetch plant, involves on poor land the failure of at least the first crop of vetch, or else it necessitates sowing vetch seed on rich land or the use of the expensive nitrogenous fertilizer for the proper growth of the first crop of vetch.

Two experiments recently made by the writer suggest that with the vetch plant we can expect natural or spontaneous inoculation to occur the second season, when vetch grows during two years in succession on the land.

On recently cleared land where hairy vetch grew in the spring of 1898 without artificial inoculation and without tubercles, vetch seed were again sown in the fall of 1898. The resulting plants become fairly well supplied with tubercles.

Likewise on a fairly good upland loam soil, where in the season of 1897-'98 diligent and repeated search failed to discover a single tubercle on the roots of hairy vetch, the vetch plants of 1898-'99, produced by self seeding or shattering, had developed tubercles on about two-thirds of the plants as early as December 7, 1898. Later, the supply of tubercles was adequate.

In both cases the location of the plots was such as to render it highly improbable that wind or drainage water was responsible for the introduction of the requisite number of vetch germs. It seemed to be rather a case of a change in the germs already in the soil, by which they adapted themselves to the vetch plant. Experiments with other leguminous plants in one of the same fields further strengthen this conclusion.

The practical importance of these results is apparent, if this conclusion is sustained by further investigation. They suggest a means by which any farmer, who may be unable to obtain suitable inoculating material or unwilling to take the pains necessary for artificial inoculation, may, by persistent planting of vetch after vetch, crimson clover after clover, alfalfa after alfalfa, and so on, in the second or third year grow vetch, clover, or alfalfa plants amply stocked with root nodules.

Moreover these results explain the success that a few have already met with in growing vetch and other unusual legumes before practically anything was known about the advantages of inoculating such plants on certain soils.

For those who decide to dispense with artificial inoculation and to wait for nature to do this work, failure of the first crop can be avoided by sowing vetch seed on (1) land naturally rich, or (2) on poorer land where the stubble or vines of cowpeas have recently been plowed in, or (3) by the use of nitrogenous fertilizers, especially stable manure, or even cotton seed meal.

Either of the above courses should insure a fair crop of forage the first year and this fertilization with nitrogenous material need not be repeated when on the same land vetch is grown for the second or third year, the presence of tubercles then rendering the plant independent of the nitrogen of fertilizers.

The soil of a field where vetch tubercles have been thus caused to develop in numbers can subsequently be used as inoculating material for the remainder of the farm.

Artificial inoculation is important, but it is more important to get started *at once* a patch of this valuable plant, no matter how small the area. By sowing a plat this fall, the farmer will have in one to three years soil filled with vetch germs, which soil can then be used as a germ fertilizer for vetch on larger areas of poor land, needing upbuilding.

Where to get seed.—Our supply of seed of hairy vetch was bought this summer from T. W. Wood & Sons, Richmond, Va., at $3.25 per bushel. A few years ago we bought of Peter Henderson & Co., New York City. Prices are apt to advance somewhat after mid-summer. At the usual catalogue prices for small amounts, a quart of hairy vetch seed, weighing 1½ pounds, would cost, including postage, about 25 cents. A better investment could scarcely be made except in a larger quantity of the same seed.

Nearly every extensive dealer in field seeds can supply hairy vetch. Do not accept just any kind of vetch seed the seedsman may offer, but insist on having hairy or sand vetch (*Vicia villosa.*) If the stock is exhausted, common vetch (*Vicia sativa*), though less valuable, is worth sowing as a means of obtaining inoculating material for use in future years. The earth from around the roots of common vetch supplied with tubercles is suitable inoculating material for hairy vetch.

MAKING A START WITH HAIRY VETCH.

Artificial inoculation is important. But whether or not it is convenient to inoculate vetch at this time, every provident farmer should at once take steps to have home-made inoculating material available for use in future years. Sow a plot of vetch this fall, no matter how limited the area, so as to be able in future to use the soil from this plot as inoculating material. A lot sown now *with thorough inoculation* should afford a supply of inoculating earth for use on the vetch seed to be sown in the fall of 1900. If the present sowing is made *without* inoculation, and vetch is grown on the same area each winter, the soil should naturally become sufficiently stocked with vetch germs for use as inoculating material for the seed which will be sown in the fall of 1901 and 1902.

A very small plot runs the risk of injury by rabbits, chickens, and insects. However, it is better to sow a quart this fall (on a square about 33 feet each way) than to wait until a larger area can be sown. Inoculate this small area if practicabe. If not, or if doubtful about the character of the earth used as inoculating material, use for this first sowing a moderate application of stable manure or about 200 pounds per acre of cotton seed meal in addition to acid phosphate and kainit or wood ashes. This little plot will be worth something when its soil becomes abundantly stocked with "vetch germs."

DOES INOCULATION OF HAIRY VETCH PAY?

Experiments already reported in Bulletins Nos. 87 and 96 of this Station show that in a poor sandy field vetch seed, inoculated by dipping the seed in a soil-extract prepared from the earth of a patch of wild vetch, afforded more than a ton of hay per acre in excess of seed sown the same day alongside, but without inoculation. The next year, by use of Nitragin, the commercial germ fertilizer, the yield of hay in another sandy field was increased by more than a ton and a quarter per acre.

These results answer very plainly the above question, and show that under such conditions we were several times repaid for the pains or expense incurred in inoculating the seed or the soil.

USES OF HAIRY VETCH.

This plant is valuable for winter pasturage, for hay, and for soil improvement.

For winter pasturage.—Hairy vetch, coming up as a volunteer crop in the early part of September, 1898, was large enough to afford pasturage by the first of January. Another field, where a mixture of turf oats and hairy vetch was sown as late as October 24, 1898, was ready for grazing by March 1, in spite of the unprecedented cold weather in February. This field was grazed by a sow and pigs from April 1 until May 26. Moreover, the portions of the field grazed in April made a second growth, affording 1,041 to 1,633 pounds of hay per acre. It seems safe to count on getting moderate grazing by February 1 and good grazing by March 1, when hairy vetch alone, or hairy vetch and turf oats are sown in September. As a pasture plant, hairy vetch is relished by all classes of farm animals.

For hay.—Hay from hairy vetch is ready for cutting from April 20 to May 10. The hay of all the hay-producing legumes is rich in protein or nitrogenous matter, the so-called "muscle forming" nutrients. Vetch is especially rich in this valuable ingredient. The absence of coarse stems is another point of superiority with vetch hay.

As the branches of hairy vetch are slender they need the support afforded by sowing with the vetch seed one of the small grains. For this purpose turf or grazing oats are most generally used. Without such support heavy rains beat the vetch plant down, reducing the yield and injuring the quality of the hay. The mixed vetch and oat hay is of excellent quality, though less rich in protein than unmixed vetch hay. The mixture is cut when the vetch is in bloom, before the oat heads have filled and before the oat stems have become very woody.

Best stage for hay.—The experiment described below was recently made here to determine the best stage for cutting vetch hay, grown without the support of any small grain or other admixture. Samples carefully taken under the writer's direction and analyzed by Mr. C. L. Hare, of the Chemical Department of this Station, show the composition of hairy vetch hay when cut at different dates. For comparison, average analyses of corn blades or "fodder" and of hay from Johnson grass, cowpeas, and red clover are inserted.

Composition of hairy vetch hay cut at different dates.

Date and stage when cut (1899.)	Composition of hay.					
	Moisture.	Crude protein.	Carbohydrates.	Fats.	Crude Fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	
April 19; just before blooming	20.72	23.45	26.25	2.22	20.24	7.12
April 26; 5% of blooms showing	22.83	18.97	29.06	2.11	20.44	6.59
May 2; in full bloom	20.30	17.15	32.12	2.14	22.50	5.79
May 9; seed pods formed, but not filled	22.48	18.71	29.50	2.35	19.92	7.04
* Johnson grass hay	9.64	6.08	42.23	1.79	32.80	6.46
* Red Clover hay	13.14	12.28	38.66	3.22	25.34	6.99
* Cowpea hay	10.46	14.77	39.34	3.07	24.35	8.01
*Corn blades ("fodder.")	14.09	10.86	42.59	2.65	21.16	8.74

In judging of the nutritive value of hay by its chemical composition, it should be remembered that protein (nitrogenous material) is the most valuable nutrient, carbohydrates and fats next in value, that ash may be left out of consideration, and that the larger the proportion of fiber (woody matter) the coarser the hay.

The percentage of protein ("muscle formers") in vetch hay is higher than in the other leguminous hays, red clover and cowpea vines, which are usually taken as standards in this respect, and much higher than in corn blades or "fodder;" vetch hay contains three times as much of these "muscle formers" as Johnson grass hay.

As regards the percentage of carbohydrates or carbonaceous material, samples of vetch hay rank below the other hays named.

Vetch hay, cut at whatever stage, was highly nutritious. The several samples did not differ widely except that the hay of the earliest cutting was richest in nitrogenous material and poorest in starchy matter.

The following table shows the results in a more practical

* McBryde; Tenn. Expt. Sta., Bul. Vol ix, No. 3

shape, and gives for each cutting the yield per acre of hay, of dry matter, and of the most important food constituents in the hay.

Yield of hay and principal nutrients per acre from hairy vetch.

Date and stage when cut.	Yield per acre.			
	Hay.	Dry matter.	Crude protein.	Carbohydrates and fat.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
April 19; just before blooming..	3117	2471	731	887
April 26; 5% of blooms showing.	3705	2859	707	1154
May 2; in full bloom..........	5789	4614	993	1983
May 9; seed pods formed, but not filled........................	5463	4235	1022	1740

The yield of hay was over 1½ tons per acre before the plants bloomed; during the next six days and up to the time when only a few blooms had appeared, it increased by nearly a third of a ton per acre. In the week immediately preceding full bloom there was an increase of nearly a ton per acre. In the week between full bloom and the formation of pods there was a slight decrease in the yield of hay, many leaves and blooms having fallen.

The total amount of dry matter produced varied in about the same proportion as the hay, the maximum of 4,614 pounds of dry matter per acre being reached May 2, when the plants were in full bloom. There was a rapid increase of crude protein (or nitrogenous material) in the week preceding full bloom, after which there was practically no increase.

The two most important carbonaceous nutrients, or "fat formers," carbohydrates and fat, increased during each period until the time of full bloom, after which there was a decline. The most rapid gain was in the week preceding full bloom, during which week these nutrients increased 62 per cent. or 729 pounds per acre.

The figures indicate that, of the four dates chosen for cutting the hay, best results were obtained from thecutting made

May 2 when the plants were in full bloom, this date giving the maximum amount of hay, of dry motter, and of carbohydrates and fat, with practically no sacrifice of nitrogeneous material.

Judging the hay by appearances alone, the plants in full bloom were slightly too mature for hay of best color, the lower leaves having turned yellow. Judging the hay by looks alone, before chemical analyses were made, and also having regard to yield of hay, the writer deemed April 30, or the period when one-half or two-thirds of the blooms were showing, the best time for cutting the crop.

Hairy vetch for green manuring, or soil improvement.

The superiority of the legumes over other plants for green manuring has already been referred to. In the South, the cowpea is the standard for green manure or soil improvement. Hairy vetch seems the equal of the cowpea and has the advantage of growing in the winter, thus preventing leaching of fertilizing material from the soil, and displacing no summer crop.

In an experiment which will be detailed in another bulletin, corn was planted in May and June, 1898, on adjacent plots where a few days before had been plowed in, on different plots, either the stubble of hairy vetch, the entire growth of vetch, the stubble of rye, or the entire growth of nearly mature rye plants. The yield of corn in 1898 was at least 50 per cent. and in some instances 100 per cent. greater on the plots where vetch or vetch stubble had been plowed in than on the plots where rye had grown.

The same plots, uniformly fertilized, were again planted in corn in the spring of 1899. The present appearance of the crop (August, 1899), indicates that the superiority as fertilizers of vetch stubble or vines is still maintained.

Still more strikingly has a crop of silage corn, planted a few days after plowing in vetch or vetch stubble, shown the great value of hairy vetch as a fertilizer or green manure, these causing nearly the quadrupling or trebling of the yield of corn on an adjoining plot.

In both of these experiments, here only briefly alluded to, the entire vetch plant was compared with the roots and stubble as fertilizer. With corn, the yield of grain was scarcely different, whether the entire vetch plant or only the stubble had been plowed in. With silage corn, the yield of green material per acre grown on the vetch stubble plot was $2\frac{3}{4}$ tons less than on the plot where vetch vines, stubble and roots had been plowed in. This superior yield of silage corn resulting from the plowing in of the entire growth of vetch was more than offset by the 3,600 pounds of hay per acre obtained from the vetch-stubble plot. This hay contained a greater amount of dry matter of better quality than that in the $2\frac{3}{4}$ tons of silage corn.

Fertilizing materials in hairy vetch.—The experiment to ascertain the best time to cut hairy vetch for hay,—which has been reported on a preceding page,—had also another aim, viz., to determine the stage of growth when hairy vetch is most valuable as a green manure.

By the use of a frame, six feet square, samples of tops (or hay) and of the stubble and roots were carefully taken. The roots to a depth of six inches were collected, the earth being separated from the roots by sifting. The loss of a small weight of the finer roots was unavoidable, but the error thus involved was inconsiderable and nearly constant for all samples. The stubble, two to three inches long, was collected with the roots, except on May 9, when roots were separated from stubble and fallen leaves.

The following table shows the composition, from the standpoint of fertilizer value, of tops and roots and stubble of hairy vetch at different stages of growth, and for comparison, the composition of the corresponding parts of the rye plant:

Analyses of vines and roots and stubble of hairy vetch harvested at different dates.

Material analyzed (by C. L. Hare.)	Date (1899) and stage when cut	Fertilizing materials.		
		Nitrogen.	Phosphoric acid. (P2 O5).	Potash. (K2 O).
		Per cent.	*Per cent.*	*Per cent.*
Tops; hairy vetch....	April 19; just before bloom.....	3.75	.81	2.18
Tops; " "	April 26; 5% of blooms showing.	3.03	.78	2.14
Tops; " "	May 2; in full bloom	2.75	.79	2.21
Tops; " "	May 9; seed pods formed, but not filled.	2.99	.74	2.68
Roots and stubble; hairy vetch.......	April 19; just before bloom.....	2.36	.49	1.23
Roots and stubble; hairy vetch.......	April 26; 5% of blooms showing.	2.03	.48	.88
Roots and stubble; hairy vetch.. ...	May 2; in full bloom..........	1.97	.48	.88
Roots alone; hairy vetch..........	May 9; seed pods formed......	2.19	.43	.96
Stubble & fallen leaves and blooms; hairy vetch	May 9; seed pods formed.......	2.07	.42	1.14
Rye tops.............	May 7, 1898; in dough stage......	.52		
Rye roots and stubble.	May 7, 1898; in dough stage......	.35		

It should be noted that the tops of the hairy vetch plant are about six times as rich in nitrogen as the corresponding portion of the nearly mature rye plant, and that the roots and stubble of vetch are also about six times as rich in nitrogen as those of rye.

The practical points are more clearly brought out in the following table, which shows the number of pounds of nitrogen, phosphoric acid, and potash contained in the vetch crop on one acre:

Pounds of fertilizing material per acre in hairy vetch cut at different dates.

Date when cut.	Pounds per acre.			
	Air dry material.	Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
April 19; vines	3117	117.0	25.2	70.0
April 19; roots and stubble	850	20.0	4.2	10.5
April 19; total	**3967**	**137.0**	**29.4**	**80.5**
April 26; vines	3705	112.3	28.9	79.3
April 26; roots and stubble	870	17.7	4.2	7.7
April 27; total	**4575**	**130.0**	**33.1**	**87.0**
May 2; vines	5789	159.2	45.6	127.9
May 2; roots and stubble	1054	20.8	5.1	9.2
May 2; total	**6843**	**180.0**	**50.7**	**137.1**
May 9; vines	5463	173.3	40.4	156.4
May 9; roots alone	346	7.0	1.5	3.4
May 9; stubble and fallen material	1061	22.0	4.5	12.1
May 9; total	**6870**	**202.8**	**46.4**	**171.9**

The total amount of air dry vines, roots, and stubble increased at first slowly, and later rapidly, up to the time of full bloom, after which there was no increase. The maximum amount of air dry material was nearly $3\frac{1}{2}$ tons. This was on a stiff, reddish upland loam, thoroughly supplied with root nodule bacteria through the artificial inoculation of the preceding crop of hairy vetch.

The amount of phosphoric acid attained its maximum at the time of full bloom, while the quantity of potash appropriated increased rapidly as the plant grew older.

IS HAIRY VETCH OR COTTON SEED MEAL THE CHEAPEST NITROGENOUS FERTILIZER?

Of greatest importance are the figures showing the amount of nitrogen in the crop of vetch hay and in the roots and stubble.

As early as April 19, and before a single bloom could be seen, the entire plant contained per acre 137 pounds of nitrogen, or as much nitrogenous fertilizer as is contained in 1,957 pounds of cotton seed meal (7 per cent. nitrogen). The failure of the nitrogen to increase during the next week is only apparent and probably due to inequalities in sampling. In the week elapsing between the stages of early bloom and of full bloom (April 26 to May 2) the nitrogen increased very rapidly. When the plants were in full bloom the hay contained 159.2 pounds of nitrogen, and the roots and stubble 20.8 pounds per acre, the nitrogen in the hay alone being equivalent to that in 2274 pounds of cotton seed meal and the nitrogen in the roots and stubble to that in 297 pounds of cotton seed meal.

A still further increase in nitrogen took place during the week following the period of full bloom, bringing up the nitrogen in the hay to 173.3 pounds and in the roots, stubble and fallen leaves and blooms to 29.5 pounds. The nitrogen equivalent for these maximum figures would be respectively 2,475 and 421 pounds of cotton seed meal, or nearly as much nitrogen in the entire vetch plant growing on an acre (202.8 pounds nitrogen) as is contained in one and one-half tons of cotton seed meal.

Not all of this nitrogen is clear gain, for an undetermined proportion of it comes from the soil. But, as the soil is not rich and as non-leguminous crops are able to obtain only a fraction of this amount of nitrogen, it seems safe to assume that much more than half of the nitrogen contained in this heavy growth of vetch was obtained from the air, and thus was a clear gain to the soil when the vetch plant was plowed in.

Proportion of nitrogen in tops and roots.—Of the total amount of nitrogen in the entire plant the roots, short stubble and fallen material contained 14.6 per cent. just before the blooms appeared, 13.6 per cent. in the earliest blooming stage, 11.6 per cent. at the period of full bloom, and 14.6 per cent. in the pod-bearing stage.

Thus analysis found in roots, stubble and fallen material less than one-sixth of the total nitrogen. The real proportion was somewhat greater, as, in taking the samples, portions of the finest roots were unavoidably left in the soil. Moreover the stubble was much shorter than that left by the mowing machine, stems being cut by hand two or three inches from the ground. In view of these two facts we will not be far wrong in assuming that the portion of the vetch plant used for hay contains about four-fifths of the nitrogen, and that what is left on the ground contains about one-fifth. This agrees with results of 1898, given in Bulletin No. 96, when vetch roots and stubble contained 19 per cent. of the total nitrogen. This fifth of nitrogen itself represents considerable fertilizing material, as the different samples of roots and stubble contained as much nitrogen per acre as is found in from 253 to 421 pounds of cotton seed meal, and enough to insure a good growth of crops following vetch stubble.

These experiments teach: (1) That hairy vetch when stocked with an abundance of root nodules, is able to accumulate exceedingly large quantities of nitrogen from the air; (2) That when the entire growth is to be turned in as a green manure, the plowing should be postponed as late in the life of the plant as practicable; (3) That the greater portion of the fertilizing material is in the vines or tops, although the roots and stubble often contain sufficient nitrogen for the needs of the succeeding crop; (The high value of the hay and the richness of the manure made from this hay, make it usually advisable to cut the hay and use only the stubble as green manure).

DIRECTIONS FOR SOWING HAIRY VETCH.

Time to sow.—September is the best month in this latitude. October 15th is not too late for the Southern half of the State, though earlier sowing is preferred. In one instance we sowed as late as November 4th, with success. Most of our November sowings have partially or completely failed. Seed sown here between October 1 and October 15 has usually given satisfactory results. On land not liable to severe injury from drought, August sowing, though risky, is permissible, especially when this date coincides with the last working of sorghum, late corn, etc.

Preparation of land.—If the land is weedy, plow it as for wheat or oats. Having inoculated the seed, sow them broadcast. Sow acid phosphate or some potash fertilizer, or both, if the land is poor or needs either or both. Cover seed and fertilizers with any deep working harrow, or with cultivator, or with any other implement that will cover the seed 1 to 3 inches deep.

If the land is in cotton, very late corn, or drilled forage plants, sow vetch seed broadcast without breaking the land. Work the seed and mineral fertilizer in with cultivator or one horse harrow. This will not materially injure the cotton if the cotton rows are as wide as they should be and if the cultivator, with short single-tree, is used immediately after the first or second picking.

Amount of seed.—If hairy vetch is sown alone or with only a few pecks of oats to support the vines, one bushel of vetch seed per acre will be needed for a full crop of hay. On large areas, especially where the farmer is doubtful about his ability to thoroughly inoculate the seed, it is safer to sow nearly or quite the usual amount of fall oats, adding as many vetch seed as the pocketbook permits, from one gallon to one-half bushel per acre. The greater the proportion of vetch seed the greater the quantity of hay or pasturage, the richer its quality, and the greater the improvement of the soil. At least one peck of vetch seed per acre is desirable. For hay or pasturage, or both, this may be sown with $1\frac{1}{2}$ to $2\frac{1}{2}$ bushels of turf oats, or if only pasturage is wanted it may be sown with $1\frac{1}{2}$ bushels of rye per acre.

Red rust proof, or Texas, oats may be used where hay or grain, is desired, rather than pasturage and in localities where September and October sowings of this variety of oat usually escape winter killing. On soils of fair fertility the turf oat is preferable for hay as well as on account of its superior hardiness and suitability for grazing. On very poor soils we have found the turf oat almost too late for cutting when vetch is at its best. Our Southern rye ripens too early for cutting with heavy vetch.

A more promising oat for sowing with vetch is Hatchett's Black, which, though never sown here with vetch, has, when sown alone, proved hardy here; its advantages over the red oat are its hardiness and length of straw and over the Myers turf oat, its earlier maturity. Our seed were obtained from T. W. Wood & Sons, Richmond, Va.

Hairy vetch has been successfully grown for winter pasturage on Bermuda sod. To insure the germination of the vetch seed it is desirable to scarrify the Bermuda sod every fall. For this purpose we have used a narrow scooter plow, but probably a heavily weighted disk harrow might be used for this purpose with greater convenience and reduced cost. Of course stock must be removed for at least a few weeks at the time when vetch seed are being formed to insure annual reseeding of the pasture.

FERTILIZERS FOR HAIRY VETCH AND OTHER LEGUMES.

The legumes, if supplied with tubercles, that is, if thoroughly inoculated either naturally or artificially, need no nitrogenous fertilizers,—no stable manure, cotton seed, cotton seed meal, or ammoniated guano. By the aid of root nodule bacteria they can get their nitrogen from the air.

But they are entirely dependent on the soil or the fertilizer for mineral fertilizers, that is, for phosphoric acid and potash. The table given on page —— shows that the hay from an acre of hairy vetch plants in full bloom removed from the soil as much phosphoric acid as is contained in 365 pounds of ordinary ($12\frac{1}{2}$ per cent.) acid phosphate, and as much potash as would be supplied by 1,097 pounds of kainit containing $12\frac{1}{2}$ per cent. of potash.

Although this was an exceptionally heavy crop and an unusual draft on the soil, the figures suggest that even an ordinary crop of vetch hay (indeed, of any hay), removes a large amount of phosphates and potash from the soil. To grow vetch hay for several years without supplying these mineral fertilizers will exhaust the phosphates and potash in poor or medium soils and will result in reduced yields of vetch. Vetch used exclusively for pasturage or soil improvement would not thus rapidly exhaust the phosphates and potash of the soil.

On the sandy and loamy soils of this vicinity we have found it profitable to use 240 pounds of acid phosphate and forty pounds of muriate of potash per acre. If kainit is used instead of the muriate, 150 to 200 pounds per acre are employed. The phosphate alone will doubtless be sufficient on many soils, especially if the vetch is used for pasturage or for soil improvement and if no hay is removed from the field. Of course, some of the soils of Alabama need no commercial fertilizer for an occasional crop of hay, but the removal of many successive crops of any kind of hay will, on almost any upland soil, finally necessitate the use of fertilizers for both leguminous and other crops.

As elsewhere stated, the farmer whose land is not already supplied with "vetch germs," and who cannot or will not make use of artificial inoculation, must, on ordinary soils, go to the additional expense of applying nitrogenous fertilizers on his first crop of vetch. He may use, in addition to above-mentioned mineral fertilizers, say 200 pounds of cotton seed meal per acre, or a liberal application of stable manure, or he may sow vetch on land recently enriched in nitrogen by a crop of cowpeas.

THE WEED QUESTION.

That farmer is wise who, before introducing a new plant on his farm, asks whether there is danger of its becoming a troublesome weed. The writer has never heard or read any complaint of vetch as a weed. There is a probability that if carelessly managed on a wheat farm hairy vetch might give trouble through possible admixture of early ripening of vetch seed with late ripening wheat, The grains could not be separated on the farm, and the writer does not know whether they could be separated at the flouring mills. This mixture is conjectural only. Even if the seasons of maturing of wheat and vetch should occasionally thus overlap, careful management could avoid the danger by cutting vetch hay early, or by plowing in vetch before the seeds form, on any fields where wheat is to be sown the following fall. If the wheat field were terraced, care would be necessary to prevent the vetch plants on the terrace bank from seeding.

Hairy vetch is strictly an annual, and hence if kept from seeding it will not re-appear. The admixture of vetch seed with oats is not objectionable in oats fed on the farm, as vetch seed has been successfully used as a grain food.

ENEMIES OF VETCH.

It is not intended to give a list of the diseases and insects that injure vetch.

Hairy vetch is hardy as regards cold. Sowing in October or earlier, it withstood the exceptional cold of the past winter when the thermometer in February showed the phenominally low record of degrees Fahrenheit below zero. Younger plants were injured, and the stand thinned, but not killed out entirely.

The most serious trouble with vetch on the Station Farm at Auburn is the nematode worm, with which our fields, and gardens and orchards in many parts of the State, are infested. It is because of the presence of this pest in the soils of this Station that we are not justified in shipping our soil for use as inoculating material. Whoever uses garden soil as inoculating material for vetch should first endeavor to make sure that this pest is not in the soil of his garden.

The presence of the nematode worm, microscopic in size, may be known by the enlargements or galls which it causes on nearly all plants with tender succulent roots, especially on cabbages, turnips, beets, celery, okra, tomatoes, most legumes, and even cotton.

The nematode gall, which is the result of an injury to the root by a minute worm, may be distinguished from the beneficial root nodule or tubercle found on thrifty leguminous plants, by the following differences:

(1) The desirable nodules are usually but slightly attached to the root, occupying a position on the side of the root, while the nematode gall, in its early stages, is usually concentric with the root; the root seems to grow through the center of the little spindle-shaped gall, the shape and location of which on the root may be compared to a sweet potato. The gall has only the diameter of a knitting needle or wheat straw; later, when the gall becomes corky or begins to rot it loses all constancy of shape and greatly enlarges;

(3) The presence of enlargements on the roots of cabbage, squash, okra, tomatoes, or related plants indicates the presence of the nematode pest, for tubercles are never found on the roots of the non-leguminous plants of the farm and garden.

It is not meant to say that the presence of the nematode pest prevents the growth of vetch. Doubtless the yield of vetch is greatly reduced by the presence of the nematode galls, but we have obtained heavy crops of hairy vetch hay from a loam soil badly infested with nematodes. One failure of vetch on deep white sandy soil on this farm was attributed to the joint effects of nematode injuries and late sowing. Nematodes are more often found and more injurious in light sandy soils than in those containing a fair proportion of clay.

Mention must also be made here of the destruction of the green seeds of vetch, which occurred here for the first time during the past May and June. On certain small, isolated areas, the destruction of seed by one or more unidentified insects was so great that not enough seed matured to re-seed the land. This injury was felt, but was less serious, on larger areas of vetch.

SUGGESTIONS ABOUT THE RESEEDING OF HAIRY VETCH.

One of the reasons for giving preference to hairy vetch as compared with crimson clover is because of the ease with which the former reseeds the land. When the ripe seed pods burst open they scatter the seed to considerable distances. These seed do not ordinarily germinate until the latter part of summer, so that it has been recommended to sow cowpeas on fields where hairy vetch has shed its seed in June. Sometimes the cowpeas are sown in drills and cultivated. But if the summer is wet, causing the early germination of the vetch seed, the cultivation of the peas may be at the expense of the stand of vetch. By omitting the cultivation of the cowpeas when vetch plants have come up, or by sowing the cowpeas broadcast, this danger may be avoided.

Hairy vetch used as pasturage will reseed the land if stock are removed a few weeks before the time of seed formation, On the Mississippi Agricultural College farm hairy vetch and turf oats are cut for the grain crop at such a late stage as to insure the shattering of enough seed of both vetch and oats to reseed the land,—invariably with vetch, and generally with oats.

By sowing hairy vetch with red oats sown early in the fall for grain, reseeding will sometimes occur by leaving a long stubble including considerable of the lower portion of the vetch plant, with attached seed.

Here, by cutting *quite early* a mixture of vetch and oats, we have obtained a hay crop of best quality, and the vetch stubble has afterwards (in favorable seasons) made sufficient growth to reseed the land. If vetch is expected to make enough second growth to insure the reseeding of the land, cutting should occur when the plants are in the early blooming stage.

Or by pursuing exactly the opposite course, cutting the vetch after some pods have matured, hay can be made from hairy vetch without interfering with reseeding. Such hay is not of good quality and not marketable, but may be fairly nutritious.

ADAPTING VETCH TO ORDINARY ROTATIONS.

From what has just preceded it may be inferred that the self-seeding of vetch is comparatively easy in a rotation where vetch is every year the principal crop and where the intervening summer crops are those that occupy the land but a few months. Among the crops suitable for such use are cowpeas, sorghum, late-planted corn for grain or for the silo, Spanish peanuts, aud a number of quickly maturing forage crops.

However, it is still an open question whether hairy vetch can be so managed as to annually reseed itself when the rotation is one suitable for an ordinary cotton farm, needing relatively little forage. Possibly those who work terraced land, especially where the terraces are near together, may be able to effect this by having vetch on the otherwise unoccupied terrace banks and allowing it to grow there continuously, expecting it, with or without the farmer's help, to distribute its seed into the cultivated land on either side.

It is certain that the cotton farmer needs hairy vetch in his rotation, since it will pay in soil improvement alone, leaving out of consideration the forage incidentally produced. He will have no difficulty in utilizing hairy vetch in rotation with cotton if he will sow vetch seed each fall, either purchasing or saving the seed.

Let us take for example a rotation, which, even without vetch, is one of the best and most practicable for cotton farms maintaining some live stock in addition to work teams:

First year, cotton;

Second year, corn, with cowpeas between rows;

Third year, fall-sown small grain, followed next June by cowpeas, which in turn is followed by cotton the next year.

The introduction of hairy vetch (or of crimson clover) as a catch crop to occupy the land in winter would certainly improve this rotation. Is its introduction practicable? It is, as may be seen by the following example of one means of utilizing vetch in a three year rotation of cotton, corn and oats:

First year:—Cotton, with vetch seed worked in during September immediately after first or second picking; the vetch to be turned under in March, or if to be followed by late corn, plowing may take place later when the fertilizer value of the vetch will have increased.

Second year:—Corn; the corn to be harvested in time for breaking the land in latter part of September or October for a mixture of oats and vetch.

Third year:—Oats and vetch sown together; the harvesting (for hay or grain) to occur at such a time as to insure the self seeding of the vetch; broadcast cowpeas to be grown during the summer and cut for hay in time for the volunteer vetch plants to occupy the ground. This vetch should afford grazing in February and March and be plowed under in time for cotton to be planted in April of the fourth year, thus beginning again the same rotation.

The amount of vetch seed required during the entire period of rotation would be as follows for each acre:

For sowing after cotton........................	1	bushel
For sowing with oats after cotton...........	$\frac{1}{4}$ to $\frac{1}{2}$	"
For volunteer vetch crop after above............	0	
Total amount of seed for 1 acre for 3 years...	$1\frac{1}{2}$	bushel
Average annual amt. seed per acre thus cropped.	$\frac{1}{2}$	"

In return for this outlay for seed and for the cost or working in the seed among the growing cotton plants, there would be obtained from vetch the following benefits:

(1) *In food;* (a) February and March grazing during two seasons and (b) the vetch hay harvested with the oats;

(2) *In soil improvement;* (a) The nitrogen that is obtained from the air by two crops of immature vetch grazed and turned in;

(b) The air-derived nitrogen of the half crop of vetch (with oats) stored up during an entire season, part of this fertility being represented by the vetch stubble and part by the hay or by the manure obtained from feeding this hay;

(c) The soluble soil nitrogen whose escape in the drainage water of winter has been prevented by winter-growing vetch;

(d) The mechanical improvement and increased ability to withstand drought, due to the incorporation of the vegetable matter contained in the several crops of vetch.

In view of these gains from sowing hairy vetch can there be any question as to whether the annual outlay for a half bushel of seed (say $1.50 per acre) is a profitable investment? These benefits are conditional upon the presence of root nodules, whether these occur as the result of natural or of artificial inoculation.

BULLETIN No 106. NOVEMBER, 1899.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

ORCHARD NOTES.

By

F. S. EARLE.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS
1899.

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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, Alabama.

ORCHARD NOTES.

The feature of the year from the point of view of the orchardist was the unprecedented cold of the middle of February. Following as it did weather sufficiently warm to start vegetation and bring the earliest blooming fruit trees into flower, the destruction was much greater than it would have been had the cold occurred earlier in the season. On the morning of February 14th the thermometer was below zero in all parts of Alabama. At Auburn it registered six and one-half degrees below, which was ten degrees lower than at any time in the thirty years during which records have been kept here. In North Alabama the temperature was several degrees lower, while at Mobile and other points on the coast it was only some four or five degrees warmer, and here naturally the destruction was greatest. Tender shrubs and trees of all kinds were killed to the ground, the long moss (Tillandsia) on the trees was killed, and the thickets of saw Palmetto were scorched, as if by fire. The live oaks and magnolias lost their leaves, and even some of the pines were injured. Throughout the state the peach crop, and with few exceptions, the plum crop, was an entire failure.

The effects of the freeze will be considered more in detail in the following pages in discussing the different fruits.

Apples.

As apples start growth rather late in the spring the buds were not swollen and they were entirely uninjured by the February cold. So far as observed in different parts of the state the crop was an uneven one, quite a number of kinds failing to bear. At the Station, however, the old orchard set the best crop that it has in a number of years. This was due to heavy pruning two years ago, and to good cultivation so that the trees were in a vigorous condition. Nearly all the trees set a full crop, and yet except on one or two early varieties, very few perfect fruits ripened. For various reasons this orchard was not sprayed this year, and consequently the Codlin moth and the summer rot destroyed what promised to be a fine crop. This serves to emphasize the necessity for fighting these pests with all the means at our command if we hope to grow satisfactory crops of apples.

In the young orchard the trees as a whole made a satisfactory growth, though some of them were considerably injured by the green aphis.

Apple Varieties.—As the result of the seasons observations it is advised to add Yellow Transparent for summer, and Kinnards Choice for late fall and winter to the provisional list recommended in Bulletion 98, p. 265. Some of the most experienced growers in North Alabama place these two kinds first in their lists for market planting.

Green Aphis of the Apple--During the winter the minute black shining eggs of this aphis were noticed abundantly on the twigs of many of the trees. On February 6th it was noted that a few of these eggs were beginning to hatch. On February 9th all young trees were sprayed with the mechanical mixture of kerosene and water, using a strength of 33 per cent. kerosene in the hope of killing the eggs. This treatment seemed to have been quite effective, for when spring opened very few lice could be found. These few, however, multiplied very rapidly, and soon on many of the trees, the young growth was literally encased by the crowded green aphids. Various lines of treatment were tried for destroying this pest. Certain trees were sprayed at frequent intervals with various strengths of tobacco decoction. It was used as strong as one pound of dried tobacco leaves and stems to the gallon of water. At this strength a few of the lice were killed but not enough of them to do any appreciable amount of good. This spray did no injury to the foliage.

Other trees were sprayed with the rosin mixture recommended as a vehicle for applying Paris green to cabbages. The formula used was resin, 5 lbs.; concentrated lye, 1 lb.;

fish oil or animal oil, 1 pt.; water, 5 gal. This stock solution was used up to one-half strength both with and without lime. When applied with the Bovee & Caapenter attomizer it did no harm to the foliage, but like the tobacco decoction, it killed very few lice.

A considerable number of experiments were tried with solutions of whale oil soap. A strength of one-fourth pound to the gallon of water when applied with an ordinary bucket pump and a Bordeaux nozzle was found to injure the young tender leaves slightly when the spray collected in large drops. It was much more effective than either of the foregoing sprays, but not over two-thirds or three-fourths of the aphids were killed, and the remainder re-stocked the twig so quickly that in a week or two the lice were as thick as ever. Repeated applications of this strength with the coarse spray from the Bordeaux nozzle injured the foliage quite seriously without ridding the trees of the lice. Where the very fine spray from the Bovee & Carpenter attomizer was used a strength of one-half pound to the gallon of water when carefully applied, did no harm to the foliage, and a strength of one pound to the gallon injured the foliage less than the one-fourth pound solution applied as a coarse spray. This very strong whale oil soap solution was quite effective, seeming to kill all the lice with which it came in contact, even though applied as an almost impalpable mist.

In previous seasons a 10 per cent. mechanical mixture of kerosene and water applied with an ordinary nozzle and knapsack pump was found to injure the foliage severely without ridding the trees of the lice. The success of the attomizer sprayer in applying the strong solution of whale oil soap suggested trying it for applying a strong kerosene emulsion. A 25 per cent. emulsion was made by dissolving one-fourth pound of whale oil soap in one quart of boiling water, and emulsifying with two quarts of kerosene, afterwards diluting to two gallons. As applied by the attomizer, this proved so satisfactory that it was adopted as the treatment for all the infested trees in the young orchard. A single application did no appreciable damage to the foliage except where enough was used so that it began to collect in little crops. Of course so strong an emulsion applied in the ordinary way would have badly burned the leaves. At this strength the slightest touch of the spray was deadly to the lice, but owing to the shelter furnished by the crumpled leaves it was often impossible to reach them all even by taking the greatest care in walking around the tree to direct the spray against the infested twigs from every quarter. In four or five days these protected aphids would be found to have left their shelter and be collected on fresher feeding grounds near the young point of the advancing twig. A second spraying within a week of the first would thus kill most of these, and in many instances the two sprayings entirely cleared the tree. In other cases, a few lice kept re-appearing so that weekly sprayings were necessary for five or six weeks. Even then the lice were not entirely conquered till some heavy rains in August, when they suddenly disappeared. By September 1st the trees were almost entirely clear of them even in those parts of the orchard where no spraying had been done. The trees that it was found necessary to treat so often were finally a good deal injured by the frequent caustic applications. The leaves were thick and crumpled, and seemed somewhat seared. The bark of the young twigs, too, was effected in much the same way, being hard and thick. In these cases it was hard to decide which had done the more damage, the lice or the treatment. While this use of 25 per cent. kerosene emulsion applied as an impalpable mist was not fully satisfactory, it was much better than anything else that was tried, and it must be recommended for the want of something better. It must be applied with great care and only during the middle of bright, warm days when the kerosene evaporates quickly, or great harm may be done. The Bovee & Carpenter sprayer used in these experiments is a hand implement used somewhat like the ordinary garden syringe. The spray being so fine it can only be thrown a short distance. It is only useful for young trees and could not be used successfully where they were more than seven or eight feet high. It is probable that for large trees a Vermorel nozzle with an exceedingly fine apperture might answer an equally good purpose. This will be tested another season, as many of the trees in the bearing orchard suffered severely from the lice.

It was noted that certain varieties were exempt from this scourge while others in the same blocks suffered severely. This was probably in part at least accidental, but as it seemed that many of those varieties with heavy hairy twigs and foliage were exempt while those with nearly glabrous twigs often suffered badly, it is deemed advisable to place on record the following notes on varietal resistance for this season.

Entirely free from aphis:—Aiken, Arkansas Black, Babbit, Battyani, Black Ben Davis, Bradford, Carolina Greening, Cillagos, Coopers Early, Hames, Haywood, Horse, Hyari-Piros, Kismet, Limber Twig, Magyur, Maidens Blush, Malalyfi, Mamma, Metel, Ponyike, Red Astrachan, Red June, Selymos, Shockley, Texas Red, Thorntons Seedling, Tull, Winesap, Yakor, Yates, Yellow English, Yellow Transparent, York Imperial.

Attacked by aphis but not serious injured:—Apple of Commerce, Benoni, Bledsoe, Buda Summer, Buncomb, Cannon Pearmain, Carters Blue, Champion, Chattahooche, Coopers Red, Dam, Duchess, Early Harvest, Eper, Equinettelee, Fall Pippin, Family, Fanny, Gravenstine, Grimes Golden, Hews Crab, Holiday, Jeffries, Jennings, Jonathan, Julian, Kinnards Choice, Mammouth Black Twig, Mangum, Moultries, Nickajack, Pasman, Pear (or Palmer), Rawls Janeton, Red Astrahan, Red Beitigheimer, Red Limbertwig, Rhodes Orange, Rome Beauty, Sabadka, Saxon, Priest, Sekula, Senator, Shackelford, Summer King, Summer Queen, Taunton, Tuscaloosa.

Badly injured by aphis:—American Summer, Early Red Margaret, Elgin Pippin, Mavarack Sweet, Noble Savor, Oszi-vaj, Santa, Shockley, Summer Cheese, Summer Queen, Summer Wafer, Sweet Bough, Wealthy, Yellow English, Yellow Horse, Yopps Favorite.

That part of this difference is purely accidental, is shown by the fact that the same variety in several cases appears in more than one of these lists when growing in different parts of the orchard. Several years observation are necsary to determine if any of the kinds are truly resistant to the aphis.

Apple Leaf Rust:—The yellow leaf rust of the apple (*Roestelia pirata Thax.*) which is the Accidial stage of the fungus *Gymnosporangium macropus* causing the galls on red cedars known as "cedar apples," often causes serious damage to the apple foliage in this state. Some varieties are very susceptible to this disease while others are entirely exempt. I know of no plant disease where different varieties of the host have such different powers of resistance. As the red cedar is abundant in most parts of the state where apples are grown, at least as a door-yard tree, it becomes a matter of some moment to select rust resisting varieties for planting. Of the lists enumerated above of the varieties growing on the Station grounds only, the following developed rust during this season. It will be noticed that none of the Russian or Hungarian varieties are included in this list. So far as I know they have always proved to be "rust proof."

List of Varieties Showing Leaf Rust in 1899:—American Summer, Carters Blue, Family, Jonathan, Mamma, Moultries, Nicajack, Rhodes Orange, Rome Beauty, Santa, Senator, Shockley, Wealthy.

Of the above Family, Jonathan, Nickajack, Rhodes Orange, Santa, Shockley and Wealthy were very badly affected. The others while showing the disease were but little injured by it.

The leaf spot (*Phyllosticta*) appeared on many of the trees and caused some of the leaves to fall prematurely. It is interesting to note that the following kinds were entirely free from aphis, rust and leaf spot, making a good growth and holding their leaves green and fresh to the end of the Fall:—Aiken, Arkansas Black, Babbitt, Carolina Greening, Duchess, Fanny, Hames, Haywood, Hyari Piros, Magyur, Maidens Blush, Metel, Milalyfi, Ponyike, Thorntons Seedling and York Imperial.

The Adaptability of Apple Trees to Changed Environment:—In Bulletin No. 98 the fact was noted that apple trees brought from the North and planted here during the Winter, started into growth in the Spring a number of days earlier than similar trees from Southern nurseries. This Spring these different lots of trees were watched closely to see if the Northern grown ones still felt the effect of their early environment. Apparently not; during their one season's growth at the South they seemed to have completely adapted themselves to the changed conditions, for this Spring all lots started alike, not the slightest difference could be seen between them.

CHERRIES.

Cherries are very little grown in the South, but evidence is accumulating that some of the sour kinds at least can be safely planted as far south as Northern and Central Alabama, That they will fail on the coast is almost certain. Of twelve kinds planted at the Station in 1898 the following are now in good condition and give promise of fruiting next year:—Montmorency, Wragg, Dyehouse, Early Richmond, Suda, Ostheimer. The Wragg trees bore a few fruits this season. In north Alabama English Morello is proving very satisfactory, and it is recommended for planting in that region. Cherries were not injured by the February cold.

FIGS.

The freeze killed every fig tree in the state to the ground. This is not unusual in North and Central Alabama. The trees are killed to the ground by every exceptionally hard winter, but the recuperative power of this wonderful tree is so great that only one crop is lost. Sprouts spring up from the roots and grow with great rapidity and bear freely the following year. Under these circumstances the fig is a great bush rather than a tree. On the coast well established fig trees are seldom seriously injured by the cold, but this freeze killed many noble old trees with trunks a foot or more in diameter.

On the Station grounds the figs were all killed down during the winter of 1894–5. They sprouted and grew freely during the summer of 1895, and have since born three successive heavy crops. Of course they were killed to the ground again in February, but most of them have sprouted and made a good growth during the Summer and some kinds have even set a little fruit that ripened late during September and October. The following kinds have ripened some fruit this year, and they are among the best for general planting:—Celeste or Celestial (the "Sugar Fig" of Central Alabama), White Ischia, Brown Turkey, Brunswick and White Smyrna. Of these the Celeste is the one that is most widely planted. It is hardy and vigorous and a most abundant bearer. Though small it is of the best quality. It usually ripens in July. Green Ischia seems to be a very promising kind, and should be planted much more widely since it ripens late in August and in September thus serving to greatly lengthen the season for this most delicious and healthful fruit. It is larger than Celeste, dull green when ripe with a thin skin that often cracks slightly. The seeds and pulp are dark red which makes it very attractive when cut up on the table. Its flavor is rich and agreeable though perhaps hardly as sweet as the Celeste. Figs are so easily grown and yield so regularly and abundantly and furnish so healthful an article of diet they should be planted much more widely for family use. No garden or lot is too small to afford room for one or more fig trees, and no family can afford to be without them.

Grapes.

Grapes were still dormant at the time of the freeze and none of the varieties of bunch grapes on the Station grounds were injured. Many of the *rotundifolia* varieties however, suffered severely. The Scuppernong, which is more widely planted than any of the others, was killed to the ground in many parts of the state. Here it was severely injured but not entirely killed. Of the kinds growing at the Station, Memory proved much the hardiest. In fact it was not at all injured. This is a very vigorous grower and it is one of the best of the black varieties. It ripens with the Scuppernong, Flowers proved unexpectedly tender. A number of the largest vines were entirely killed, not even sprouting from the root. The others were very badly injured and have made only a few weak new canes. Thomas, Jeter, Tenderpulp and Mish were all somewhat injured but not seriously enough to prevent their bearing nearly a full crop this season. Mish is the most valuable of these kinds The berry is rather small but it has a peculiarly rich, sweet flavor and it ripens late after Scuppernong, Memory and Thomas are nearly gone. Flowers is still later but this season has proved it tender and the quality of the fruit is poor. The Station has no vines of these kinds for sale or distribution.

Kaki, or Japanese Persimmon.

This fruit suffered severely from the freeze the trees being killed almost or quite to the ground. For a time it seemed that all were dead, but finally some of them sprouted from the crown and will be in condition to bear some fruit another year. The present condition of the different varieties is as follows:—Hyakume, dead; Imperial, small sprout on one tree; Tane Nashe, killed to the snow line, sprouted freely and has made good growth; Hachiya, one dead, one very feeble; Yeddo Ichi, killed to the snow line, has made a good growth; Tabors No. 23, killed to the snow line, has made good growth; Tabors No. 72, killed to the snow line, has made good growth; Tabors No. 129, the only kind not killed to the ground. This put out sprouts from the trunk and larger branches, and made a strong growth; Zingi, nearly killed; Tsuru, nearly killed; O kame, one dead, one sprouted freely; Yemon, killed to the ground but made a good growth; Costata, dead.

Peaches.

The freeze killed the peach crop of nearly the entire South. In some sections the trees were much injured, but here those that were well cultivated and thrifty were not hurt, though some feeble neglected trees were killed.

On February 5th preceding the freeze notes were taken on the condition of the varieties in the orchard planted in 1898 as a co-operative experiment for testing the successful geographical limits for the different races of peaches. Duplicate orchards of three trees each of three varieties representing each of the five races of peaches that are cultivated in this country were planted by a number of the Experiment Stations. On the Chinese Cling, Elberta and Mamie Ross representing the North China type, the buds were still nearly dorment. On the Honey, Tabor and Pallas, representing the South China type, the buds were much swollen, but were hardly showing the pink. The Peento was in nearly full bloom and Angel and Waldow of the Peento type were beginning to bloom. Mountain Rose, Alexander and Old Mixon Free of the Persian type, were nearly dorment. Onderdonk, Coblers Indian and Imperial of the Spanish type had buds much swollen, a few showing pink. Older trees of the North China and Persian types were somewhat more advanced, the buds being conspicuously swollen and by the date of the freeze some were even showing the pink. While all the fruit buds were killed on all of the varieties, the wood was practically uninjured except in the trees of the Peento type that were so much more advanced than the others. Peento itself was killed to the ground two of the trees sprouted from near the ground and have made a feeble growth. Angel and Waldow had all the twigs and small brances killed, but the trunks were not injured and they have made new, vigorous tops.

For Central Alabama it is doubtful if we are safe in planting varieties of other than the Persian and North China types.

PEARS.

The flower buds of Kieffer and LeConte on the Station grounds were swollen enough to begin to separate at the time of the freeze. Of course, they were all killed. Bartletts and other varieties of the European type were entirely dorment and they escaped injury. The older LeConte and

Keiffer trees suffered but little except in loss of crop, but the trees in the young orchard (planted in 1896) were many of them, seriously injured. The bark of the trunk for a few inches above the ground, or rather the snow line, was blackened on fully half of the trees, and from one-fourth to one-third were killed outright. Some trees that looked all right and started to grow in the spring died from time to time during the summer.

One of the most striking results of the complete destruction of the flowers was the almost entire suppression of the blight. A few of the old Kieffers finally made a light second blooming in April or May, and a few of these culsters contracted blight, but these were the only cases that developed in the entire orchard.

It is a curious fact often noted that fruit trees of all kinds bloom later on the coast than they do one or two hundred miles farther North in the interior. This season the Kieffer flower buds on the coast were so much less advanced that quite a portion of them escaped the freeze and bore fruit.

Plums.

On February 4th the following notes were taken on the condition of the different varieties of plums in the orchard: Kelsey, showing first blooms; Berckmans, buds separating. Blood No. 3, full bloom. Blood No. 4, first blooms. Chabot, buds separating. Excelsior, buds separating. Baileys Japan, buds separating. Botan, buds separating. Gold, buds separating. Orient, buds separating. Yellow Japan, buds separating. Satsuma, first blooms. Lone Star, buds separating. Emerson, buds white. Transpaaent, buds separating. Hattankio, buds separating.

All the other varieties in the orchard (see list in Bull. 98, p. 273.) were still nearly or quite dormant. During the week of open weather preceding the freeze after these notes were taken the general condition had advanced considerably. The injury done was almost exactly in proportion to the state of advancement. Blood No. 3 was killed outright. Blood No. 4, Kelsey, Satsuma and Wickson lost considerable portion of their tops, and a number of the other Japanese kinds showed some injured twigs. During the summer trees died of Kelsey, Chabot, Long Fruited, Burbank, Excelsior and Satsuma. Whether this was in all cases due to the freeze is uncertain.

The flowers seemed to open normally on all later blooming kinds but the usual sequence of blossoming was disarranged, all blooming more nearly together. Only the five following kinds bore full crops:—Milton, Whitaker, Wooten, Wayland and Golden Beauty. None of the Japs had more than a few scattering fruits. Again, as with the pears the Southern part of the state fared better as the buds were more nearly dormant, and some good crops of Abundance, and other of the later blooming Japs, were reported from that section.

It is worthy of note that this makes the fourth consecutive full crop for the Golden Beauty on these grounds. Wayland was planted later or its record would be equally good and it is a handsomer and rather better flavored plum.

This Wayland group of plums is evidently well adapted to our conditions and they should be more widely planted. It is true they are small and not of the first quality, but they ripen late, July or August, after other plums are gone and they are very serviceable for canning and preserving. A considerable quantity of them could be sold in the Southern markets at fair prices. They would hardly pay for Northern shipment as they would come in competition with better kinds grown nearer home.

San Jose Scale.

During the Summer of 1897 it was discovered that a number of trees in the old plum orchard were infested with the San Jose Scale. As this orchard was otherwise in poor condition and of but little value, no attempt was made to treat it, but it was promptly dug up and burned. The scale had spread somewhat to the adjoining apple orchard. As there are no large orchard interests in the neighborhood to be endangered, it was deemed permissible to keep these trees for experimental purposes. All were pruned back heavily. A few were reserved for experiment with the scale insect fungus, *Sphœrostilbe coccophila*, which had been reported as destroying the San Jose Scale in Florida.

The remaining trees were sprayed during the Winter with kerosene. On some it was applied full strength, on others a 50 per cent., and on still others a 35 per cent. mechanical mixture was used. In some cases the full strength did some injury causing a dying and shelling of the outer bark. Other trees were not at all hurt. Whether this was due to the variety or the particular condition of the individual tree could not be determined. The treatment was quite effective. No spraying was done last Winter and the trees are still practically free from scale though it is planned to treat them all again this coming Winter.

Sphœrostilbe coccophila is a common fungus here, growing abundantly on the water oak scale, *Aspidioius obscurus.* Bark from the water oak bearing the fungus, was tied in some of the infested apple trees during the winter of 1897-8. The fungus spread slowly to the San Jose Scale and has been growing on it ever since, but it works so slowly that it is evident that in this dry climate at least, it will not prove an efficient remedy.

Two trees in the new plum orchard (planted in 1896) were also found to be infested. These were allowed to remain untreated to watch the normal rate of spread of the insect. This has been less rapid than was expected, During the Summer of 1898, it only found its way to four additional trees. The foliage at this writing still prevents a careful inspection, but the spread during 1899, has certainly been very little more rapid. The two trees first infested are now getting pretty well coated with the scales, but as yet they show very little signs of exhaustion from the presence of the insect. On one of the trees a natural infection of the scale with the *Sphœrostilbe* took place. Only a few of the red pustules have developed and it seems to be entirely inefficient. This entire orchard will be sprayed with the mechanical mixture of kerosene, this Winter, and a determined effort will be made to stamp out the scale by this means.

The facts of the slow spread of the insect and the practicability of controlling it with kerosene are certainly encouraging for those who have been unfortunate enough to get it on their premises. It is unfortunately now quite widely scattered in different parts of the state, and since we have no law to prevent the sale of infested nursery stock it is likely to be still more widely scattered in the future. Parties finding it on their places are strongly urged to treat it at once, this Winter, using 35% strength of kerosene on apple and 25% on peach and plum. It can be applied either as an emulsion, or with the special pump for making a mechanical mixture. In either case, the important thing is to apply it as a fine spray and with some force, and to make certain that the spray reaches all parts of the trunk and limbs. Kerosene should always be applied during sunshine so that it will evaporate quickly in order to avoid injury to the trees. It must be remembered that though this scale works slowly it will surely kill in time every tree on which it gains a lodgment, unless held in check by vigorous and careful treatment. Planters cannot be too careful in buying nursery stock to insist on getting only that that is known to be free from scale.

The extensive nursery interests at Huntsville are to be congratulated that so far their neighborhood has remained free from this pest.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

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RESULTS OF EXPERIMENTS ON COTTON IN ALABAMA.

MONTGOMERY, ALABAMA.
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ASSISTANTS.

C. L. HARE..First Assistant Chemist.

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H. S. HOUGHTON..Third Assistant Chemist.

T. U. CULVER..Superintendent of Farm.

R. W. CLARK..Assistant Agriculturist.

MOSES CRAIG..Assistant Horticulturist.

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

INTRODUCTION.

This bulletin has been prepared at the request of the Committee of the American Association of Agricultural Colleges and Experiment Stations which has in charge the collective exhibit of the Experiment Stations at the World's Fair in Paris in 1900. The Alabama Station has been engaged in the experiments on cotton since 1883 and a large amount of valuable material has accumulated in reference to its cultivation, chemistry, botany, diseases, entomology and physiology, and because of the variety of experiments conducted it was deemed appropriate for this station to prepare this work on cotton.

During the period covered by the experiments the following bulletins have been issued by the Station that relate to cotton:

In volume 1 there are 33 bulletins and 6 of these contain the results of experiments on cotton. 122 pages.

No. 5—Cotton experiments. 16 pages.

No. 13—Microscopic study of certain varieties of cotton. 20 pages.

No. 16—Fertilizer experiments with cotton. 20 pages.

No. 17—Dry application of Paris green and London purple for the cotton worm. 18 pages.

No. 21—A new root rot disease of cotton. 11 pages.

No. 22—Experiments with cotton. 24 pages.

No. 23—Co-operative tests of fertilizers on cotton. 61 pages.

No. 27—Black rust of cotton. 18 pages.

No. 33—Cotton. 1 2pages.

No. 34—Co-operative fertilizer tests on cotton. 46 pages.

No. 36—Some leaf blights of cotton. 32 pages.

No. 40—Cotton experiments. 15 pages.

No. 41—Some diseases of cotton. 65 pages.

No. 42—Co-operative soil tests of cotton. 34 pages.

No. 45—Insects of cotton. 5 pages.

No. 52—Cotton experiments. 2 pages.

No. 55—A new disease of the cotton; cotton boll rot. 13 pages.

No. 56—Experiments in crossing cotton. 51 pages.

No. 57—Fertilizers required by cotton as determined by the analysis of the plant. 16 pages.

No. 62—Cotton experiments. 7 pages.

No. 65—Co-operative seed tests. 4 pages.

No. 69—Fungus diseases of the cotton. 1 page.

No. 71—Experiments with foreign cottons. 12 pages.

No. 76—Cotton experiments. 23 pages.

No. 78—Co-operative fertilizer experiments with cotton in 1896. 48 pages.

No. 83—Hybrids from American and foreign cottons. 32 pages.

No. 91—Co-operative fertilizer experiments with cotton in 1897. 63 pages.

No. 99—Cotton rust. 31 pages.

No. 101—Experiments with cotton in 1898. 19 pages.

No. 102—Co-operative experiments with fertilizers on cotton in 1898. 75 pages.

Climatology of the cotton plant. Issued by the United States Weather Bureau. 70 pages.

The above list comprises 37 bulletins, containing a total of 986 pages.

In the prosecution of the work indicated by the above bulletins the following parties have been more or less intimately connected with and responsible for the results of the experiments:

W. H. Chambers, Agriculturist.
W. C. Stubbs, Chemist.
J. S. Newman, Agriculturist.
J. J. Barclay, Agriculturist.
N. T. Lupton, Chemist.
P. H. Mell, Botanist and Meteorologist.
G. F. Atkinson, Mycologist.
B. B. Ross, Chemist.
A. J. Bondurant, Agriculturist.
J. M. Stedman, Mycologist and Entomologist.
J. F. Duggar, Agriculturist.
F. S. Earle, Mycologist.
J. T. Anderson, Associate Chemist.
B. M. Duggar, Assistant Mycologist.
James Clayton, Assistant Agriculturist.
T. U. Culver, Assistant Agriculturist.
A. L. Quaintance, Assistant Entomologist.
T. D. Samford, Assistant Botanist.
George Clark, Assistant Botanist.
A. M. Lloyd, Assistant Botanist and Meteorologist.

A number of experimenters located in different parts of the State who had charge of the co-operative fertilizer tests on cotton have also contributed much valuable material.

P. H. MELL,
Director.

VARIETIES OF COTTON.

BY J. F. DUGGAR.

PURPOSES OF TESTS OF VARIETIES.

Variety tests of cotton have had a prominent place at nearly every experiment station in the Cotton Belt. Although these experiments have had some value, yet they do not afford a concise answer to the question so often asked "What is the best variety of cotton?"

Nor can we expect experimenters or farmers to be able to answer this question with a single name. Such an answer is up to this time impossible, for diligent search has failed to find any one variety of cotton which is universally superior to all other kinds. The variety which affords the largest yield on one soil is surpassed on a different soil by another kind. Even on the same soil, the relative productiveness of two given varieties differs, prevailing weather conditions perhaps favoring an early variety in one year, a late kind in another season. Conditions vary, and hence the list of most productive varieties changes from year to year.

Statements of results of variety tests will prove useful in proportion as they take careful account of the conditions under which each test was made, so that we may come in time to learn what class of varieties in normal seasons may be expected to yield more than other kinds on poor soil, what sort to head the list when the soil is fertile, what kinds to prefer for localities subject to early frosts, what varieties best respond to liberal fertilization, and so on.

Another promising field of investigation in variety testing is the study of the characters of each so called variety with a view to fixing a more definite standard of purity and uniformity, the data thus obtained being also useful in determining how many of the numerous so-called varieties of cotton stand for distinct types and how many are only useless and confusing synonyms. Our observations, made on 70 so-called varieties in 1899, with a view to ascertaining what varieties are distinct and what names are mere synonyms need to be repeated before publication.

PRODUCTIVENESS OF VARIETIES.

Tests of varieties of cotton have been made on the Station Farm at Auburn nearly every year during the past decade. The list of varieties varied from year to year, thus making difficult a comparison of the productiveness of the different kinds. An examination of all these lists shows that altogether 48 varieties have been tested at Auburn on plots large enough to determine the yield per acre. The usual size of plots in recent years has been one-sixteenth acre. In addition, the list of varieties tested in 1899 on plots too small to permit an accurate determination of yield per acre contains 45 new names, making a total of 93 so-called varieties tested by the Agricultural Department of this station.

In the following table is given only the data obtained in the field tests on the farm at Auburn. It indicates the rank of each variety in each test, as shown by the yield of lint cotton per acre. When the stand of plants is known to be defective, that variety is excluded from the table. The number 1 opposite any variety shows that in the test that year this variety produced more lint than any other; so the number 2 denotes second place in production of lint, and so on for other numbers.

Rank of Varieties of Cotton on the Basis of Yield of Lint Per Acre.

	1889	1890	1891	'91*	1892	1893	1896	1897	1898	1899
Allen Long Staple	2	....	8	....	21	....	....	14	....	....
Allen Hybrid L. S.	....	....	....	....	....	....	11	16	....	....
African..	....	....	....	....	....	....	....	....	....	1
Barnett...	4	....	3	....	....	....	....	....	....	....
Bailey...	....	....	....	12	18	....	....	....	....	....
Cherry Cluster.. ..	6	....	4	....	17	....	....	....	....	....
Colthorp Pride.. .	....	....	....	....	11	7	....	....	....	....
Colthorp Eureka..	....	....	....	....	14	4	....	....	....	....
Cook, J. C.......	....	....	12	....	....	....	....	....	....	....
Cook, W. A.......	....	....	4	....	24	1	....	....	....	....
Common..	....	....	....	10	....	....	....	....	....	....
Crossland..	....	....	....	....	9	....	....	....	....	....
Dalkeith Eureka..	....	....	....	....	15	10	....	....	....	....
Dearing	....	....	....	....	....	....	....	4	2	14
Dickson..	....	....	2	....	20	....	3	12	....	....
Duncan..	....	....	....	....	....	....	9	6	....	13
Ellsworth..	12	....	....	....	....	....	....	....	....	....
Gold Dust..	....	....	7	....	22	....	....	....	....	....
Griffin..	....	....	....	....	....	....	....	2	....	....
Hawkins Improved	9	....	9	....	16	....	8	3	....	3
Herlong..	....	....	6	....	23	6	13	....	....	....
Hunnicutt.	....	....	1	....	14	....	12	13	....	....
Hutchinson.. .. .	....	....	....	....	....	....	1	7	7	....
Jones Improved...	5	....	10	....	....	....	10	5	8	7
Jones Long Staple	....	....	11	....	19	5	14	....	....	....
Jones No. 1.......	....	....	....	....	17	....	....	....	....	....
Keith...	....	....	5	....	11	....	....	....	....	....
King...	10	....	....	6	8	....	5	....	....	10
Lowry...	....	....	....	....	....	....	....	....	....	12
Matthews L. Staple	....	....	....	....	7	11	....	....	....	....
Okra..	9	....	....	13	12	8	....	....	....	....
Peeler...	....	....	....	7	8	....	....	....	....	....
Peerless...	7	1	....	4	6	....	4	11	....	....
Peterkin.	....	2	....	5	1	....	7	8	3	4
Petit Gulf..	....	....	....	3	3	....	17	....	....	....
Rameses..	8	....	....	9	....	....	....	....	....	....
Russell..	....	....	....	....	....	....	....	....	1	8
Southern Hope. ..	....	5	....	8	5	....	....	....	....	....
Storm Proof.. ...	....	4	....	15	2	....	....	....	....	....
Smith Improved..	....	....	....	....	....	....	....	....	4	....
Strickland.	....	....	....	....	....	....	....	....	....	11
Truitt..	1	3	....	2	4	....	2	9	5	2
Tyler...	....	....	....	....	....	....	6	15	....	9
Texas Oak...	....	....	....	....	....	....	....	1	6	6
Welborn..	3	....	....	11	13	2	15	....	....	5
Whatley Improved	....	....	....	....	....	9	16	10	....	....
Wonderful..	....	....	....	14	16	1	....	....	....	....
Zellner..	11	....	....	1	10	....	....	....	....	....
No. varieties in test.....	13	5	13	15	29	11	17	16	8	14

Size of Seed.—The data showing size of seed were obtained by taking the average of three samples of seed, each sample from a different plant.

Examining, in the above table, the records of those varieties which have been tested four or more times, we find the following facts:

The best records are apparently those of Peterkin and Truitt. Peterkin made the largest yield of lint in one test, ranked not lower than fifth in all except two tests, and never lower than eighth.

Truitt ranked from first to fifth except in one test, where it occupied the ninth place.

Inasmuch as these two varieties rank high in most tests and have been more frequently tested than any others, it is convenient to regard one of them as a standard to which the records of other varieties may be referred for comparison.

To determine which of the above named varieties shall be used in these pages as a standard, it is necessary that we examine more in detail the records made by each of these varieties in the seven expriments in which both entered:

Comparison of Varieties Peterkin and Truitt on Basis of Yield of Lint in Seven Years.

YEAR WHEN TEST WAS MADE.	Yield of lint cotton per acre.	
	Peterkin	Truitt
1890	786	783
1891	465	489
1892	338	302
1896	320	384
1897	246	245
1898	339	330
1899	427	442
Average for 7 years	417	425

The difference in the average yields of the two varieties is only 8 pounds of lint per acre, an amount too small to demonstrate that one variety is distinctly better than the other, as regards production of lint.

Both may be counted safe varieties, having never failed in our tests to make fair to excellent records.

The value of the total product is greater with Truitt, which affords a larger percentage of seed than does Peterkin. For this reason we shall use Truitt as the standard of comparison in this article.

Comparing Jones' Improved with Truitt, we find that both varieties are common to five tests, in four of which the rank of Truitt is higher than that of Jones.

Hawkins was compared with Truitt in five tests, and in four of these was defeated. Dickson invited comparison with the standard in three tests, in all of which it was surpassed. King and Truitt were compared five times, and in every instance the yield of lint was in favor of Truitt. Peerless was six times compared with this standard and only once was Peerless superior. In each of five tests Welborn was surpassed in yield of lint by Truitt. Allen Long Staple, Herlong, Hunnicutt and Jones Improved were each twice in competition with Truitt and in all cases they were beaten by this last named variety.

Each of the varieties mentioned in the preceding paragraph has one or more excellent qualities, and no one of them is unproductive. It is quite probable that under some conditions each of these would prove more productive than either of those which have made the best average at Auburn. Nor do these tests imply that Truitt and Peterkin are superior to some of the best of the recently introduced varieties, for example Russell, which, however, has been tested here only twice, or not often enough to definitely determine its value in comparison with older varieties.

VARIETIES STUDIED IN 1899.

It is extremely desirable that varieties should be classified according to their natural relations. A satisfactory classification should be of practical benefit to the farmer in protecting him against the purchase of old varieties under new names and at high prices. It would undoubtedly reduce the number of so-called varieties, of which the writer has found more than 150 mentioned in agricultural publications. The importance of the end to be attained seems to justify an endeavor to classify the varieties in the fact of the almost insuperable obstacles. The difficulties are formidable, and among them may be mentioned:

(1) The tendency of even a pure variety to vary with its environment;

(2) The multiplication of names, especially local names, of varieties; and

(3) The relatively small amount of descriptive and statistical data on record showing the character of the so-called varieties.

In 1899 the writer grew a large number of varieties with a view to obtaining correct descriptions of each and additional data regarding the characteristics of all kinds tested.

The collection consisted of 70 sorts, the seed in most cases being procured from the originator or from parties supposed to be most interested in furnishing seed pure and true to name. Nevertheless there was in a number of varieties great diversity as between individual plants. To overcome this, as far as possible, selection was made in each variety of those plants which showed decided similarity in habit of growth and form of stalk, and which evidently represented the prevailing type. Later, from this number of selected plants were chosen the best three plants, as nearly as could be judged by the eye; these three twice-selected plants furnish the data as to size of plants, bolls, seed, etc., and the most representative of the three was photographed for use in this article.

With the small plots,—which were necessitated by the large number of varieties,—and with the small number of selected plants, it was impracticable to secure any reliable data relative to the yield of each kind.

A part of the data obtained from the selected plants of each sort are recorded in the tables which follow. Frequently the three samples from which an average was in all cases made were not entirely accordant. When the failure to agree was considerable, the samples were re-weighed.

The data which appear in the following table represent the characteristics of the several varieties as they revealed themselves under the conditions of a test made here in 1899, on sandy upland soil, well fertilized with commercial fertilizers, and with the plants allowed ample space on every side. Weather conditions were unfavorable, drougth doing considerable injury. Planting was done at a late date, May 8. It is not necessarily true that in other years or under different soil and weather conditions the data secured would exactly correspond with those obtained in 1899. Such tests as this need to be several times repeated so as to obtain averages of maximum value.

Illustrations showing representative plants of nearly every variety grown here in 1889 may be seen in plates I to XII. The last plate shows the appearance and relative size of an average full-grown but unopened boll of each variety. The entire credit for all illustrations is due to the Director, P. H. Mell, who made all the photographs.

The following 24 varieties may be considered as having large bolls, that is, requiring only 50 to 65 bolls to make a pound of seed cotton:

Banks, Cheise, Christopher, Coppedge, Culpepper, Cummings, Drake, Duncan, Ellis, Griffin, Japan, Jones Improved, Lee, Maddox, Nancy Hanks, Peerless, Pruitt, Russell, Scroggins, Sprueill, Strickland, Texas Storm Proof, Thrash, and Truitt.

Weight of Seed Cotton in 100 Bolls and Number of Bolls Required to Make One Pound of Seed Cotton.

VARIETY.	Wght. 100 boll contents. Lbs	No. bolls per lb seed cotton	VARIETY.	Wgt. 100 boll contents. Lbs	No. bolls per lb. seed cotton
Cheise Improved	2.00	50	W. A. Cook	1.37	73
Texas Storm Proof	1.97	50	Doughty	1.37	73
Drake	1.80	56	Big Boll	1.33	75
Strickland	1.80	56	Minor	1.33	75
Banks	1.77	57	Texas Oak	1.33	75
Russell	1.73	58	Mattis	1.30	77
Lee Improved	1.70	59	Hawkins	1.30	77
Japan	1.70	59	Hawkins Jumbo	1.30	77
Christopher Improved	1.67	60	Hilliard	1.30	77
Culpepper	1.67	60	Pinkerton	1.30	77
Peerless	1.64	61	Petit Gulf	1.30	77
Thrash Select	1.64	61	Allen Impd. L. S.	1.30	77
Truitt	1.64	61	Bur	1.27	79
Jones Improved (Alexander)	1.64	61	King	1.23	81
Jones Imp'd (Curry)	1.60	63	Lowry	1.23	81
Ellis	1.60	63	Texas Wood	1.23	81
Duncan	1.57	64	Cobweb	1.23	81
Scroggins Prolific	1.57	64	Improved L. S.	1.23	81
Nancy Hanks	1.57	64	Jackson African (Alexander)	1.23	81
Norris	1.57	64	Moon	1.20	83
Pruitt Premium	1.57	64	Welborn	1.17	86
Maddox	1.57	64	Tyler Limb Cluster	1.17	86
Cummings	1.53	65	Allen Hybrid L. S.	1.17	86
Sprueill	1.53	65	No. 12 [(?) Herlong]	1.13	89
Coppedge	1.53	65	Borden Prolific	1.13	89
Griffin	1.53	65	Wise	1.13	89
Parks Own	1.50	67	Peterkin	1.10	91
Grayson Big Boll	1.47	68	Dickson	1.07	94
Gunn	1.47	68	Boyd Prolific	1.07	94
Matthews L. S.	1.47	68	Shine Early	1.07	94
Texas Bur	1.40	71	Dearing	1.07	94
Smith Improved	1.40	71	Norris	1.07	94
Jackson Limbless (U. S. Dept. Agriculture	1.40	71	Bates Poor Land	1.03	96
Herndon Select	1.40	71	Excelsior	.87	111
			Sea Island	.77	130

The following 21 varieties have bolls of medium size, from 65 to 80 being required to make one pound of seed cotton:

Allen Improved, Big Boll, Bur, W. A. Cook, Doughty, Grayson Big Boll, Gunn, Hawkins, Hawkins Jumbo, Herndon, Hilliard, Jackson Limbless, Matthews Long Staple, Mattis, Minor, Parks, Petit Gulf, Pinkerton, Smith Improved, Texas Bur and Texas Oak.

The small boll varieties, or those requiring from 80 to 130 bolls to make a pound of seed cotton, numbered 22, and were as follows:

Allen Hybrid, Bates Poor Land, Borden, Boyd, Cobweb, Dearing, Dickson, Excelsior, No. 12 (the so-called Herlong), Improved Long Staple, Jackson African, King, Lowry, Moon, Norris, Peterkin, Sea Island, Shine Early, Texas Wood, Tyler, Welborn and Wise.

SIZE OF SEED.

The data showing size of seed were obtained by taking the average of three samples of seed, each sample from a different plant.

Average weight of cotton seed of each variety.

	Grams.		Grams.
Duncan	16.64	Nancy Hanks	12.42
Banks	15.98	Cummings	12.34
Texas Storm Proof	15.98	Jones	12.34
Russell	15.74	Sprueill	12.34
Allen Improved	15.64	Cobweb	12.32
Thrash	15.52	Griffin	12.10
Drake	15.30	Bur	11.98
Ellis	15.20	Moon	11.70
Maddox	15.12	Allen Hybrid	11.56
Strickland	15.08	Lowry	11.54
Cheise	14.82	Minor	11.24
Culpepper	14.78	King	10.96
Christopher	14.50	Mattis	10.86
Coppedge	14.32	Petit Gulf	10.78
Lee	14.32	Jackson (African) from Alexander	10.54
Scroggins	14.18	Jackson Limbless from U. S. D. A.	10.46
Matthews L. S.	14.06	Texas Oak	10.34
Truitt	13.78	Hawkins	10.30
Sea Island	13.74	Shine	10.16
Jones	13.62	Peterkin	10.08
Peerless	13.54	Borden	10.04
Grayson	13.44	Welborn	10.04
Japan	13.44	No. 12 (? Herlong)	9.96
(?) Pruitt Premium	13.44	Dickson	9.94
Doughty	13.26	Pinkerton	9.74
Texas Wood	12.96	Boyd	9.54
Hilliard	12.96	Dearing	9.50
Cook (W. A.)	12.80	Peterkin	9.24
Gunn	12.70	Excelsior	9.10
Improved Long Staple	12.68	Texas Wood	8.72
Parks	12.66	Tyler	8.36
Smith Improved	12.64	Wise	8.28
Norris	12.62	Bates (Poor Land)	8.16
Texas Bur	12.52		
Big Boll	12.48		
Hawkins Jumbo	12.44		

If we would describe the seed as large, medium and small, an arbitrary division of varieties becomes necessary. The first 25 varieties in the above list, having seed weighing more than 13 grams per hundred, may be regarded as having large seed. Seed weighing 10.5 to 13 grams per 100 may be classed as medium in size, and those weighing 8 to 10.5 grams per hundred as small seed.

PROPORTION OF LINT TO SEED COTTON.

The following table gives the percentage of lint in the seed cotton of each variety. The figures are average results obtained by carefully handpicking samples of seed cotton from three plants of each variety and weighing the lint and seed on chemical balances.

VARIETY.	Per cent. lint.	VARIETY.	Per cent lint.
Pinkerton	38.6	Dickson	32.1
Bates (Poor Land)	37.6	Lowry	31.9
Borden	37.5	Scroggins	31.9
Wise	37.0	Lee	31.7
Thrash	36.2	Gunn	31.6
Peterkin (26 S.)	35.[illegible]	Shine	31.6
Texas Wood	35.4	Mattis	31.5
Peterkin (26 N.)	35.1	Jones Improved	31.4
Hawkins	35.0	Jones Improved	31.3
Jackson	34.5	Norris	31.2
Jackson	34.4	Russell	31.2
Minor	34.4	Cummings	31.1
No. 12 (? Herlong)	34.1	Ellis	31.1
Cheise	33.7	Hawkins Jumbo	31.1
Pruitt Premium (?)	34.0	Grayson	30.8
Sprueill	33.8	Petit Gulf	30.7
Parks	33.7	Banks	30.6
Nancy Hanks	33.6	Smith Improved	30.5
King	33.3	Drake	30.3
Tyler	33.2	Truitt	30.3
Maddox	33.1	Duncan	30.0
Texas Storm Proof	33.1	Texas Bur	29.9
Boyd	33.0	Cobweb	29.7
Welborn	32.9	Japan	29.7
Peerless	32.9	(?) Dearing	29.6
Bur	32.8	Strickland	29.6
Excelsior	32.8	Griffin L. S.	29.2
Hilliard	32.8	Herndon	29.1
Coppedge	32.8	Improved Long Staple	28.3
Moon	32.7	Doughty L. S.	28.2
Culpepper	32.5	Allen Hybrid L. S.	26.9
Christopher	32.4	Allen Improved L. S.	26.7
Texas Oak	32.4	Matthews L. S.	27.6
Big Boll	32.1	Sea Island	25.9
		Cook (W. A.) L. S.	25.8

In the list of varieties having at least 35 per cent. of lint there are only 9 names, all of these except Thrash being closely related varieties and in many respects resembling Peterkin. Only 14 names occur in the list of those having less than 30 per cent. of lint, most of these being long staple kinds. This leaves two-thirds of the varieties here tested in the class that has 30 to 35 per cent. of lint.

NUMBER OF FORMS PER PLANT AND TIME OF MATURING OF VARIETIES.

In order to ascertain the relative earliness of the varieties grown here in 1899, a count was made Oct. 9-11, of all bolls then open and also of all immature "forms," including blooms and unopened bolls of all sizes. The following table gives the data obtained by counting the "forms" on three plants of each variety, the percentage of open bolls being obtained by taking the total number of mature and immature forms as 100:

Average number of blooms, bolls and open burs and percentage of open bur, October 9-11, 1899.

VARIETY.	No forms per plant.	Per cent open bolls
Nancy Hanks	47	100
Texas Wood	40	100
Borden	36	97
Griffin	40	97
Parks	34	97
(?) Dearing	37	95
Boyd	55	94
Norris	32	94
Smith	32	94
Shine	48	92
Texas Bur	24	92
Hawkins Jumbo	34	91
Peterkin (26 S.)	46	91
Moon	31	90
Bur	34	89
Lowry	36	89
Minor	47	89
No. 12 [(?) Herlong]	28	88
Gunn	28	86
Texas Oak	29	86
Drake	40	85
Coppedge	48	85
Pruitt Premium	34	85
Ellis	25	84
Big Boll	37	84
Cheise	25	84
Allen Hybrid	54	84
Bates (Poor Land)	38	83
King	43	82
Jones Impd. (from Curry-Arrington)	40	82
Truitt	33	82
Japan	37	81
Cobweb	54	80
Doughty	40	80

VARIETY.	No forms per plant.	Per cent. open bolls
Peterkin (26 N.)	44	80
Dickson	48	79
Grayson	38	79
Pinkerton	43	79
Banks	32	78
Culpepper	30	77
Duncan	38	77
Jones Impd. (from Alexander)	29	76
Mattis	63	76
Excelsior	52	75
Hilliard	40	75
Russell	35	75
Maddox	39	74
Wise	39	74
Improved Long Staple	49	73
Herndon	41	71
Hawkins	33	70
Texas Storm Proof	26	70
Peerless	43	69
Cook (W. A.)	52	67
Matthews	36	64
Sprueill	31	64
Thrash	39	62
Welborn	55	62
Cummings	62	58
Strickland	23	56
Tyler	35	50
Jackson African (Alexander)	43	42
Lee	45	36
Christopher	39	35
Jackson Limbless (U. S. D. A.)	51	29
Sea Island	95	23

Not only was the proportion of mature and immature fruit determined by counting, but field notes were made indicating the earliness of the variety as judged by appearances only. These notes show that the data in the tables do not constitute safe guides for dividing varieties into groups of early, medium and late maturity; the table is of greater use in showing what varieties would be most injured by early frost, which under the conditions of this test would have been those that occupy a position low down in the table. For example Welborn, although an early variety (in the sense of affording a heavy picking early in the season) had nevertheless about one-third of its forms in immature condition on October 11. A still more notable instance of large proportion of immature forms as late as October 11 is afforded by the Jackson.

An examination of this table shows that the following 27 varieties averaged 40 or more mature and immature forms per plant, those producing the largest number being placed first:

Sea Island, Mattis, Cummings, Welborn, Allen Hybrid, Boyd, Cook (W. A.), Cobweb, Excelsior, Jackson, Improved Long Staple, Shine, Coppedge, Dickson, Minor, Nancy Hanks, Peterkin, Lee, Peerless, King, Pinkerton, Herndon, Hilliard, Jones, Drake, Griffin and Texas Wood.

Those varieties on which the total number of forms averaged less than 30 were only 8, viz: Strickland, Texas Storm Proof, Cheise, Ellis, Texas Oak, Gunn, No. 12 (so-called Herlong), and Texas Bur.

More than half of the varieties in this test averaged from 30 to 40 blooms, bolls, and mature fruit on October 9-11, 1899.

Of course the number of fruit forms produced by the plant during the entire season of growth was much greater than the figures above would show, for the count did not include the large number of blooms and bolls which had been shed, as the result of very unfavorable weather conditions.

As judged by the eye the varieties were classed in the field with reference to time of maturity, as follows;

Very early.	*Early.*	*Early to medium.*	*Medium.*	*Medium to late.*	*Late.*	*Very late.*
Dickson,	Borden,	Cummings,	Griffin,	Big Boll,	Allen Hybrid,	Cheise,
Dearing,	Bur,	Drake,	Hawkins Jumbo,	Culpepper,	Banks,	Japan,
King,	Bates Poor Land,	Herndon,	Minor,	Hilliard,	Christopher,[1]	Thrash,
Lowry,	Hawkins,	Jackson African.	Texas Oak,[1]	Jones.	Coppedge,	Improved Long Staple,
Nancy Hanks,	Peerless,	Jackson Limbless,	Texas Bur,	Norris,	Cobweb,	Sea Island.
Parks.	Shine Early,	Sprueill.	Wise.	Peterkin Limb Cluster.	W. A. Cook,	
	Smith Improved,	Welborn,		Peterkin,	Duncan,	
	Texas Wood.			Pruitt,	Doughty L. S.	
				Truitt,	Excelsior,[1]	
				Tyler.	Ellis,	
					Grayson,	
					Gunn,	
					Jones Improved.	
					Mattis,	
					Maddox,	
					Moon,	
					Matthews L. S.	
					Pinkerton,	
					Petit Gulf,	
					Russell,	
					Scroggins,	
					Strickland,	
					Texas Storm Proof	

CORRELATION OF CHARACTERS IN VARIETIES OF COTTON.

One of the ends in view in making this detailed statistical study of varieties was to learn what qualities are correlated, or what characters we may expect to find combined in one variety and what qualities are antagonistic or usually not to be found united in the same variety. This question has a decidedly practical bearing for the conclusion reached by such studies should afford a means of correctly interpreting the results of variety tests. Knowledge of the characteristics of varieties should also enable the farmer more intelligently to choose the kind of cotton best suited to his conditions. A knowledge of qualities that may easily be united in the same plant and of those that are antagonistic should be of supreme value to the plant breeder who endeavors to intelligently originate varieties having certain definite characters.

A study of preceding tables shows that in general there is a fairly constant relation between the size (weight) of boll contents and the weight of 100 seed. Large seed are usually from varieties having large bolls, and *vice versa*. For proof of this assertion let the reader notice that of the 25 varieties classed as producing heavy seed, nearly all are also to be found in the list of large boll varieties. With one possible exception (Grayson) this is true of all short staple kinds under test. Apparently this law has little, if any, application to the long staple varieties, for Matthews, Doughty, Allen Improved and Sea Island,—all having long staple,—produce large seed though bearing bolls of medium or small size.

Further study of the tables shows that most small seed varieties, whether of Peterkin, Cluster, or other type, bear small bolls.

These investigations afford no answer to the question whether *within a given variety* the seeds average heavier in large bolls than in small. Is the superiority in weight of large bolls over small bolls of the same variety chiefly due to heavier, more completely developed seed or to their greater number? This question invites further study. Our work thus far leads to the conclusion that among short staple varieties those that bear large bolls are usually those that bear large seed.

The writer has compiled a table showing the percentage of lint afforded by every variety in the tests published by American Experiment Station prior to 1895. That compilation showed clearly that long staple varieties yield but a low percentage of lint. The results obtained in our collection of 70 varieties in 1899 affords additional evidence that great length of staple is antagonistic to a large proportion of lint. For example, all long staple varieties in this test yield less than 30 per cent. of lint, while only two or three of the short staple varieties tested show such a small proportion of lint.

Let us examine the several tables which precede this paragraph in order to ascertain whether the size of the seed has any relation to the percentage of lint. We are so accustomed to obtaining a large percentage of lint with Peterkin, a variety having very small seed, that we involuntarily associate small seed with great outturn of lint. This does seem to be the general rule, but there are possibly exceptions, as in the case of Thrash and the so-called Dearing of this test.

Small seed are usually an indication of a large percentage of lint.

PROVISIONAL CLASSIFICATION OF AGRICULTURAL VARIETIES.

Agricultural varieties of cotton are far from showing fixed characteristics. Moreover, the points of difference between any two extreme plants within one variety are

*Bulletin No. 33, Office of Experiment Stations, U. S. Dept Agr.

often greater than the dissimilarity between the average plants of two closely related varieties. Hence the impossibility of accurately separating varieties according to single definite qualities, as form of stalk alone, size of bolls alone, etc.

Instead, it seems best to arrange the varieties into groups on the basis of general resemblance in several characters.

The following attempt to arrange the varieties grown here in 1899 is merely a provisional classification, to be modified as future investigations may suggest.

The short staple or upland varieties of cotton may conveniently be divided into six classes, and to these may be added the long staple upland varieties as a seventh. I would propose for each of these general classes a name giving, when practicable, an idea of the manner of growth of the plant, and with each class name would associate the name of some distinct and well known variety as a type or standard. I shall designate these classes as

(1) Cluster varieties, or Dickson type.
(2) Semi-cluster varieties, or Peerless type.
(3) Rio Grande varieties, or Peterkin type.
(4) Short Limb varieties, or King type.
(5) Big Boll varieties or Duncan type.
(6) Long Limb varieties, or Petit Gulf type.
(7) Long Staple Upland varieties, or Allen type.

The lines of demarkation between these groups are not always clear and distinct; one group often merges into another by almost imperceptible gradations, just as is the case with related varieties.

Below is given a list of the varieties (as grown here in 1899), which are included under these several groupings, and also a general description of the varieties composing each class. Varieties of which the classification, according to this scheme, is doubtful are named in a separate list, or are discussed in connection with the class to which they seem to bear the greatest resemblance. Further work will be done with a view to improving the classification and to more definitely determining the group to which each variety belongs.

CLASS I—CLUSTER VARIETIES, OR DICKSON TYPE.

The transition between this and the next succeeding class is so gradual that any other than arbitrary division is impossible. In this first class we include of the varieties grown here in 1899 only Dickson, Jackson (Jackson's African or Limbless) and Welborn.

With all these the most striking characters are (1) the absence of long wood limbs except at the base, and (2) the tendency of the bolls to grow in clusters, or in twos or threes from the same node of the stem or limb. The plants are usually tall, slender, and erect, though often bent down by the weight of bolls growing at the upper extremity of the main stem. The few base limbs are often long. The bolls and seed are usually small, but may be of medium size;—the seed are thickly covered with fuzz, which is usually whitish, with little or no brownish or greenish tinge.

As to the time of maturity these varieties must be classed as early, for though they sometimes make a second growth of bolls in the top of the plant which may fail to mature, they afford a large proportion of their total crop at the first picking. In earliness they are surpassed by the varieties of the King type (Class IV.)

In per centage of lint they present no striking peculiarity, seldom equalling in this respect the Rio Grands and usually ranging between 32 and 34 per cent. lint.

CLASS II—SEMI-CLUSTER VARIETIES, OR PEERLESS TYPE.

Here we include Boyd, Cummings, Drake, No. 28 N. (doubtfully labeled Dearing), Hawkins Prolific, Hawkins Jumbo, Herndon, Minor, Norris and Tyler.

These varieties have in less marked degree some of the qualities which distinguish Class I, being erect and having bolls more or less in clusters. Along the main stem are very short limbs above the base limbs, which latter are usually of medium length. In size of bolls and size of seed and percentage of lint there is considerable diversity among these varieties. The seed are usually of medium size, well covered with fuzz, except Tyler (which in this respect somewhat resembles Peterkin and may perhaps claim a place in Class III); fuzz of many shades, whitish, greenish, or brownish. These varieties are early or medium in time of maturity.

CLASS III—RIO GRAND VARIETIES, OR PETERKIN TYPE.

In this class we place Peterkin, Peterkin Limb Cluster, Texas Wood and Wise.

The characters which most distinctly mark this class are:

(1) The large proportion of lint, usually 35 per cent. or more of the weight of seed cotton, and

(2) Seeds that are bare of fuzz or nearly so, except at the tip end.

The plants are well branched, and usually, on upland soil, of medium size. The bolls are small and the nearly bare black seed are quite small. In time of maturing these varieties are usually neither very early nor extremely late.

The following varieties may perhaps be classed here to advantage, though in one or more respects they differ so widely from the type that they require further study before they can be positively assigned to this class:

Bates Poor Land, Borden, Excelsior, Pinkerton, Texas Oak, Tyler.

The low percentage of lint would seem to exclude all these except Bates, Borden and Pinkerton, and all six of the varieties in this list have fuzz, usually thin or brownish, on the seed. In small size and in the absence of any shade of green on the seed they all resemble Peterkin.

The following varieties have been mentioned in a work on cotton as related to Rio Grand, viz: Dearing and Shine, but in per cent. of lint and in some other respects they in 1899 differ widely from Peterkin, which we have taken as the type of this class.

CLASS IV—SHORT LIMB VARIETIES, OR KING TYPE.

King and Lowry constitute the basis of this group. Both are early, indeed the earliest varieties ever tested by the writer.

The plants are small and well branched near the top as well as at the base. The limbs are short, the bolls small, the seed medium in size, and thickly covered with fuzz, usually brownish, though a greenish shade is often visible. The percentage of lint is usually 32 to 34.

In the field Parks and the kind furnished us under the (probably incorrect) name of Herlong were not distinguishable from King, and we think that both these varieties belong here. Shine has some claims to a position in this group.

CLASS V—BIG BOLL VARIETIES, OR DUNCAN TYPE.

To this group we would assign:

Banks, Christopher, Coppedge, Culpepper, Duncan, Grayson, Jones Improved, Lee, Russell, Scroggins, Strickland, Texas Storm Proof, Thrash, Truitt and its equivalent, sent to us as Pruitt Premium.

The large bolls and large seed and late growth of Maddox seem to place it here, though its nearly bare seed are at variance with all the varieties above. The large bolls and seed characters of Sprueill and Japan would bring these two varieties to this group, but in 1899 these two matured too early to be ranked alongside of the late varieties in the list above.

The character which especially distinguishes this class is the large size of bolls, of which only 51 to 68 are required to yield a pound of seed cotton. Other specially notable qualities are late maturity and vigorous growth of stalk. The seed are large or very large, and covered usually (Maddox being an exception) with a thick fuzz, generally brownish white or whitish, a part of the seed of many of these varieties being covered with a deep green fuzz. The per cent. of lint often runs rather low and is usually between 30 and 33. The bolls are never clustered; in some varieties the upper limbs are so short as to give the top of the plant the erect, slender appearance which is common among semi-cluster varieties.

CLASS VI—LONG LIMB UPLAND VARIETIES, OR PETIT GULF TYPE.

Ellis, Gunn, and Petit Gulf find a place in this class. Cheise may be classed here, though it has also some of the qualities of the Big Boll group.

The varieties in this class grow to large size and have long limbs, the plants presenting a straggling appearance or marked want of compactness. The bolls and seed are both of medium to large size, the latter covered with fuzz of various shades. The per cent. of lint is low or medium. This class seems poorly suited to upland soils, and indeed, as grown here in 1899, does not impress one as pre-eminent in any specially valuable qualities.

CLASS VII—LONG STAPLE VARIETIES, OR ALLEN TYPE.

This group includes Allen Hybrid, Allen Improved, Cobweb, Cook (W. A.), Doughty, Griffin, Improved Long Staple (from Holloway), Matthews and Moon.

The length of staple is the distinguishing characteristic. The lint usually measures 1 3-16 to 1$\frac{3}{8}$ inches in length, or 30 to 35 millimeters. An almost invariable accompaniment to great length of staple is a low proportion of lint, which in all varieties of this class tested here, except Moon, has been less than 30 per cent.

The plants grow to large size, have limbs of great length, and usually present a straggling appearance, though in some varieties only the base limbs are long, the upper limbs bearing a number of bolls close to the main stem, and giving the upper portion of the plant the appearance of great prolificacy.

The bolls are not very large, but are long, slender, tapering to a sharp point. All of these long staple varieties are late in maturing a crop.

The seed are of medium to large size, usually densely covered with fuzz, from which all trace of green is absent, the color being almost pure white, or in some varieties of a brownish tint. In some varieties, as with all the seed of Cobweb and with a small proportion of the seed of Cook as grown here in 1899, the fuzz is absent, and the seed bare, these naked seeds being distinguishable from Peterkin by their larger size. If the length of staple in these long staple inland varieties were the results of hybridization between the Sea Island

and the ordinary short staple upland varieties we should expect the hybrid more frequently to inherit the naked or bare seed from its Sea Island parent.

LIST OF UNCLASSIFIED VARIETIES.

In addition to the varieties enumerated in the seven classes before named, we grew in 1899 the following varieties which must remain unclassified until the observations intended to ascertain their characteristics can be repeated:

Bur, Texas Burr, Big Boll (from Holloway), Japan, Mattis (a large boll straggling variety, with bare seed), Nancy Hanks and Smith Improved.

CHOICE OF VARIETIES.

No one variety can be universally recommended. A knowledge of the characteristics of each variety may sometimes aid a farmer in the selection of a kind suited to his conditions. For example, in the extreme northern portion of the cotton belt, where the growing season is short, earliness is one of the qualities desired. In addition to some good new varieties we find in the list of the very early, early, and medium early varieties on page 200 the names of the following well known kinds, King, Welborn, Dickson and Peerless, which are among the safe varieties for localities where the growing season is short.

For late planting, even in lower latitudes, early varieties are preferable.

Other qualities besides earliness which must be taken into consideration in choosing a variety are ease of picking, ability to withstand unfavorable weather without excessive shedding of forms, relative resistance to rust, tendency to produce a clean or trashy cotton, relative freedom from boll rot, etc. The writer's observation is that the varieties bearing bolls in clusters are apt to shed a larger proportion of their forms than those with a greater development of limbs. This probably implies that a grower of a cluster variety should be even more careful than other cotton planters to give frequent and thorough cultivation so as to avoid the excessive drying of the soil which occurs very rapidly while an unbroken crust covers the ground, and which condition of dryness often increases the tendency to shedding of forms.

Ease of picking is usually in proportion to the size of the bolls. Another factor is the character of the burs, which in some varieties offer special difficulties to clean and rapid picking. Varieties having this character are often termed "storm proof," in recognition of their relative resistance to the blowing out or beating out of the cotton by wind or rain. This quality is of doubtful advantage since it is directly opposed to ease of picking. Moreover, notes made on all these varieties in the field showed that the varieties offering considerable resistance to clean picking were by no means exempt from having a part of the seed cotton blown or beaten out by wind and rain.

As a rule, extreme length of limbs and want of compactness in the plant is undesirable. It is not the variety of straggling appearance that heads the list in productiveness.

For upland soils the long staple varieties are scarcely to be considered, for they require good, moist soil, are less productive than the short staples, and generally mature late.

Neither our tests nor those made elsewhere point to any one variety as absolutely the best. The farmer who would make use of our results can do so only by deciding for himself whether for his conditions he needs an early or late, a cluster or limbed, a large seed or small seed variety; and then, having decided on the kind of cotton he wishes, he should note all the varieties that we have included on previous pages in the class which he prefers. The rank of all the varieties of this class as regards productiveness or other qualities he can study with the aid of the tables given in this article. In nearly any class he may select he will find several varieties of about equal value, for the difference in productiveness between any two pure, well established varieties of the same type is far less than is generally supposed.

Let us consider carefully what particular characters or qualities are best adapted to a given soil and method of cultivation; then there is no danger of going far wrong, whichever one of the well established varieties of this class may be chosen.

EXPLANATION OF PLATES.

PLATE X—An accident caused the failure to present an illustration of the Truitt plant; however, see figure in Plate X, showing Pruitt Premium, which is identical with Truitt and which probably owes its name originally to an error in spelling.

2. Peerless.
3. Cummings.
4. Drake.
5. Mattis.
6. Dickson.
7. Boyd.
8. Lee.
9. Welborn.
10. Jackson Limbless, from U. S. Dept. Agr.
11. Jackson African, from Alexander Seed Co.
12. Seed incorrectly labeled Herlong.
13. Tyler.
14. Scroggins.
15. Christopher.
16. Herndon.
17. King.
18. Lowry.
19. Parks.
20. Sprueill.
21. Grayson.
23. Hawkins Prolific.
24. Hawkins Jumbo.
25. Nancy Hanks.
27. Peterkin Limb Cluster.
28. Dearing.
29. Texas Wood.
30. Wise.
31. Culpepper.
32. Strickland.

33. Norris.
34. Pinkerton.
35. Pruitt.
36. Ellis.
37. Jones Improved.
38. Bates Poor Land.
39. Bur.
40. Texas Bur.
41. Minor.
42. Smith Improved.
43. Petit Gulf.
44. Texas Oak.
45. Matthews Long Staple.
46. Griffin Long Staple.
47. Allen Hybrid Long Staple.
48. Allen Improved Long Staple
49. W. A. Cook Long Staple.
50. Doughty Long Staple.
51. Moon Long Staple.
52. Cobweb Long Staple.
53. Improved Long Staple.

26 S. Peterkin.
27 S. Gunn.
28 S. Excelsior.
29 S. Hilliard.
30 S. Shine.
31 S. Culpepper.
32 S. Banks.
33 S. Norris.
34 S. Pinkerton.
35 S. Pruitt Premium.
36 S. Big Boll.
37 S. Jones Improved.
38 S. Cheise.
39 S. Borden.
40 S. Maddox.
41 S. Coppedge.
42 S. Japan.
43 S. Sea Island.
44 S. Texas Storm Proof.

WHERE TO OBTAIN SEED.

As this Station has no seed for sale or distribution, the following list of parties supplying us with seed is given, so that intending purchasers may know where seed of each variety can be obtained:

Allen Hybrid, from J. B. Allen, Port Gibson, Miss.

Allen Improved, from J. B. Allen, Port Gibson, Miss.

Banks, from W. H. Banks, Newnan, Ga.

Bates Poor Land, from R. Bates, Jackson Sta., S. C.

Big Boll, from Holloway Seed & Grain Co. Dallas, Tex.

Boyd Prolific, from R. Frotscher, New Orleans, La.

Bur, from R. Frotscher, New Orleans, La.

Cheise, from Holloway Seed & Grain Co., Dallas, Tex.

Christopher, from R. H. Christopher, Asbury, Ga.

Cobweb, from W. E. Collins, Mayersville, Miss.

W. A. Cook, from W. A. Cook, Newman, Miss.

Coppedge, from C. S. Coppedge, Nyson, Ga.

Culpepper, from J. E. Culpepper, Luthersville, Ga.
Cummings, from T. A. Whatley, Opelika, Ala.
Dearing, from H. P. Jones, Herndon, Ga.
Dickson, from Curry-Arrington Seed Co., Rome, Ga.
Doughty, from Curry-Arrington Seed Co., Rome, Ga.
Drake Cluster, from M. W. Johnson Seed Co., Atlanta, Ga.
Duncan, from M. W. Johnson Seed Co., Atlanta, Ga.
Ellis, from G. B. Ellis, Palalto, Ga.
Excelsior, from C. F. Moore, Bennettsville, S. C.
Grayson Big Boll, from W. B. Grayson, Grayson, La.
Griffin, from John Griffin, Greenville, Miss.
Gunn, from C. S. Gunn, Temple, Miss.
Hawkins Improved, from W. B. Hawkins, Nona, Ga.
Hawkins Jumbo, from W. B. Hawkins, Nona, Ga.
Herlong, from Curry-Arrington Seed Co., Rome, Ga.
Herndon Select, from S. J. Thornton, Coldwater, Ga.
Hilliard, from W. A. Hilliard, Bowersville, Ga.
Improved Long Staple, from Holloway Seed & Grain Co., Dallas, Tex.
Jackson African, from Alexander Seed Co., Augusta, Ga.
Jackson Limbless, from Division of Botany, U. S. Dept. Agriculture.
Japan, from Holloway Seed & Grain Co., Dallas, Tex.
Jones Improved, from Alexander Seed Co., Augusta, Ga.
Jones Improved, from Curry-Arrington Seed Co., Rome, Ga.
King, from H. P. Jones, Herndon, Ga.
Lee Improved, from E. E. Lee, Wildwood, Ala.
Lowry, from J. G. Lowry, Cartersville, Ga.
Maddox, from J. S. Maddox, Orchard Hill, Ga.
Matthews Long Staple, from J. A. Matthews, Holly Springs, Miss.

Mattis, from C. F. Mattis, Learned, Miss.

Minor, from J. D. Minor, Meriwether, Ga.

Moon, from J. M. Moon, Peytonville, Ark.

Nancy Hanks, from Curry-Arrington Seed Co., Rome, Ga.

Norris, from H. H. Steiner, Grovetown, Ga.

Park's Own, from G. F. Park, Alexander City, Ala.

Peerless, from M. W. Johnson Seed Co., Atlanta, Ga.

Peterkin, from J. A. Peterkin, Fort Motte, S. C.

Petit Gulf, from H. C. Prevost, New Orleans, La.

Pinkerton, from H. R. Pinkerton, Eatonton, Ga.

Russell Big Boll, from G. F. Park, Alexander City, Ala.

Sea Island, from Alexander Seed Co., Augusta, Ga.

Scroggins Prolific, from J. T. Scroggins, Luthersville, Ga.

Shine Early, from J. A. Shine, Shine, N. C.

Smith Improved, from A. J. Smith, Conyers, Ga.

Sprueill, from A. M. Sprueill, Brompton, Ala.

Strickland, from Curry-Arrington Seed Co., Rome, Ga.

Texas Bur, from Alexander Seed Co., Augusta, Ga.

Texas Oak, from M. G. Smith, Lightfoot, Ga.

Texas Storm Proof, from W. J. Smiley, Baileyville, Tex.

Texas Wood, from D. F. Miles, Marion, S. C.

Thrash Select, from E. C. Thrash, Silvey, Ga.

Truitt, from Curry-Arrington Seed Co., Rome, Ga.

Tyler Limb Cluster, from Alexander Seed Co., Augusta, Ga.

Welborn Pet, from M. W. Johnson Seed Co., Atlanta, Ga.

Wise, from H. P. Jones, Herndon Ga.

PREPARATION AND CULTIVATION OF THE SOIL FOR COTTON.

BY J. F. DUGGAR.

The manner of preparing the seed bed for cotton varies greatly, being chiefly dependent on the amount of clay, sand, and vegetable matter in the soil. If commercial fertilizers are used preparation may be slightly different from that which is necessary for cotton receiving no fertilizer.

In clay or heavy loam soils receiving fertilizers, land on which there is much vegetable matter is usually broken broadcast (flushed) with a turn plow of some corresponding plow (half shovel, turn shovel, twister, scooter, etc.). Then the rows are opened, fertilizer placed in the row and a ridge or list formed over the fertilizer with two furrows. The proceedure is the same for sandy soils, and for clean land on which cotton is the preceding crop, except that the broadcast plowing is usually omitted. The row is completed by throwing two furrow slices on the list formed above the fertilizer, this bedding or "throwing out middles" being often delayed for several weeks after the formation of the original small ridge or list, which delay, though convenient, is of questionable wisdom on sandy soils. This question needs the exact investigation which it has not yet received. Presumably the narrow sharp ridges formed by balks or middles and lists dry out too rapidly in seasons of deficient rainfall.

On the Station Farm the beds are completed as soon as fertilizers are applied. In applying fertilizers our practice differs from that of most farmers in that before the fertilizers are covered they are mixed with the soil by running a scooter plow through the line of fertilizer. This is probably necessary only when the fertilizer exceeds 200 pounds per acre. Fertilizers are drilled in the opening or center furrow over which the ridge or bed is formed.

Subsoiling.—No real subsoiling has been done on the Station Farm prior to 1900. Partial subsoiling, effected while the land was being flushed by running a scooter plow to a depth of about 4 inches in the bottom of a shallow turn plow furrow, was done on reddish loam land in January, 1896. The yield on the partially subsoiled land exceeded that on land not subsoiled by 139 pounds of seed cotton per acre in 1896. However, the next year, the same land, on which the subsoiling was not repeated, gave no increase that could be attributed to subsoiling. Partial subsoiling of the same field, as above, on Feb. 24, 1898, failed to increase the yield of cotton in 1898 to any appreciable extent.

Harrowing and rolling.—A defective stand of cotton plants is frequently the consequence of dry weather in April and May. The effects of dry weather at this season can be largely overcome by using the harrow before planting to break the surface crust whenever it forms, thus conserving moisture which may soon be urgently needed by the germinating seed and young plants. Another method of aiding germination on sandy soils that are very loose and dry at time of planting is by the use of the roller just after the seed are placed in the ground. The most convenient means of rolling is by the use of a very small but heavy roller attached to the planter. The wooden roller on some planters is often not heavy enough. In the dry spring of 1896 rolling of the land just after planting, either with an ordinary one horse roller, or with a narrow iron pulley, which packed only the drill, caused the seed to germinate promptly and thoroughly, while on unrolled ground few plants appeared until rain had fallen.

Cultivating implements.—The cultivation of the cotton crop after the young plants appear usually consists of hoeing two or three times and the use of some form of horse cultivation three to six times. The implement used by the best farmers on sandy and loam land is the heel scrape, which, properly regulated, can be made to do very shallow, and yet effective, cultivation. A practice which is deservedly falling into disuse is "barring off," accomplished by the use of the turn plow at the first cultivation of cotton. In "barring off" the young cotton plants are left, usually for several days,—in some cases for a week or more,—on a narrow ridge, which, drying rapidly, must check growth in dry seasons, especially as it is necessarily accompanied by severe root pruning. In wet seasons or on undrained land it may do no permanent harm, but even in such cases the turn plow should be run as shallow as possible and the hoeing should follow immediately, so that there may be no delay in throwing the dirt back against the roots.

We have been able to do equally as good work in siding with a heel scrape and have thus avoided the risks always incurred when a turn plow is used as a cultivating implement.

Cultivation with hell scrape should occur whenever a crust forms after a rain, the number of furrows per row being usually two, occasionally three, and sometimes towards the close of the season only one, in which case a 30 or 36-inch heel scrape is used.

Late cultivation.—An experiment to ascertain the effects of an extra late cultivation showed a slight gain in yield as the result of a cultivation given two weeks after the close of the usual cultivating season. A good general rule, which must be modified somewhat according to the presence or absence of weeds, is to practice late cultivation when the cotton stalks are small, and to stop at an earlier date in fields where there may be danger of excessive development of stems and foliage.

Depth of cultivation.—The depth of cultivation has been studied at this station, both by examination of the natural position of the roots in the soil and by noting the effect of both deep and shallow cultivation on the yield. The danger of severe mutilation of the roots may be inferred from the fact that most of the lateral roots were found to originate at a point only 1½ or 2 inches below the surface of the ground. Their position and direction was such that deep cultivation would unavoidably have broken a large proportion of the feeding roots. A single deep cultivation (at the second plowing, all other cultivation being shallow), reduced the yield of seed cotton in a test on prairie soil at Uniontown, Ala., by 85 pounds and on sandy soil at Auburn by 105 pounds of seed cotton per acre.

SELECTION OF SEED.

Old versus fresh seed.—The productiveness of a given seed is largely dependent, not only on the variety, but also on the individual character of that seed. Although unnecessarily large quantities of cotton seed are usually planted as the result of the low price of ordinary cotton seed, it is nevertheless important that the seed planted shall have a high germinative ability. This is especially important when high priced seed is employed. As a rule, those that are fresh germinate more completely than old seed, and unless there is a distinct advantage in the use of the latter the farmer should plant only fresh cotton seed, that is those from the crop of the preceding year.

However, at least one seed dealer has made the claim that old cotton seed are best, his idea being that in using old seed only the best seed germinate and that these should produce the most vigorous and productive cotton plants.

However, the average of three experiments made at Auburn in 1896 and 1897 showed no difference in yield that could be ascribed to the age of seed when all samples used had sufficient vitality to bring forth a full stand of plants.

Size and position of seed.—Size of seed, position of seed on parent plant, and environment under which the seed was produced, are also factors that probably influence the yield of the succeeding crop.

None of these subjects has been sufficiently investigated to permit of positive statements touching these points. Unpublished data obtained by the writer in 1896 indicated that under the conditions of those tests, seed from the top bolls afforded a smaller crop than seed from bolls growing low down on the cotton plant and that large seed produced a heavier crop of seed cotton than small seed of the same variety grown under identical conditions. The experiments pointing to the apparent superiority of seed from lower bolls, although partially confirmatory of a similar experiment in Arkansas, need to be repeated before we can safely assume that these results represent a general law. The same is true of the experiment in which large and small seed were compared. The superiority of large seed is generally acknowledged as a law applicable to many species of plants, and the superiority of large cotton seed, suggested by this experiment, is not surprising. But we must not jump at the conclusion that the larger the seed the greater the crop, for some of the most productive varieties, for example Peterkin, have small seed.

Effect of climate.—The effect of climate on cotton has received practically no attention. Several of the earliest varieties have originated near the northern limit of the Cotton Belt. This fact, together with the well known fact that seed of many cultivated plants as corn, garden peas, etc., grown in high latitudes produce plants which mature earlier than those from Southern seed, makes it probable that the season of growth of any variety could be shortened by having the seed grown for several years in the extreme upper limit of the Cotton Belt. As shown by our experiments in 1897, this increased earliness was not effected by the use of seed grown only one year in high latitudes. It would be necessary for several generations of seed to be produced in the cooler climate before the quality of early maturity would become pronounced.

Selection of seed as a means of improving cotton. In improving a variety of cotton by selection of seed, the most careful farmers select bolls that open early and that grow on the lower portion of the plant. Since the lower bolls average larger in size and earlier in maturity, this practice is commendable, provided choice is not made of the undersized bolls, some of which at the extreme lower portion of the plant are among the first to open. The whole subject of selection of seed of the cotton plant, the relative importance of size of seed, position and size of bolls, and climatic and soil conditions environing the parent seed,—are worthy of extended investigation at the Southern Experiment Stations.

The danger of drawing the supplies of seed from a common pile at a public gin without regard to the character of the seed cannot be too strongly emphasized. Cotton degenerates easily and it also improves rapidly under careful selection. Hence every cotton farmer should have each year at least one small field of cotton, grown from pure and carefully selected seed, the seed of this field to be used in planting the entire area of cotton the following year.

Best distance between cotton plants.—In 1886 the yield of cotton was nearly constant for distances of 1, 2, or 3 feet between plants in the drill; when the distance was increased to 4 feet the yield was reduced. These results were obtained with cotton in rows 4 feet apart and on low rich soil only recently brought into cultivation. The maximum yield was about 1,200 pounds of seed cotton per acre. The name of the variety used is not on record.

The results above are in essential accord with those obtained in 1887 on rich prairie slough land at Uniontown, Ala. In that test cotton in rows four feet apart made practically identical yields, whether the distance between plants was 1, 2, 3, or 4 feet, all yields being about 900 pounds of seed cotton per acre. At Auburn in 1889, on land which produced about 1,000 pounds of seed cotton, there was no material difference in yield when the distance between plants were 1, 2, 3, and 4 feet in the drill, the rows in all cases being 4 feet apart.

In 1890, with heavy fertilization and rows four feet apart, a distance of two feet afforded a larger yield (1,131 pounds of seed cotton per acre), than did distances of 1, 3, or 4 feet between plants. With rows 3 feet apart the yield of cotton was greater when the plants were spaced 3 feet apart in the row than with closer planting. These narrow rows (3 feet wide) afforded a smaller yield than rows 4 feet wide.

In 1891, both a cluster variety and a long-limbed variety were used in a distance experiment, with rows 4 feet apart. The cluster variety, Welborn, devoid of spreading limbs, was benefited by close planting, giving its maximum yield of 2,519 pounds of seed cotton per acre when the plants stood 1 foot apart in the drill, the decrease in yield being great when the distance was increased to 2, 3 or 4 feet between plants. Peeler, the variety having long spreading limbs, gave its maximum yield, 1,983 pounds, when the plants were spaced 2 by 4 feet, at which distance the yields of the cluster and long-limbed variety were practically equal.

In 1896 the variety used in testing the best distance for planting cotton was Peerless, a variety which does not occupy much space. In 1897, Truitt, a variety with long limbs, was used. The rows were $3\frac{1}{2}$ feet apart, with Peerless, $3\frac{1}{3}$ with Truitt. The following table shows the results in pounds of seed cotton per acre, each figure being the average for at least two plots:

Best distance for cotton, 1896 and 1897.

Distance between plants.	Peerless, 1896.	Truitt, 1897.
	Lbs.	*Lbs.*
12 inches	770	922
18 "	804	912
24 "	673	918
30 "	544	878
36 "	530	853

The above table shows that with Truitt cotton in narrow rows there was practically no difference in yield between distances of 12, 18 and 24 inches in the drill. When the space was increased to 30 inches a decided reduction in yield followed. When the distance became 36 inches a further reduction occurred, which, however, was only slight. The yield per plant increased rapidly as the space allowed to each was enlarged.

It should be remembered that the Truitt variety makes a large growth, and that its originator recommends thin planting for this variety. With Peerless, a smaller variety, planted in 1896 on a more sandy soil, best results were obtained by spacing either 12 or 18 inches in rows 42 inches apart.

The average percentages of the whole crop that were obtained at the first picking, August 26, 1897, were as follows: 42 per cent. for plants 12 inches apart; 38 per cent. for plants spaced 18 inches; 30 per cent. for plants 24 inches apart; 26 per cent. for plants spaced 36 inches apart. These averages suggest that thin planting retarded opening and that very thick planting decidedly hastened the maturity of the plants. However, different plots planted at identical distances varied considerably in the percentage of the total crop which was open at the time of the first picking.

Undoubtedly much of the cotton grown in Alabama is unduly crowded in the row and in many localities the rows are too narrow for economical cultivation. With almost any variety on medium or fair soil it is probably safe to allow a distance of 18 inches between plants in the drill. To increase this distance beyond two feet is doubtless unwise except when the variety is long-limbed, and in this case considerable risk of reducing the yield is incurred if the distance approaches or exceeds 3 feet. For erect and short-limbed varieties we feel safe in recommending a distance of 18 inches on good land and 12 inches on poor land. The richer the land the greater the spread of the limbs and the greater the area demanded by each cotton plant.

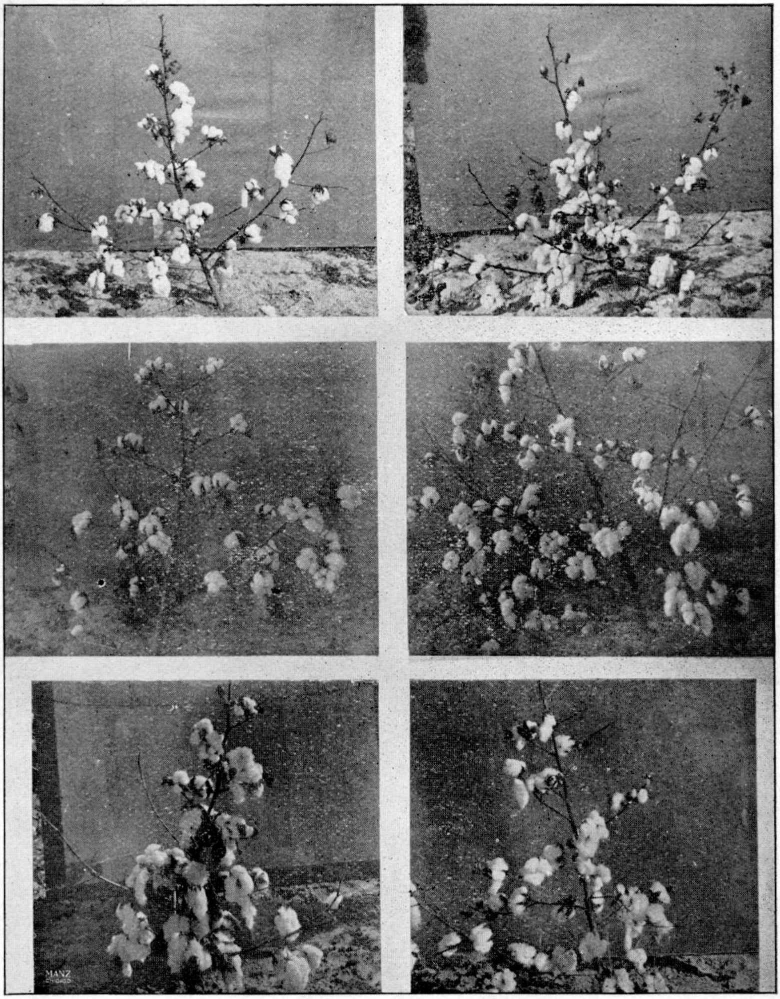
If in some exceptional soils there is such a tendency towards producing a large cotton stalk as to require more than 10 square feet per plant, the crop will usually be most conveniently cultivated if the needed space is afforded by widening the row to 4, 4½, or even 5 feet, leaving the space between plants in the drill not greater than 3 feet. Labor is economized by spacing the plants as far apart as is consistent with maximum yield, but on the average cotton lands of Alabama, with ordinary fertilization, a distance of 12 to 18 inches is safer than wider spacing.

Topping.—This operation, which is not often practiced at the present time, consists in the removal of a few inches of the extreme top of the cotton stalk, late in summer. The idea was probably to check the upward growth of the plant and to favor the more complete development of the bolls already formed.

Our tests here failed to show any advantage from topping, either on rich bottom land in 1886 or on rather poor up-land in 1897. In the latter experiment the Truitt variety was used and the yield of seed cotton per acre was, on the plots not topped at all 946 pounds; topped August 19, it was 906 pounds; and only 710 pounds when topping was performed as early as July 22.

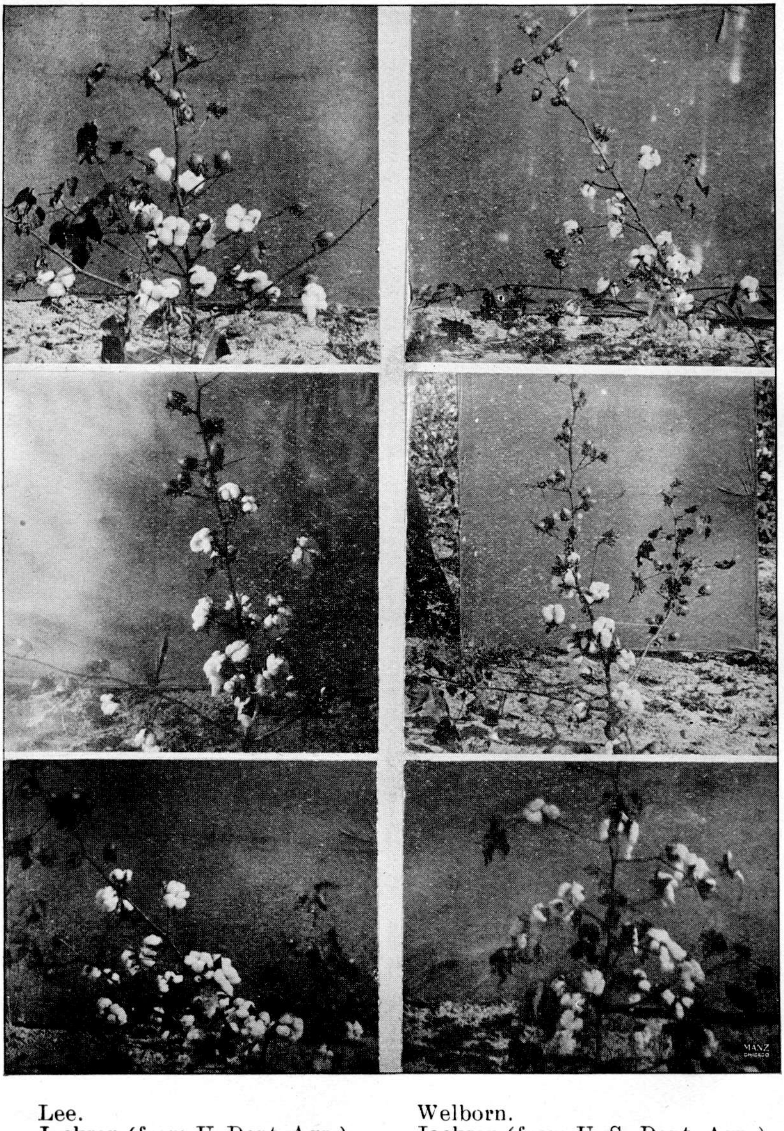
Our experiments and those made at several other stations, agree in showing that ordinarily no advantage results from topping cotton.

PLATE I.

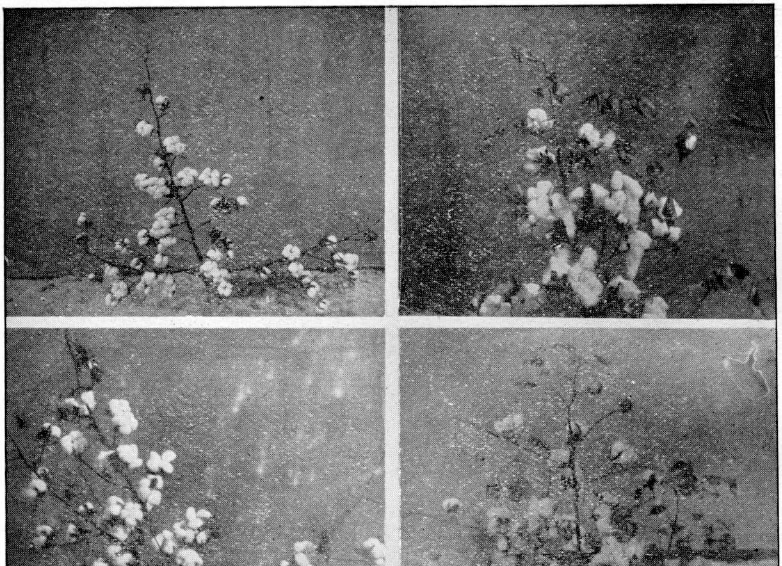


Peerless.	Cummings.
Drake.	Mattis,
Dickson.	Boyd,

PLATE II.



Lee.	Welborn.
Jackson (from U. Dept. Agr.)	Jackson (from U. S. Dept. Agr.)
Jackson (from Alexander).	12 B (so-called Herlong.)



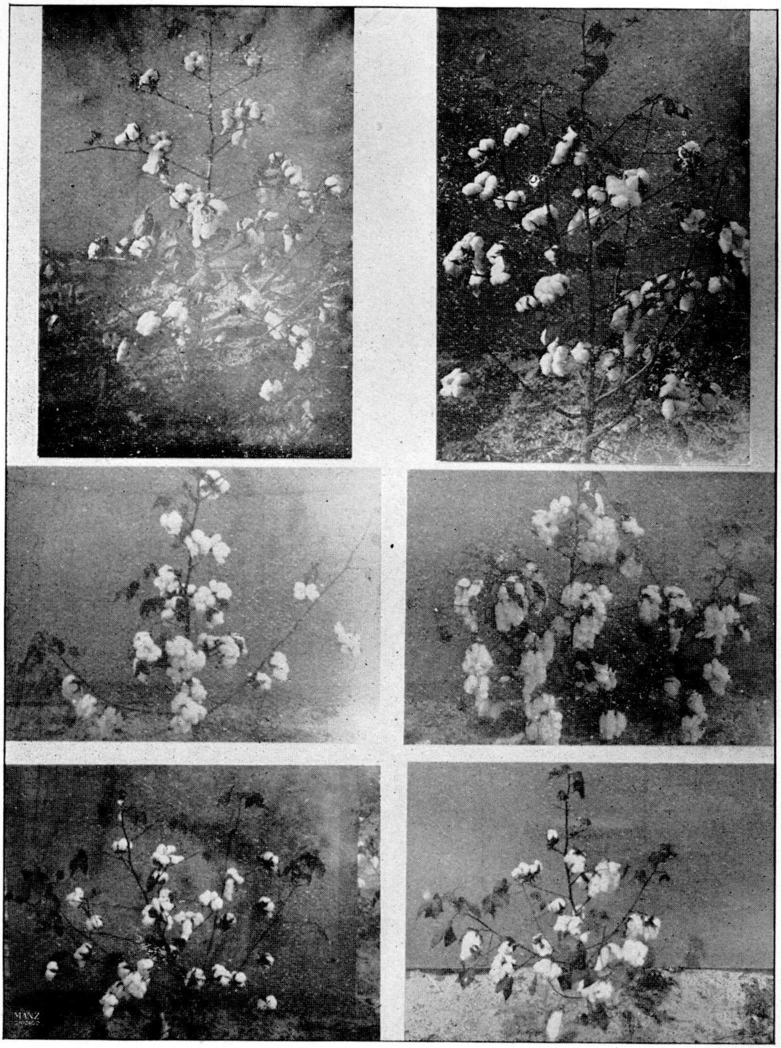
Tyler.
Herndon.
King (a).

Scroggins.
King (b).
Lowry.

PLATE IV.

Parks.
Hawkins Prolific.
Sea Island.

Grayson.
Hawkins Jumbo.
Nancy Hanks.



Peterkin Limb Cluster (b.)
Dearing.
Wise.

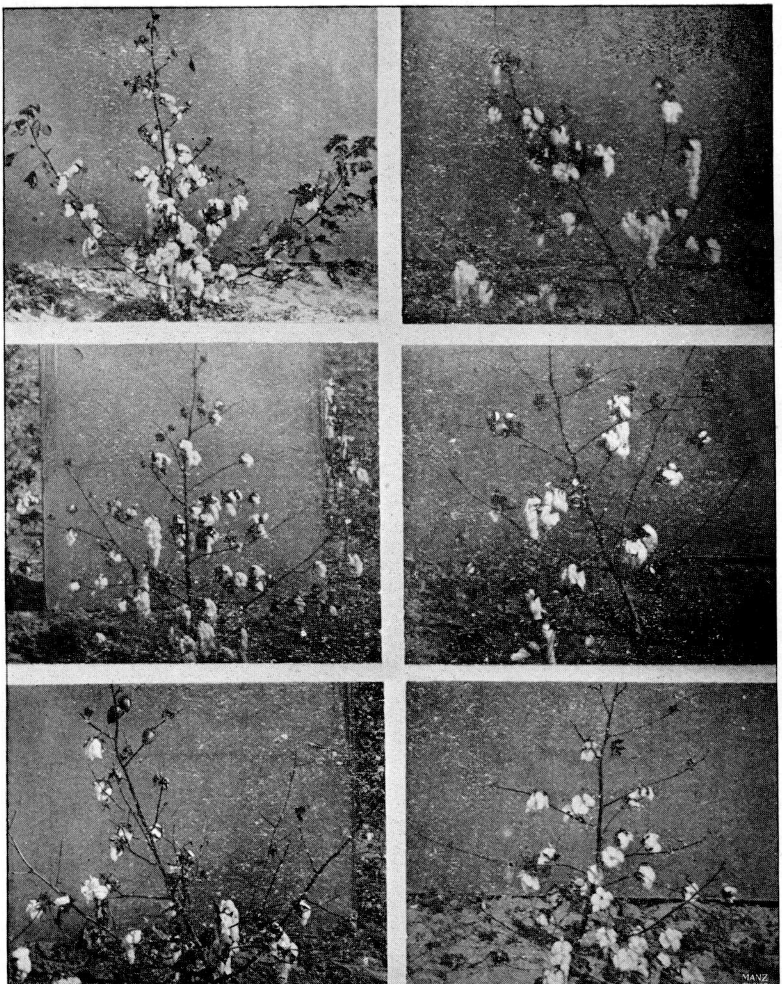
Peterkin Limb Cluster (c.)
Texas Wood.
Culpepper.

PLATE VI.

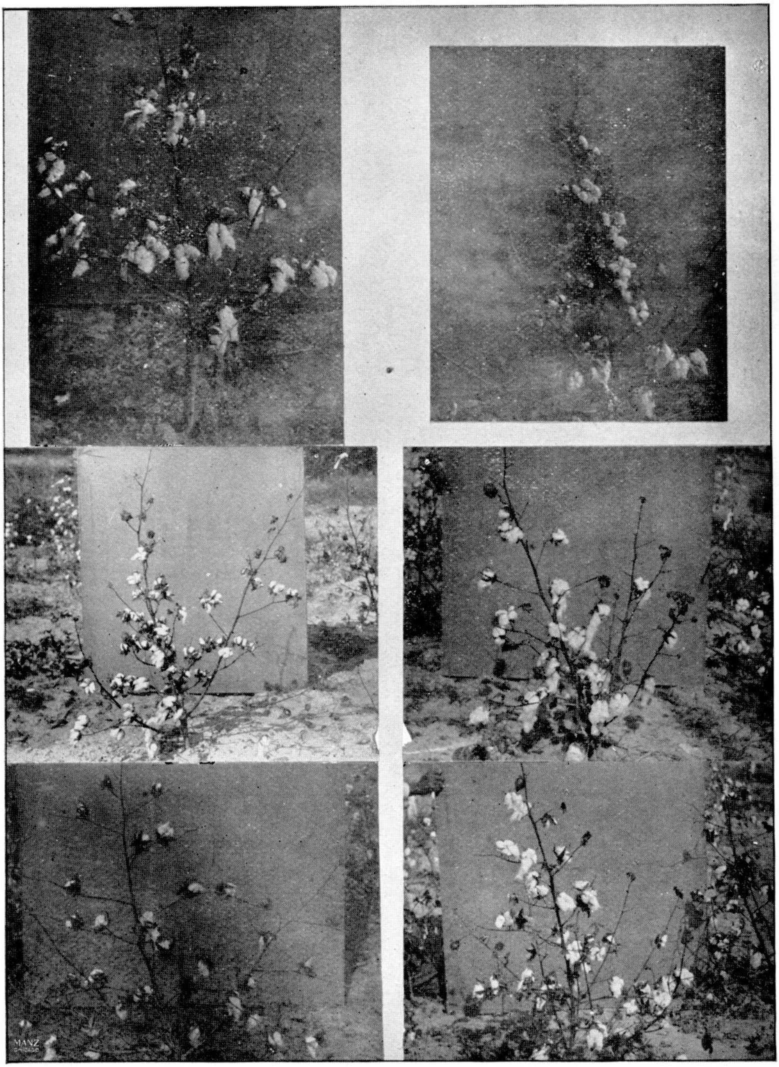
Duncan.
Jones Improved (N. 37 C.)
Bur.

Russell.
Bates Poor Land.
Texas Bur.

PLATE VII.



Minor. Smith Improved.
Petit Gulf. Texas Oak.
Matthews L. S. Griffin L. S,



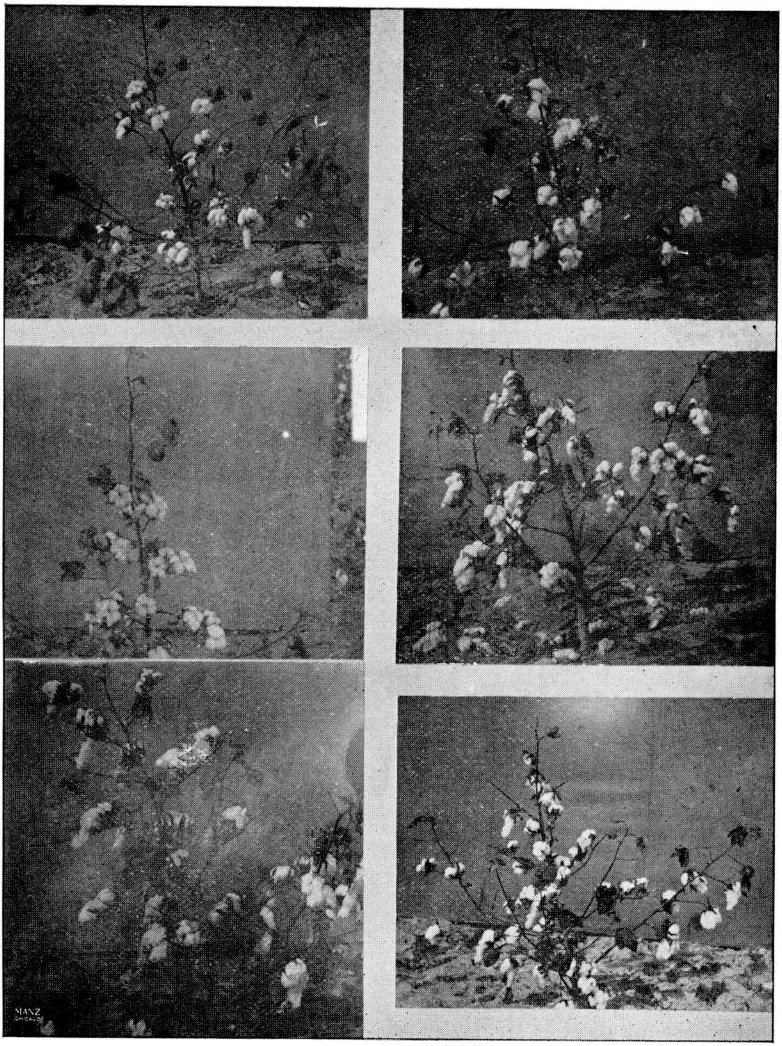
Allen Hybrid L. S.
W. A. Cook L. S.
Moon L. S.

Allen Improved L. S.
Doughty L. S.
Cobweb L. S.

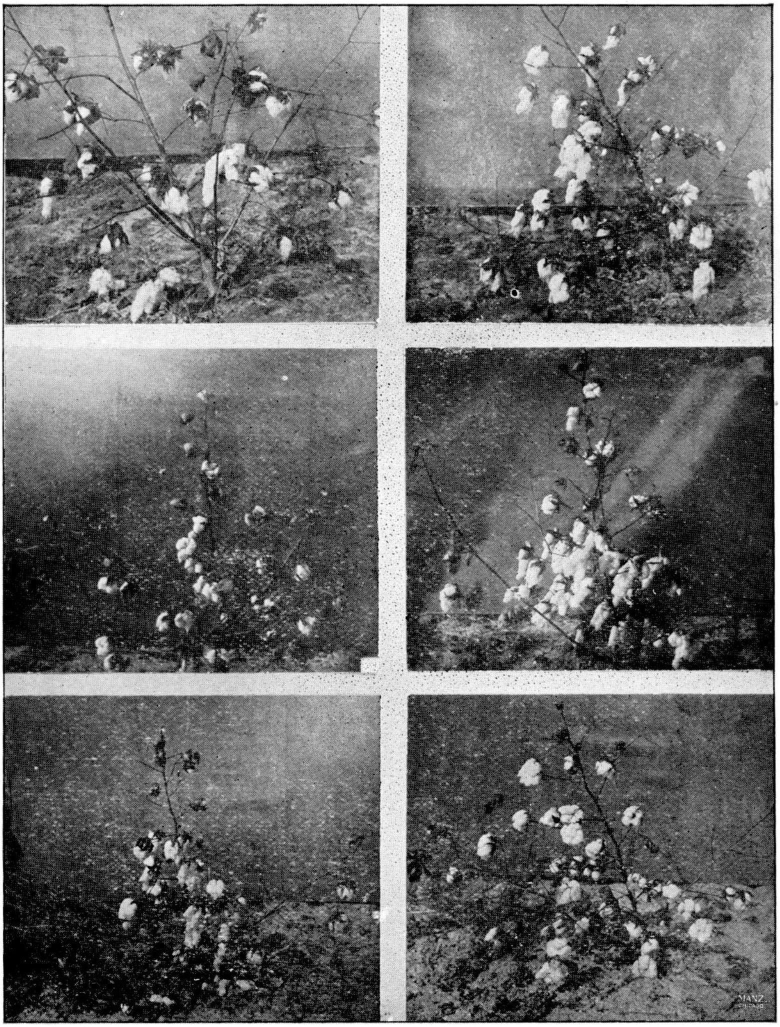
PLATE IX

Improved Long Staple.	Peterkin.
Gunn.	Excelsior.
Hilliard.	Shine.

PLATE X.

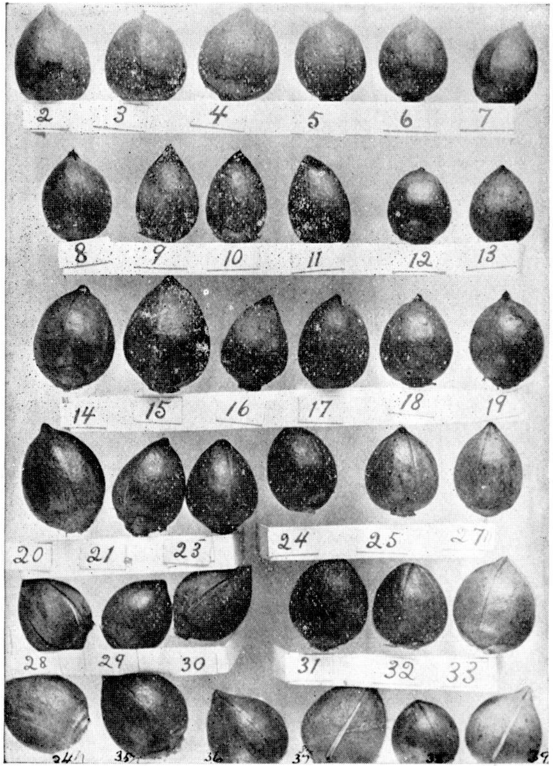


Thrash.	Banks.
Norris.	Pruitt Premium.
Big Boll.	Jones Improved (S. 37 C.)



Cheise.
Maddox.
Japan.

Borden.
Coppedge.
Texas Storm Proof.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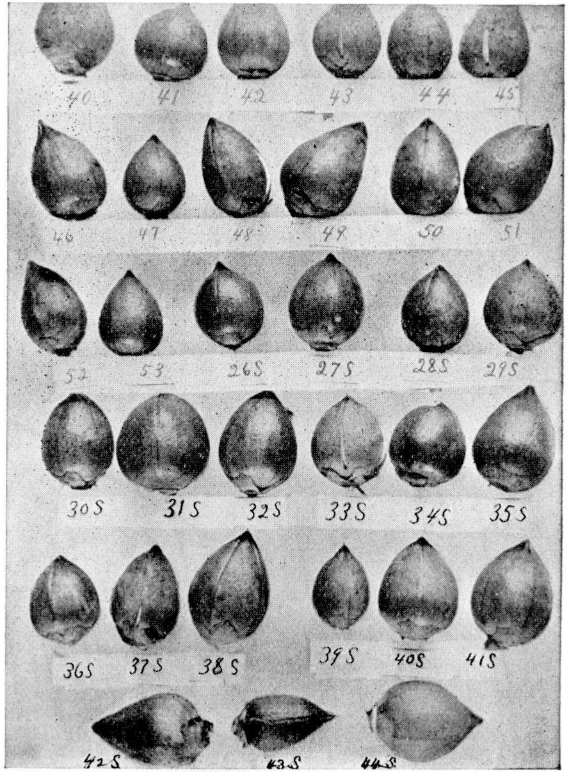
40 41 42 43 44 45
46 47 48 49 50 51
52 53 26S 27S 28S 29S
30S 31S 32S 33S 34S 35S
36S 37S 38S 39S 40S 41S
42S 43S 44S

THE MANURING OF COTTON.

BY J. F. DUGGAR.

THE EXTENT OF THE USE OF COMMERCIAL FERTILIZERS.

No statistics have been gathered to show what percentage of the area planted in cotton in Alabama is fertilized. A few decades ago practically the entire cotton crop of Alabama was grown without manuring, the use of commercial fertilizers being rare and the manures produced on the farm being more frequently used for food crops than for cotton. It still remains true that other crops than cotton have the first claim on the too-limited supplies of home-made manures. But the use of commercial fertilizers, or chemical manures, has been steadily and rapidly extending, especially during the last two decades.

The statistics furnished by the Commissioner of Agriculture of Alabama show that the following number of fertilizer tags have been sold during the past three years, the figures opposite representing the number of tons of commercial fertilizers (exclusive of cotton seed meal) sold annually in Alabama:

	No. of tags sold.	Equivalent to tons of fertilizer.
For the crop of 1897	1,101,830	110,183
For the crop of 1898	1,210,444	121,044
For the crop of 1899	993,480	99,348
Average for three years	1,101,918	110,192

There are no means of ascertaining the amount of cotton seed meal used as fertilizer in this State, but 10,000 tons per annum would probably be a low estimate. The cotton crop receives by far the larger portion of these commercial fertilizers. If we assume 105,000 tons as the average quantity of chemicals and cotton seed meal annually applied to the cotton fields of Alabama and if we assume 150 pounds per acre as the average amount applied, we have a calculated area of 1,400,000 acres of cotton annually receiving an application of commercial fertilizers. It is probably safe to say that in Alabama more than half of the land on which cotton is grown is fertilized with purchased materials.

There is no means of ascertaining the average selling price of commercial fertilizers, which, though chiefly consisting of goods sold until recently at $11.00 to $16.00 per ton, include also cotton seed meal and other fertilizers that cost considerable more than $16.00 per ton. The cost of the commercial fertilizers (including cotton seed meal) used by the cotton farmers of Alabama, either for cotton or for other crops on cotton plantations, must aggregate between $1,700,000 and $2,000,000 per annum.

The figures used above give some idea of the importance of the fertilizer question in cotton culture and justify the large amount of attention which the Alabama Experiment Station has given to investigations designed to aid the farmer in any part of the State in the selection of the most profitable fertilizer for the particular soil on which he grows cotton.

Not for all soils, nor indeed fully for any soil, has this problem been solved, but the lessons already learned as the results of these multitudinous experiments can be so used as to guide the farmer in many parts of the State in his choice of fertilizers and to materially increase the profits of cotton culture.

Do Fertilizers pay when Cotton is Five Cents per Pound?

We may in part answer this question by showing the average amount of increase in yield of seed cotton per acre attributable to different fertilizers. The following table (from Ala. Sta. Bul. 102) gives the *average* results for 22 co-operative fertilizer tests in 1897, and for 30 in 1898, made on a great variety of soils. The price assumed for a pound of seed cotton, $1\frac{5}{9}$ cents, is the *net* price of increase, or value of the seed cotton after paying 33 cents per 100 pounds for picking, and is equivalent to a gross price of 5 cents per pound for lint and $6.67 per ton for seed. At prices obtained for the crop of 1899 the profits would in many cases be double those shown in the table below.

Average increase in seed cotton per acre over unfertilized plots in 1897 and 1898.

Fertilizers.				Average 22 tests in 1897		Average 30 tests in 1898	
Plot No.	Amount per acre.	Kind.	Cost of fertilizers.	Increase over unfertilized plots.	Profit from fertilizers.	Increase over unfertilized plots.	Profit from fertilizers.
	Lbs.			*Lbs.*		*Lbs.*	
1	200	Cotton seed meal...........	$ 1.90	**113**	$—.15	**205**	$ 1.29
2	240	Acid Phosphate...........	1.50	**194**	1.51	**230**	2.08
3	00	No fertilizer................	.....	.....	....	....	.. ..
4	200	Kainit......................	1.38	**144**	.86	**97**	.13
5	200 240	Cotton seed meal......... Acid phosphate...........	3.40	**339**	1.87	**375**	2.43
6	200 240	Cotton Seed meal........ Kainit.....................	3.28	**282**	1.10	**258**	.73
7	200 200	Acid phosphate........... Kainit.....................	2.88	**287**	1.58	**283**	.88
8	00	No fertilizer...............	.....	.....	.....	.....	.....
9	200 240 200	Cotton seed meal......... Acid phosphate........... Kainit.....................	4.78	**419**	1.73	**392**	1.32
10	200 240 100	Cotton seed meal......... Acid phosphate........... Kainit....	4.08	**372**	1.79	**435**	2.84

This table shows that fertilizers, even when used indiscriminately, or without any attempt to suit the fertilizer to the soil were, as judged by *average* results, moderately profitable.

Averages, however, do not do full justice to the amount of increase which fertilizers afford when selected with special reference to their suitability for the soil on which they are to be applied. The detailed results from which the preceding table is made up, show that in a number of localities, the complete fertilizer, the meal and phosphate mixture, or even the phosphate applied by itself afford profits of more than $5 per acre after paying for cost of picking the increased yield due to the fertilizer, and this, too, when lint cotton was worth only 5 cents per pound. At the higher prices current in the winter of 1899-1900, each one of fertilizers or mixtures named in the above table would show a very satisfactory profit.

The absolute necessity for using fertilizers in the regions where they are now in general use can also be inferred from the small yields obtained in most tests on the plots that received no fertilizer. In our 52 conclusive tests in 1897 and 1898, the average yields *without fertilizers* were respectively 474 and 506 pounds of seed cotton per acre. Excluding all tests where the unfertilized plots produced 500 pounds or more of seed cotton per acre, we find that 11 soils in 1897 averaged without fertilizers only 281 pounds, and 17 soils in 1898 averaged, when unfertilized, only 299 pounds of seed cotton per acre, the entire product, including seed, being worth less than $6 per acre, at the low prices then prevailing.

To many minds even more conclusive in proving that commercial fertilizers are profitable than the results of any experiments is the fact that their use is constantly increasing. Both experience and experiment show that on many soils commercial fertilizers are indispensable to profitable cotton culture.

They have been occasionally charged with being largely responsible for the impoverished conditions of the cotton fields and the scant profits of the cotton grower. They are acquitted of the first charge by those who know the real causes of the deterioration of Southern soils. The exhaustion of the fertility of the cotton fields is due chiefly to leaching, washing, and loss of vegetable matter as the result of continuous clean cultivation. For the scant profits obtained in the culture of five-cent cotton, many causes are responsible, not least of which are impoverished soil, purchased supplies, unintelligent use of fertilizers, and the failure to master the principles which underly a rational system of farming. What we should condemn is not the *use,* but the *abuse,* or purposeless use, of commercial fertilizers.

KINDS OF FERTILIZER GENERALLY FOUND ON THE MARKET.

At the outset the farmer must choose whether he will buy a fertilizer already mixed, paying the fertilizer factory for the cost of mixing and for its profit, or whether he will buy the simple ingredients and do his own mixing on the farm. Of the ready mixed, or "manipulated" fertilizers, to which the name guano is so commonly applied, there are numerous varieties or brands on every important market, so that the farmer has the choice among brands that vary considerably in composition. He can buy phosphate with potash, or ammoniated phosphate with potash, and can choose between brands representing various proportions and percentages of nitrogen, phosphoric acid and potash.

As a general rule the complete manipulated guanos contain from 2 to 4 per cent. of nitrogen, 7 to 10 per cent. of available phosphoric acid, and 1 to 3 per cent. of potash.

If the farmer decides to buy the separate materials and do his own proportioning and mixing, (thus getting his fertilizing material at a lower price), he usually purchases cotton seed meal, acid phosphate, and kainit.

On the larger markets he has a choice from among a number of other simple fertilizers, as nitrate of soda, dried blood, muriate of potash, etc. On the farm of the Alabama Experiment Station no manipulated fertilizers are used, as we find it cheaper and more satisfactory to do our own proportioning and mixing.

The main consideration in buying fertilizers is to obtain available phosphoric acid, nitrogen and potash at the lowest cost per pound of each. This implies the necessity of buying according to analysis of the material under consideration and requires some figuring by simple arithmetical methods. A low price per ton of fertilizer is often accompanied by a high cost per pound of the nitrogen, phosphoric acid and potash, which it contains, especially where freight rates from the centers of fertilizer production are high. It frequently happens that the cheapest fertilizer is the dearest or least economical, and that low grade goods are poor investments.

In most of our experiments we have used in recent years chiefly Edisto High Grade acid phosphate, guaranteed to contain 14 per cent. of available phosphoric acid. The cotton seed meal and kainit used have been of average composition.

BEST FORMS OF NITROGENOUS FERTILIZERS.

The forms in which the cotton farmer may most conveniently purchase his supplies of nitrogen for purposes of fertilization are barn manure, cotton seed, cotton seed meal, and nitrate of soda. To this list might also be added sulphate of ammonia and various slaughter-house products, as dried blood and tankage. Of these cotton seed and cotton seed meal are most extensively used. At Auburn, as at nearly every experiment station in the Cotton Belt, tests have been made to determine the relative values of the nitrogen in these materials.

The number of comparisons made here of dried blood and sulphate of ammonia has not been sufficient to definitely establish their relative values for the soils of this region. However, the few experiments made suggest that the nitrogen in these materials is scarcely equal, and certainly not superior, to that in cotton seed meal.

Cotton seed meal versus nitrate of soda.—It is of greater importance to know the relative values of the nitrogen in cotton seed, cotton seed meal, and nitrate of soda. Let us first compare cotton seed meal and nitrate of soda.

In 1886 and again in 1887, on extremely poor soil, there was a decidedly larger yield of cotton where 420 pounds of cotton seed meal per acre was used than where 210 pounds of nitrate of soda was employed. This result is perfectly natural in view of the fact that these fertilizers were applied alone, the cotton supplied with nitrate of soda thus receiving only nitrogen, while with the 420 pounds of cotton seed meal were necessarily supplied the 12 pounds of phosphoric acid and the 7.4 pounds of potash contained in the meal.

In other tests here in 1886 and 1887, the above quantities of nitrate of soda and of cotton seed meal were again compared, this time in connection with a heavy application of floats. In this case the plants on both plots had a large amount of phosphoric acid at their disposal, and were thus able to make as good use of the nitrogen in nitrate of soda as in that of cotton seed meal. The yields were practically equal.

In 1897 and 1899 at Auburn, 75 pounds of nitrate of soda afforded a larger yield of cotton than did 216 pounds of cotton seed meal,—acid phosphate and kainit being used in connection with both nitrogenous fertilizers.

The co-operative experiments that were conducted in 1891 and 1892 under the direction of this station, afford a large number of comparisons between nitrate of soda and cotton seed meal. The quantity of nitrate of soda was 96 pounds per acre, in contrast with 240 pounds of cotton seed meal, the amounts of nitrogen in these two applications being practically equal. With both forms of nitrogenous fertilizer there was also applied 240 pounds of acid phosphate per acre.

The results of 49 co-operative tests are summarized in the following table:

	Yield seed cotton per acre.		
	1891. (27 tests.)	1892. (22 tests)	Average of 49 tests.
Average yield with cotton seed meal.....	814	879	844
" " " nitrate of soda	824	863	841

These results show the practical equality of nitrogen from these two sources, cotton seed meal and nitrate of soda. And to this conclusion we are also led by the majority of the experiments made at Auburn.

Taken as a whole, the experiments conducted by this Station on a number of soils, justify the recommendation that the farmer purchase nitrogen in whichever of these two forms a pound of nitrogen costs least. This is usually in cotton seed meal.

Cotton seed versus cotton seed meal.—The determination of the relative fertilizer values of cotton seed and cotton seed meal was the aim of a number of co-operative experiments conducted under the writer's direction in 1896. The tests were made on 14 different soils. The seed were crushed before being used, and hence were probably more quickly available and of greater value to the crop to which they were applied than uncrushed seed would have been. Cotton seed meal was used at the rate of 200 pounds per acre, crushed seed at the rate of 472 pounds. The following extract from Bulletin No. 78 of this Station, summarizes the results of these 14 tests:

"In deciding on the amounts of cotton seed and meal to be compared, quantities of each were employed which would afford equal amounts of nitrogen, as indicated by the analyses then available. A more nearly complete compilation of analyses published since this experiment was planned indicates that it would have been more strictly accurate to have used 434 pounds of cotton seed per acre instead of 472.

Seven experiments give larger yields with cotton seed and seven afford heavier crops with cotton seed meal. Combining the results of these 14 experiments we find that crushed cotton seed afforded an average of 10 pounds per acre of seed cotton more than did the meal. This difference in yield in favor of the seed is amply sufficient to counterbalance the fact that there was used as fertilizer 38 pounds per acre of crushed cotton seed in excess of what was necessary to supply the required amount of nitrogen. After making this allowance, we find that cotton seed and cotton seed meal were on an average equally effective when such quantities of each were compared as contained equal amounts of nitrogen.

A pound of nitrogen was just as valuable in one as in the other.

But the market prices of cotton seed and meal are not governed wholly by the relative amounts of essential fertilizer ingredients in each. Whether it is more profitable to sell seed and buy meal, or apply seed to the land, depends on the relative prices of these two materials. The average figures for 14 experiments in 1896 showed that one ton of crushed seed was equal to an amount of meal containing a like quantity of nitrogen, which we find to be 922 pounds of meal; from this it follows that 1 pound of meal was equal to 2.06 pounds of seed. Hence we get the price per ton of seed at which the farmer could afford to swap seed for meal by dividing the price of meal by 2.06 ($2\frac{1}{16}$). For example, assuming a price of $20 per ton for cotton seed meal and dividing this by 2.06 we have $9.22 per ton as the relative fertilizer value of seed. Of course, to this price of seed should be added the cost of getting the seed to the oil mill. To put the average results of fourteen tests made in 1896 into still another form, we may say that a ton of crushed cotton seed was worth on the farm as fertilizer 46 per cent. of the fertilizer value of a ton of cotton seed meal.

The preceding are only average results, and individual soils and crops may be more responsive to the one or to the other source of nitrogen. For example, or certain compact clay or prairie soils deficient in vegetable matter, cotton seed may be the more valuable because of its effect on the mechanical condition of the soil. On the other hand we can scarcely doubt that cotton seed meal has some advantage under conditions when it is necessary that the fertilizer should exert its effect quickly. In this connection attention is called to the fact that the fertilizers for this test were applied later than is customary, the great majority of them being put in the ground in April, while in a few cases they were not applied until May. This may have been a greater disadvantage to the cotton seed than to the meal."

A discussion of this subject necessarily turns largely on the chemical composition of the materials compared. Hence, the following figures calculated from many analyses compiled in Bulletin No. 33 of the Office of Experiment Stations, U. S. Department of Agriculture, are added:

	Nitrogen. Lbs.	Phosphoric Acid. Lbs.	Potash. Lbs.
2,000 lbs. of cotton seed contains	62.6	25.4	23.4
922 lbs. of c. s. meal contains	62.6	26.5	16.3

A comparison of cotton seed and cotton seed meal as fertilizers for cotton has been made at Auburn during each of the past four years, using such amounts of each as would supply equal quantities of nitrogen. The cotton seed has either been crushed or rotted. One test was inconclusive; in one test the seed afforded the larger yield, and in two experiments the nitrogen in cotton seed meal was more effective.

In some years and on some soils the nitrogen in cotton seed meal proves more available than that in cotton seed, while under different climatic conditions or on other soils the advantage is with the seed.

The average of 14 experiments mentioned above showed that one pound of meal was equal to $2\frac{1}{16}$ pounds of crushed seed; since uncrushed seed would be less quickly available, it would doubtless require a larger amount of these, perhaps $2\frac{1}{2}$ to 3 pounds, to equal one pound cotton seed meal, as regards the effect exerted on the crop to which it is immediately applied.

The exact value of cotton seed meal in terms of cotton seed is by no means determined by the experiments thus far made; indeed, though further investigation is needed, a universal mathematical relation between the fertilizing values of cotton seed and cotton seed meal cannot be expected, since the relation between them will vary with the kind of soil and with some other environments.

Cotton seed versus stable manure.—This comparison was made in many localities in Alabama in 1890, 1892, and 1893, under the direction of this Station. In 1890 the amount of cotton seed employed was 795 pounds; in 1891 and 1892 it was 848 pounds per acre. In every test there was used 5 pounds of stable manure as a substitute for each pound of cotton seed, the amounts of manure being respectively 3,975 and 4,240 pounds per acre. The term "green cotton seed" implies that this fertilizing material was used without being crushed or rotted. In this condition it decomposes more slowly than if crushed or rotted, exerts a smaller effect the first year, and doubtless leaves in the soil a larger unused residue of fertilizing material for the use of the next crop.

No description of the barn manure is given, but it was almost certainly manure from horse or mule stables. As it was obtained from a great number of farms we may assume that its composition did not greatly differ from the average published analyses of horse manure, viz: $\frac{1}{2}$ per cent. nitrogen, $\frac{1}{4}$ per cent. phosphoric acid, and $\frac{1}{2}$ per cent. potash.

The following table summarizes the results of seventy experiments, omitting only the few tests that are obviously incorrect. It refers only to the plots on which stable manure (3,975 or 4,240 pounds per acre) or cotton seed (795 or 848 pounds per acre) were used alone, and to the nearest unfertilized plot.

FERTILIZER.	Pounds seed cotton per acre.				Averege per cent. increase in crop.
	1990. (21) tests.	1891. (27) tests.	1892. (22) tests	Aver'ge of (70) tests.	
	Lbs.	*Lbs.*	*Lbs*	*Lbs.*	
Average yield unfertilized plots, seed cotton	494	400	425	**436**	
Average yield with stable man're	922	828	906	**880**	**101**
Average yield with cotton seed.	782	679	723	**724**	**64**
Increase in yield due to stable manure	428	424	481	**444**	
Increase in yield due to cotton seed	288	279	298	**288**	
Stable manure more effective by	140	145	183	**156**	

From this condensation of the results of the 70 tests it appears that 5 pounds of stable manure exerted during the year when applied a greater influence on the yield of cotton than did one pound of green cotton seed used as fertilizer; that the yield was increased by 101 per cent. when stable manure was used and by 64 per cent. when cotton seed was used; and that to obtain an increase of one pound in the yield of seed cotton there was required 3 pounds of cotton seed or nearly 10 pounds of stable manure.

To put the evidence in another form, it may be said that in 79 per cent. of these tests the yield was greater with stable manure than with cotton seed.

The quantity of stable manure used contained a larger amount of vegetable matter than did the smaller application of cotton seed. Both seed and manure undoubtedly left in the soil large amounts of unused fertilizing material for the benefit of subsequent crops.

LEGUMINOUS PLANTS AS FERTILIZERS FOR COTTON.

Nearly every cotton farmer is aware of the fact that the cowpea is a valuable fertilizing plant. Yet there are few who use cowpeas or other legumes to the extent that they may be employed as fertilizers. In the past few years a special effort has been made by the Agricultural Department of this Station to determine the values of cowpeas, velvet beans, and other legumes as fertilizers, not only for cotton, but also for corn, oats, wheat, and sorghum.

The experiments in which cotton was used to measure the fertilizing value of legumes are mentioned below.

Velvet beans and cowpeas as fertilizers.—At Auburn the yield of seed cotton in 1899 on a plot where wonderful cowpea vines,—grown in 1898 in drills,—had been plowed under after being picked was greater than on a plot cropped in cotton in 1898, the peas and cotton having been fertilized alike in 1898. The actual difference in yield of seed cotton was 157 pounds per acre, or making allowance for the fact that on the green-manured plot there was only 89 per cent. of a perfect stand, the difference in the yields thus corrected was 367 pounds of seed cotton per acre in favor of the plot previously cropped in cowpeas. The soil was fertile.

In 1898 in a poorer field there were grown on adjacent plots cowpeas, velvet beans, and cotton, all fertilized alike with acid phosphate and kainit. The cowpeas and velvet beans were planted thickly in drills, using per acre 112 pounds of cowpeas and 120 pounds of velvet beans. The variety of cowpeas used was the Unknown or Wonderful. Both cowpeas and velvet beans were picked and removed from the field, though the latter did not fully mature. The vines were turned under in March, 1899, and all plots were planted to cotton; each plot of cotton was fertilized at the rate of 240 pounds of acid phosphate and 96 pounds of kainit per acre.

The yield of seed cotton per acre in 1899 was 1,533 pounds following cowpeas, 1,373 pounds following velvet beans, and 837 pounds following cotton.

These figures show that the increased yield of seed cotton attributable to manuring with cowpea vines was 696 pounds per acre; the gain apparently due to the fertilization with velvet beans was 546 pounds per acre. In percentage the increase is 83 and 64 per cent. respectively. Valuing seed cotton at $2\frac{1}{2}$ cents per pound (which is equivalent to $6\frac{3}{4}$ cents per pound of lint and $7.50 per ton of seed), the gain with cowpeas and velvet beans is worth respectively $17.40 and $13.65 per acre.

Surely it was more profitable to grow cotton every alternate year at the rate of a bale per acre rather than to grow continuous cotton crops of about one-half bale per acre. If there be any doubt of this it should certainly be dispelled by the fact that one of these plots afforded in 1898 a yield of $18\frac{1}{4}$ bushels of peas per acre, besides increasing the cotton crop of the following year to the extent of $17.40 per acre.

It is but fair to state that in a rotation experiment begun in 1896 and which cannot be expected to afford positive results for several years yet, the increase in the yield of cotton following cowpeas (sown broadcast) has considerably less than the gains noted above. The smaller fertilizing effect of cowpeas in this incomplete rotation experiment is possibly due in part to want of uniformity in the plots, but is probably due chiefly to the fact that all cotton plots in the rotation experiment are fertilized with 120 pounds of cotton seed meal per acre, while in the experiments previously noted and in those detailed in the following paragraphs, no nitrogenous fertilizer was used, the plowed-in legume being the sole source of the nitrogen supply.

Vines and stubble of velvet beans as fertilizers for cotton.—On poor soil at Auburn an effort was made in 1898 and 1899 to ascertain the manurial value of the vines and stubble of velvet beans (*Mucuna utilis.*)

In 1898 cotton was grown on certain plots and velvet beans on others. The fertilization of all plots in 1898 was not identical, but for a given fertilizer applied to cotton there was a plot of velvet beans receiving the same fertilizer. The velvet beans grew in drills 3½ feet apart; the vines formed a dense net of vegetation, but did not mature seed. In March, 1899, velvet beans and cotton stalks were plowed in and soon afterwards all plots were fertilized alike with a mixture of 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre.

Russell cotton was planted in 3½ feet drills on all plots on April 21. From midsummer forward there was a remarkable difference in the appearance of the two sets of plots, the cotton plants being much larger, greener, and more luxuriant on the plots where velvet beans had grown the year before.

The following table gives such of the results as bear on the fertilizing value of velvet beans:

Value of velvet beans as a fertilizer for cotton.

Fertilizers used the previous year.	Plot No.	Preceding crop.	Seed cotton per acre in 1899. Yield.	Seed cotton per acre in 1899. Increase due to velvet beans.
			Lbs.	*Lbs.*
Acid phosphate used in 1898	6	Velvet beans in 1898 ..	1502	622
	1	Cotton in 1898	880	
Raw phosphate used in 1898	7	Velvet beans in 1898...	1570	602
	2	Cotton in 1898	968	
No phosphate used in 1898	8	Velvet beans in 1898....	1661	755
	3	Cotton in 1898.........	906	
Average increase attributable to velvet beans..........				**660**

The above table shows that the average increase attributable to velvet beans used as a fertilizer was 660 pounds of seed cotton per acre, a gain of 72 per cent. as compared with the average yield on plots where the preceding crop had been cotton. At $2\frac{1}{2}$ cents per pound of seed cotton (equivalent to $6\frac{3}{4}$ cents per pound for lint and $7.50 per ton for seed) this increase is worth $16.50 per acre. Moreover, experiments with other plants indicate that the fertilizing effect of legumes is not all felt the first year, so that there undoubtedly still remains in the soil to the credit of the velvet-bean manuring a considerable proportion of unused fertilizing materials available for future crops.

In the same field the velvet beans on one plot were cut for hay October 12, 1898. The stubble and roots were plowed in at the same time as the vines on the other plots referred to above.

Cotton on the plot where only roots and stubble were plowed in yielded in 1899 an amount of seed cotton which was 510 pounds greater than the yield on the corresponding plot previously cropped in 1898 in cotton.

Following roots and stubble the yield of seed cotton was 112 pounds less than on a comparable plot where the entire growth of velvet beans had been plowed under as fertilizer.

Experiments here and at other Southern Experiment Stations prove that it is generally more profitable to utilize the legumes for hay, plowing under only the roots and stubble as fertilizer, than to turn under the entire growth.

Cowpeas as fertilizer on lime land.—A co-operative fertilizer experiment nearly parallel to the above was conducted for this Station by Capt. A. A. McGregor on lime land at Town Creek, in North Alabama. In his experiment the cowpea was the legume employed.

In 1898 cowpeas were grown on certain plots and cotton on others. The cowpea vines, on which no fruit had matured, were plowed under in the spring of 1899. Cotton was planted on plots which had borne a crop of cotton in 1898 and on others which had grown cowpeas for fertilizing purposes, as above indicated. All cotton plots referred to in this paragraph were unfertilized in 1899, and the fertilization of cowpeas and cotton in 1898 had been identical, only phosphate being used with either crop.

The weather was exceedingly unfavorable in 1899, so that the full measure of the fertilizing value of cowpeas is not revealed in this test.

Value of cowpeas as fertilizer for cotton at Town Creek, Ala.

Fertilizers used the previous year	Plot No.	Preceding crop.	Seed cotton per acre in 1899.	
			Yield.	Increase due to cowpeas.
			Lbs.	*Lbs.*
Acid phosphate used in 1898..	6	Cowpeas in 1898........	468	140
	1	Cotton in 1898..........	328	
Raw phosphate used in 1898..	7	Cowpeas in 1898........	316	152
	2	Cotton in 1698	164	
No phosphate used in 1898..	8	Cowpeas in 1898........	228	84
	3	Cotton in 1898..........	144	
Average increase attributable to cowpeas				125

In this case the average increase in the yield of seed cotton, which we may attribute to the cowpea vines is, even under very adverse conditions, 125 pounds, worth at $2\frac{1}{2}$ cents per pound, $3.92 per acre. Doubtless future crops will also be benefited by the fertilization with cowpeas.

The importance of the teachings of these experiments can scarcely be over-estimated. The figures show that the first cotton crop following a leguminous plant, as the cowpea and velvet bean, was much larger than was obtained on plots where the preceding crop was cotton.

According to these figures a farmer can reasonably expect to obtain an increase of 300 to 600 pounds of seed cotton per acre by plowing under the entire growth of a leguminous plant, when conditions are favorable and when the legume grows luxuriantly and is the sole nitrogenous fertilizer. The gain is somewhat less when only the stubble of the legume is used as fertilizer, or when the legumes make a poor growth or occupies only a portion of the land, as occurs when cowpeas are drilled between the corn rows. But under all these conditions leguminous plants augment the yield of the following cotton crop to a profitable extent.

In the writer's opinion *the most promising means for increasing the yield of cotton per acre and the profits of cotton culture is by a more general use of leguminous plants as fertilizers.* These invaluable allies are by some farmers utilized and appreciated, but their use might be increased twentyfold with advantage to the current crop, to the permanent upbuilding of the soil, and to the filling of the farmer's pocket. It is putting the case very mildly to say that the average yield of cotton per acre in Alabama might be increased by at least fifty per cent. through the general use of legumes as fertilizers.

The limits of this article preclude a discussion of the best means of utilizing the legumes as fertilizers and of the best kinds to employ under varied local conditions. However the section headed "Rotation on Cotton Farms" affords a suggestive outline of one method of making the valuable leguminous plants tributary to profitable cotton planting, and numerous bulletins published by this Station deal with those leguminous plants that are most available to the farmers of the Cotton States.

RESIDUAL EFFECTS OF NITROGENOUS FERTILIZERS.

Few experiments have been made here or elsewhere in the South to determine the extent to which cotton may be benefitted by applications of fertilizers made to previous crops.

A test made in 1888 suggested that compost (composition or constituents not given) exerted no effect on the second crop when the amount of compost used was only 840 pounds per acre. Certainly larger amounts of compost,—and on some soils, the quantity mentioned above,—would prove beneficial to the second as well as to the first crop of cotton.

In one experiment it was thought that cotton seed meal, used in large quantity, exerted some residual effect, but the data were not entirely conclusive.

At Auburn in 1899 the increase in the yield of seed cotton attributable to 720 pounds of rotted cotton seed applied the preceding year, was in one case 28 pounds, and in another instance 35 pounds, an average increase of only 32 pounds of seed cotton per acre.

In a similar experiment, conducted under the direction of this Station by Capt. A. A. McGregor at Town Creek in 1898, the increase in the yield of seed cotton apparently attributable to the use of 720 pounds per acre of heated or rotted cotton seed was 84 pounds, when used in connection with acid phosphate, and 120 pounds when used in combination with raw phosphate. The average increase due to the seed was in the first crop 101 pounds of seed cotton per acre.

The second crop, viz., the crop of 1899, grown on the same plots without additional fertilization, showed no favorable effect from the application the preceding year of this amount of heated seed.

It is not safe to conclude that cotton seed will usually show practically no residual effect, for the very unfavorable weather conditions of 1899 may have been responsible for the above mentioned negative results. With larger amounts of seed, and on other soils observation has shown that cotton seed do exert a marked residual or "second-year" effect.

As a general rule we may safely assume that the coarser, less concentrated, and less soluble the nitrogenous fertilizer the larger the percentage of its manurial value fails to be appropriated by the first crop and remains in the soil for the use of subsequent crops. Hence in permanency of effect we should expect stable manure and leguminous plants to rank first, followed by green cotton seed, and then by crushed or rotted cotton seed. Cotton seed meal is very largely, if not entirely, utilized or wasted the first year, while from nitrate of soda we can expect no perceptible residual effect.

A RATIONAL SYSTEM OF FERTILIZATION.

Considering permanency of effect, as well as influence on the crop immediately following, the cowpea and other leguminous plants must be ranked as a cheaper source of nitrogen than is any nitrogenous material which may be bought as commercial fertilizers. The aim of the cotton farmer should be to grow such areas of legumes as will enable him to dispense with the purchase of nitrogenous fertilizers for cotton, using the funds thus saved to purchase increased amounts of phosphates or other necessary non-nitrogenous fertilizers. The money that would have been necessary to purchase one pound of nitrogen will buy about three pounds of phosphoric acid, or of potash, which larger purchases of phosphate and potash will enable the farmer to grow heavier crops of legumes. And heavier crops of legumes trap larger amounts of otherwise unavailable atmospheric nitrogen and result in further soil enrichment and in increased amounts of forage, enabling the cotton planter to maintain more livestock and to save more barn manure.

RAW VERSUS ACID PHOSPHATE.

On the College Farm at Auburn in 1882, the increase attributable to acid phosphate was 182 pounds of seed cotton per acre, while the increase ascribed to an equal weight of raw phosphate averaged 91 pounds, both phosphates having been used in connection with cotton seed meal.

In 1884, in the presence of 360 pounds of cotton seed meal per acre, raw phosphate was practically as effective as acid phosphate. In 1885 the results bearing on this question were inconclusive by reason of want of uniformity in the soil of the plots. In 1886 the results show that in the absence of nitrogenous fertilizers, neither raw nor acid phosphate at the rate of 420 pounds per acre was greatly advantageous, the yield being slightly in favor of the raw phosphate.

In 1887, in the presence of 210 pounds of cotton seed meal per acre, the yield was greater with raw than with acid phosphate (210 pounds of either), while in the absence of organic fertilizers the yields were practically identical with these two forms of phosphate.

In 1888, in connection with 400 pounds of cotton seed meal per acre, floats and acid phosphate afforded nearly equal yields of seed cotton.

In 1896 at Auburn, acid phosphate afforded a larger yield of seed cotton than did Florida soft phosphate, both being applied in the presence of cotton seed meal.

In 1897 high grade acid phosphate was compared with Tennessee (raw) phosphate and with (raw) Florida soft phosphate. In all cases, whether rotting vegetable matter (in the form of cotton seed meal) was present or absent, the acid phosphate afforded the larger yield.

The single instance in the experiments of recent years in which raw phosphate afforded a larger yield than acid phosphate, was when in 1897 equal quantities of each were composted with 1,500 pounds per acre of horse manure. Under these conditions the yield was 44 pounds greater with raw that with acid phosphate.

ACID PHOSPHATE VERSUS RAW PHOSPHATE.

In the co-operative experiments conducted under the direction of this Station on many different classes of soils, numerous comparisons of acidulated and raw phosphate have been made.

In 1890 the comparison was between 195 pounds of dissolved bone and 300 pounds of floats per acre, 90 pounds of sulphate of ammonia per acre being used with each. In 20 tests the average yield of seed cotton per acre was 904 pounds when the acidulated phosphate was used and only 780 pounds with floats. The difference in favor of dissolved bone was 124 pounds of seed cotton per acre.

In 1891 and 1892 the comparison was between equal weights of acid phosphate and floats, 240 pounds per acre, both being used in connection with 96 pounds of sulphate of ammonia per acre.

The average of 27 tests in 1891 shows a yield per acre of 824 pounds of seed cotton with acid phosphate and of only 609 pounds with floats. The difference in favor of acid phosphate was 215 pounds of seed cotton per acre.

The average of 22 tests in 1892 shows that the yield of seed cotton per acre was 863 pounds with acid phosphate and only 703 pounds with floats. The superior effect of the acidulated phosphate is measured by the difference of 160 pounds of seed cotton per acre.

It is of interest to note that in 27 tests in 1891 a mixture of cotton seed and 240 pounds of floats per acre afforded an average yield of seed cotton which exceeded the yield obtained with an application of cotton seed alone by only 64 pounds of seed cotton per acre. Likewise in 22 tests in 1892 the addition of floats to cotton seed increased the average yield by only 76 pounds of seed cotton per acre. In these tests the amount of seed used as fertilizer was about 800 pounds per acre.

Thus, under conditions favorable to raw phosphate, (that is, in the presence of decomposing vegetable matter), it was able to increase the yield only to the extent of 64 or 76 pounds of seed cotton per acre. On the basis of the prices prevailing in 1897 and 1898, the cost of the raw phosphate was greater than the value of the increased yield attributable to this fertilizer.

Not only was the average yield much smaller with raw than with acid phosphate, but in 58 of these tests, that is, in 88 per cent. of the separate experiments, the acid phosphate afforded the larger yields.

In the co-operative experiments of 1896 a comparison was made between equal weights of high grade acid phosphate (16.2 per cent. available phosphoric acid) and Florida soft phosphate, the latter containing 29.2 per cent. of total phosphoric acid, nearly all being in an insoluble form. With both phosphates kainit was used and also 200 pounds per acre of cotton seed meal.

In 14 tests the average yield of seed cotton per acre was 43 pounds greater with acidulated than with raw phosphate. The superiority of the acid phosphate was shown by the higher yields with this fertilizer in each of 11 experiments, or in 79 per cent. of the tests.

A series of experiments planned to throw light on the immediate and residual effects of raw and acid phosphate and cotton seed and on the value of green manuring was begun in 1898 at Auburn and in co-operative tests under our direction in other localities. The data relative to cotton seed and cotton seed meal and green manuring have been briefly discussed elsewhere in this article. For various reasons most of these experiments were not continued as planned, hence the following table is somewhat fragmentary, showing only such data as directly bear on the relative values of acid phosphate and Tennessee phosphate. Equal quantities of the two phosphates were used, 240 pounds per acre.

Yield in pounds of seed cotton per acre; acidulated vs. raw (Tennessee) phosphate in 1898.

Plot No.	Fertilizer per acre.	Blountsville. Yield.	Blountsville. Increase due to phosphate	Town Creek. Yield.	Town Creek. Increase due to phosphate.	Notasulga. Yield.	Notasulga. Increase due to phosphate.	Auburn.	Average increase due to phosphate.
	No vegetable matter (1898).	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		
1	240 lbs. acid phosphate	960	696	544	304	552	136	....	279
2	240 lbs. raw phosphate	512	248	244	4	506	46	....	99
3	No phosphate	264	....	240	....	416	....	....	....
	Vegetable matter in cotton seed (1898).								
4	240 lbs. acid phosphate 720 lbs. cotton seed	1280	....	628	....	1020	....	....	....
5	240 lbs raw phosphate 720 lbs. cotton seed	811	....	360	....	796	....	....	....
	Abundance of vegetable matter in 1899, from cowpea vines of 1898.								
8	Cowpea vines No phosphate	....	....	....	....	....	....	....	....
9	Cowpea vines 240 lbs. acid phosphate	....	....	356	128	....	....	1390	....
10	Cowpea vines 240 lbs. raw phosphate	....	....	256	28	....	....	1184	....

At Town Creek and Blountsville, on lime soils, and at Tuskegee and Auburn on sandy soils, the results point to a common conclusion, to decided preference of the cotton plant for the acidulated form of phosphate.

It has been claimed that raw phosphate is as effective as acid phosphate when used in connection with large quantities of organic fertilizers or on land containing much vegetable matter. The rotting vegetable matter is thought to convert a part of the insoluble phosphoric acid into a soluble form.

The records in the above table do not show an equality of the two classes of phosphates even under these favorable conditions. Raw phosphate was decidedly less advantageous than acid phosphate even when applied to land on which a few months before a heavy growth of cowpea vines had been incorporated with the soil. Notwithstanding the assumed favorable effect of the vegetable matter in increasing the availability of the raw phosphate, the yield, under these conditions, was, with acid phosphate, greater by 100 pounds of seed cotton in one case and by 206 pounds in another instance.

When vegetable matter was not thus supplied the superiority of acid phosphate was still more marked, the differences in yield in its favor being respectively 448, 300 and 90 pounds of seed cotton, an average excess of 279 pounds per acre.

While a few of the earlier tests made at Auburn were thought at the time to indicate the possibility of the economical substitution of the cheaper raw phosphate for the most costly acidulated material, our hundred or more experiments bearing on this question, taken as a whole, declare emphatically that under ordinary conditions and present prices it is more profitable to fertilize cotton with acidulated than with raw phosphate. When the latter is employed at all it is best to use in connection with it some form of organic nitrogenous material as stable manure, cotton seed, or even cotton seed meal.

REVERTED VS. SOLUBLE AND INSOLUBLE PHOSPHORIC ACID.

At Auburn in 1882, 1886, 1887 and 1897, phosphate in which the phosphoric acid existed in reverted or citrate-soluble form was compared with raw and with acid phosphate.

In the two earlier tests reversion was caused by the addition of slaked lime to double its weight of acid phosphate, the resulting mixture being compared with the same amount of acid phosphate as had been used in the preparation of the reverted phosphate.

In 1882, in the presence of cotton seed meal, the increase in yield attributable to the reverted phosphate was 106 pounds of seed cotton per acre, against an increase of 182 pounds with acid phosphate and 91 pounds with raw phosphate. In 1884, in the presence of very large amounts of cotton seed meal, reverted, raw, and acid phosphate gave practically identical results. In 1886, in the absence of vegetable matter, the yield with 420 pounds of reverted phosphate per acre (source and method of manufacture not indicated) was greater than with an equal weight of English acid phosphate or of raw phosphate. In 1887 the results were inconclusive.

In 1897 the reverted phosphate was prepared as follows:

Equal quantities of acid phosphate and Florida soft phosphate were thoroughly mixed and moistened about one month before being applied to the soil. The mixture was then allowed to dry thoroughly, after which it was pulverized as thoroughly as practicable. This was done in order that reverted phosphate might be formed from some of the phosphoric acid previously existing in an insoluble form in the Florida soft phosphate.

The raw, reverted, and acid phosphate was each used at the rate of 240 pounds per acre, and with each was cotton seed meal and kainit.

With a mixture of these two kinds of phosphates the yields were larger than with an equal weight of Florida soft phosphate, but smaller than with an equal weight of acid phosphate.

The experiments made at this Station are not entirely conclusive as to the value of reverted phosphate as a fertilizer for cotton. On the whole they afford no proof that citrate soluble phosphoric acid is decidedly inferior to the water soluble form; they strongly suggest the superiority of reverted phosphoric acid to the insoluble form.

SOLUBLE PHOSPHORIC ACID FROM DIFFERENT SOURCES.

From the results of experiments conducted at Auburn in 1883 and 1884, Prof. J. S. Newman drew the conclusion that "the cotton plant has no choice between soluble phosphoric acid from bone and from phosphate rock."

RESIDUAL EFFECTS OF PHOSPHATES.

In 1888 cotton was grown without fertilizers on plots which both in 1886 and 1887 had been fertilized with 420 pounds per acre of either raw, reverted, or acid phosphate. The results are scarcely conclusive; the yields show no greater residual effect from raw phosphate than from reverted phosphate and apparently little if any advantage of raw over acid phosphate in its second-year or residual effects. Indeed there was apparently but little increase in yield on most plots as the result of the application of large doses of any of the several forms of phosphate.

The results bearing on the relative residual effects of raw and acid phosphate obtained in three experiments in 1898 and 1899 are given in the table below. In 1898 high-grade acid phosphate and Tennessee raw phosphate, without nitrogen, were used in fertilizing cotton on adjacent plots, a third plot being unfertilized in 1898. In 1899 all three plots were unfertilized.

Pounds seed cotton per acre in 1899 on plots fertilized in 1898 with raw and acid phosphates.

	Yield in 1899.	Auburn	Town Creek.	Average Yield.	Average increase due to 2nd year effect of phosphate.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
P. 1	240 lbs. acid phosphate in 1898	1156	328	742	....
P. 2	240 lbs. Tenn. (raw) phosphate in 1898	1100	164	632	....
P. 3	No fertilizer in 1898	820	144	382	....
	Increase in yield in 1899, due to fertilizers of 1898				
P. 1	240 lbs. acid phosphate in 1898	336	184	....	260
P. 2	240 lbs. Tenn. (raw) phosphate in 1898	280	20	....	150
P. 3	No fertilizer in 1898	....	....	....	....

Both in the test conducted on sandy and on lime land, at Auburn and on the farm of A. A. McGregor, at Town Creek,—the yield of cotton was greater in 1899 on land which the year previous had been fertilized with acid phosphate than on that previously fertilized with raw phosphate. These two experiments indicate plainly that acid phosphate, applied to cotton at the rate of 240 pounds per acre, is not necessarily exhausted the first year, but may extend its beneficial effect to the crop of the second year. They contradict the supposition that raw phosphate, by reason of its slow solubility must necessarily have a greater residual or second-year effect than an equal amount of acid phosphate.

Taking into consideration all experiments made by or under the direction of this Station, there seems to be abundant reason for preferring the acidulated to the raw phosphate, and little ground for expecting the raw phosphate to show a superiority to acid phosphate in the years subsequent to that in which the application is made.

Acid phosphate now is, and is likely to remain, the cotton planter's most economical source of phosphoric acid.

BEST FORM OF POTASH.

Of the several forms of potash kainit is most used by the cotton planter. Its effects in restraining black rust have been often noted in the publications issued both by the Biological and Agricultural Departments of the Alabama Experiment Station. But inasmuch as this subject is discussed at length by the Biologist, it is only necessary here to refer to it.

In our fertilizer experiments two facts relative to kainit and rust are noticeable, viz: (1) the usual favorable effect of kainit in checking rust, and (2) its occasional failure on some soils and in some seasons to reduce the injury resulting from this disease.

An example of the very effective use of kainit in checking rust occurred on the farm of this Station on sandy soil in 1898; on the other hand in 1899 there was little benefit from kainit in restraining rust, this negative result being obtained on the same soil which had the previous year gratefully responded to applications of potash.

An experiment conducted by the writer in 1898 showed that a pound of potash in the form of muriate was as effective in checking rust as when an equal amount was applied in the form of kainit. A comparison of potash in the form of kainit, muriate, sulphate and silicate was made in 1889 on light sandy soil on the farm of J. Binford, near Auburn. The results were inconclusive except in showing that under the unfavorable conditions of soil and weather no form of potash was decidedly advantageous.

In our co-operative fertilizer experiments 100 pounds of kainit per acre has been repeatedly contrasted with 200 pounds, both being used in connection with cotton seed meal and acid phosphate. The smaller as well as the larger amount has exerted a noticeable effect in checking rust. In 1898 on the Station Farm 200, 100, and 60 pounds of kainit per acre were compared, each forming part of a complete fertilizer. The larger amount was most marked in its restraining effect upon rust, while 60 pounds exerted a slightly favorable influence. If kainit is used to prevent rust it seems advisable to use at least 100 pounds per acre, and quantities much smaller than this can scarcely be expected to have much effect on rust, though in a general way they may be beneficial.

Usually potash can be purchased at a cheaper rate in muriate of potash or kainit than in the sulphate, or in other forms. In deciding between muriate and kainit the farmer should remember that it is slightly less convenient to apply muriate of potash; for as this is four times as strong as kainit, it is advisable to use only 25 to 50 pounds of the muriate per acre, which small amount necessitates extreme care in pulverizing and evenly distributing this fertilizer.

Aside from this slight consideration of convenience, the farmer should buy that one of these materials in which a pound of potash delivered at his farm costs him least. Where the freight rate or cost of hauling is high the muriate will be the cheaper source of potash; near seaport cities, or where freight rates are low, kainit may be the cheaper form of potash.

Where very large doses of kainit are employed it is doubtless preferable that the kainit be placed in the soil at least several weeks before the seed are planted. In using 200 pounds of kainit per acre, carefully incorporated with the soil by running a scooter plow in the drill, we have been able to detect no injury from applying this fertilizer immediately in advance of planting, though our preference is to apply all fertilizers some weeks in advance so as to insure their diffusion through the soil and to permit the ridges or beds to become moderately compact before planting.

BEST POTASH FERTILIZERS.

In 1898 and 1899 comparison was made of several kinds and of varying amounts of potash fertilizers. The experiment was continued for two years on the Station Farm. The plots were located on the crest of a hill, where the soil was a deep, white or gray sand, and very poor. This spot was selected because of its extreme liability to cause cotton growing on it to suffer from rust, a disease for which kainit has often been recommended as a preventive.

In 1898 muriate of potash at the rate of 50 pounds per acre was at least as effective as 200 pounds of kainit in restraining rust and in augmenting the yield. Black rust was very severe on the plots receiving no potash and on the plot to which had been applied in large quantity an insoluble form of potash,—native potash feldspar rock. In checking rust 200 pounds of kainit per acre was better than 100 pounds, and this latter amount was slightly more effective than 60 pounds of kainit per acre.

The results of tests made in 1899 on this poor field are given below; the basal mixture referred to consisted of 120 pounds of cotton seed meal and 240 pounds of acid phosphate per acre.

Yield of seed cotton obtained with the use of different forms of potash.

Plot No.	Fertilizers. Am't per acre.	Fertilizers. Kind.	Yield of seed cotton per acre.
	Lbs.		*Lbs.*
1	200	Kainit and basal mixture	678
2	100	Kainit and basal mixture	592
3	60	Kainit and basal mixture	526
4	......	No potash; only basal mixture	272
5	1000	Potash feldspar in 1898; only basal mixture in 1899	244
6	50	Muriate of potash and basal mixture	768

Although there was some rust in 1899, the amount was much less than in the preceding year. Potash only moderately increased the yield in 1898, and to an extent by no means commensurate with its effect in checking rust and causing the plants to retain their leaves late into the season. In 1899, on the other hand the yield with potash was at least double that of the plots receiving none of this material, but little of which increase can be attributed to the rust-restraining effect of potash. Even the small amount of 60 pounds of kainit per acre was highly beneficial, 100 pounds still more advantageous, and 200 pounds of kainit or 50 pounds of muriate afforded a large increase in the yield of cotton.

A special potash experiment made by Mr. R. Neighbors, near Auburn, for this Station, was inconclusive by reason of want of uniformity in the soil.

In 1899 a special potash experiment was made under the direction of the writer by Mr. John Binford, on his farm two miles southeast of Auburn. This soil is a gray sand. On the plots receiving full rations of potash, such an amount of the several fertilizers was used as would supply equal quantities of potash. On one plot common salt was substituted for kainit. There was some little rust, but in this respect there was no very great difference among the several plots, though it was noted August 18th, that rust was most abundant on the plot receiving neither potash nor salt and that it was least abundant on the plot fertilized with silicate of potash.

The basal mixture referred to in the following table consisted of 200 pounds of cotton seed meal and 240 pounds of acid phosphate per acre. The stand of plants was good on all plots. The results of the special potash experiment on Mr. Binford's farm are shown in the following table:

Results of special potash experiment in 1899.

Plot No.	Amount per acre.	FERTILIZER.	Yield seed cotton per acre.
	Lbs.		*Lbs.*
1	200	Common salt (NaCl) and basal mixture...	576
2	50	Muriate of potash and basal mixture......	608
3	....	Only basal mixture......................	584
4	200	Kainit and basal mixture................	624
5	60	Kainit and basal mixture................	524
6	100	Kainit and basal mixture................	492
7	28	Sulphate of potash and basal mixture.....	672
8	32	Silicate of potash and basal mixture......	612

In no form was potash notably advantageous, for the higher yields of Plots 7 and 8 were apparently due to want of perfect uniformity in the soil.

The three experiments referred to above, together with data obtained incidentally from other experiments at Auburn and numerous co-operative fertilizer tests seem to warrant the following conclusions relative to the use of potash fertilizers with cotton:

(1) Not only kainit, but other soluble forms of potash, as the muriate, sulphate, and silicate may, under suitable atmospheric conditions, restrain the spread of black rust.

(2) The minimum amount required to exert a notably beneficial rust-restraining influence is not yet determined, but is between 50 and 100 pounds of kainit per acre, and apparently nearer the latter figure.

EFFECTS OF LIME ON COTTON.

Few experiments have been made at the Alabama Experiment Station or elsewhere in applying lime to cotton. Those made here, are mentioned below.

In 1885, 300 pounds of floats (raw phosphate) per acre used alone afforded an average yield of 337 pounds of seed cotton per acre. An adjacent plot fertilized with the same amount of floats and also with 150 pounds of air slaked lime per acre yielded 442 pounds, an increase of 105 pounds of seed cotton per acre.

In 1886, and again in 1887, air slaked lime at the rate of 420 pounds per acre was applied to cotton in connection with an equal quantity of floats and also on other plots with an equal amount of acid phosphate. There was no increase in yield on the plots receiving lime, either during the year when applied, or in the succeeding year.

In 1896, air slaked lime was applied broadcast in January at the rate of 640 pounds per acre to our stiffest grade of land, in addition to a complete fertilizer applied in the drill. The plot receiving lime afforded in 1896 practically the same yield as the check plot. However, the cotton crop in 1897, growing on a plot where a similar dressing of lime had in 1896 been applied to cowpeas, afforded an increase of 91 pounds of seed cotton per acre in comparison with the yield of the check plot.

In short, light applications of lime in four experiments failed to increase the yield of cotton; in two experiments a moderate increase in yield of cotton accompanied the use of lime. These favorable effects seem to be exceptional and may be due in the one case to the effect of lime in changing insoluble into soluble potash in the soil, and in the other to the action of lime in hastening the rotting of the cowpeas which had recently been plowed into the soil.

On our upland soils at Auburn there appears to be no advantage in applying lime. However, on this farm is one reclaimed swamp, with a poorly drained acid soil. Probably on soils of this nature cotton would respond to applications of lime.

Nor should it be assumed that a sour or acid condition is found only in low-lying, poorly drained fields. On the flat sandy top of the Little Mountain in Lawrence county, in the northern part of the State, the writer tested a number of samples of cultivated, apparently well drained soils, and in most cases they showed an acid reaction. In the extreme southern part of the State sour soils are frequently to be found. The writer found a number of such tracts near Brewton and Prof. F. S. Earle has noted their occurence near Citronelle, in the same part of the State.

We know that many plants are intolerant of acid soils and that others are indifferent. It is not known to which class of plants cotton belongs, but on all soils which show an acid reaction,—indicated by the moist soil turning blue litmus paper to a pink or reddish tint,—there is a probability that lime will be helpful to most cultivated plants.

BARN MANURE.

Only an inconsiderable proportion of the acreage in cotton is fertilized with barn manure. In explanation it must be said that the number of livestock maintained on most cotton farms is entirely inadequate to furnish barn manure for any large acreage. Often this consists of little more than the teams necessary to cultivate the crop, or one mule for each 15 to 25 acres of cotton. A large proportion of the manure obtained from work teams is applied to corn and other food crops.

An increase in the number of head of livestock maintained on cotton farms would do much towards bringing prosperity to cotton planters. * At prices recently prevailing there is little if any profit in growing cotton except on land naturally fertile or on well manured soil. It is probably a conservative estimate if we regard only half the acres that the *average* farmer cultivates in cotton as returning a profit, the other half barely paying expenses or incurring a loss. The conversion of these poorer areas, at present unprofitably cultivated in cotton, into pastures on which to maintain an increased number of livestock, offers obvious advantages both in direct and indirect profits. Thus utilized, poor soils are renovated, and the livestock maintained on them would also afford a home market for the cotton seed produced on the farm, checking this drain upon the fertility of the soil, and manufacturing manures that can in large part take the

* These statements refer to a price of 5 to 6 cents per pound of lint cotton.

place of purchased chemical fertilizers.

This is said with a due recognition of the fact that on many cotton farms there are, at present, conditions that make it impracticable for their owners to engage in the growing of livestock on an extensive scale. In such cases the main reliance for the permanent improvement of cotton soils must be the use of leguminous plants as direct fertilizing agencies. When the system of growing leguminous plants (the cowpea, vetch, and their kin) for plowing under as fertilizers becomes established on any farm, many of the obstacles in the way of stock raising will have been overcome and it will be relatively easy to make the further advance step of keeping animals to consume the legumes, thus getting the food value of these plants, with very slight diminution of their fertilizing properties.

COMPOSTING.

As the word compost is used by the cotton planter it usually refers to a mixture of stable manure, cotton seed, and acid phosphate, which after being brought together are allowed to ferment 4 to 10 weeks. Other coarse materials and also other chemical fertilizers often enter into a compost. The theory underlying the making of composts is that during the fermentation materials previously insoluble are decomposed and converted into a soluble condition.

Our experiments with composts have been concerned with the question of relative profits from composts and from the use of the same fertilizers in their fresh or unfermented condition.

In 1896 a compost made up of 1 part (by weight) of acid phosphate, 1 part of crushed cotton seed, and 4 parts horse manure, was compared with the same materials applied in the drill March 17, in their unfermented condition. The compost was allowed to ferment under shelter for four weeks, being meanwhile kept moist, and was applied in the drill April 14. The yield of seed cotton was greater by 222 pounds per acre on the plot receiving the fresh materials than on the compost plot. This result may have been due, entirely or in part, to the greater looseness of the seed bed incident to the late application of compost.

To eliminate this condition of uneven looseness of the seed bed, the compost and the corresponding fresh materials were applied on the same day, April 16, in 1897. The compost had been made four weeks before, and had been kept under most favorable conditions. It consisted chiefly of stable manure, supplemented by acid phosphate and cotton seed meal. The difference in the yields was 54 pounds of seed cotton per acre in favor of the fresh materials.

In 1899 a compost of 1 part acid phosphate and 7 parts horse manure afforded a yield of 1,384 pounds of seed cotton, against a yield of 1,237 pounds with the corresponding fresh materials, a difference of 147 pounds in favor of the compost, when compost and fresh materials were applied the same day.

In plots which adjoined those just referred to Tennessee raw phosphate and horse manure, in proportions as above, gave practically the same yield when applied fresh as when made into compost.

Taken as a whole, these four experiments offer no arguments in favor of composting such materials as cotton seed, fine stable manure, cotton seed meal, and phosphate. Nor do the experiments along this line made at other experiment stations sustain the claim that these materials can usually be profitably composted for cotton, when the price of this staple is as low as it has been in recent years.

Composting involves a large amount of labor, in return for which it offers the advantage of being more quickly available to the plant than are the corresponding raw materials. Hence composting is advisable where quick action of a fertilizer is desired, as in truck farming, where earliness is an important consideration. With cotton it has not been shown that an immediately available fertilizer is as desirable as it would be on truck crops. On the contrary the long growing season of the cotton plant allows a long period for nitrogenous fertilizing materials to decompose and become soluble.

In applying the fertilizers referred to above, the coarser constituents have been drilled in the center furrow, the acid phosphate being applied last and mixed with the barn manure by the use of a scooter plow.

It is not contended that either our experiments or those at other stations have definitely settled the question against composting stable manure and cotton seed. Their teachings, as we interpret them, are that convenience and cost of labor should be the chief consideration in determining whether the composting of *fine* stable manure, cotton seed, and acid phosphate is advisable. The case is quite different when coarse litter of any sort, as oak leaves, pine needles, or coarse manure is obtainable at slight outlay for labor. And there is a good argument for placing in the compost heap such cotton seed as cannot be applied in the drill early enough to prevent germination, many farmers finding composting a convenient means of killing the seed that are to be applied late in the season. On theoretical grounds there should be some advantage in composting raw phosphates instead of placing them directly in the soil. But it will scarcely be contended that composting effects any improvement in the availability of acid phosphate, for the phosphoric acid in this is in a soluble condition when purchased.

METHODS OF APPLYING FERTILIZERS.

Fractional or intercultural application of fertilizers. The question is often asked whether it is best to apply all of the commercial fertilizer before planting or to reserve a portion of it to apply at a later date. To aid in the solution of this question numerous experiments have been made here. In two of these tests a part of the phosphate was reserved for use in the early summer. In neither case did this procedure result in a larger crop than when all of the phosphate was applied before planting in the usual manner.

In one experiment a mixture of equal parts of acid phosphate and cotton seed meal was applied in the center furrow in the usual way before planting, and at the rate of 420 pounds of the mixture per acre. In comparison with this, other plots received half of this mixture before planting and the other half either at the time of the first, second, or third plowing. Thus the amount of fertilizer was the same on all plots, but the distribution of half of it varied. The yields of seed cotton per acre were 1603 pounds when all was employed before planting, 1425 pounds when half was reserved until the first plowing; 1385 pounds when half was used at the time of the second plowing, and only 1357 pounds when half the fertilizer was not applied until the third plowing.

Dividing the fertilizer and applying part of it as above during the growth of the plant necessitates additional expense. The three experiments referred to above, which are the ones giving plainest testimony on this point, indicate that dividing the fertilizer failed to increase the crop. In none of our intercultural experiments with cotton is there clear evidence of advantage resulting from fractional applications of acid phosphate, kainit, or cotton seed meal. Since the usual method is cheaper and the dividing of the fertilizer fails to increase the yield, we must regard it as generally more profitable to apply all the fertilizer before planting.

The preceding statements do not imply that fertilizers are ineffective if employed after the plant comes up. On the other hand our tests afford some evidence that nitrate of soda applied as late as the middle of July and cotton seed meal used as late as the latter part of June may exert a favorable effect on the yield of cotton when the supply of nitrogenous fertilizer used before planting is inadequate. In other words we may increase the yield by an addition of nitrogenous fertilizer as late as July, but the augmentation in yield is greater in proportion to the earliness of application, and the extra amount of fertilizer is apparently in most cases most beneficial if it also is placed in the soil before the seed. In a test to determine the latest date at which fertilizers can be applied, it was found that neither 200 pounds of cotton seed meal per acre nor a like amount of kainit was at all effective when employed as late as August 13 on plots liberally fertilized with cotton seed meal and phosphate at the time of planting.

There is room for further investigation to determine whether kainit or other potash salts will exert a restraining effect upon black rust if applied after the first symptoms of rust have appeared.

With this possible exception, and the further possible exception of nitrate of soda, we may safely conclude that the best time to apply commercial fertilizers (in usual amounts) to cotton is before the seed is planted.

Reserving part of the fertilizer for application in the seed drill.—In three experiments, made at Auburn in 1896 and 1897, this matter was under test. A complete fertilizer, made up of acid phosphate, cotton seed meal and kainit, was used at the rate of 420, 560, and 635 pounds per acre, these unusually large amounts being employed in order to emphasize any difference in yield that might be obtained. The greater portion of the fertilizer was placed in the center or "marking off" furrow in the usual manner before the beds or ridges were formed. Either one-third or one-fourth of the total amount of fertilizer was reserved and applied at the time of planting in immediate contact with the seed.

In all three experiments the yield was slightly less on plots where the fertilizer was applied in this manner than on comparable plots receiving all of the fertilizer in the center furrow according to the usual custom.

FERTILIZING IN CENTER FURROW VERSUS IN LISTING FURROWS.

In 1898 a complete fertilizer, consisting of acid phosphate, cotton seed meal, and kainit was applied just before planting either (1) all in the center furrow as usual, or (2) one-third in center furrow and one-third in each listing (side) furrow, or (3) one-half in each listing furrow. No special pains were taken to incorporate fertilizer with the soil except on the plots where all the fertilizer was applied in the center furrow, in which case a scooter plow was used to mix the large amount of fertilizer with the soil.

The results of this single experiment showed that there was a loss in placing all of the fertilizer in the listing furrows. Comparing only those plots which have since given proof of uniformity in natural fertility we find little or no advantage in dividing the fertilizer equally between the center and the two listing furrows as compared with placing all of the fertilizer as usual in the center furrow. Possibly the former method may be found advantageous when amounts of commercial fertilizer considerably exceeding 500 pounds per acre to be employed.

In using less than 500 pounds of fertilizer per acre there seems to be no advantage in dividing it between center and list furrows. If 300 pounds or more of commercial fertilizer is applied in the center furrow, it is desirable to mix this with the soil by the use of a scooter plow.

DEPTH AT WHICH FERTILIZERS SHOULD BE APPLIED.

In 1885 a fertilizer called Tinsley's Standard was drilled at the rate of 300 pounds per acre in center furrows which were 2 and 4 inches deep. The resulting yields were practically identical and apparently uninfluenced by the variations in the positions of the fertilizer.

CO-OPERATIVE FERTILIZER TESTS MADE BY FARMERS.

In recognition of the fact that the soils of the Experiment Station Farm at Auburn represent a comparatively small area of the cotton lands of the State, local fertilizer experiments, conducted by farmers under the direction of the Alabama Experiment Station, were begun in 1889. The weighing and mixing of fertilizers has been done at Auburn, and the separate packages for each plot, properly labeled, have been shipped to the local experimenters. Detailed directions as to choice of land, dimensions of plots, methods of securing uniform stand of plants, and precautions to be taken in harvesting the crop, have each year been furnished to each experimenter; uniform blank forms for reporting results have been supplied, and in the last three years these blank forms have been so designed that when filled out by the local experimenters they may afford detailed information regarding the nature of the original forest growth, nature of the soil, history and previous cropping of the land, and details of cultivation, etc.

The following list indicates the large amount of data thus far obtained as the result of these local fertilizer tests, or "soil tests" with cotton:

Year.	No. tests.	Reported in	Under direction of
1889	3	Alabama Sta. Bul. 12...	J. S Newman.
1890	24	Alabama Sta. Bul. 23...	do.
1891	43	Alabama Sta. Bul. 34....	do.
1892	36	Alabama Sta. Bul. 42....	A. J. Bondurant.
1896	21	Alabama Sta. Bul. 78....	J. F. Duggar.
1897	30	Alabama Sta. Bul 91....	do.
1898	36	Alabama Sta, Bul. 102....	do
1899	22	....	do
	215		

This list of 215 separate tests, requiring in the aggregate 2,766 plots, does not include a number of special fertilizer tests made by farmers for this Station in the past three years to determine the best forms of phosphate and of potash for cotton. Nor does it include any fertilizer tests on other crops than cotton, and it excludes all tests not reported in full to the Agricultural Department of the Experiment Station.

The size of plots during the first two years of these tests was one-fifteenth acre, and subsequently one-sixteenth acre; in 1896 and in all later experiments the size was increased to one-eighth acre.

The number of plots in each test, which at first was 15, was reduced when, for the sake of greater accuracy, the size of plots was increased.

The experiments of 1896 were directed especially towards a comparison of different forms of phosphatic and nitrogenous fertilizers, and only incidentally have they a value as soil tests.

The co-operative fertilizer experiments of 1897, 1898, 1899 and those arranged for in the present year are on a uniform plan. In each of these experiments there are 10 plots, 2 of which are unfertilized, In determining the increased yield on the plots lying between the two unfertilized plots, the yields on both of the latter are used, giving to each a weight inversely proportional to its distance from the plot under comparison.

The tenth plot of each test is not really a part of the regular soil test, but is added to ascertain the economy and rust-restraining influence of a half ration of kainit in a complete fertilizer.

The following table shows the general plan of the series of co-operative fertilizer experiments now under way, and gives the kind and amount of each fertilizer and the number of pounds of nitrogen, phosphoric acid, and potash in each formula:

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

Plot No.	FERTILIZERS. Amount per acre.	Kind.	MIXTURE CONTAINS Nitrogen.	†Available phosphoric acid.	Potash.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...............	13.58	5.76	3.54
		In 100 *lbs. c. s. meal**..........	6.79	2.88	1.77
2	240	Acid phosphate................	....	36.12	....
		In 100 *lbs. acid phosphate*.....	....	15.05	....
4	200	Kainit..........................	....	....	24.60
		In 100 *lbs. kainit*..............	....	....	12.30
5	200 240	Cotton seed meal........... Acid phosphate.............	13.58	41.88	3.54
		In 100 *lbs. above mixture*......	3.09	9.52	.80
6	200 200	Cotton seed meal........... Kainit......................	13.58	5.76	28.14
		In 100 *lbs. above mixture*.......	3.39	1.44	7.03
7	240 200	Acid phosphate............. Kainit......................	....	....	....
		In 100 *lbs. above mixture*	....	8.21	5.59
9	200 240 200	Cotton seed meal........... Acid phosphate............. Kainit......................	13.58	41.88	28.14
		In 100 *lbs. above mixture*......	2.12	6.54	4.39
10	200 240 100	Cotton seed meal........... Acid phosphate............. Kainit......................	13.58	41.88	15.84
		In 100 *lbs. above mixture*......	2.59	7.75	2.93

* Average of many analyses.

† Counting all of the phosphoric acid in cotton seed meal as available.

The choice of cotton seed meal as the best nitrogenous fertilizer for these tests was made after careful weighing of its advantages and disadvantages as compared with sulphate of ammonia and nitrate of soda, which had been used in the earlier tests. The one disadvantage of cotton seed meal in fertilizer experiments is the fact that it contains, in addition to nitrogen, small amounts of phosphoric acid and potash. The arguments for its use, in spite of this disadvantage, were these: Cotton seed meal is a cheap source of nitrogen and by far the most generally used form of purchased nitrogenous fertilizer, hence farmers will immediately make use of any formulas that may be found best in experiments with cotton seed meal, while they might be slow to avail themselves of even the best formulas, if they contained an unfamiliar material, not always easily obtained, like nitrate of soda or sulphate of ammonia. It was thought best in these tests, which were intended as popular demonstrations, as well as local investigations, to use only materials to which the farmers are accustomed, and which, if they proved desirable, could be easily obtained in any market. In other words, it was thought to be more necessary to ascertain whether cotton seed meal was a profitable fertilizer for a given soil than to answer the nearly equivalent question whether that soil demanded nitrogen.

In the space at hand it is not possible to present in detail the results of several hundred fertilizer tests, nor even to include the results of the soil tests made in 1899, which have not yet appeared in print.

Hence data for only a few tests can be published in this article. Choosing only those experiments which have been conducted under a uniform plan for three years on the same farm, and in which each year the results have apparently been fairly conclusive, we find that the only tests which up to date have complied with these strict conditions are those made in Monroe, Chambers, Henry, Clarke, and Randolph counties.

The following table shows the increased yield of seed cotton per acre attributable to the use, under four different conditions in each of three years, of either 200 pounds of cotton seed meal, or 240 pounds of high grade acid phosphate, or 200 pounds of kainit per acre.

Increase in pounds of seed cotton per acre attributable to 200 lbs. cotton seed meal, 240 lbs. acid phosphate and 200 lbs. kainit per acre, respectively.

Locality.	Year.	No. year.	*Increase* by adding c. s. meal					*Increase* by adding phosphate					*Increase* by adding kainit				
			To nothing.	To phosphate.	To kainit	To phosphate and kainit	Average due to meal	To nothing.	To meal.	To kainit	To meal and kainit	Average due to phosphate.	To nothing.	To meal.	To phosphate.	To meal and phos.	Average due to kainit.
			Lbs	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*
Burnt Corn.	1897.		40	94	239	132	126	208	262	210	144	206	51	250	53	132	122
	1898		292	6	151	341	198	344	158	92	282	219	—13	—154	—265	70	—90
	1899		216	223	266	155	215	299	310	438	320	342	27	77	173	394	93
	Av.	3	183	108	217	209	180	284	210	247	249	255	22	58	—13	99	42
Cusseta.	1897.		104	202	235	253	199	160	258	84	114	156	29	150	—45	6	36
	1898.		120	228	115	– 33	107	152	260	261	117	175	—8	—13	107	—156	—15
	1899		104	38	142	164	112	264	198	305	327	274	—45	—7	—4	122	17
	Av.	3	109	156	164	128	139	192	239	217	189	202	—8	43	15	– 9	10
Dothan.	1897		80	—39	91	120	63	152	33	132	161	120	234	245	214	373	267
	1898.		32	22	32	228	78	40	30	20	216	76	136	136	116	322	178
	1899.		248	110	119	123	150	208	70	227	231	184	106	—23	125	138	87
	Av.	3	120	31	81	157	130	133	44	126	153	104	159	119	152	278	177
Jackson.	1897.		170	103	247	—64	114	150	83	182	—129	72	22	99	54	—113	16
	1898.		8	152	—32	320	112	272	416	160	512	340	136	96	24	192	112
	1899		136	—90	—146	500	103	336	110	—7	639	269	115	—167	—228	362	21
	Av.	3	105	55	23	252	109	353	203	112	341	227	91	9	—52	147	49
Kaylor.	1897.		228	35	131	170	141	352	159	28	67	152	114	17	—210	—75	—39
	1898		312	98	155	271	209	368	154	222	338	270	107	—50	—39	134	38
	1899.		112	278	183	274	212	72	238	133	224	167	49	120	110	106	96
	Av.	3	217	137	156	238	187	264	184	128	210	197	90	29	—80	54	31

Tests at Burnt Corn, Monroe County.—These tests were conducted by J. P. and J. C. Watkins on a farm two miles north of Burnt Corn. The soil is described as gray, sandy, and stony, with red clay subsoil at a depth of 6 to 8 inches from the surface. The original growth was short leaf pine, sweet gum, and red and white oaks. The land had been in cultivation about thirty years. The yields without fertilizers were, in the three years of the test, 333, 398, and 236 pounds of seed cotton per acre.

Taking the average results for three years, 200 pounds of cotton seed meal per acre applied alone afforded an increase of 183 pounds of seed cotton per acre, and applied under four different conditions in each of three years, the average increase was 180 pounds. This is sufficient to pay the cost of the cotton seed meal and to leave some profit.

Examining next the increased yield of seed cotton attributable to the use of 240 pounds of high grade acid phosphate per acre, we find that it is, when applied alone, 284 pounds; when employed under four different conditions in each of three years the average increase is 255 pounds of seed cotton; in every combination its use is highly profitable.

Kainit (200 pounds per acre), applied alone, was practically useless; in combination with the other fertilizers it was seldom decidedly beneficial; and the average increase attributable to kainit under all conditions was only 42 pounds of seed cotton per acre, which result would entail a loss from the use of kainit on this soil and in years when rust was not prevalent.

Tests at Cusseta, Chambers County.—These tests were made by T. T. Meadows on his farm one-half mile north of Cusseta, on land from which the growth of oak, hickory, and pine had been cleared about 50 years ago.

The soil, which is representative of considerable areas of the Metamorphic Region of East Alabama, is shallow, stony and red, with a subsoil of the same color. Whatever may be its deficiencies as regards composition, it is evident that it is in poor mechanical condition, and that it needs vegetable matter.

The yields, without fertilizers in the three years of the tests were respectively 84, 300, and 204 pounds of seed cotton per acre.

Cotton seed meal at the rate of 200 pounds per acre, applied alone, has given quite uniform results in the three years, the average increase being 109 pounds of seed cotton per acre, thus leaving little or no profit from the use of cotton seed meal applied alone. In all combinations its results are somewhat better, the increased yield of seed cotton averaging under all conditions 139 pounds per acre, or sufficient to yield but a small profit.

With 240 pounds of high grade phosphate per acre the gain is much greater, averaging 192 pounds of seed cotton when the phosphate was applied alone and 202 pounds as the result of using phosphate under many different conditions. This leaves a moderate or fair profit from the use of phosphate.

It is clear that kainit was not needed on this soil, for alone it failed to afford any increase and its average gain under many conditions was only the inconsiderable amount of 10 pounds of seed cotton per acre.

Other tests reported in previous publications of this Station show that phosphate is indispensable to profitable cotton culture on the soils of this region.

The more difficult problem is the determination of the proper proportion of cotton seed meal for use with the phosphate. The small size of the plant on the red soils around Cusseta indicate a need for nitrogen, but Mr. Meadow's results show gains too small, I think, to justify the use of 200 pounds of cotton seed meal per acre on soils in such poor mechanical condition and so liable to disaster from drought. One-third cotton seed meal and two-thirds phosphate is probably a safer, because cheaper proportion. And yet one hesitates to recommend as a permanent policy the expenditure necessary for even 100 pounds of cotton seed meal per acre, in view of the fact that vegetable matter is so obviously needed by these stiff red soils as a defense against injury from drought, and in view of the further fact that by choosing cowpeas or other legumes to supply this vegetable matter all necessary nitrogen would be supplied in abundance.

It would seem advisable in the cultivation of this soil to aim at putting it in such condition by the use of an occasional leguminous crop in the rotation, as to require only the purchase of acid phosphate for cotton.

Tests at Dothan, Henry County.—These tests were made by T. M. Borland, on his farm adjoining the town of Dothan. The soil is a gray sand, level, rather more subject to excessive moisture than to special injury from dry weather. The land was cleared less than 10 years ago of the growth of long leaf pine. This soil is typical in texture and moisture conditions of large areas of land in the southern tiers of counties in Alabama. Rotting of bolls in 1898 reduced the yields. The yields of seed cotton per acre in the three years of the test were 356, 268, and 584 pounds respectively. No report of marked injury from rust has been made by the experimenter.

Cotton seed meal has been beneficial to the extent of giving an average increase for all condition of 130 pounds of seed cotton per acre, which leaves a small profit. The comparative freshness of the land and the amount of vegetable matter which it still contains account for the rather slight increase with cotton seed meal, which will doubtless become more necessary as the soil remains longer in cultivation and parts with more of its original vegetable matter.

Phosphate has been beneficial, but its effects have been less marked than in most other parts of the State, possibly as a result of local weather conditions at Dothan during 1898.

Kainit has been more distinctly beneficial at Dothan than in any other locality where an equal number of tests have been made in recent years. The increase attributable to 200 pounds of kainit per acre was, when it was applied alone, 159 pounds of seed cotton per acre; averaging all the figures bearing on the use of kainit under four different conditions in each of three years, we find the average increase attributable to kainit to be 177 pounds of seed cotton per acre. Here is margin for a fair profit, and for a profit greater than that due either to cotton seed meal or to phosphate. This favorable effect of kainit is especially interesting as occurring under conditions where we cannot, apparently, attribute the benefit either to the hypothetical power of kainit to increase the moisture supply in the soil or to its rust-restraining tendency. The cause apparently lies in a deficient supply of available potash in the soil; but in the absence of chemical analysis of this soil the true cause of the good effect of kainit cannot be positively determined.

TESTS AT JACKSON, CLARKE COUNTY.

These experiments were conducted by J. L. Ballard, on the farm of the Southwest Alabama Agricultural School. The soil is described as red, with red clay subsoil. The original growth of oak, sweet gum, dogwood, and long and short leaf pine was removed about 10 years ago. The soil is naturally in good condition as shown by the yields on the unfertilized plots which, during the three years of the experiment, were respectively 735, 1,048 and 896 pounds of seed cotton per acre.

The average increase attributable to cotton seed meal was 109 pounds of seed cotton, or enough to allow little if any profit. But it should be noted that this land is still comparatively fresh.

Except in the very dry season of 1897 the returns from acid phosphate have generally been satisfactory; the increase in the yield of seed cotton per acre was 253 pounds when it was applied alone, and averaged 227 pounds when phosphate was used under many conditions. This gives a good profit. Kainit was seldom very beneficial and the gain attributable to kainit, used under all conditions, was 49 pounds. Apparently this soil did not need kainit, was not in its comparative freshness very responsive to applications of cotton seed meal, and was greatly benefitted by the use of phosphate.

TESTS AT KAYLOR, RANDOLPH COUNTY.

This series of experiments was conducted by Judge T. J. Thomason, near Kaylor and two miles south of Ranburne, on gray soil with yellow subsoil, rather retentive of water. The original growth was oak, hickory, and long leaf pine. That the soil was naturally rather fertile or in good mechanical condition is suggested by the fact that the unfertilized plots averaged in 1899, 944 pounds, and in 1897, 722 pounds of seed cotton per acre. In 1898 the unfertilizer plots yielded only 364 pounds.

The increased yield with cotton seed meal was in every case sufficient to afford a moderate profit, the average increase under all conditions being 187 pounds of seed cotton per acre.

With acid phosphate the results were decidedly favorable; the average increase in yield attributable to acid phosphate was, when it was used alone, 264 pounds, and as the average of all conditions, 197 pounds of seed cotton per acre.

The effect of kainit was irregular and in no case markedly beneficial. The average increase, under all conditions, was only 31 pounds of seed cotton, an amount entirely insufficient to pay the cost of this fertilizer.

Having considered somewhat in detail the results of 15 tests made in five localities, there still remain the corresponding data for 200 other tests, of which more than half merit consideration as conclusive so far as they go, and as affording valuable aid in the choosing of fertilizer formulas for certain soil belts.

Valuable as are these results just referred to when considered separately and in their local bearing, they cannot be chiefly summarized. The results obtained in the uniform tests of the last three years have been arranged in accordance with the following scheme of classification, in which completeness (especially as regards the effects of nitrogen) has been sacrificed for the sake of simplicity.

Group I. Phosphate much more important than kainit; latter not needed or used at financial loss.

Group II. Phosphate much more important than kainit; latter of secondary importance.

Group III. Phosphate and kainit both important and about equally effective.

Group IV. Kainit more important than phosphate; latter of secondary importance, but needed.

Group V. Kainit much more important than phosphate; latter not needed, or used at financial loss.

Group VI. Only cotton seed meal very important; phosphate and kainit of slight or no benefit.

Group VII. No fertilizer used very effective.

The following table practically summarizes the soil tests of the past three years, the Roman numerals referring to the number of the group which furnishes an explanation of the result of each test. Thus in all tests in which the Roman number 1 occurs, the benefit from phosphate is marked and the use of kainit unsatisfactory. The number II shows also that phosphate was of prime importance, and that in addition kainit was beneficial, but to a less extent than phosphate. In the same way the other numbers in the table may be understood by referring to the explanation of the corresponding group, which is to be found on page 280.

In brief it may be said that the predominant need indicated by the first and second group is for phosphate, in the fourth and fifth for kainit, and in the third for both in equal degree. Tests in which cotton seed meal (as well as one or both mineral fertilizers) is exceedingly beneficial, may occur in any of these first five groups. The sixth group is intended to embrace only those tests in which cotton seed meal was the sole very effective fertilizer.

Locality.	County.	(1897) *Group.*	(1898) *Group.*	(1899) *Group.*
1. Town Creek	Lawrence	I.		
2. Blountsville	Blount		I.	
3. Larimore	DeKalb		I.	II.
4. Snow Hill	Wilcox		(?) I.	(?)II.
5. Dillburgh	Pickens		II.	
6. Gordo	Pickens		II.	I.
7. Sulligent	Lamar		I.	
8. Clanton	Chilton	II.		
9. Marvyn	Russell		II.	VII.
10. Prattville	Autauga	II.		
11. Tuscaloosa	Tuscaloosa.	II.	II.	
12. Notasulga	Macon		I.	I.
13. Vick	Bibb			VI.
14*a*. Auburn (Sta. farm)	Lee	IV.	IV.	VII.
14*b*. Auburn (Foster farm)	Lee			VI.
15. Cusseta	Chambers	I.	I.	I.
16. Kaylor	Randolph	I.	I.	II.
17. Brewton	Escambia	I.	III.	
18. Burnt Corn	Monroe	II.	I.	II.
19. Dothan	Henry	IV.	IV.	II.
20. Garland	Butler			II.
21. Hartford	Geneva		VII.	
22. Jackson	Clarke	VII	II.	I.
23. Lumber Mills	Butler	II.	II.	
24. Newton (unpublished.)	Dale		II.	
25. Wilson	Escambia	III.		I.
26. Berneys	Talladega	III.	I.	?
27. Bevil	Choctaw		III.	VII.
28. Calhoun	Lowndes			I.
29. Coosa Valley (bottom)	St Clair		V. (rust)	
30. Coatopa	Sumter	IV.	I.	
31 Cullman	Cullman			VII.
32. Greensboro'	Hale	VI.	VI.	?
33. Hurtsboro	Russell		I.	
34. LeGrand	Montgom'y.	III	III.	
35. Maple Grove	Cherokee			(?)VI.
36. Naftel	Montgom'y.	IV.	IV.	
37. Rutledge	Crenshaw	III.		
38. Sterrett	Shelby	1.	III.	VII.
39. Thomaston	Marengo	IV. (rust)	VI.	
40. Union Springs	Bullock	IV.	VI.	?

The first twenty-five localities in the above table are so arranged as to bring together those which, according to the map prepared by the State Geologist, Dr. E. A. Smith, are in the same or closely related geological formations. It is not intended to convey the idea that the soil is exactly similar in each group of localities. Personal inspection and chemical and mechanical analyses of each soil are needed before we can very positively assign the soils represented in these experiments to their proper position and before a very useful soil map of the State can be prepared.

The soils on which the first four tests in the above table were made are all calcareous, but of dissimilar origin.

Numbers 5 to 7 inclusive are localities which come within the area mapped by Dr. Smith as the "Oak, Hickory and Short Leaf Pine Region;" numbers 8 to 13 inclusive come within the region of "Gravelly Hills, with Long Leaf Pine;" numbers 14 to 16 inclusive embrace localities in the "Gray Isinglass and Red Clay" soil belt of the central portion of East Alabama; the "Long Leaf Pine Region" of South Alabama is represented by numbers 17 to 25 inclusive; numbers 26 to 40 stand for soils which for the present must remain unclassified even tentatively.

The soil tests referred to in the above table, supplemented by numerous other experiments which it is not now practicable to condense into tabular form, constitute the basis for the deductions drawn in the following paragraphs.

I. With the probable exception of most of the soils of the Central Prairie Region (calcareous), all soil belts on which tests have been made by this Station show benefit from acid phosphate applied to cotton. Indeed acid phosphate may be said to be a fertilizer universally advantageous to cotton on Alabama soils, with the single exception noted above.

II. Kainit (at the rate of 200 pounds per acre) is less frequently needed than either acid phosphate or cotton seed meal, and a considerable proportion of the soils on which it has been most advantageous lie in the southern part of the State. On soils especially liable to "black rust" in all parts of the State, and in seasons when that disease is especially injurious, kainit is at its best. On many soils, especially on those containing clay, it can be profitably dispensed with. Where needed, an application of 100 pounds per acre is often sufficient for cotton.

III. Cotton seed meal is highly beneficial to cotton on a large proportion of the cultivated area of every soil belt in Alabama. Apparently it is universally needed on uplands except on (1) new grounds and (2) on soils containing considerable vegetable matter, as the result of proper rotation with cowpeas or other humus-forming crops. Though cotton seed meal is almost invariably beneficial, it is not always *profitable* when applied to cotton at the rate of *200 pounds per acre.* Poor mechanical condition of the soil, resulting in a scarcity of moisture in summer, is the greatest hindrance to the profitable use of large doses of cotton seed meal. But even with poor mechanical condition of the soil it is usually profitable on soils where the stalk is small to use cotton seed meal. A better method of fertilizing with nitrogen through the use of leguminous plants is pointed out elsewhere in this article.

IV. On old soils, as a rule, it is more profitable to employ for cotton a mixture of acid phosphate and cotton seed meal, or of these two and kainit, than to use an equal money value of any one of them alone.

V. The universal basis for a fertilizer formula for cotton in regions where commercial fertilizers are employed should be acid phosphate; of which 100 to 240 pounds should be used per acre, in addition to cotton seed meal as necessary.

VI. The proper proportion of cotton seed meal to acid phosphate in a fertilizer formula for cotton depends more on the recent chopping and manuring of the field than on the character of the rocks from which the soil is derived. An intelligent decision on this point can be reached by a judicious application of the following facts:

(a) Small stalks, (if not due to climatic influences, poor cultivation, etc.), are usually an indication that nitrogen (as in cotton seed meal) is needed.

(b) Excessive stalk or "weed growth" of cotton is an indication that nitrogen can be dispensed with, wholly or partially.

(c) Phosphate hastens maturity and may aggravate the injury from black rust.

(d) The fresher the land the less the need for nitrogen.

(e) A luxuriant growth of cowpeas just preceding cotton dispenses with the necessity for cotton seed meal, as does also a recent heavy dressing with stable manure or cotton seed.

(f) The flat lands of the Southern Long Leaf Pine region probably require a smaller proportion of cotton seed meal than the soils of the central part of the State; this may be due to the former having been, as a rule, in cultivation for a shorter period of time, or it may be attributable to a more constant supply of soil moisture in the first mentioned region, with consequent ample development of the cotton stalk.

VII. The amount of commercial fertilizer per acre that yields the largest net profit varies with a multitude of conditions, as soil, season, amount of cash or capital, cost of labor and fertilizers and price of cotton. Generally moderate to large applications pay best when the season is favorable, but involve the risk of loss should climatic conditions be extremely unfavorable. To ren- as safe as possible intensive fertilization, the soils on which it is employed should be in good mechanical condition, especially as regards drainage and power to retain sufficient moisture during drougth, which latter condition may usually be brought about by a rotation that affords an abundance of vegetable matter and by judicious preparation and cultivation. On soils needing the following materials it seems generally advisable to apply them at the rate per acre of 100 to 240 pounds for acid phosphate, 60 to 200 pounds for cotton seed meal, and 60 to 100 pounds for kainit.

VIII. In response to requests for recommendation of definite fertilizer formulas for cotton on different soils, the writer would tentatively suggest the following,—to be modified somewhat when the facts mentioned in paragraph VI seem to require it;—(a) For calcareous clays or clay loams in North Alabama; for the red clay lands occupying a triangular area in the central portion of East Alabama (for the most part north of the Western Railroad and east of the Coosa River)—; and for the stiffer non-calcareous soils of the northwestern and western part of the State:

80 to 120 pounds cotton seed meal per acre.
160 to 240 pounds acid phosphate per acre.

240 to 320 pounds total per acre.

(b) For sandy soils in the eastern and central part of the State:

80 to 120 pounds cotton seed meal per acre.
160 to 240 pounds acid phosphate per acre.
40 to 60 pounds kainit per acre.

280 to 420 pounds total per acre.

(c) For the level lands of the Southern Long Leaf Pine Region:

60 to 120 lbs. cotton seed meal per acre.
120 to 240 lbs. acid phosphate per acre.
60 to 80 lbs. kainit per acre.

240 to 440 lbs. total per acre.

(d) For any well drained soil in any part of the State on which cotton is known to be especialy liable to black rust:

120 to 160 lbs. cotton seed meal per acre.
80 to 120 lbs. acid phosphate per acre.
80 to 120 lbs. kainit per acre.

280 to 400 lbs. total per acre.

IX. The formulas suggested above contain approximately the following percentages of nitrogen, (and its equivalent in ammonia), available phosphoric acid, and potash, using phosphate containing 12½ per cent of avalable phosphoric acid:

Formula	Per cent. nitrogen.	Per cent. ammonia	Per cent. available phos. acid.	Per cent. potash.
(*a*). For certain red lands, etc.	2 3	2 8	9.3	0.6
(*b*). For certain sandy lands..	2.0	2 4	8 0	2.3
(*c*). For low, long leaf pine lands....................	1 9	2.3	7.6	2.8
(*d*). For "rusting" soils	3.0	3.6	4.8	4.3

X. The lime soils of the Central Prairia Region have usually failed to make profitable use of commercial fertilizers. It is a generally accepted belief that commercial fertilizers on these soils are unprofitable, and so they have proved on good prairie soil at Uniontown, Ala. As a rule prairie soils are in poor mechanical condition and need vegetable matter rather than commercial fertilizers. Their improvement is especially marked when a leguminous crop, as mellilotus or cowpeas, is plowed in. Some of the best of these soils need drainage rather than fertilization. On the poorer soils, observation indicates that cotton seed meal is advantageous, and the few experiments made on bald prairie suggest that phosphate may increase the yield of cotton there.

The acid condition of certain soils found in many parts of the State may render ineffective commercial fertilizers that may be applied to them. For acid soils, which, when moistened and brought in contact with blue litmus paper, change the paper to a reddish color, the remedy is usually to be found in drainage or in the application of lime or marl, supplemented by the usual fertilizers.

To make commercial fertilizers afford a maximum profit it is desirable to use them on soils which are in good mechanical condition, especially as regards the supply of moisture in periods of drougth. Generally the cheapest means of accomplishing this improvement in the mechanical condition of a soil is by the growth of humus-forming crops, and especially by the growth of leguminous plants as food for stock or fertilizer for the soil, or for both purposes combined.

DISEASES OF COTTON.

BY F. S. EARLE.

The systematic investigation of cotton diseases was first undertaken at this station on the appointment of Dr. Geo. F. Atkinson as Biologist in the Fall of 1889. It has been continued as opportunity offered by the various officers filling this position up to the present time. Six bulletins* have been published dealing exclusively with the diseases of cotton besides minor notes in a number of the other publications of the Station.

The article on Diseases of Cotton (pp. 279-316) in the treatise on The Cotton Plant published as Bulletin 33, of the Office of Experiment Stations, United States Department of Agriculture, was written by Dr. Atkinson after severing his connection with this Institution, but it was based almost entirely on work done while here, and it may be considered as his final summing up of the results obtained while here.

In the following pages a brief account will be given of the present state of our knowledge of each of the diseases of cotton that has been detected in this State, drawing freely on the matter already published, but also incorporating the results of my own study and observation during the past four years.

In studying the diseases of cotton it has seemed desireable to prepare a Bibliography giving the title, place and time of publication, and where possible, a brief outline of the contents of the papers that have been published on this subject in different parts of the world.

*For a detailed statement of the contents of these bulletins see chapter on Bibliography p. 324.

Diligent search has discovered a surprisingly meager literature considering the great importance of cotton as an agricultural crop. This Bibliography is appended as a part of this paper. It is probable that some titles have been omitted especially as library resources have been limited, but the fact is evident that almost nothing has been published outside of the United States; and that of our own Experiment Station, only two have given the subject serious attention. The United States Department of Agriculture has from time to time, published papers and notes on cotton diseases. The first noteworthy one was the paper by Townend Glover on "Accidents and Diseases of the Cotton Plant," in the Annual Report for 1855, and the last is the admirable monograph on "The wilt Disease of Cotton, Watermelon and Cowpea," by Dr. Erwin F. Smith, just issued as Bulletin No. 17, of the Division of Vegetable Physiology and Pathology. It is gratifying to learn that during the past Summer one of the members of this Division has been assigned to special work on cotton diseases.

In volumes 5 and 6, of the Tenth Census, which are devoted to the cotton industry of the United States there are chapters devoted to diseases for each of the cotton States which contain much valuable information on distribution.

A list of the fungi that have been detected as growing on cotton or on the cotton plant in any part of the world has been prepared and is added as a part of this paper. Many of the species named are saprophytes and are probably of little or no economic importance; but since so many supposed saprophytes have the power under certain conditions of becoming partial or facultative parasites it is thought best to include them in this list.

In taking up the different diseases as a matter of convenience those will be considered first that more obviously affect the root and stem, second, those affecting the leaves, and third, those affecting the bolls. Under the first heading we have Root Knot, Sore Shin, Wilt, and Anthracnose of the Stem. The diseases of the leaves are Rust, Red Rust, Angular Leaf Spot, Leaf Blight and Mildew. The diseases of the bolls are Anthracnose, Boll Rot and Shedding. Under each of these diseases reference will be made by number to the more important papers bearing on it that are mentioned in the bibliography.

ROOT KNOT.*

Syn. Root Galls.

In common with many other cultivated plants at the South the roots of cotton are subject to the attack of a microscopic nematode worm, *Heterodera radicicola* (Greef.) Muell. The larval nematodes invade the tissues of the rootlets where they become encysted, and their presence causes a gall like swelling of the root. The gravid females are large enough to be seen with a hand magnifier when the fresh galls are broken open. Each female produces from 100 to 200 eggs, and the life cycle is completed in about one month, thus allowing seven or eight generations during the growing season. Under favoring conditions they therefore increase very rapidly. The galls or knots are usually about the size of a pea, but by confluence they may become much larger. If only a few are present no great damage is done, though the part of the root below the knot usually after a time rots away. If the knots are very numerous the nutrition of the plant is seriously deranged, growth is feeble or ceases entirely, and finally the rotting of the roots causes the premature death of the plant.

Cotton is less seriously affected by "root knot" than

* Bibliography, Nos. 4, 10, 13. See also Ala. Sta. Bull. 9.

many kinds of vegetables and some kinds of fruit trees. The cotton farmer therefore has less cause to dread it than the orchardist or trucker to whom it is often a veritable scourge. It however injures the cotton quite seriously, and it is so widely distributed, occurring more or less in most of the sandy and alluvial soils of the Gulf States that its total injury to the cotton crop must be very considerable. As Atkinson has pointed out, its greatest injury to cotton takes place when it occurs, as it often does, in the same fields with the fungus producing cotton wilt (see p. 296), since the breaking down of the root tissue by the nematode serves to aid the wilt fungus in obtaining an entrance.

Numerous experiments have been conducted at this Station during the past four years with the hope of finding some means of freeing the soil from this pest. The organism seems to be remarkably resistant, and so far the experiments have largely given only negative results. It has been suggested* that kainit and lime applied to soils would greatly reduce the injury from root knot. A number of tests were made with these substances without result. In one case both lime and kainit were applied to a plot at the rate of 2000 lbs of each per acre. The plot was planted to okra and every plant developed root knot.

With the soil in pots in the green house carbon di sulphid has given encouraging results. When 10 c. c. have been injected into 12 in. pots before planting the percentage of root knot has been greatly reduced. It has not been found safe to inject it near the roots of living plants either in pots or in the field. Some field experiments have been tried with it but with less marked

* J. C. Neal—The Root Knot Disease of the Peach, Orange and other Plants in Florida, U. S. Dept. of Agr. Div. of Entomology, Bull. 20.

results. In 1899 two plots were treated with it. On one plot 10 c. c. were injected once in two feet in each direction and in the other a like quantity was injected once a foot. Both plots and a check plot were planted to cow peas and okra. The place selected chanced to be rather free from the nematodes as but few of the plants on the check plot were affected. Well developed cases were found however on all three of the plots in about equal proportions. No benefit could be detected from the treatment. It is to be noted however, that the workman in injecting the carbon di sulphid carelessly left the holes made by the injector open so that part of the fumes probably escaped.

In 1899 plots were also prepared with varying quantities of sulphur broadcasted and plowed in two weeks in advance of planting. The amount of sulphur used varied from two to sixteen pounds per square rod. All of the plots were planted to cowpeas and okra. The okra failed to germinate when more than 4 lbs. of sulphur per rod was used. The cowpeas were not affected, germinating and growing well on all of the plots. Where the heaviest applications were made the fumes of the sulphur could be detected easily, when the sun was hot, at any time during the summer. None of the cowpeas in this experiment suffered seriously from the nematodes. It did not prove to be a good plant for the experimental work, but well developed cases of root knot were found on all the plots. In fact it so happened that the plot receiving 16 lbs. of sulphur developed more cases than some of the checks. It is also interesting to note that root tubercles developed freely on this heavily sulphured plot and that on one of the plants underground perithecia developed of the fungus causing the cowpea wilt, *Neocosmospora vasinfecta tracheiphila*, E. F. Smith.

The only soil treatment that has proved at all efficacious in reducing the numbers of this pest has been a perfectly clean fallow continued through two growing seasons. During the summer of 1896, certain plots were given perfectly clean cultivation, no growth of any kind being allowed on them. In the spring of 1897, a portion of these plots were planted in okra and other vegetables. Root Knot developed on all of them but in only about half the normal quantity. On the other plots the clean fallow was continued throughout the Summer of 1897, till September, when celery plants were set out on them. Celery is the most susceptible of all vegetables to the nematode root knot disease, but the plants remained entirely free from the trouble. An absolutely clean fallow extending over two Summers is hardly a practical remedy on account of the cost, and on account of the injurious effect on the soil. Probably equally good results would be secured by allowing only such plants to grow on the land as are known to be entirely free from the nematodes. None of the grasses or small grains are known to harbor them, so by planting to wheat, oats or rye in the Fall and following with German millet or sorghum in the Summer, and continuing this for two or three years it seems that the land should be quite thoroughly cleaned of them. It would be necessary to take great care to keep down all succulent rooted weeds that might serve to harbor the nematodes. This style of cropping would prove very exhausting on most of our cotton lands, and on the lighter of them it would not be practicable. It is unfortunate that our best known soil improving plant, the cowpea, should prove a nurse plant for the nematode but such is the case, and its frequent use cannot be advised on soils known to be infested by them. The velvet bean, (*Mucuna utilis*), a new soil improving plant that has attracted much attention during the past few years, it is claimed is nearly or quite exempt from its attack. If this claim proves to be well founded, and there is strong evidence in its favor, then oats followed by velvet beans for two seasons will not only practically rid the land of nematodes but will vastly increase its fertility.

SORE SHIN.*—DAMPING OFF.

Young cotton plants are sometimes observed to fall over and die. This is known as damping off. It usually occurs in wet, unfavorable weather. Atkinson has shown that this disease is caused by a fungus that penetrates the young stems just below the surface of the soil, causing their tissue to become soft and decomposed. In some cases, especially as the plants get a little older, only one side of the plant becomes affected. The stem is not cut off, but an ulcerous depression is formed. Such plants may ultimately recover, though their growth is retarded. This is the condition sometimes known as Sore shin. From the fact that the fungus causing this trouble has not been found to produce spores or other fruit bodies, Atkinson called it the "Sterile Damping Off Fungus," to distinguish it from other fungi that cause the damping off of young seedlings. He found similar sterile mycelia attacking many other plants besides cotton and that they are widey distributed as damping off agents. One of these sterile fungi has since been studied by B. M. Duggar as causing a serious disease of the sugar beet, and by F. C. Stewart as causing a stem rot of carna. tions. These investigators agree in placing these sterile fungi in the form genus *Rhizoctonia,* but their studies have not yet progressed sufficiently far to admit of assigning specific names to the different forms. Their observations and experiments suggest liming the soil as a possible remedy.

* Bibliography, Nos. 10, 12, 13, 19, 29, 81.

The *Rhizoctonia* of cotton is very widely distributed. It probably occurs in every cotton field in the State. During wet, unfavorable springs it kills a great many plants, and yet owing to the habit of very heavy seeding and of only chopping to a stand after the plants begin to form rough leaves, it is doubtful if the disease often causes serious loss. Atkinson claims that, like the nematode root knot, it sometimes does harm by aiding the wilt fungus to gain an entrance into the stem of the cotton plant.

The suggestion for liming the land will doubtless be useful in all cases where the soil is acid, as in the case with many of our sandy lands. We have no direct observations, however, as to its effect on this disease in the cotton field. Running the smoothing harrow obliquely across the rows as soon as the ground can be stirred after each rain while the plants are small, will tend to check the disease by quickly drying the surface layer of the soil in which the *Rhizoctonia* is most active. On lands that are free from rocks and trash such harrowings will not injure the stand, but will prove the cheapest and most efficient form of cultivation.

COTTON WILT.*

Syn. Frenching.

This disease has sometimes been called "Frenching," but it is best to drop this meaningless term, especially as it has not come into general use. There are a number of closely related diseases of cultivated plants, as of the bean, the cow pea and the watermelon that are known by the expressive name of "Wilt," and it seems best to make the usage uniform.

The disease is caused by a fungus parasite, *Neocosmospora vasinfecta* (Atk). E. F. Smith, that lives in the

*Bibliography, Nos. 10, 13, 39, 40, 41.

soil and gains entrance to the vascular bundles of the stem through the roots. The disease may be present in the plant for some time before it becomes externally manifest, except in the somewhat dwarfed growth, but its presence can be easily detected by splitting open the stem. In the healthy stem the internal tissue is white, but when the wilt disease is present it becomes stained a dark brown. This staining of the tissues, particularly of the vascular bundles, is always present, but the external symptoms are somewhat variable. In typical cases when the disease is progressing rapidly the growth of the fungus plugs up the ducts, thus cutting off the water supply from the leaves, causing them to suddenly wilt. At first this wilting may only be noticed on certain branches. In some cases the branches on one side of the plant wilt and die, while those of the other side remain green and possibly even mature their crop. Usually the whole top becomes involved within a few days after the wilting is first noticed and the plant soon dies. Instances have been observed where nearly all the plants in fields several acres in extent have died in this manner by mid-summer. At other times the disease seems less active. The leaves do not wilt, but gradually die and fall off, beginning with the lowest ones. The margins of the leaves first turn yellow and then brown, the color changes extending down between the main veins in V shaped areas. The green color may persist along the veins for some time, but the leaf finally falls. New shoots will sometimes start from near the base of the plant after the top is quite badly diseased, for the fungus seems to grow upward from the point of attack much more rapidly than it does downwards so that the roots remain comparatively healthy, excepting the ones by which the fungus first entered the plant.

The fungus found in the tissues of these wilted plants belongs to the form genus *Fusarium*, and it was described by Atkinson, who first detected it as *Fusarium vasinfectum*. Within the tissues it produces only minute oval spores, but on culture media it develops the curved septate spores characteristic of this genus. Dr. Erwin F. Smith first detected the perfect, ascigerous form of the fungus which consists of bright red, minute, Nectriaceous perithecia, thickly or thinly scattered over the underground part of the stem and the larger roots. The Ascospores are nearly spherical, one celled and at maturity dark brown, with a thick and more or less roughened epispore. These characters do not admit of placing it in any of the previously described genera of the *Nectriaceae* so that Dr. Smith has described it as a new genus under the name *Neocosmospora*.

The fungi causing the wilt of cowpeas and of watermelons are so similar in structure to the cotton wilt fungus that after much careful study Dr. Smith is unable to separate them specifically. The failure of cross inoculations, and the results of field tests and observations, all show that, though so closely alike in form, the fungus from one of these hosts is not able to infect either of the others. He therefore considers the watermelon and cowpea fungi as being physiological varieties of the cotton fungus.

This disease is a very serious one. It lives over in the soil from year to year, and when once established in a field it continues to spread and grow worse as long as cotton is planted on the land. No remedy is known, and it becomes necessary to discontinue growing cotton on lands where the disease makes its appearance. How long the disease will persist in the soil is not known. Few direct experiments on this very important point have been made, but instances have been reported by intelligent farmers where fields infested with this disease have been planted in other crops as corn or oats for two seasons, and yet when again planted to cotton on the third year the disease still made its appearance, though not so bad as before the change of crop. Some melon growers claim that five to seven years' rest is necessary for infested lands, if indeed, it is ever safe to plant again where melons have once wilted.

So far as known, the cotton wilt attacks no other plant except okra. The fact that it is at least physiologically distinct from the wilts of cowpeas and watermelons is an important one practically since it admits of planting cowpeas as a restorative crop on lands infested with the cotton wilt. If the disease was communicable from one of these plants to the other as was at one time feared this would not be permissible. Dr. Smith's opinion of their physiological distinctness seems to be well founded. It is fully supported by some field observations of my own. In July, 1898, I was called to investigate an outbreak of this disease on the farm of Mr. James Hall at Midway, Bullock Co., Ala. In a field of about three acres three-fourths of the cotton was dead or dying. Mr. Hall said that it had been dying for two months, and in order not to leave the ground entirely vacant he had been replanting with cowpeas. At the time of my visit the peas were growing luxuriantly among the dying cotton without showing the slightest sign of disease. Mr. Hall wrote me in the fall that the peas remained healthy to the end of the season, showing that in this case at least they did not contract the disease from the cotton.

A certain garden lot in Auburn, belonging to Mr. C. E. Little was planted to cowpeas, following oats, during 1897 and 1898. In both seasons nearly all of the peas died from wilt, showing the land to be thoroughly infested with the cowpea wilt fungus. In 1899 Mr. Little kindly allowed me to plant some cotton in this garden, as well as cowpeas, snap beans and velvet beans. Half or more of the cowpeas and a few plants of the snap beans contracted the wilt, but the cotton and the velvet beans remain entirely healthy.

Sound, healthy cotton roots seem to have a certain power of resistance to the wilt fungus. It is not uncommon to find plants that have evidently been attacked through a single root only. It is possible that the fungus usually gains entrance through injured roots, as where they are broken by the plow. The injury caused by nematodes and the ulcers caused by the *Rhizoctonia* or "sore shin" fungus also seem to serve to enable the wilt fungus to attack the plants.

This disease is quite widely scattered. It is known to occur in Arkansas, South Carolina, Alabama and Florida. In this State it is widely distributed throughout the southern half. It has been found in Montgomery and in the south edge of Lee county, but so far it has not been reported north of a line drawn through these two points with the exception of an isolated outbreak at Athens, in the Tennessee valley.

The most important practical point remaining to be learned in connection with this disease is the length of time the fungus can exist in the soil if no cotton or okra is planted. The fact that the similar cowpea wilt (See p. 293) developed on a plot that had received at the rate of more than 1,500 pounds of sulphur per acre does not make experiments for destroying the fungus in the soil seem encouraging.

ANTHRACNOSE OF THE STEM.*

The fungus causing Anthracnose of the bolls, *Colletotrichum Gossypii* South, sometimes attacks the

*See Bibliography, Nos. 5, 6, 8, 10, 13.

stems, causing a blighting of the bark over extensive areas. The term anthracnose is usually associated with diseases producing little sunken pits or ulcers as in the case of the anthracnoses of the grape and the raspberry. There is no such appearance in this case. The bark at first turns a uniform reddish brown and finally dies. The foliage soon shows the effect of the disease, yellowing and finally dying and falling much as with the rust. The latter disease, however, does not usually affect the stems. They remain green and frequently put out new leaves after the old ones have all fallen. This stem blight often occurs in connection with the rust, but again it may occur on vigorous plants and on soils where the rust does not occur. This disease is rather prevalent, though it has attracted but little attention, its effects being usually confounded with those of the rust. No remedies can be suggested.

This fungus is an active parasite, attacking at various times nearly all parts of the cotton plant. It has been known to damp off seedlings, it develops on the seed-leaves, on the bark, on the leaves and bracts and especially on the bolls. It is a serious pest and annually causes much loss.

RUST.*

Synonyms: Black Rust, Yellow Leaf Blight, Mosaic Disease.

This disease has attracted more attention than any of the others affecting cotton. It causes the premature falling of the leaves, thus preventing the proper maturing of the crop. It occurs very commonly in the older cotton growing States, usually, though not always, on the thinner sandier lands. The losses occasioned by it when present vary from 5 per cent. to 50 per cent. or more of

* Bibliography Nos 5 6, 9, 10, 13, 18, 20—25, 26, 29, 31, 32, 33, 34.

the crop, and as it is so widely distributed the total loss is very great. The disease is a complex one, depending in part on unfavorable soil and weather conditions, and in part on the attacks of several species of fungi. None of these seem to be able to grow on perfectly vigorous, rapidly growing cotton foliage, but during hot, showery weather they develop rapidly on any leaves where there is reduced vitality from any cause, as where the foliage has prematurely ripened from the effects of drouth or of a poor sterile soil. The disease is really a remarkable one as illustrating the marked effect of soil conditions and the general vigor of the host plant in enabling it to resist the attacks of a certain class of parasites. It may be safely asserted that this disease cannot attack a cotton plant that is in full, vigorous growth, but that a sudden checking of growth and lowering of the vitality from any cause will render it liable to serious injury if the weather conditions favor the growth of these fungi. The species of fungi usually connected with this disease are *Macrosporium nigricantium* Atk., an undescribed species of *Alternaria, Cercospora gossypina* Cke. and *Colletotrichum Gossypii* South. The exact course of the disease varies with the weather conditions. In some cases the leaves of affected plants first exhibit a more or less mottled yellow color. This is the condition that suggested the name of "Mosaic Disease" that Dr. Atkinson applied to it in his later publications. When a period of warm summer rains suddenly follows a long drouth in July or August, this mosaic condition will be hardly apparent, but the seemingly healthy leaves will be seared and blackened by the rapid growth of these various fungi. Under these conditions the leaves often wither and fall very quickly, leaving the stalks entirely bare. In such cases a second crop of leaves is sometimes produced so that fields that were quite bare in early September become green again in October, but such leaves are produced at the expense of reserve food material that should go to developing the bolls, and they are an injury rather than a help to the crop, as frost usually comes before the new leaves have had time to elaborate a new food supply. It more often happens that the leaves do not all fall at first, but that many of them, though badly blotched and spotted by the fungi, still hang on for some time and assist in ripening the more advanced bolls. Of course such plants do not set a top crop so that even if all the formed bolls on the plant when it is attacked ripen, the crop is seriously reduced. The quality of the fiber, too, is often injured on badly rusted plants. It is light and chaffy and the same bulk of it weighs less than cotton from healthy plants.

It seems certain that the damage done by this complex disease is mainly due to the growth of the associated fungi. These attack and destroy the tissues of leaves that would otherwise continue to perform their functions. The physiological disturbances due to drouth or other unfavorable conditions would disappear with the advent of more favorable weather, and the plant would resume its normal growth but for these fungus attacks. On the other hand it is equally certain that perfectly vigorous plants have the power to resist these fungus attacks, and that when the soil is in the proper condition of tilth and fertility the cotton plants will pass unharmed through conditions of weather sufficiently unfavorable to induce serious outbreaks of rust on less favorable soils. This has been forcibly illustrated for several years past in the sandy fields south and west of Auburn. Owing to the passage of a stock law the fences have been removed and the old fence rows have been grubbed out and plowed and planted with the rest of the fields. These fence rows are practically new land.

The soil is rich from the accumulation of vegetable matter for many years, and its mechanical condition is such that it resists drouth and keeps the plant constantly growing. The old fields on the other hand have been cropped in cotton year after year for many years till their vegetable matter and other elements of fertility have been exhausted. These soils are in no condition to resist drouth, and with the advent of hot dry weather in mid-summer growth ceases and the foliage hangs limp and wilted during the noon-day heat. Now when rains occur the fence row cotton grows with increased vigor, while that in the poor, worn-out fields soon shows the unsightly spots of rust, and for the past three years it has been bare of leaves and practically dead by the middle of September, while that of the bordering fence rows, subjected to identically the same climatic conditions, has remained green and vigorous to the end of the season.

The obvious remedy then for cotton rust lies in ameliorating unfavorable soil conditions, and securing a state of fertility that will support continued vigorous growth of the plant. Judging from a wide series of observations and an extended correspondence the usual inciting cause of cotton rust is the inability of the soil to withstand drouth. In other cases the cause is just the reverse and rust is induced by lack of drainage. Cotton roots require a well areated soil, and they are quickly affected by standing water or by too great a rise of the water-table. In such cases drainage would prove an efficient remedy. There are still other classes of soils with abundant vegetable matter and where the mechanical conditions all seem favorable where cotton rusts badly in ordinary seasons. In these cases the trouble seems to come from a lack of sufficient potash in the soil, and applications of kainit or other potash fertilizers remedy the trouble. In fact the good effect of potash has often been so marked that kainit has come to be considered as almost a specific for this disease. It has been held that this favorable effect of kainit might be due to the effect of the salts it contains on the hydrostatic pressure and surface tension of the soil moisture. Recent experiments seem to show that it is rather the specific effect of the potash since muriate, sulphate and other potash salts are found to be effective about in proportion to the per cent. of potassium they contain. Thus 50 pounds of muriate is fully as effective as 200 pounds of kainit per acre in enabling the plants to resist rust. On drouthy soils applications of potash alone will often prevent rust during favorable seasons, but at other times its effects will be much less marked. On the Station Farm during 1896 and 1897 potash fertilizers gave almost no effect in preventing rust. In 1898 its effect was very markedly beneficial. In 1899 its good effects were plainly visible but were much less marked than in the previous year. On these drouthy soils the mechanical conditions need ameliorating in addition to supplying the needed chemical elements. This is best done by plowing under leguminous soil improving crops. Of these the cowpea is the best known, and on most soils it is exceedingly satisfactory. For the southern half of the State, and especially on sandy soils where the nematode root knot trouble prevails, the recently introduced velvet bean promises to be a marked improvement. On very poor soils both of these crops should be liberally fertilized with acid phosphate and potash, as otherwise the growth obtained will be too small to accomplish much in the way of soil improvement. It is not necessary to apply nitrogenous fertilizers, since these crops have the power of gathering nitrogen from the atmosphere, which accounts for their great usefulness in increasing soil fertility. For growing either of these crops it is necessary to miss growing one crop of cotton on the land. The peas can usually be most economicaly grown after a crop of wheat or oats, but the velvet bean requires a long growing season in which to reach full development, and it will pay best to give up the land to it during an entire season.

There are two other leguminous crops, Hairy Vetch and Crimson Clover, that make their growth during the winter and early spring. By sowing these seeds between the standing cotton stalks in October and cultivating them in lightly, the growing crops will occupy the land during the winter, thus preventing the leaching and washing away of fertility by the winter rains. They will be ready to cut for hay by the first of May in time to put in a late cotton crop on the stubble, or if preferred they may be plowed down in April and the cotton can be planted at the usual time. In either case the soil will be gradually improving year by year and the loss from rust will be decreasing, and that without losing the use of the land for a single cotton crop. Under the practice now usually prevailing exactly the reverse of this is the case. The soils are being rapidly depleted of their fertility and the losses from rust are becoming heavier and heavier. Of these two crops vetch is for several reasons decidedly preferable and its greatly extended use cannot be too strongly urged. Directions for seeding and for the soil inoculation that is necessary for success with this crop will be found in Bulletins 87, 96, and 105 of this Station.

Our knowledge of this much discussed and complex disease may be summarized as follows:

Cotton rust is a composite disease, being due partly to physiological derangements caused by improper soil conditions, and partly to the attacks of a number of facultative fungus parasites, among which the most important are *Macrosporium nigricantium* Atk. *Alternaria sp., Cercospora gossypina* Cke. and *Colletotrichum Gossypii* South.

The plants would largely recover from the physiological derangement on the advent of more favorable weather if it were not for the attacks of the fungi.

On the other hand the fungi are not able to attack plants that are in a vigorous growing condition.

In some cases the lack of vigor that permits these fungus attacks is due to too much standing water in the soil. Such cases can be remedied by drainage.

In other cases it is due to the lack of some chemical element in the soil, usually potash, when the remedy consists in supplying the needed element in the fertilizer.

In the great majority of cases lack of vigor is due to the exhaustion of the soil humus thus greatly reducing its water holding and drouth resisting capacity. In such cases the potash is also usually exhausted. The remedy consists in restoring the vegetable matter needed to form humus by plowing in leguminous crops and in supplying the needed mineral fertilizers.

RED RUST.*

This name is usually applied to a peculiar reddening of cotton foliage due to the attacks of a mite, *Tetranychus telarius,* which resembles the "red spider" of greenhouses in its habits and causes very similar injuries. It is of rather common occurrence in North Alabama, usually on newly cleared lands, and it has been observed doing conspicuous injury in a few fields near Auburn. Judging from the older accounts of cotton diseases, it occurs quite widely in most of the cotton growing

* Bibliography, Nos. 1, 2, 5, 6, 9, 10, 13, 29, 31.

States. Its injuries are often confounded with those produced by other causes. It seldom invades entire fields, but is usually confined to limited patches or areas. The mite multiplies rapidly during hot dry weather, but it is held in check by rains. While locally troublesome it can only be classed among the minor enemies of the cotton plant. So far no remedial measures have been tried. Judging from experience with the allied greenhouse pest the prospects for finding a practicable remedy are not flattering.

The suffused reddening of the foliage due to premature ripening so often seen on sterile rocky hillsides can hardly be called a disease. It is simply starvation and can be promptly remedied by ameliorating the soil conditions.

According to Atkinson* the term Red Rust is sometimes applied to certain stages of the true or black rust when the fungus spots on the leaves are surrounded by a reddish border. This is certainly not a common use of the term. In my experience farmers employ it almost exclusively for the injury caused by mites.

LEAF BLIGHT.†

When the fungus, *Cercospora gossypina* develops alone on the leaves the resulting condition may properly be called leaf blight. The fungus occupies deadened whitish areas 1-2 c. m. in diameter. These are usually surrounded by an indistinct reddish border. Scattered spots of it may appear at almost any stage of the growth of the plant. When acting alone it is usually a disease of minor importance, but it is very widespread and it frequently merges into the rust for this is one of the fungi associated with that disease.

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* Ala. Bull. 27:6.

† Bibliography Nos. 5, 6. 7, 9, 10, 13, 38.

The perfect or ascus bearing stage of this fungus was first detected by Atkinson, who called it *Sphaerella gossypina*. As has been recently pointed out * the generic name *Sphaerella* is not tenable for this group of fungi as it had been previously employed for a different class of plants and the name *Mycosphaerella* has been proposed instead. Our cotton fungus, therefor, will have to be called *Mycosphaerella gosspyina.* The so-called *Cercospora* is only the early or immature conidial stage of the fungus, but, as in so many other cases, it is in this stage that the injury is done.

COTTON MILDEW. †

In late summer and fall the under surface of the leaves of cotton growing in moist places is often covered by white frosted areas. These are usually rather small and angular, being bounded by the veinlets of the leaf, but sometimes they become confluent, covering the entire leaf surface. This frosted appearance is due to the growth of a fungus, *Ramularia areola* Atk. It results in the rather premature falling of the affected leaves, but as it usually only occurs on rank plants in low moist places this partial defoliation coming so late in the season does no appreciable damage.

No remedies have been tried for this disease. If it should ever be worth the while it could doubtless be held in check by spraying with fungicides, but the spraying of a field crop like cotton is a task that will seldom be undertaken.

ANGULAR LEAF SPOT. ‡

In the first stages of this disease clear watery spots are seen in the leaves. These are usually bounded by the

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* See Engler-Plantl. Nat. Plantz. Fam 1:1:423.

† Bibliography Nos. 3, 10, 13. Syn. Areolate Mildew.

‡ Bibliography Nos. 5, 6, 10, 13.

veins and are thus somewhat angular. Sometimes these transparent spots are confluent along both sides of one of the larger veins or ribs. At this stage of the disease these spots are swarming with bacteria. Later the spots become bounded by a blackish border, the leaf tissue of the spot becomes dry and dead, and often finally breaks away, leaving a jagged hole. This disease is very widely distributed. It is doubtful if there is a cotton field in the State entirely free from it. It usually first appears in June or early July or from two to six weeks earlier than the rust, though it is often found in connection with that disease, when it contributes not a little to the defoliation of the plants. When acting alone it seldom involves a sufficiently large portion of the leaf surface of the plant to prove very detrimental, but it doubtless aids in lowering the vitality of the plant and thus paves the way for the attacks of the rust fungi.

In his earlier accounts of the disease Atkinson attributed it to the action of the bacteria that always accompany it in its early watery stages. Later, owing to the failure of some inoculation experiments he seems to have changed his views for he includes it among the diseases due primarily to physiological causes. My own observations favor the former theory as the disease is by no means confined to plants that are lacking in vigor, and it usually appears at the season of the year when the cotton is making its most vigorous growth. I am of the opinion that the disease is directly due to the action of the accompanying bacteria, that they are able to develop in vigorous healthy leaf tissues, and that in many cases, at least, the cotton aphis is instrumental in spreading the contagion. These views, however, require confirmation, as the disease greatly needs further study. No remedies have been proposed.

COTTON BOLL ROT.*

The rotting of the unripe bolls often causes serious loss to the cotton grower. During the wet Fall of 1898 there were instances where almost the entire crop of some fields was lost, and there were considerable areas in different parts of the State where the percentage of loss was very heavy. Owing to the prevailing dry weather the loss during 1899 has been comparatively small. Like the rust this seems to be a composite trouble that cannot be traced to any one uniform cause. Unlike the rust, however, it is not as a rule the poor, worn out lands that suffer from it. It causes its worst injury on the richest lands where the growth of the cotton is rankest and most vigorous. Although it has been observed since the early years of the century our knowledge of this disease is very fragmentary. The following remarks regarding it must largely be taken as suggestions of probabilities rather than as statements of proven facts. Stedman, who studied the disease, thought that he had discovered the cause in a germ that he called *Bacillus gossypina.* His results have not been fully confirmed. In 1897 C. F. Baker investigated a serious outbreak of boll rot near Dadeville, Ala. He came to the conclusion (not before published) that the primary cause of the disease, at least in the case under investigation, was the puncture of the boll by one of the small leaf hoppers sometimes known as "sharpshooters." †

He found these insects very abundant in the infested fields, and brought back numerous specimens of the

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* Bibliography Nos. 13, 15, 29, 31, 37, 43 45,

†In a recent letter Mr. Baker says: "The Tettigonid "sharpshooters" most conspicuous in the work at Dadeville were two species of the genus *Diedrocephala* as that genus has been recognized by American entomologists. These two occurred in greatest numbers, but a few others, Jassids and Tettigonids were also involved.

bolls in all stages from the fresh puncture to complete rottenness. In the Laboratory various organisms were isolated from these rotting bolls, including at least three species of *Bacillus, Colletotrichum Gossypii, Fusarium sp., Alternaria sp., Rhinotrichum macrosporum* and *R. tenellum.* One of the bacilli was the red pigment producing *B. prodigiosus.* Most of these organisms were doubtless mere saprophytes feeding on the broken-down tissues of the boll. Which one or ones it was that first invaded the insect punctures and started the rot could not be determined with certainly. Field inoculations were made with the different bacilli, but without success. The inoculation punctures in the bolls dried down without producing rot. This, perhaps, should have been expected as the weather was by this time dry and the bolls inoculated were on rather small, feeble plants. The rot only occurs in nature during wet weather or on plants that are so rank as to fully shade the ground thus preventing the drying off of the dew and maintaining a moist atmosphere. It was impossible to decide whether either of the germs was the one isolated by Stedman.

Whether the organisms that produce rot are always dependent on insect punctures for gaining an entrance to the boll is perhaps an open question. There is some evidence that when the plants are rank and the weather wet insect punctures are not always necessary. *Colletotrichum Gossypii,* at least, among the species eumerated above as developing on the rotting bolls, is known to be an active parasite. Quite possibly its attacks on the carpels may so injure the tissue as to admit the other organisms to the immature lint which seems to furnish so favorable a nidus for their growth. On the other hand Stedman's hypothesis of an actively parasitic germ, able in some unknown way to gain entrance to the bolls unaided, may in some cases be the correct one. The whole subject is very obscure and there is great need for farther careful investigation. The disease has not been prevalent in the fields near Auburn which has rendered study of it difficult.

In any event the fact seems well established that it is the rankest, most luxuriant cotton that is most subject to boll rot. This suggest the following practical recommendations for lessening its injuries. 1st to avoid as far as possible planting cotton on lands that produce an excessive growth of stalk or "weed." Such lands are usually more valuable for corn and hay. 2nd. If necessary to plant on such lands give more space between the rows than is the common practice. This will give better circulation of air and will tend to dry the plants more quickly. 3rd. On such lands use acid phosphate freely and no other fertilizer. Even on soils so rich that no fertilizer is ordinarily used the acid phosphate will be profitable on account of its well known tendency to promote fruitfulness and early maturity rather than a rank growth of stalk. Nitrogenous fertilizers should particularly be avoided on such soils. 4th. Plant the short growing, early maturing varieties, rather than the rank long-limbed late kinds. In other words, the treatment where boll rot is feared should be largely the reverse of that indicated for combating rust. In that case we want to promote vigor of stalk and foliage by all possible means, here the object should be to reduce over-luxuriance and provide for the free circulation of air and the rapid drying off of the plants.

ANTHRACNOSE OF THE BOLL.*

The fungus *Colletotrichum Gossypii* is an active parasite of the cotton plant in all stages of its growth. It attacks the stems of young seedlings near the ground,

* Bibliography Nos. 8, 10, 13, 27, 42.

causing death, much as in damping off. It produces characteristic lesions on the margin of the seed leaves, especially where the latter are caught and impeded in growth while trying to escape from the hull. It develops on the leaf—scars on the stem, and on feeble or injured leaves being one of the fungi associated with rust. It causes a blight of the bark of the twigs and larger stems, but its most conspicuous injuries are to the bolls. It is very common in all cotton fields to see the bolls when approaching maturity lose their green color and assume, especially on the side exposed to the sun, a dull red or bronzed color. This change in color is due to the growth of the mycelium of this fungus in the carpels. If the invasion has not taken place till the boll is nearly mature and the weather is not too wet the fungus may not reach the fruiting stage, or at least it will produce spores sparingly and inconspicuously, and the boll may open quite normally, so that no material damage results. This is very frequently the case. At other times the fungus causes a premature dying of the tissues of the carpels, causing them to crack open, thus exposing the immature lint which may rot in consequence. If too mature to rot, the carpels do not open freely, making the lint hard to pick. It is only under conditions especially favorable to it that the fungus produces the peculiar spotting, and the pustules filled with pink spores, that have been figured as characteristic of the disease. In very many cases bolls and stems are affected by the fungus that do not show these symptoms at all.

It has been found by Atkinson that scalding the seed before planting prevented the appearance of this fungus on seedlings grown for experimental purposes in the greenhouse, probably by destroying spores that were lodged on the lint, and he has suggested this treatment of the seed as a possible remedy for the disease under field conditions. The proposed remedy has not been tried in the field, and in fact it gives little promise of success since the plant is liable to infection at any stage of its growth ,and the crop is so universally grown that any treated area would almost inevitably become infested from neighboring plantations before the close of the season. No other remedy has been suggested. The disease causes in the aggregate very serious losses.

SHEDDING OF BOLLS.*

Young cotton bolls often fall as the result of injury by the boll worm or other insects, but the term "shedding" is usually applied to a falling of the bolls that is not caused by insect or fungus injuries. It seems to be entirely a physiological trouble and to be dependent on soil and weather conditions. The trouble has not been sufficiently studied to admit of any definite statements as to the predisposing causes. Some varieties or classes of varieties seem to be more subject to shedding than others. The texture and moisture holding capacity of the soil doubtless has a considerable influence. In some cases the character of the fertilizer used has a marked effect on shedding. † Probably, however, the character of the season and the abundance or absence of rainfall has more to do with shedding than any other factor. During a period of seasonable rains the plant puts on as many bolls as it could carry to maturity if these favorable conditions were to continue. If now a period of drouth comes on the lessened water supply in the soil

*Bibliography Nos. 10, 13, 29, 31.

† See Ala. Bull. 99:304. On very poor sandy land plots with only phosphate and with phosphate and kainit shed the bolls of the top crop badly, while those with complete fertilizer set and carried a full top crop.

prevents the taking in by the roots of a sufficient quantity to meet the needs of the crop, and as a measure of self-protection the plant throws off part of its load. Again a plant may be carrying a good crop of bolls during a comparatively dry period in which case growth of stalk will have largely ceased, and the food elaborated by the leaves is practically all going to develop the fruit. If now rains come on, a rapid new growth of stalk may be induced that will divert the prepared food from the bolls, and thus cause some of them to fall, or if the rains are very heavy and prolonged the soil may become so water-logged as to cause the dying of some of the feeding rootlets and root hairs, thus deranging the nutrition of the plant. At the same time, the continued dark, cloudy weather would interfere with the normal action of the leaves. Whatever the physical explanation it is a frequently observed fact that sudden changes in weather conditions either from wet to dry or from dry to wet will affect the plant unfavorably and cause shedding. Of course these conditions of weather are beyond our control and in so far as they are the active cause of shedding it will be impossible to avert the trouble. Such a system of soil preparation, cultivation and fertilization as will tend to keep the plant in the best possible condition of thrift and vigor will do much to minimize the bad effects of unfavorable weather.

The trouble is a serious one, often causing the loss of a considerable percentage of the crop. It should be studied until the effect on fruitfulness of each of the factors constituting the environment is fully understood.

List of Fungi Recorded as Growing on Cotton or the Cotton Plant.

Aecidium Desmium B. & Br. Fungi of Ceylon No. 850 Sacc. Syl. Fung. 7:782.

On leaves of *Gossypium*, Island of Ceylon.

Aecidium Gossypii E. & E. Erythea 5:6—1897.

On leaves of *Gossypium*, Lower California.

Alternaria sp.

An undetermimed species mentioned by Atkinson as one of the fungi associated with cotton rust in Alabama. Bot. Gazette 16: 61-65. Ala. Exp. Sta. Bull. 27:6-10.

Alternaria tenuis Nees. Syst. d. Pilze 2:72. Sacc. Syl. Fung. 4:545. On leaves and stems of various plants in Europe and North America. Said by Gasparrini to be associated with a disease of cotton in Italy known as "Palagra."

Bacillus gossypinus Stedman. Ala. Exp. Sta. Bull. 55:6. Apr. 1894. In rotting cotton bolls in Alabama. Figured and described as causing a boll rot of cotton.

Bacillus prodigiosus.

Mentioned in this publication, p. 312, as isolated from rotting cotton bolls in Alabama.

Botryosphaeria Berengeriana DeNot. Sfer. Ital. 82. Fig. 90. Sacc. Syl. Fung. 1:457. On various trees and shrubs in Europe and America. Atkinson, Bull. Cornell Uni. 3:11 refers to this species, on the authority of Dr. Massee who examined the specimens, his No. 2354 on capsules of *Gossypium herbaceum* from Alabama. Ellis, N. A. Pyrenomycetes p. 546 gives this as a synonym for *Botryosphaeria fuliginosa* (M. & N.) E. & E. while Saccardo, Syl. Fung. 1:456 gives *Sphaeria fuliginosa* M. & N. as a synonym for *Botryosphaeria Quercuum* (Schw.) Sacc.

Botryosphaeria horizontalis (B. & C.) Sacc. Syl. Fung. 1:463.

Syn. *Melogramma horizontalis* B. & C. Grev. 4:98.

On stems of cotton from South Carolina, Ravenel No. 1892.

Botryosphaeria subconnata (Schw.) Cke. Grev. 13:101.

Syn. *Sphaeria subconnata* Schw. Syn. N. A. Fungi No. 1443. *Thuemenia valsarioides* Rehm. Thuem. Myc. Univ. No. 2166.

On stems of cotton, Carolina, Schweinitz; Georgia, Ravenel.

Cercospora gossypina Cke.

See Mycosphaerella gossypina (Cke.) Earle.

Cercosporella Gossypii Speg. Guar. 1;162.

Sacc. Syl. Fung. 10:565. On cotton leaves, Brazil.

Chaetomium olivaceum C. & E. Grev. 6:96.

Sacc. Syl. Fung. 1:225, on dead stems of *Erigeron* New Jersey. Atkinson refers here specimens on dead stems of cotton from Alabama. Bull. Cornell Uni. 3:6.

Cladosporium herbarum (Pers.) Lk.

Developing on cotton roots killed by *Ozonium* and placed in a moist chamber. Pammel Tex. Exp. Sta. Bull. 7:20.

Cleistotheca papyrophila Zuk. Mykol. Mitheil, p. 4. (Bot. Zeitsch). Sacc. Syl. Fung. 11:270. On cotton fiber, Austria.

Colletotrichum gossypii South. Jour. of Myc. 6:101. Sacc. Syl. Fung. 10:469. Also Atkinson in Jour. of Myc. 6:175, Ala. Exp. Sta. Bulls. 17:8 and 41:40. Abundant in Alabama and other Southern States causing anthracnose of the bolls and stems, also on the leaves associated with rust.

Dyplodia gossypina Cke. Grev. 7:95. Sacc. Syl. Fung. 3:366. On dead capsules of cotton, Bombay, India, and Washington, U. S. A. Atkinson, Bull. Cornell Uni. 3:29 refers here to specimens from Alabama.

Diplodia herbarum (Corda) Lev. Ann. Sci. Nat. 1846, p. 292.

Syn. *Sporocadus herbarum Corda*, Ic. 3, fig 63.

Sacc. Syl. Fung. 3:370. On dead stems of various plants including cotton, Europe, Algeria, North America.

Diplodiella Cowdelli (B. & Br.) Sacc. Syl. Fung. 3:377.

Syn. *Diplodia Cowdelli B. & Br.* Ann. N. H. No. 406.

On cotton paper, England.

Doassansia Gossypii Lagh. Jour. of Myc. 7:49. Sacc. Syl. Fung. 11:235. On leaves of *Gossypium*, Ecudor.

Dothiorella botryosphaerioides Sacc. Mich 1:145. Sacc. Syl. Fung. 3:242. On stems of *Gossypium* South Carolina, (Ravenel).

Eurotium sp.

Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. Bull. 33:307, mentions this as appearing in cultures from diseased cotton roots from Texas.

Fusarium sp.

Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. Bull. 33:307, common on cultures from diseased cotton roots from Texas.

Fusarium aurantiacum (Lk.) Sacc. Syl. Fung. 3:720.

Syn. *Fusisporium aurantiacum Lk.* Obs. 1:17.

Mentioned in Sacc. Syl. Fung. 13:538 [Host Index] as occurring on stems of *Gossypium herbaceum.*

Fusarium oxysporum Schlecht. Fl. Berol. 2:139. Sacc. Syl. Fung. 4;705. Specimens on bolls of *Gossypium herbaceum* from Alabama are referred to this species by Atkinson. Bull. Cornell Uni. 3:49.

Fusarium vasinfectum Atk.

See Neocosmospora vasinfecta (Atk.) E. F. Smith.

Gibberella pulicaris (Fr.) Sacc. Mich. 1:43.

Syn. *Sphaeria pulicaris Fr.* Syst. Myc. 2:417. Given by Sydow in Host Index Sacc. Syl. Fung. 23:538 as occurring on *Gossypium herbaceum.*

Licea Lindheimeri Berk? Grev. 2:68.

Mentioned by Atkinson as occurring in cultures from diseased cotton roots from Texas. Div. of Exp. Sta. U. S. Dept. of Agr. 33:307.

Macrosporium gossypinum Thuem, Herb. Myc. oeconom. No. 513. Sacc. Syl. Fung. 4:526. On dead stems of *Gossypium herbaceum,* South Carolina, (Ravenel).

Macrosporium nigricantium Atk. Bot. Gazette, 16:62. Ala. Exp. Sta. Bull. 27:8; Sacc. Syl. Fung. 10:676 (under the name *M. nigricans* Atk). Abundant on living or languishing cotton leaves throughout the Gulf States associated with the disease called rust.

Mucor Mucedo L.

Reported by Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. 33:107 as occurring in cultures of diseased cotton roots from Texas.

Mycosphaerella gossypina (Cke.) Earle, this publication, p. 309. Syn. *Cercospora gossypina* Cke. Grev. 12:21.

Sphaerella gossypina Atk. Bull. Torr. Bot. Cl. 18:300.

The *Cercospora* stage of this fungus is common on cotton leaves in the Gulf States causing leaf blight. It is also associated with rust.

Neocosmospora vasinfecta (Atk.) E. F. Smith. Div. of Veg. Pys. and Path. U. S. Dept. of Agr. Bull. 17:46. 1899.

Syn. *Fusarium vasinfectum Atk.* Ala. Exp. Sta. Bull. 41:26. The conidial stage is parasitic within the stem of the cotton plant causing wilt. Frequent in the Gulf States.

Oedocephalum echinulatum Thax. Bot. Gaz. 16:17.

Sacc. Syl. Fung. 10:522. Reported by Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. 33:307 as occurring in cultures of diseased cotton roots from Texas.

Olpitrichum carpophilum Atk. Bot. Gaz. 19:244.

Sacc. Syl. Fung. 11:594. On rotting cotton bolls in Alabama.

Ophiobolus porphyrogonus (Tode) Sacc. Syl. Fung. 2:338.

Syn. *Sphaeria porphyrogona Tode* Meckl. 2;12.

On many herbaceous stems Europe and America. Specimens on dead cotton stems from Alabama are so determined by Atkinson, Bull. Cornell Uni. 3:8.

Ozonium sp.

Pammell, Texas Exp. Sta. Bulls. 4 and 7. Atkinson, Bot. Gaz. 18:16–19. Div. of Exp. Sta. U. S. Dep. of Agr. Bull. 33, 300–308, causing a serious root rot of cotton and other plants and trees in Texas. Pammel referred it provisionally to the species *O. auricomum Lk.* Atkinson decides that it cannot be that species. No fruiting forms have been observed.

Penicillium candidum Lk.

Penicillium Duclauxi Delacr.

Penicillium glaucum Lk.

All three of the above species of *Penicillium* developed in cultures of diseased cotton roots from Texas. Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. Bull. 3 :307.

Pestalozziella gossypina Atk. Cornell Uni. Bull. 3:38. On dead stems of cotton from Alabama.

Phlyctaena Gossypii Sacc. Mich. 2:144 (as *Septoria*). Sacc. Syl. Fung. 3:595. On stems of cotton, Carolina, Ravenel; Alabama, Atkinson, Cornell Uni. Bull. 3:30.

Phoma corvina Rav. Grev. 17:75. Sacc. Syl. Fung. 10:171. On branches of *Gossypium*, South Carolina.

Phoma Gossypii Sacc. Mich. 2:144. Syl. Fung 3:121. On stems of *Gossypium*, Carolina, Ravenel; Alabama, Atkinson, Cornell Uni. Bull. 3:30.

Phyllosticta gossypina Ell. & Martin. Jour. of Myc. 2:129. Sacc. Syl. Fung. 10:130. On fading leaves of cotton, F. L. Scribner; Alabama, Atkinson, Cornell Uni. Bull. 3:31.

Pleospora nigricantia Atk. Cornell Uni. Bull. 3:9. On fallen leaves of *Gossypium herbaceum* that were attacked by *Macrosporium nigricantium*.

Polyporus (or Trametes) sp.

On cotton roots, developing on a brown mycelium quite distinct from the *Ozonium*. Pammel, Tex. Exp. Sta. Bull. 7:18.

Pyrenophora hyphasmatis Ell. & Ev. Jour. of Myc. 4:77 (or as quoted by Saccardo owing to error in pagination 4:65) Sacc. Syl. 9:805. On exposed cotton cloth, Louisiana.

Ramularia areola Atk. Bot. Gazette, 15:166. Ala. Exp. Sta. Bull. 41:55-58. On living cotton leaves in the Gulf States causing mildew.

Rhinotrichum macrosporum Farl. Mich. 2:148. Sacc. Syl. Fung. 4:91. On rotten wood. Mass. On dead capsules of *Gossypium herbaceum*, Alabama, Atkinson, Cornell Uni. Bull. 3:39.

Rhinotrichum tenellum B. & C. Grev. 3:109. Sacc. Syl. Fung. 4:91. On rotten onions So. Car.

On dead capsules of *Gossypium herbaceum*, Alabama, Atkinson, Cornell Univ. Bull. 3:39.

Rhizoctonia sp.

Sterile damping off fungus, Atkinson, Ala. Exp. Sta Bull. 41:30-39. Cornell Exp. Sta. Bull. 94:265-268. Duggar, Cornell Exp, Sta. Bull. 163:330-352. Causing a damping off of cotton seedlings, and the disease known as sore shin.

Rhizopus nigricans Ehrb. De Mycetog, Nova Acta. 19:108. Sacc. Syl. Fung. 7:212. A common mould.

On tissues of cotton seedlings that have died from damping off. Atkinson, Ala. Exp. Sta. Bull. 41:31.

Saccharomyces sp.

Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. Bull. 33:307 mentions a "pink yeast" as occurring in cultures of diseased cotton roots from Texas.

Sclerotium sp. An undetermined species causing Rolf's "Sclerotium Wilt" of various plants. Mentioned by E. F. Smith, Div. of Veg. Phys. & Path. U. S. Dept. of Agr. Bull. 17:44, as causing a wilt of cotton in Florida.

Septoria gossypina Cke. Grev. 12:25

Sacc. Syl. Fung. 3:516. On leaves of *Gossypium*, Carolina, Ravenel.

Sphaerella gossypina Atk.

See Mycosphaerella gossypina (Cke) Earle.

Sporotrichum chlorinum Link. Obs. Myc. 2:35.

Sacc. Syl. Fung. 4:112. Occurring in cultures from diseased cotton roots from Texas. Atkinson, Div. of Exp. Sta. U. S. Dept. of Agr. Bull. 33:307.

Thielavia basicola Zopf. Verhand, Bot. Brand, p. 101. Sacc. Syl. Fung. 1:39. Making wounds in cotton stems beneath the surface of the earth, E. F. Smith, Div. of Veg. Phys. & Path. U. S. Dept. of Agr. Bull. 17:38.

Torula incarcerata Cke. Grev. 1:90.

Sacc. Syl. Fung. 4:258. Causing a disease of cotton seeds in India.

Tricothecium roseum (Pers.) Lk. Obs. Myc. 1:16.

Syn. *Trichoderma roseum* Pers. Syn. Fung. p. 231.

Sacc. Syl. Fung. 4:178. On decaying carpels of *Gossypium*, Atkinson, Cornell Uni. Bull. 3:39.

Uredo Gossypii Lagh. Jour. of Myc. 7:48.

Sacc. Syl. Fung. 11:224. Causing a destructive rust of the foliage of *Gossypium* in Ecudor.

Valsa gosspinay Cke. Valsei of U. S. p. 115 (in Proc. Phil. Acad. Sci. 1877). Sacc. Syl. Fung. 1:127.

On branches of cotton, Carolina, Ravenel.

Verticillium Rexianum Sacc. Mich. 2:577.

Sacc. Syl. Fung. 4:153, occurring in cultures of diseased cotton roots from Texas, Atkinson, Div. of Exp. Sta. U. S. Dept of Agr. Bull. 33:307.

Zignoella funicola (Ell.) Sacc. Syl. Fung. 2:217.

Syn. *Sphaeria funicola* Ell. Bull. Torr. Bot. Club, 8:90.

On exposed cotton cord in a grape trellis, New Jersey.

This makes a total of 61 species reported as growing on Gossypium.

Species Excludende.

In examining Mycological literature for cotton inhabiting fungi references have been found to the following species as occurring on *Gossypium* which on investigation prove to be erroneous. These errors have mostly occurred through a misunderstanding on the part of foreign botanists of our popular use of the of the term "cottonwood" for the different species of *Populus*.

Amphisphaeria separans Ell. & Ev. Bull. Torr. Bot. Club 24:130. "On an old cottonwood shingle." This is mentioned by Sydow. Host Index Sacc. Syl. Fung. 13:548 as occurring on wood of *Gossypium.*

Diplodiella striispora Ell. & Barth. Erythera 41:24. "On cottonwood stump." Mentioned by Sydow l. c. as on trunk of *Gossypium.*

Gloeosporium carpigenum Cke. & Hark. Grev. 13:113. "On capsules of cottonwood." This is given in Sacc. Syl. Fung. 10:453 as "*in capsulis Gossypii arborei.*" Miss E. A. Southworth in her article on Anthracnose of cotton, Jour. of

Myc. 6:100, says, "When this fungus [*Colletotrichum Gossypii*] was first brought to our notice some immature specimens were sent to Mr. Ellis who afterward sent them to Mr. Cooke; both agreed that they were identical with *Gloeosporium carpigenum* Cke. & Hark. and the fungus was distributed in Ellis North American Fungi under that name. Through the kindness of Mr. Harkness I have been able to compare it with type specimens of *G. carpigenum* and find it quite distinct from this fungus."

It may be mentioned in this connection that *Gloeosporium carpigenum* Cke. & Hark. on capsules of cottonwood is antedated by *Gloeosporium carpigenum* Cke. Grev. 7:109 on fruits of *Aesculus*, California. As the spore measurements in the two descriptions do not agree it is to be supposed that they are two distinct species, in which case the one on "cottonwood" is without a name.

Hyponectria Gossypii (Schw) Sacc. Syl. Fung. 2:456.

Syn. *Sphaeria Gossypii* Schw. Fung. Car. No. 207. Dr. Erwin F. Smith has conclusively shown, Div. of Veg. Phys. & Path. U. S. Dept. of Agr. Bull. 17:51, that this should be considered *nom. excludendum* as it was founded on a misconception, the type specimen showing only a wrinkling of the capsule, no fungus at all being present.

Macrosporium nigricans Atk. Sacc. Syl. Fung. 10:674. This seems to be a missprint for *Macrosporium nigricantium* which see.

Ozonium auricomum Lk.

Pammell so called the fungus causing root rot of cotton in Texas, but Atkinson decides after farther study of the fungus that it cannot be this species. See *Ozonium sp.*

Sphaeria Gossypii Schw.

See Hyponectria Gossypii (Schw.) Sacc.

Bibliography of Cotton Diseases.

In the following pages the attempt has been made to bring together the titles of all the papers that have been published on cotton diseases. Owing to limited library facilities the list is necessarily incomplete and the writer will be greatly obliged for notes on any omitted articles. The papers are arranged alphabetically by authors and as far as possible chronologically under each author. No attempt has been made to list reviews or compilations, but only such papers as give the results of original observation and study. Papers in the agricultural press* or other transient publications are not included.

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1. **Atkinson, Geo. F.—The Cotton Worm and other Enemies of the Cotton Plant.** So. Car. Dept. of Agr. Monthly Rept. Oct. 1888, p. 91. Mention is made of Red Rust as caused by mites, *Tetranychus tetarius*.

2. **Atkinson, G. F.**—So. Car. Exp. Sta. Bull. 4:60. Jan. 1889. Mentions the Red Rust caused by mites.

3. **Atkinson, G. F.—A New Ramularia on Cotton.** Bot. Gazette 15:166-8. July, 1890. A description of the botanical characters of the fungus *Ramularia areola* causing mildew of cotton.

4. **Atkinson, G. F.—A New Root Rot Disease of Cotton.** Ala. Exp Sta. Bull. 21, p. 1-11, Dec. 1890. Describes the attacks of the nematode, *Heterodera radicicola* on cotton roots.

5. **Atkinson, G F.—Black Rust of Cotton; a Preliminary Note.** Bot. Gazette, 16:61-5, Mch. 1891 A paper read before the Assoc. of Agr. Col. & Exp. Sta's. at Champaign, Illinois, Nov. 1890, giving a brief discussion of the characteristics of the disease and of the fungi accompanying it He describes as new *Macrosporium nigricantium* and mentions a bacterial leaf disease [angular spot].

6. **Atkinson, G. F.—Black Rust of Cotton.** Ala. Exp. Sta. Bull. 27, pp. 1-16, with two plates, May, 1891. A more extended discussion of the matter presented in the preliminary paper.

7. **Atkinson, G. F.—Sphaerella Gossypina n. sp.—the Perfect Stage of Cercospora Gossypina Cke.** Bull. Torr. Bot. Club, 18:300-301 with plate, Oct. 1891. a botanical description of the fungus.

8. **Atkinson, G. F.—Anthracnose of Cotton.** Jour. of Myc. 6:173-8 with two plates, 1891

Read before the Assoc. of Agr. Col. & Exp. Sta's. Champaign, Ills. Nov. 1890.

Describes the occurrence of the fungus *Colletotrichum Gossypii* South on different parts of the cotton plant, and its behavior in artificial cultures.

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* A long list of references to newspaper articles on the Texas root rot, of cotton and other plants is given by Pammel at the end of Texas Exp. Sta. Bull. No 7.

9. **Atkinson, G. F.—Some Leaf Blights of Cotton.** Ala. Exp. Sta. Bull. 36, pp. 1-32, with two plates, March 1892. Describes rust, under the name of "Yellow Leaf Blight," calls attention to its being, primarily a physiological disease, gives history of kainit as a preventive of the disease and discusses the effect of humus. Makes brief mention under the name of "Red Leaf Blight" of a reddening of the leaves, often seen on poor lands, due to poor nutrition.

10. **Atkinson, G. F.—Some Diseases of Cotton.** Ala. Exp. Sta. Bull. 41, pp. 1-65, with numerous figures, Dec. 1892. This was prepared by Dr. Atkinson before severing his connection with the Ala. Exp. Station as a summary of his studies on cotton diseases. It includes a somewhat full discussion of the following topics: General Nature of Cotton Diseases, p. 5. Yellow Leaf Blight or Mosaic Disease [Rust], p. 9. Frenching [Wilt], p. 19. Damping Off or Sore Shin, p. 30. Anthracnose, p. p. 40. Shedding of Bolls, p. 50. Angular Spot of Cotton, p. 54. Areolate Mildew of Cotton, p. 55. Cotton Leaf Blight, p. 58. Root Galls, p. 61.

11. **Atkinson, G. F.—Methods for Obtaining Pure Cultures of Pammel's Fungus of Texas Root Rot of Cotton.** Bot Gazette, 18:16-19, Jan. 1893. Read before Amer. Assoc. Agr. Coll. & Exp. Sta's, New Orleans, Nov. 1892. Describes methods of baiting the fungus.

12. **Atkinson, G. F.—Damping Off.** Cornell Exp. Sta. Bull 94:265-8. Discusses the sterile damping off fungus [*Rhizoctonia*] which is the cause of sore shin in cotton.

13. **Atkinson, G. F.—Diseases of Cotton.** The Cotton Plant, Office of Exp. Sta. U. S Dept. of Agr. Bull. 33, pp. 279-316, with numerous cuts, 1896. This gives a detailed account of all cotton diseases known to occur in North America. It is largely the result of the author's work while connected with the Ala. Exp. Station. The diseases discussed are Mosaic Disease or Yellow Leaf Blight [Rust], Red Leaf Blight [Red Rust in part], Shedding of Bolls, Angular Leaf Spot, Frenching [Wilt], Sore Shin, Damping Off or Seedling Rot, Anthracnose, Root Rot (Ozonium), Cotton Leaf Blight, Areolate Mildew, Cotton Boll Rot, Root Galls of Cotton.

14. **Atkinson, G. F.—Some Fungi from Alabama.** Cornell Uni. Bull. Vol. 3, No. 1, pp 1-50. June. 1897. This mentions among others, 20 species of fungi as occurring on cotton in Alabama, two of which are described as new.

15. **Comstock, J. Henry—Report upon Cotton Insects.** U. S. Dept. of Agr. 1879. Appendix II, p. 384. Mentions cotton boll rot. Dr. Lee reporting from Lowndes Co., Ala, says "From 1825 to 1832 the crop was cut off very much by an infection called 'the rot.' The bolls which were not matured became diseased and sour."

16. **Cooke, M. C.—Blights of Tea and Cotton**, Grevillea, 1:90. Dec 1872. Describes a disease of Cotton seeds in India caused by the fungus *Torula incarcerata* Cke.

17. **Curtis, Geo. W.**—Tex. Exp. Sta. Bull. 22:211-216. Sept. 1882. Discusses a root rot of alfalfa found to be the same as the cotton root rot [*Ozonium*]. Reports experiments that suggest salt as a possible remedy.

18. **Dabney, Chas W.**—Ann. Rept. N. Car. Exp. Sta. for 1882, pp. 68-73. In discussing kainit as fertilizer for cotton he refers at some length to its effect in preventing rust and the shedding of bolls.

19. **Duggar, B. M.—Three Important Diseases of the Sugar Beet.** Cornell Exp. Sta. Bull 163:329-352. Feb. 1899. Discusses the sterile fungus of cotton sore shin in connection with a similar fungus causing a disease of beets and refers it to the genus *Rhizoctonia*.

20. **Duggar, J. F.—Experiments with Cotton**. Ala. Exp. Sta. Bull. 76:22. Jan. 1897. Mentions the failure of kainit in moderate quantity to resist rust in experiments during 1896. With 600 lbs. per acre there was a noticeable effect.

21. **Duggar, J. F—Co-operative Fertilizer Experiments with Cotton in 1896**. Ala. Exp. Sta. Bull. 78. Feb. 1897. On pp. 63 and 66 are brief notes on the effect of fertilizers on rust.

22 **Duggar, J. F.—Experiments with Cotton**. Ala. Exp. Sta. Bull. 89. Jan. 1898. On pp 4 and 20 are notes on the effect of kainit on rust.

23 **Duggar, J. F.—Co-operative Fertilizer Experiments with Cotton in 1897**. Ala Exp Sta, Bull. 91 Feb. 1898, p. 44. "Kainit greatly reduced the injury from leaf diseases in 61 per cent. of the experiments." There are numerous notes on the effect of kainit in controlling rust

24. **Duggar, J. F.—Experiments with Cotton in 1898**. Ala. Exp. Sta. Bull. 101, Jan. 1899, pp. 3, 16 and 17 give result of special potash experiments showing marked effect of kainit and muriate of potash in decreasing the amount of rust.

25. **Duggar, J. F.—Co-operative Fertilizer Experiments with Cotton in 1898**. Ala. Exp. Sta Bull. 102, Feb. 1899. Many brief notes on rust and some mention of boll rot.

26. **Earle. F. S.—Cotton Rust.** Ala. Exp. Sta. Bull 99. pp. 281-309, Dec. 1898. A report on farther investigations of this disease. Atkinson's views are in the main confirmed. Attention is especially called to the necessity for soil improvement in combatting this disease. It is shown that muriate of potash is as effective as kainit in controlling it.

27. **Galloway, B. T.—Anthracnose of Cotton.** Ann. Rept. U. S. Dept. of Agr. 1890, pp. 407-8 with colored plate. A brief account of the disease.

28. **Gasparrini,—Observationi sopra una Malattea del Cottone, &c.** Insti. D'Incorag. Napoli, 1865. Describes a disease known as

Pelagra. *Alternaria tenuis* Nees, and other moulds are associated with it.

29. **Glover, Townend—Accidents and Diseases of the Cotton Plant.** Ann. Rept. U. S. Dept. of Agr. 1855, pp 230-234. Gives an account of the following diseases: "Sore Shin," attributed to careless hoeing, also to twisting by the wind. "Frenching," a name applied to plants with variegated leaves. "Effects of Bad Subsoil," the sudden dying of plants near Tallahassee, Fla. [evidently cotton wilt]. "The Rust." [The author seems to confuse Rust, Red Rust, and probably anthracnose under this term.] "Shedding of Young Buds or Bolls," caused by wet weather. "The Rot," quotes a very full description by Mr. Thorp in American Farmer [no date given].

30. **Lagerheim, G.—Observations on New Fungi from North and South America.** Jour. of Myc 7:44-50. Sept. 1891. Describes *Uredo Gossypii* as a new species causing a serious disease of cotton in Ecudor. Mentions a disease reported from Cuenca under the name of "Cancha" cause not known and describes *Doassansia Gossypii.*

31. **Loughridge, R. H.**—Tenth Census, Vols. 5 and 6. Under the heading "Diseases of Cotton" a brief resume is given of reports from most of the counties in each of the cotton States. The diseases mentioned are Shedding, Boll Rot, Rust, Blight, and Sore Shin. In Texas the term blight evidently refers to Root Rot. In Florida it seems to refer to Wilt. In the other States the terms rust and blight seem to include all leaf diseases of cotton. Read in the light of our present knowledge of cotton diseases these reports are exceedingly interesting and throw much light on geographical distribution.

32. **Lyman, Jos. B.—Enemies of the Cotton Plant.** Ann. Rept. U. S. Dept. of Agr 1866, p. 199. Mentions rust, states it is worse on soils of moderate depth that have been long in cultivation. "Rotation of crops and a liberal application of manures, especially those rich in potash and phosphoric acid will in nine cases out of ten give relief."

33. **Newman, J. S.—Experiments with Cotton.** Ala. Exp Sta. Bull. 22:19, Jan. 1891. Calls attention to the effect of kainit in preventing leaf blight [rust].

34. **Newman, J. S.—Co-operative Soil Tests of Fertilizers.** Ala. Exp. Sta. Bull. 23. Feb 1891. Brief notes on rust.

35. **Pammel, L. H—Root Rot of Cotton or Cotton Blight.** Texas Exp. Sta. Bull. 4, pp. 1-18, Dec. 1888. Discusses geographical distribution, characteristics, and the various theories to account for it. Ascribes it to the growth on the roots of the fungus *Ozonium auricomum* Lk. as determined by Dr. W. G. Farlow.

36. **Pammel, L. H.—Cotton Root Rot.** Texas Exp. Sta. Bull. 7, pp. 1-30, with 5 plates, Nov. 1899. A fuller discussion than in previous paper Gives list of host plants for *Ozonium* in Texas and suggests rotation with the serials as the most promising remedy. Mentions Seedling Rot or Sore Shin, p. 7.

37. **Riley, C. V.** 4th Rept. U. S. Ent. Com. p 357, 1885. Describes Boll Rot. Thinks Steele mistaken in attributing it to work of boll worm, states that it has been destructive at times since 1814.

38. **Scribner, F. Lamson.—Cotton Leaf Blight.** Ann. Rept. U. S. Dept. of Agr. 1887, p. 355 with colored plate. Describes *Cercospora gossypina* Cke. States that it is "distinct from the dreaded cotton rust.... and in comparison is of little consequence."

39. **Smith, Erwin F.—The Watermelon Wilt and Other Wilt Diseases due to Fusarium.** Proc. A. A. A. Sci. 44:190, May, 1896. Mentions cotton wilt and the discovery of the ascigerous form of the fungus causing it, considers it probably identical with the wilts of the watermelon and the cowpea.

40. **Smith, Erwin F.—The Spread of Plant Diseases.** Trans. Mass. Hort. Soc. 1897, pp. 128-9. Mentions cotton wilt incidentally as an example of a disease infesting soils. Cites a sea-island cotton grower who has abandoned 15 acres of his best land on account of it

41. **Smith, Erwin F.—Wilt Disease of Cotton, Watermelon and Cow Pea.** U. S Dept. of Agr. Div. of Veg. Phys. & Path. Bull. 17, pp. 1-53, with 10 plates, Nov. 1899. A very full description of the fungus causing the wilt disease of cotton, *Neocosmospora vasinfecta* (Atk.) Smith, with extended culture experiments. He considers it the type of a new genus in the *Nectriaceae*. The forms on watermelon and cowpea are physiological varieties since they do not seem capable of transmission from one host to another, although structurally indistinguishable. An exceedingly valuable paper.

42. **Southworth, Miss E. A.—Anthracnose of Cotton.** Jour. of Myc. 6:100-105 with 1 plate, 1890. A description of the fungus, *Colletotrichum Gossypii* South, which is considered a new species, with notes on the damage to cotton crop and on geographical distribution.

43. **Stedman, J M.—Cotton Boll Rot.** Ala. Exp. Sta. Bull. 55, pp. 1-12 with 2 plates, Apr. 1894. Describes a disease of cotton bolls which he considers of bacterial origin and ascribes to the growth of *Bacillus gossypina* Sted. Cultural notes and inoculation experiments are recorded.

44. **Stelle, J. P.—Cotton Blight.** 4th Rept. U. S. Ent. Com. App. III, p. 25. 1885. Says the disease is also known in Texas as Stalk Rust and Root Rot. Gives a fairly good description, decides it is not due to insects and suggests rotation of crops.

45. **Stelle, J. P.—Boll Rot,** l. c. p. 26. Observes the cotton boll worm to frequently bite into bolls that they do not enter and considers these injuries as the cause of boll rot.

46. **Wailes, B. C. L.—The Cotton Plant; Its Origin and Varieties and its Enemies and Diseases.** Agriculture and Geology of Mississippi, 1st Rept. 1854, pp. 146-148. Not seen.

47. **Watts.—Dictionary of Economic Products of India.** In the chapter on cotton several diseases are mentioned under their native names. They are mostly ascribed to unfavorable weather conditions, but they do not seem to have been scientifically studied.

CLIMATIC CONDITION OF COTTON BELT.*

BY P. H. MELL.

THE GENERAL CLIMATIC FEATURES PREVAILING IN THE SOUTHERN UNITED STATES DURING THE PREPARATION OF THE LAND FOR THE PLANTING OF THE SEED.

The winters of the South are seldom severe, and the temperature rarely reaches zero except in the more northern latitudes of the cotton region, and not often even there. It is a well recognized fact among cotton planters that in those portions of the country where the changes of temperature are sudden and the fall reaches zero during every winter and sometimes frequently during the same winter, the period is too short between frosts to enable the cotton plant to perfect its growth and mature its fruit. Many efforts have been made to force the plant to produce fiber in the northern portions of Kentucky and the colder regions in west and northwest Texas, but all such efforts have proved total failures, even though the general conditions of the soil in those sections of the country are of a nature well suited for the cultivation of cotton.

The following table of winter temperatures at those stations in the cotton region, giving continuous records for ten years or more, is given to bring out the above conclusions in regard to the growth of cotton. A careful study of this table will show that wherever the altitude or latitude causes the temperature to range low during the winter and spring months the cultivation of cotton is correspondingly reduced to a minimum:

*Condensed from "Climatology of Cotton Plant." P. H. Mell, Bulletin 8 U. S. Weather Bureau.

TABLE I.—*Winter minimum temperatures at stations of the cotton belt of the Southern States.*

STATIONS.	Length of record.	Minimum.	Month and year.	Mean minimum.			No of times min. was down to zero and below.
				December.	January.	February.	
Northern portion.	*Years.*	°		°	°	°	
Atlanta, Ga........	13	— 2	Jan., 1886	37.6	35.4	39.7	2
Charlotte, N. C.....	13	— 5	Dec., 1880	35.5	33.8	37.4	2
Chattanooga, Tenn.	13	— 7	Jan., 1886	35.6	34.0	37.7	2
El Paso, Tex.	14	— 5	Dec., 1880	32.9	30.7	35.8	2
Fort Davis, Tex ..	11	— 3	Jan., 1886	33.2	30.1	34.8	2
Fort Elliott, Tex...	10	—14	Jan., 1888	25.6	18.7	24.2	12
Fort Smith, Ark....	10	— 7	Jan., 1886	33.8	26.8	32.3	3
Knoxville, Tenn. ..	21	—16	Jan., 1884	32.3	30.6	34.2	7
Little Rock, Ark...	13	— 5	Jan., 1886	38.5	33.7	38.0	1
Memphis, Tenn....	20	— 8	Jan., 1886	38.1	32.8	37.7	2
Nashville, Tenn ..	21	—10	Jan., 1884	33.9	30.5	34.1	9
Middle portion.							
Auburn, Ala.......	14	3	Jan., 1884	39.7	38.2	44.8	0
Augusta, Ga.	20	6	Jan., 1886	39.0	38.8	42.0	0
Charleston, S. C ..	20	10	Jan., 1886	44.8	44.5	46.2	0
Green Springs, Ala.	27	2	Jan., 1886	......	......	......	0
Hatteras, N. C. ...	17	8	Dec., 1880	42.0	39.3	41.9	0
Kittyhawk, N. C ...	17	5	Feb., 1886	40.1	36.6	39.4	0
Montgomery, Ala ..	19	5	Jan., 1886	40.6	40.1	44.4	0
Palestine, Tex.	10	0	Jan., 1886	42.6	38.3	43.8	1
Shreveport, La.....	20	1	Jan., 1886	41.6	38.2	43.1	0
Union Springs, Ala.	24	8	Jan., 1886	......	......	......	0
Vicksburg, Miss ...	20	3	Jan., 1886	42.7	39.9	44.2	0
Wilmington, N. C..	21	9	Jan., 1884	39.9	38.9	41.5	0

Winter minimum temperatures, &c.—Continued.

STATIONS.	Length of record	Minimum.	Month and year	Mean mini'um December	Mean mini'um January.	Mean mini'um February.	No. of times min was down to zero and below.
Southern portion.	*Years.*	°		°	°	°	
Brownsville, Tex...	16	18	Dec., 1880 / Jan., 1881	53.5	50.0	55.2	0
Cedar Keys, Fla...	10	15.5	Jan., 1886	51.4	51.0	54.9	0
Galveston, Tex....	21	11	Jan., 1886	51.5	47.4	52.9	0
Indianola, Tex	14	12	Jan., 1886	50.1	43.8	49.9	0
Jacksonville, Fla...	20	15	Jan. 1886	49.1	47.5	50.8	0
Mobile, Ala	21	11	Jan., 1886	44.4	43.6	47.6	0
New Orleans, La...	21	15	Jan., 1886	48.7	47.3	51.2	0
Pensacola, Fla.....	12	15	Jan., 1886	47.3	46.3	51.0	0
Rio Grande City, Tex	15	19	Jan., 1881	50.5	47.7	54.2	0
San Antonio, Tex...	15	6	Jan., 1886	45.2	41.0	46.8	0
Savannah, Ga......	21	12	Jan., 1886	44.4	43.7	46.9	0

The months of February and March are spent by the planters in preparing the land for the planting of the seed, and the season is very well adapted for such work. The weather is not often so severe as to prevent outdoor work, and the ground is seldom so hard frozen as to impede the progress of the plow.

In the lower half of the Southern States, the fall of snow is very unusual, and even in the more northern limits it scarcely covers the ground above a few inches and remains only a few days at the most. It is possible, therefore, under these conditions, for the farmers to work almost continually during the winter months. The lands are generally plowed broadcast in the winter so that the rains and the frosts may disintegrate the soil and render the ingredients available to the demands of the plants. The plowing usually begins about the 1st of February and continues until planting of the seed in

April or May, depending, of course, upon the locality of the farm. In winter the rains are frequent and the soil is often soaked. The freezing of this water at night and quick thawing under the influence of the noonday sun cause great changes to take place in the chemical and physical conditions of the soil.

THE CLIMATE OF THE SEED-PLANTING SEASON.

The heavy frosts in the South have generally ended by the 15th of April, and there is little danger of the young cotton plant becoming killed if it is planted so as to germinate about the 1st of May. It is customary, therefore, to put the seed in the ground from April 1 to May 10, the time depending largely upon the locality in the cotton belt. With the exception of the extreme south the cotton that is planted before the 15th of April is apt to become reduced in its vitality by cool nights that prevail during the first half of April. In most sections of the cotton belt light frosts, with occasional killing frosts, frequently retard the growth of vegetation during the first weeks of April, particularly in the northern limits of the region. It is therefore customary in those portions of the belt to delay the planting until the first week in May so as to escape this period of cool weather.

During the months of April and May the weather is seldom so cold as to entirely destroy the tender cotton plant just after it reaches the surface of the ground when it is most susceptible to the influence of cold. Very rarely does the thermometer record temperatures lower than 33°. The maximum temperature sometimes goes as high as 98°, but the range is generally between 80° and 95°, thus supplying a large percentage of heat rays for the warmth of the soil. As far south as Mobile, during a period of 21 years, the temperature ranged above 40° as often as 18 years and above 45° as often as

10 years. At Augusta, Ga., in the middle area of the cotton belt, the minimum temperaure, throughout a period of 19 years, ranged above 40° nine times, and fell below 35° only twice. At Montgomery, Ala., in the central belt, and on the edge of the great prairie region, the minimum temperature ranged above 40° 13 years out of a record of 19 years. These facts indicate a remarkably fair season for the planting of the seed, and show that the soil is not so chilled as to prevent the rapid germination of the plant. It is therefore customary among the farmers throughout the extent of this southern area to plant a week, and in some places two weeks, earlier than in that portion of the cotton belt located north of Montgomery and Augusta.

By the first of May cotton planting is about completed throughout the entire area of the cotton belt. After the close of the second week in May frost is not likely to occur, and, although there may be a few cool nights, the cotton plant in its young, tender condition, stands a very fair chance in all sections of the country under consideration. The mean minimum for May ranges above 52° at all stations, and at the majority it is above 60°. The minimum temperature, even at the extreme northern stations, never falls below 35°, and at twenty-five out of thirty-one stations furnishing continuous records, the minimum is never lower than 40°.

THE GROWING PERIOD OF THE PLANT, AND ITS WEATHER CONDITIONS.

This period might be properly termed the season from "chopping out" to the appearance of the first boll. In the central portions of the cotton belt this time is generally from the first of June to the first of August. The first bloom opens early in June and the first boll matures early in August. During this period in the life of the plant there must be a large supply of sunshine, and only so much moisture as will furnish the plant with what it needs, and at the same time not make the soil so damp as to cause too rapid multiplication of surface roots nor cause too great a growth of what farmers term "weed," that is, rapid development of stalk and branches to the detriment of flowers and fruit.

During the months of June and July rains are not ordinarily heavy, and floods occur only at long intervals. The greatest normal rainfall is 6.83 inches for June at Cedar Keys, Fla., and for July it is 8.68 inches at the same place. The largest number of rainy days that occur during the two months usually take place at stations along the Atlantic and Gulf coasts. At stations in the interior the rain is not so frequent, but with the exception of some of the stations in Texas, there is never less than ten normal rainy days in each month, thus furnishing ample moisture for all the demands of the cotton plant while in its blooming season. Much rain during this period is decidedly injurious to the plant because the flowers are so singularly constituted that if water accumulates in the cup formed by the petal and sepals rapid decay will take place, caused by fermentation of the gelatinous substance generated at the base of the flowers, and the forms will shed off and the yield of the plant be correspondingly decreased. These flowers open in the early morning, just after the sun rises above the horizon, and remain expanded to the sun's rays until late in the evening, when the petals close and remain so until next morning, when they open again.

At this stage of their development the color changes from a delicate cream to a light red. At the close of the second day the petals fall off, leaving a small boll surrounded by the green sepals. Now, if the rains are frequent during this period the petals have their sensitive organisms greatly dulled, and the absence of the sunlight, so necessary for their activity, causes them to stick to the forming boll and decay rapidly follows. Much cloudy weather during this period is almost as injurious as continual rains, because the cotton plant is a sun plant.

This plant can stand a much longer drought while blooming than almost any other vegetation, and hence the fall of rain should not be more frequent than once in three or four days, and the showers should be very light, permitting as much as possible the largest amount of sunshine. The number of days on which rain is apt to fall during these two months does not exceed 51 per cent. at any point in the entire region of the cotton belt, and at most places it generally does not exceed 40 per cent. The average number of sunny days during June and July is 56 per cent. At many of the statons, however, the percentage of perfectly clear days is greater than that given above for the entire region. For instance, at Memphis, Tenn., it is 59 per cent.; at Vicksburg, Miss., it is 68 per cent.

CHARACTER OF WEATHER BEST SUITED FOR THE PRODUCTION OF FIBER.

The first boll generally opens early in August, the interval from the first bloom to the first boll being about 40 to 50 days, the shorter interval being required later in the season. The plant continues to bloom during the month of August and until the latter part of September, but its powers in this regard are steadily reduced as the vitality goes more and more into growing the already formed bolls and bringing them to maturity. In the Southern States the cotton plant is decidedly an annual, whatever may have been its condition in its original form, and the work of perfecting its seed completes its life.

During this period in the history of the cotton plant there must be an abundance of sunshine and a small amount of moisture. At this time the plant has reached its full height and the largest share of its vitality must go towards making seed and developing fiber. If much rain occurs at this stage in its life three deleterious results will take place: First, the "weed" or stem, leaves, and branches will begin rapidly to multiply to the detriment of the fruit. The plant will stop blooming and the squares already formed will shed because of the too rapid growth of the parts of the branches to which they are attached. Second, the bolls already formed will begin to decay, caused by the surplus water absorbed by them, and thus rendered unable to open, since it takes a large per cent. of warmth and sunlight to cause the bolls to open, they will be destroyed. Third, the fiber in the bolls already opened, when the rain season begins will be beaten out on the ground and lost or badly stained. It is therefore best for the condition of the cotton plant that much dry weather prevails during the months of August and September.

Although droughts occur frequently during the months of July and August, still the normal results indicate for the entire cotton felt 43.5 per cent. of cloudy days while the probability of rainy days is 34.5 per cent. The sun is likely, under these conditions, to shine unclouded 56.5 days in the 100. This character of the season is most propitious for the plant in its flowering and boll-forming period.

In September the probability of rain in the northern section of the cotton belt is as 1:4, or one day in four may produce rain. The normal rainfall for this month in the same region of the cotton belt is 3.03 inches. So that the eight days of precipitation may produce on an average 0.38 of an inch each day. This indicates a dry month in its normal condition, and therefore very favorable for gathering the staple. The large per cent. of sunshine, 61 per cent., causes the bolls to open rapidly and preserves the fiber in its purest whiteness. This character of weather continues through October; thus furnishing two months of fine season for gathering the crops. In the central portion of the belt we find a similar condition in the cast of the sky. The probability of rain in September is 27 per cent. out of 100; and the per cent. of cloudy days is 44, or 66 per cent. of sunshiny weather. The normal rainfall for this section for September is 4.74 inches, or 0.59 of an inch for each of the eight days of rain. There is more rain throughout the southern belt than in either of the other two. The normal is 5.72 inches, the probability of rain is 1:3, or 33 days in 100 may produce rain. The per cent. of cloudy days is 44.8. So that during September there is a probability of 55 days of sunshiny weather in 100.

THE PICKING SEASON AND ITS WEATHER.

The months of autumn are spent in gathering the staple, and by the end of November, if the season is favorable, almost the entire crop will be picked. All that the cotton planters desire during this period of the year is that frost will be delayed as late as the last week in November, and that after the middle of September heavy rainstorms will not occur, but that showers, if they come at all, shall be light and not frequent. This condition of the atmosphere wil enable the pickers to gather the cotton as fast as it opens, in all its beautiful whiteness, unsullied by dampness, mold, or dirt. It is not often in the South that heavy rains occur in autumn, and monthly averages seldom go above 3.50 inches, but more frequently fall below 2.00 inches. The winds are also generally light so that the cotton is not greatly damaged by being driven out on to the ground and stained.

In the extreme southern portions of the belt the frost will come later than in the more northern parts of the section under consideration. For instance, frosts may be expected along the coasts of Georgia and Alabama any time after November 15, while at Atlanta, Vicksburg, Starkville, and Palestine, killing frosts will come generally as soon as November 1. At Charlotte, Chattanooga, and Nashville it is as early as October 15.

THE IMPROVEMENT OF THE COTTON BY HYBRIDIZATION AND SELECTION.

BY P. H. MELL.

These experiments have been conducted at the Alabama Experiment Station for the past six years, and during that period several bulletins have been issued on the subject of the improvement of the cotton fiber. In the development of this work the first step attempted was the determination of the number of varieties then in cultivation throughout the cotton belt, and which ones of these furnished the best results in maturity of the fiber, its length and the largest yield. The second year was devoted to blending by crossing those varieties which yielded the best fiber in the largest quantity, in order to secure a plant approaching nearest the perfect cotton plant. During the second year also a third step was taken in the cultivation of a number of foreign cottons, the seeds of which were secured from India, Egypt, Mexico, South America and the Fiji Islands, with the hope that something might be accomplished to counteract the tendency to purchase Egyptian cotton now so steadily growing with some of the manufacturers in the New England mills. The new plants secured by the first step and the seeds obtained from these foreign cottons from the first season's planting were cultivated another year in order that the properties of the American hybrids might be rendered stable, and that the foreign cotton plants might be acclimated. After accomplishing these ends the fourth step was taken, viz: to blend the new American types with the foreign acclimated plants with the hope that the resulting plant would contain within itself the best properties of the two parents. The discussion that follows will determine whether this desirable end has been reached or no.

I—THE NUMBER OF VARIETIES IN CULTIVATION IN THE COTTON BELT.

To determine this question the following so-called varieties of cotton were cultivated the first season and a careful study was made in the field and under the microscope of all portions of the plant:

Allen's long staple, Bailey, Barnett, Cherry's cluster, W. A. Cook, J. C. Cook, 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, Southern hope, Truitt, Welborn's pet, Wonderful, Zellner.

After conducting many experiments in the field and in the laboratory, extending over the entire season, the following classification was adopted:

(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, Rust 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, Rust 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 lmbed forms:

Bailey, Barnett, Cherry's cluster, W. A. Cook, Dixon, Hawkins' improved, Jones' improved, Keith, Okra leaf, Rust 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, Rust 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, Rameses, Southern hope, Rust proof, Trutt, Welborn's pet, Wonderful, Zellner.

(13) The small, light brown, furry seed forms:

Barnett, Cherry's cluster, Dixon, Herlong, Jones' improved, Okra leaf.

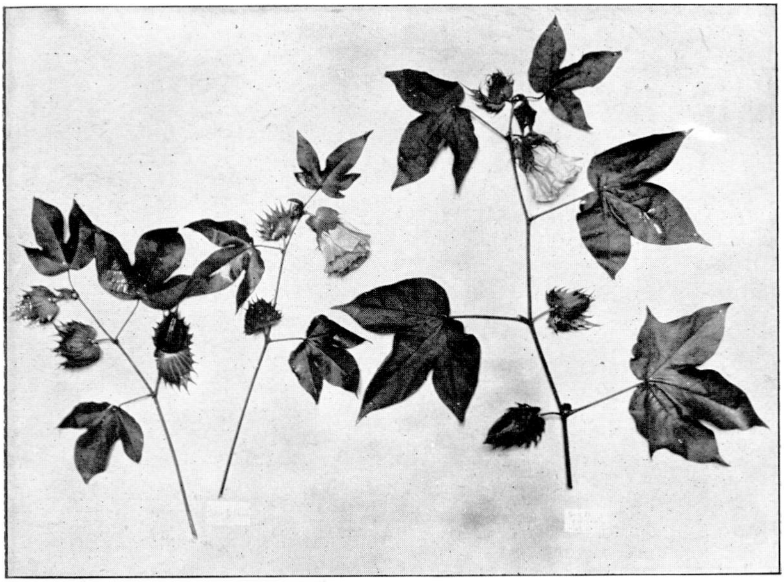
Selecting from the above classfication those forms which have features alike, we may rearrange our plants into the following seven groups:

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, Rust 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.

In this connection an effort was also made to determine the scientific names of these varieties of cotton, or in other words, what species of the genus *Gossypium* were involved in the development of these varieties. This undertaking was much more difficult than the first attempt, viz. the classification of the varieties. Cotton has been cultivated in the South for so long a period, and so many kinds of seeds have been planted in such

1 2



(Photographed by P. H. Mell)

Fig 1. 1—Sea Island Cotton,
2—Sea Island Crossed on Upland Cotton.

close proximity to each other, every opportunity has been presented for favorable hybridization, and, in the repeated replanting of these seeds year after year, the types have been well established and many of the distinctive properties of the original parents have been hopelessly obliterated. It becomes, therefore, a difficult problem to determine the names of the species from which the varieties have been derived. We may say, however, that indications point to the presence of the following species at least:

Gossypium herbaceum, L.; *Gossypium roseum*, Tod.; *Gossypium maritimum*, Tod.; *Gossypium hirsutum*, Mill.

The illustrations of leaves given herewith furnish the character of foliage usually found on the cotton plants grown in the cotton belt. Some of these leaves are thickly covered with hairs with the lobing so characteristic of the *Gossypum hirsutum;* while others are smooth and are deeply lobed like those produced on Sea Island forms or the *Gossypium maritimum.*

II—CROSSING THE VARIETIES.

In the experiments 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 under the first step, 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 were cut off just above their bases, thus exposing the stamens and pistils fully to view. The stamens 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 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 the 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 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.

From the many hundred hybrids secured by the crossing of the American varieties the following were found to be the most desirable forms and all of the other hybrids were dropped from the future experiments:

BOTANICAL CHARACTERISTICS OF AMERICAN CROSSED PLANTS.

Allen's long staple crossed on Peerless produces a boll of medium size gradually tapering to the end, and also one rather blunt pointed and cylindrical. The involucre covers about one-half of the boll and is cut into lobes extending $\frac{1}{4}$ the depth of the involucre; the surface is covered with fine hairs; the bases are slightly united. The flower is pale yellow white; the petiole is short and hairy. The plant grows to the height of 5 to 6 feet with long branches. Prolific. Leaves large and 3-lobed; covered with hairs. Seeds large, furry and light brown.

Barnett crossed on Cook produces a plant 4 to 5 feet high with branches of medium length and numerous, 5 to 8 bolls to each branch. Leaves 3-lobed and covered with hairs. Flowers light yellow with petiole about length of boll. Boll nearly cylindrical and large with involucre length of boll and deeply lobed. Seeds furry, light brown and medium sized.

Cherry's cluster crossed on Cook.—Plant 6 to 7 feet high and prolific. Branches of average length and numerous, with 5 to 9 bolls to each. Leaves 3-lobed, covered with hairs. Flower pale yellow with petiole length of flower. Boll large and ends with an erupt point; involucre length of boll with deep lobes, and free at base.

Wonderful crossed on Peerless.—A prolific plant, 4 to 6 feet high, 3-lobed leaves, limbs long, bolls medium size, 2-3 to each limb, pointed; all parts of plant covered with hairs, seeds light brown, furry. Flowers light yellow with petiole about length of petals; seed light brown; fiber long. Plant matures at average date.

Petit Gulf crossed on Peerless.—Bolls walnut shaped and acute conical, the first usually five and the second four celled. Stem triangular, leaves long petiolate, upper surface except veins glabrous, lower surface pubescent, 3 to 5 lobed; corolla nearly twice the length of the bracts, pale yellow, turning red after flowering, calyx large toothed, pale green, spotted, nerved; anther column almost covered with stamens; petiole about length of blade; peduncle about two inches in length.

Truitt crossed on Cook.—Bolls conical pointed, 4-celled, small plant, non-prolific; leaves three, four, and five lobed; limbs long, numerous; medium sized bolls; large, light brown, furry seeds, long fibre; maturity about average time.

Petit Gulf crossed on Cook.—Bolls ovate conical, 4-celled, 3 to each branch; leaves 3-lobed, smooth above except veins, pubescent below; stem somewhat pubescent, younger portions woolly, triangular in section; 4 feet in height; branches long; seed dark brown; fiber short. Late in maturing.

Rust Proof crossed on Peerless.—Boll conical, 4-celled medium sized, 4-6 to each limb; seeds large, light brown and furry; fiber long; leaves 3 to 5-lobed; long limbs; stem 4-5 feet. Average time in maturing.

The Sea Island species belongs to *Gossypium maritimum,* which is fully identified as follows:

G. maritimum.—Glabrous, stem erect, branched, tall; branches graceful, spreading, subpyramidal ascending, and later recurving; leaves rotundate ovate, subcordate, 3-5 lobed, sometimes intermingled with other entire leaves, lobes ovate, ovate-lanceolate, or lanceolate-oblong, depressions between lobes subrotundate; single peduncle above the axis of leaf and stem, an inch long during flowering period, but afterwards elongating; bracts broadly ovate, cordate adhering at middle of base with calyx, but not coalescing among themselves, deeply cut into lobes, lobes near base slightly broader, lanceolate, terminating with an elongated point; corolla longer than bracts, petals yellow, or pale sulphur color, not entirely expanded during the flowering period; lower part of style free from stamens and equal in length to another bearing column; style somewhat three parted; boll ovate conical, acute, three to four celled, 6-9 seeded; seeds beaked at hilum, black, smooth and covered with long silky fibre.

TABLE I.

Comparison between the original plants and 9 of the best improved forms.

Number.	NAME OF PLANT.	Number seed in boll.	Wt. seed in grammes.	Wt. lint in grammes.	Per cent. seed.	Per cent. lint.	Length of fiber in millimeters	Diameter of fiber in millimeters.	Character of twist.	Max. strain for breaking one strand in grammes.	Min. strain for breaking one strand in grammes.
14	**Cherry's Cluster on Cook**	**36**	**4 326**	**1.979**	**68.6**	**31.4**	33.	**0 020**	Excellent	**14.20**	**12.31**
	Cook, W. A.,	42	5.675	2.740	67.4	32.6	38	0.020	Good.		
	Average	**42**	**4.796**	**2 465**	**65 5**	**34.6**	30.	**0.018**			
	Cherry's Cluster,	42	3.917	2 190	63.5	36 5	23.	0.017	Fair.		
56	**Petit Gulf on Peerless**	**44**	**4.276**	**3.214**	**57.1**	**42.9**	23.	**0 018**	Good.	**13.71**	**11.75**
	Peerless,	42	3.217	1.751	64.8	35.2	22.	0.020	Very good		
	Average	**42**	**4.557**	**2 251**	**66.5**	**33 5**	24.	**0.020**			
	Petit Gulf,	42	5.897	2.751	68.2	31.8	26.	0 020	Very good		
58	**Rust Proof on Peerless**	**33**	**4.608**	**2 396**	**65.8**	**34.2**	26.	**0 022**	Very good	**13.10**	**12.10**
	Peerless,	42	3.217	1.751	64.8	35 2	22.	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.		
71	**Truitt on Cook**	**43**	**5.670**	**2 554**	**68.9**	**31.1**	30.	**0.014**	Excellent	**12.35**	**9.68**
	Cook, W. A.,	42	5.675	2 740	67.4	32.6	38.	0.020	Good.		
	Average	**37 5**	**5 352**	**2.580**	**67.5**	**32.5**	30.	**0.017**			
	Truitt,	33	5 029	2.419	67.6	32.4	23.	0.014	Poor.		
11	**Barnett on Cook**	**35**	**5.175**	**2.090**	**71.2**	**28.8**	35.	**0.020**	Good.	**11.01**	**8.85**
	Cook, W. A.,	42	5.675	2 740	67 4	32.6	38.	0 020	Good.		
	Average	**34.5**	**4.395**	**2 239**	**65.8**	**34.2**	32.	**0 020**			
	Barnett,	27	3.115	1.737	64.2	35.8	36.	0.020	Fair.		
76	**Wonderful on Peerless**	**34**	**5 010**	**2 575**	**64.7**	**35.3**	30.	**0 020**	Excellent	**14.48**	**11.22**
	Peerless,	42	3.217	1.751	64 8	35.2	22.	0.020	Very good		
	Average	**42**	**4.316**	**2.087**	**66 9**	**33.1**	28.	**0.019**			
	Wonderful,	42	5.415	2.423	69.0	31.0	34.	0.018	Very fair.		

TABLE I.—Continued.

Comparison between the original plants and 9 of the best improved forms.

Number.	NAME OF PLANT.	Number seed in boll.	Wt. seed in grammes.	Wt. lint in grammes.	Per cent. seed.	Per cent. lint.	Length of fiber in millimeters.	Diameter of fiber in millimeters.	Character of twist.	Max. strain for breaking one strand in grammes.	Min. strain for breaking one strand in grammes.
55	**Petit Gulf on Cook**	**43**	**4 216**	**2.507**	**62.7**	**37 3**	23.	**0.016**	Good.	**15.30**	**9.25**
	Cook, W. A.,	42	5.675	2.740	67.4	32 6	38.	0.020	Good		
	Average	**42**	**5.786**	**2.746**	**66 8**	**32.2**	32.	**0.020**			
	Petit Gulf,	42	5 897	2.751	68 2	31 8	26.	0 020	Very good		
2	**Allen's Long Staple on Peerless**	**34**	**4.540**	**2.194**	**67 4**	**32.6**	33.	**0.020**	Very good	**12.25**	**11.77**
	Peerless,	42	3.217	1 751	64 8	35 2	22.	0.020	Very good		
	Average	**43.5**	**3.469**	**1 893**	**64 8**	**35.2**	28.	**0 020**			
	Allen's Long Staple,	45	3.722	2 035	64.7	35 3	33.	0.020	Fair.		
135	**Sea Island on Wonderful & Peerless**.....	......	**5.380**	**1.743**	**67.6**	**32 4**	38.	**0 018**	Excellent	**15 42**	**14.77**
	Sea Island.	15	2.023	0.658	75.5	24 5	38.	0 017	Very good		
	Average......	33	**3.552**	**1.611**	**69 8**	**30 2**	31.	**0 018**			
	Wonderful,	42	5.415	2 423	69 1	30.9	34.	0 018	Very fair.		
	Peerless,	42	3.217	1.751	64.8	35.2	22.	0 020	Very good		

III—CULTIVATION OF THE FOREIGN COTTONS.

Within recent years much attention has been attracted to foreign cottons, especially those of India and Egypt, because of the yearly increased importation of the staple into this country. It is claimed by a few experts that the fiber, in some respects, is superior to the ordinary "upland" varieties grown in the South, and that there is danger of the importaton increasing to such an extent as to seriously injure the trade in American cottons. The Indian cotton is generally noted for its rich creamy color, its ready adaptability for certain dyes and the property the thread has of swelling in the process of bleaching, so that the cloth made of it becomes more substantial than that manufactured from the coarser grades of American cottons. These foreign staples are also used in the United States for mixing with the low grade American fibers to improve their color and the quality of the cloth.

Several of the Experiment Stations in the South have cultivated some of the varieties of the cotton from India and Egypt in order to compare their properties with our native forms, but, so far as the knowledge of the writer goes, there have been no regular systematic experiments conducted in any State extending over a period of several years, except at the Alabama Station. Of course nothing definite can be determined about any foreign plant until it has become acclimated by several years careful cultivation. The experiments at Auburn have been planned to accomplsh first this result.

The first step taken in these investigations was, therefore, to acclimate the plants; secondly, to secure the best results possible in health of plant, maturity of fiber and the yield of lint that the conditions of the soil and climate would permit.

In conducting these experiments the following so-called varieties were secured from India, Egypt and Mexico, and most of them were first planted in 1894. (Three of the varieties, however, viz: Mit Afifi, Bamieh, and Mannoah were first planted in 1893):

Bajwara (India),	Mirzapore (India),
Bamieh (Egypt),	Mit Afifi (Egypt),
*Bani,	"Mexican resists drought,"
*Bombay,	"Mexican,"
Broach (India),	"Mexican",
*Bourbon,	*"Nagpur jari,
‡Creula,	Narma (India),
Deshi (a broach cotton from India),	Nadam (Madras cotton),
Goghari (India),	Nimari bani (India),
*Guchard,	*Painaa,
Herbucco,	‡Roji,
Indrepur,	Surat Kupas (India),
*Jari,	*"Tree cotton" (Mexico),
Jakko (Egypt)	"Upland Georgian" (Mexico),
Mannoah (Egypt),	*Wagaria Wadhwan.

The following items in reference to the derivation of the local names of these cottons may be of interest:

Broach, Baroach or *Bharuch*, is a comprehensive term and is used to indicate the finer grades of cotton. It is the name of a district in India.

Manuah, Mannoah or *Jettooee*, in its native clime yields one-eighth of the cotton sold in the markets, but it is cultivated with other crops. It requires nearly a year to mature.

Miduopore or *Mirzapore* is the largest cotton mart in India.

Nadam is an inferior grade of cotton and is grown in

*These failed to germinate.

‡ Requires two years for maturing balls.

the district of the same name in India not for exportation, although it is used for adulterating the best grades which are sent to other countries. It is a triennial and poor bearer, and the fiber is cleaned with difficulty.

Narma or *Nurma,* sometimes also called *Deo-Kupas,* is a fine silky cotton. It is the name of a section in India. The plant bears ten to twelve years in its native country. The fibre is more than one inch long, and is used for the manufacture of the finest linens. It is cultivated near the temples for making the robes of priests.

Surat Kupas is named after an important seaport town through which most of the cotton from one district is shipped. This term is often used in a general sense for cotton coming from *Surat, Broach,* and *Berar* districts. *Kupas* signifies clean cotton, or ginned.

Wagaria, Wagriah or *Wadhwan* is also the name of a district in India and represents an annual cotton growing to the height of 2 or 3 feet with a single tapering stem. The bolls do not open wide, but remain closed except a crack at the apex. There is considerable trouble necessary to force them open and extract the fiber. The bolls are gathered from the plants and afterwards opened by children. This cotton is suitable for the manufacture of only the coarser grades of cloth.

The other names mentioned in the list are local rather than descriptive.

BOTANICAL CLASSIFICATION.

A careful examination of the foreign cottons under consideration would classify them as follows:

1. *Gossypium herbaceum* var *microcarpum* Tod: Broach, Goghari.

2. *G. Wightianum* Tod: Nadam, Deshi, Jakko, Roji, Nimari bani.

3. *G. roseum* var *albiflorum.* Tod: Indrepur, Goghari, Surat Kupas, Mirzapore, Roji.

4. *G. hirsutum* var *album* Tod: Indrepur, Herbucco, Surat Kupas, Mirzapore.
5. *G. maritimum* Tod: Jakko, Mannoah, Mit Afifi.
6. *G. maritimum* var *polycarpum* Tod: Bamieh.
7. *G. Braziliense* Macf: Guchard, Creulo.

The seed, when delivered at Auburn in 1893 and 1894, were badly mixed, rendering it difficult in most instances, to determine which plant represented the local name given on the package. It will thus be noted that in the above seven species and varieties the same local name has been repeated. After gathering the first year's crop the seeds were carefully assorted, however, and the classification made as above stated. (See plates XIII and XIV.)

A detailed description of these species is given in accordance with "Relazione sulla Cultura dei Cotoni—Monografia del Genere Gossypium" by Agostino Todaro.

Gossypium herbaceum, Tod. Stem erect, covered with long soft hair; branches spreading; slightly pyramidal; leaves 3-5 lobed, rarely 7 lobed, lobes rotundate obtuse, apex minutely mucronate; stipules linear lanceolate, acuminate very short; peduncle erect and nearly equal to half of peteole; bracts ovate cordate, with sharp cut teeth, general outline of bract leaf rotundate, bases united; coralla longer than the bracts, obovate, unequally wedge shaped, yellow, marked at base with purple spots, after flowering the outside surface turns reddish; bolls small ovate, hardly subrotundate, apex deeply hollowed out, 4-5 celled, cells 6-7 seeded; seeds ovate, short mucronate at hilum, covered with thick closely adhering fiber, in some cases white ash-gray, short, in other cases rather long and white.

Broach, Goghari and Deshi are varieties of this species. Professor Middleton seems to think that Goghari is a cross between Wagaria and Broach Deshi, and states that a good crop of this cotton in India will produce from 400 to 500 lbs. of seed cotton per acre. It is considered to be a high grade staple in its native country.

Gossypium hirsutum, Tod. Stem erect, branches spreading slightly ascending, pyramidal, hairy; leaves ovate rotundate cordate, 3-5 lobed, those found at end of branches are at times acute and entire, lobes truncate-semiovate, subtriangular, acute or acuminate, the middle lobes larger and longer, at fold acute plicate; stipules ovate lanceolate (unequalateral, sharp, rigid pointed, the other portion lanceolate), acuminate; bracts large ovate, acuminate, in the upper portion deeply cut into many narrow lobes, in the lower part simply dentate, the clefts are elongate linear produced at the apex into an attenuated point; corolla large, longer than bracts, during flowering period considerably expanded, petals pale sulphur color, afterwards rolling up and turning red; style long, exserted; boll large, walnut shaped, generally four celled, apex rotundate, terminating abruptly into a sharp point; seeds ovate covered with short white fiber firmly adherent.

Bajwara, Herbucco, Indrepur, Mirzapore and Surat kapas are evidently varieties of this species. They resemble very closely Todaro's *G. hirsutum var. album*, the Indrepur, however, has a large boll rapidly tapering to a point, while the Mirzapore contains one more nearly the shape of a walnut and generally four celled. The shape of boll on the Indrepur type would indicate features of *G. glabratum, Tod.*

The three forms known by the vernacular names of "Jakko," "Mannoah," and "Mit Afifi," are varieties of

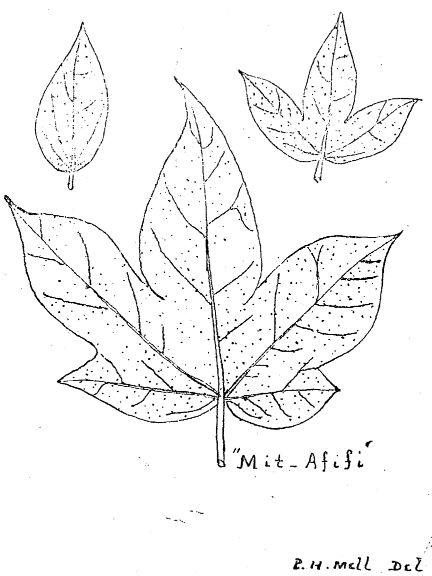


FIG. 2.

G. maritimum, Tod., the same species to which the sea island cotton is referred. These cottons are grown in different parts of Egypt and produce very superior grades of fiber. The yield is large also, averaging in its native country 350 pounds of lint per acre. An illustration of the leaves of this species of cotton is given in figure 2.

Gossypium maritimum var *polycarpum*, Tod. Stem erect, simple; 1-3 peduncles in the axis of each leaf; few if any branches.

The plant grows to the height of 7-8 feet and is glabrous throughout. The few branches, if present at all, spring from near the roots. Generally branches are wanting. The leaves are large, deep green and free from hairs. The surfaces are dotted with darker green spots. The bolls grow in clusters from the axis of the leaf and main stem. The petals of the large conspicuous flowers are bright yellow with a deep or purple spot at the base on the inside. The involucre is nearly the size of the petal, bright green and smooth.

Figure 3 is a good representation of the leaf, petal involucre and pistil of this plant.

FIG 3.—Bamieh. (P. H. Mell.)

Narma is probably a hybrid produced by blending the species *G. arboreum* Linn. and *G. Indicum*, Lam. The leaves, as well as all other surfaces, are covered with short shoft hairs. Stem is somewhat shrubby and dotted with red spots; cordate leaves are 5-lobed, lobes broadly lanceolate and terminated with a bristle, sometimes a small rounded lobe is found between the other lobes; petiole dotted with red; petals bright yellow with red extending over fully one-third of the outside surface; a red spot is found also at the base of the petal inside, inner surface covered with minute hairs; bracts are small, very nearly entire, or at least apex slightly indented, hairy outside and adhering at base; peduncles are short and hairy; calyx entire and dotted green; stamens extend as far as the stigma; boll small ovate acuminate 3-4 carpels; seeds small, 8 in each cell; fiber short and brown.

Gossypium Wightianum Tod. Stem erect and covered with soft hairs; branches spreading, slightly ascending, leaves rather rotundate, obscurely obcordate, 3-5 lobed, lobes ovate, obtuse with bases drawn together or wrinkled, the depressions between the two lobes obtuse with small dentiformed lobes now and then interjected, stipules semiovate, somewhat sickle shaped, otherwise linear lanceolate, all acuminate; peduncles erect during the blooming period but recurved during fruiting; bracts ovate, very small, base united, cordate, acute, small serrated; corolla longer than bracts, obovate, unequally shaped, yellow, base spotted dark purple, but after flower opens, petals turn red; bolls very small, ovate, 8-seeded; seeds small ovate-subrotundate, densely covered with fiber; fiber short and closely adhering and white.

Nadam. Nimari.

Professor Middleton classifies Nimari as a hybrid from *G. roseum* Tod. and *G. neglectum,* Tod. The plant cultivated at the Auburn Station, however, produced a yellow flower with a red spot at the base of the petal, while the plant described by Professor Middleton yields a white flower and resemble Todaro's *G. roseum var albiflorum.* Nadam cotton may be a variety of *G Wightianum* Tod. with a strain of *G. indicum.* Lamk. Todaro's *Wightianum* closely resembles Linneus' *G. herbaceum* and there seems to be no good reason for introducing a new species with so little, if any difference from the older form.

Professor Middleton makes the following pertinent comments in a valuable pamphlet on "Indian Cultivated Cottons," page 4, on the effects produced in cotton plants by transferring them from one country to another where the conditions in climate and soil may be materially changed. The experiments conducted at the Alabama Station so fully corroborate these conclusions of Professor Middleton they are copied into this bulletin:

"*Habit.*—Soil affects the size and general appearance of the cotton plant to a very great extent. On sandy loams and well drained land most cottons are tall, lax in habit, with long, weak, spreading branches; on clay and badly drained soils they are small bushes with short branches.

"*Hairs.*—These are not perceptibly affected in the first season by a change of soil and climate.

"*Stems, Petioles and Peduncles* are affected in size by a change in habit, but are not otherwise altered by a change of soil.

"*Leaves, Stipules and Branches* are greatly affected in size, and the first and last to some extent in conformation, by change of climate. These leafy organs are very different in a moist atmosphere from what they are in a dry, and herbarium specimens may be misleading if e. g., some are made in the monsoon and others in the dry season. The sinuate character of the leaf of the *G. herbaceum* series of cottons is only marked in the monsoon, and the more marked during this season than it is afterwards. The braceteoles of the annual and shallow rooted cottons diminish markedly in size as the hot season advances.

"*Flowers.*—These do not alter perceptibly in form or color by transference to a new district. If the plant is healthy the flowers will be normal; but like the bracteoles they diminish in size late in the season.

"*Bolls.*—The bolls also become smaller, especially on light soils, as the hot season advances, but those that form early in the season should be true to kind whether grown on clay or sandy soil.

"*Seeds.*—In those bolls which mature well, the size or number of seeds is not affected during the first season by a change of soil and climate.

"*Lint.*—The fiber, more than anything else, is injuriously affected by change."

Table II.

The following table shows the results of microscopic examination of the foreign cottons. Three of the best varieties of the American cottons are also given for the purposes of comparison.

Local Names of Cotton.	Length of fiber. Millimeters*.	Diameter of fiber. Millimeters*.	Maturity of fiber.	Condition of twist of fiber.	Rupture strain of fiber expressed in grammes*.	
					Several trials to rupture a single strand.	Average.
Bajwara	32.0	0.024 0.032	Medium	Fair	5.140, 5.875, 10.460	7.158
Bamieh	42.0	0.016. 0.018	Excellent.	Excellent.	16.700, 22.733	18.717
Broach	30.0	0.028, 0.032	Fair	Fair	5.810, 6.840, 15.600	9.413
Deshi	29.0	0.024	Irregular	Good	7.475, 8.775, 15.350	10.533
"Georgia Upland," India	36.0	0.032	Excellent	Excellent	13.600, 14.535	14.068
Goghari	38.0	0.016, 0.022	Excellent	Excellent	12.200, 14.460	13.330
Herbucco	36.0	0.016, 0.018	Excellent	Excellent	5.320, 9.830, 6.315, 12.575	8.610
Indrepur	38.5	0.032	Good	Good	4.110, 8.885, 9.335	7.443
Jakko	40.0	0.028, 0.032	Good	Good	14.260, 16.380	15.320
Mannoah	31.5	0.032	Good	Good	10.200, 12.750, 18.750	13.933
Mirzapore	38.4	0.032	Medium	Poor	6.250, 7.920	7.085
Mit afifi	42.0	0.016, 0.024	Excellent	Excellent	12.610, 10.335	11.472
Mexican	27.0	0.024, 0.048	Medium	Fair	2.925, 4.100, 6.705	6.865
Mexican	28.0	0.016, 0.048	Good	Good	9.250, 11.075	10.163
Narma	23.0	0.016, 0.032	Good	Good	9.585, 15.585	12.585
Nadam	33.0	0.016, 0.018	Excellent	Excellent	7.120, 9.780	8.450
Nimari bani	27.0	0.016, 0.032	Fair	Fair	10.055, 11.668	10.862
Surat Kupas	28.0	0.032	Fair	Good	6.750, 12.375	9.562
Cherry Cluster	22.4	0.019, 0.027	Excellent	Excellent	9.348, 17.608, 19.345	15.434
Cook, W. A.	38.7	0.020	Good	Good		7.590
Peerless	18.5	0.016, 0.024	Fair	Medium	5.811, 10.276, 14.022	10.055

* 1 Gramme is equivalent to 15.43 grains; 1 Millimeter is 0.03937 of an inch.

IV—THE HYBRIDS FROM AMERICAN AND FOREIGN TYPES.

The following American varieties of cotton improved by crossing (see first step) were selected, because of their superior qualities, to hybridize with the foreign varieties mentioned on page 352.

No. 14. Cross of Cherry's cluster and W. A. Cook.
2. Cross of Allen's long staple and Peerless.
79. Cross of Wonderful and Peerless.
58. Cross of Rust proof and Peerless.
55. Cross of Petit Gulf and W. A. Cook.
56. Cross of Petit Gulf and Peerless.
71. Cross of Truitt and W. A. Cook.
11. Cross of Barnett and W. A. Cook.
70. Cross of Truitt and Peerless.
43. Cross of King and W. A. Cook.
Sea Island.

The resulting hybrids gave the following distinguishing characteristics:

*Afifi x Cherry's x Cook (140).**—Some of the leaves have smooth surfaces above and hairy below, while others are covered with hairs, petiole and veins are dotted with black spots; petals bright yellow, in one flower red spot at base, red spot wanting in another, spotted with red on the upper margins ,those petals with red spot at base grow on the torus in a reversed position to others without the red spot, the latter are larger; involucre in one case slightly adheres at base, free in other flowers, the first are hairy on the outer surfaces and the latter are hairy only on the margins, the former is also larger than the latter; peduncle tinged red with three deep red spots just below the calyx cup.

Mannoah x Petit Gulf x Peerless (141).—Leaf with minute hairs over the under surface, all other surfaces smooth, petiole and veins dotted, only one kind of leaf

* The numbers in brackets refer to the records of experiments.

on the plants; petals in some flowers deeper yellow and larger than in others, red spot at base of all petals; involucre in some cases covered with short hairs, in others smooth, except on margins; calyx cup in those flowers with larger petals is more cleft than in the smaller flowers.

Truitt x Cook x Afifi (149).—One leaf is a decided Afifi type while others are decidedly Cook in shape (or *G. hirsutum*) and hairy surfaces; some of the flowers are more like the Afifi parentage while others resemble the *kirsutum* with the exception of a small red spot at the base of the petals.

Petit Gulf x Cook x Bamieh (153.)—The following illustrations give very clear ideas of this hybrid:

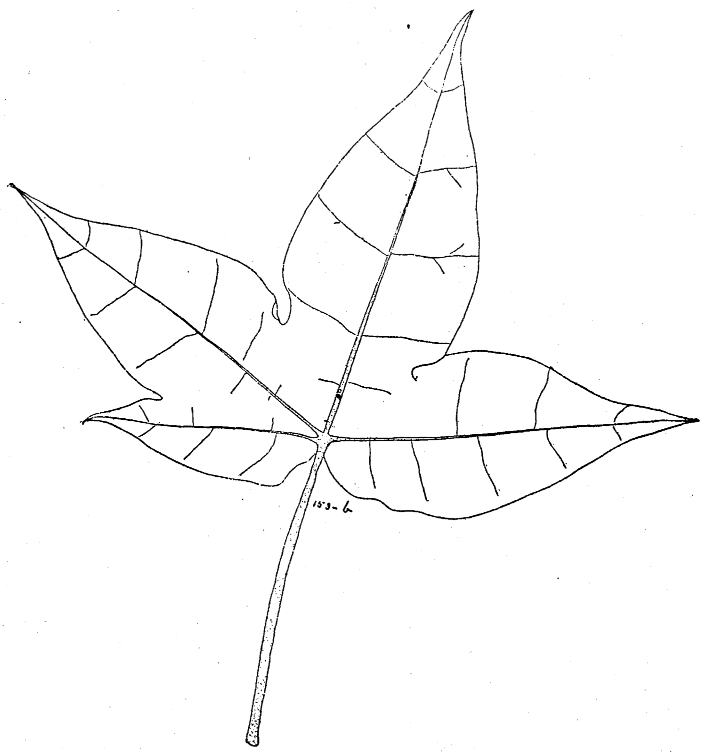


FIG 4.—Leaf from Hybrid Petit Gulf X Cook X Bamieh. (P. H. Mell.)

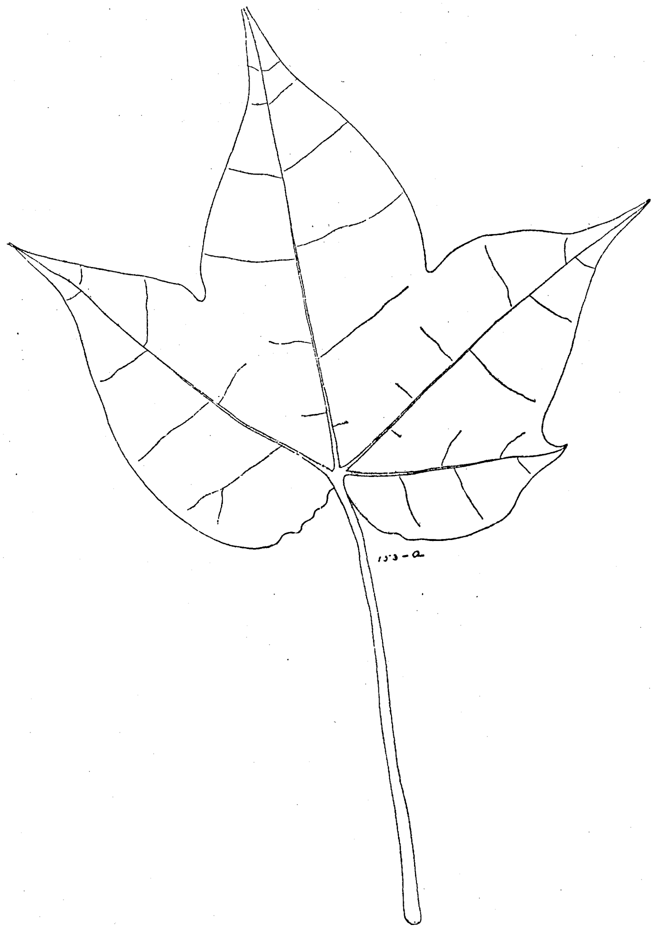


Fig 5.—Leaf from Hybrid Petit Gulf X Cook X Bamieh. (P. H. Mell.)

Leaf has fine hairs on the under surface and very few on the petiole and along the veins on the upper surface, spotted red, black dots on petiole, no hairs, petiole red-green, dotted black, contains a gland on the midrib, but this is wanting in other leaves on plant; petals bright yellow, red spot is retained at the base in some flowers, while in others it is absent; the upper half of the involucre is tinged red with a few hairs on the margins; the pistil is slender; some of the seeds are black with the staple slightly adhering, some deep green with fiber strongly adhering, some yellowish white with thickly adhering fiber.

Rust proof x Peerless x Afifi (157).—Leaves smooth on the upper surface, short hairs on the lower, petiole tinged red with dark spots over surface, also over the midrib, leaf very decidedly wrinkled; petals in some flowers bright yellow with red spot at the base, in others lighter yellow free of red spot, but in a reversed position on the torus; involucre on the bright yellow flower, large bright green tinged with red on the outer surface, spotted with darker green, only slightly joined at base, fringed with hairs, those on the lighter colored flowers about two-thirds the size and in other respects like the larger involucre; pistil in the bright yellow flowers with a long style and recurved stigma, the peduncle is as long as the involucre, the pistil in other flowers is shorter with a broader calyx cup, peduncle only one-third as long as in the other flower.

Table III.

Number of Experiment.	Names of Plants Crossed.	Seed cotton per plot—kilo.*	Seed per plot, kilo.*	Lint per plot, kilo.*	Number of plants to plot.	Per cent. of seed.	Per cent. of lint.	Length of fiber in m. m. †	Diameter of fiber, m m. †	Max. breaking strain, 1 strand, in gram. ‡	Min. breaking strain, 1 strand, in gram. ‡	Average breaking strain, 1 strand, in gram. ‡
117	**Cherry's Cluster X Cook X Miduopur**	**7.0**	**4.9**	**2.1**	**56**	**70.0**	**30.0**	**38.**	**0 016**	**18 11**	**4 86**	**7.62**
	Cherry's Cluster	1 6	1.1	0.5	13	68.7	31.3	23.	0 017	19 34	9.35	14.73
	Cook	3.1	2.2	0.9	12	70 9	29.1	38.	0.020	9 93	6.25	8.09
	Average of parents	....	....	....	....	**70.7**	**29 3**	**33.**	**0.023**	**15.79**	**7.28**	**9.97**
	Miduopur	12.8	8.8	3.7	97	72.4	27.6	38.	0.032	7 92	6.24	7.09
119	**Allen's Long Staple X Peerless X Afifi**	**5.4**	**3.7**	**1.6**	**40**	**68 5**	**31.5**	**40.**	**0.016**	**13 50**	**11.16**	**12.33**
	Allen's Long Staple	....	....	....	....	69 8	30.2	33.	0.020	11.86	7 26	8 92
	Peerless	2.2	1.5	0.7	20	68 1	31.9	22.	0 020	14 02	5 81	10.42
	Average of parents	....	....	....	....	**68 9**	**31.1**	**32.**	**0.019**	**12.83**	**7 80**	**10.27**
	Mit Afifi	2.9	2.0	0.9	63	69 0	31.0	42.	0.016	12.61	10.34	11.47
122	**Sea Island X Afifi**	**5 8**	**4.0**	**1.8**	**28**	**69.0**	**31 0**	**42.**	**0.020**	**14.02**	**9 83**	**12.13**
	Sea Island	4 5	3.3	1.2	54	73 3	26 7	38.	0.017	11.86	8.23	9.30
	Average of parents	....	....	....	....	**71.2**	**28 8**	**40.**	**0.017**	**12 24**	**9 27**	**10 39**
	Mit Afifi	2 9	2.0	0 9	63	69.0	31.0	42.	0.016	12.61	10 34	11.47
129	**Allen's Staple X Peerless X Broach**	**3.3**	**2.2**	**1.1**	**25**	**66.7**	**33.3**	**40.**	**0.016**	**12 70**	**12.42**	**12.56**
	Allen's Long Staple	....	....	....	....	69.8	30 2	33.	0.020	11.86	7.26	8.92
	Peerless	2 2	1 5	0.7	20	68 1	31.9	22	0 020	14.02	5 81	10.42
	Average of parents	....	....	....	....	....	....	**28.**	**0.023**	**10.49**	**6 29**	**9.58**
	Broach	....	....	...		....	....	30	0 028	15 60	5.81	9.41

* Kilogram=2.204 avoidupois pounds.
† Millimeter=0.03937 of an inch.
‡ Gram=15.432 grains.

TABLE III—Continued.

Number of Experiment.	NAMES OF PLANTS CROSSED.	Seed cotton per plot—kilo.*	Seed per plot, kilo.*	Lint per plot, kilo.*	Number of plants to plot.	Per cent. of seed.	Per cent. of lint.	Length of fiber in m. m. †	Diameter of fiber, m. m †	Max. breaking strain, 1 strand, in gram. ‡	Min breaking strain, 1 strand, in gram. ‡	Average breaking strain, 2 strand, in gram. ‡
130	**Wonderful X Peerless X Afifi**	**5.9**	**4.2**	**1.7**	**56**	**71.2**	**28.8**	**38.**	**0.016**	**10.90**	**9 41**	**10.16**
	Wonderful	1.5	1.04	0 46	11	69.0	31.0	34.	0.018	5 46	5 00	5.23
	Peerless	2.2	1.5	0.7	20	68.1	31.9	22.	0 020	14 02	5 81	10.42
	Average of parents	....	....	....	....	**68.7**	**31.3**	**33.**	**0.018**	**10 70**	**7.05**	**9.04**
	Mit Afifi	2.9	2.0	0.9	63	69 0	31.0	42.	0.016	12.61	10.34	11.47
140	**Afifi X Cherry's Cluster X Cook**	**5.5**	**4.0**	**1.5**	**42.**	**72.7**	**27.3**	**42.**	**0.016**	**13.89**	**10.07**	**11.98**
	Cherry's Cluster	1.6	1.1	0 5	13	68.7	31.3	23.	0 017	19 34	9 35	14.73
	Cook	3.1	2.2	0.9	12	70.9	29.1	38	0 020	9.93	6.25	8.09
	Average of parents	....	....	....	....	**69.5**	**30.5**	**34**	**0.018**	**13 96**	**8.65**	**11.43**
	Mit Afifi	2.9	2.0	0.9	63	69.0	31.0	42.	0,016	12.61	10.34	11 47
141	**Mannoah X Petit Gulf X Peerless**	**4.9**	**3.3**	**1 6**	**42**	**65.3**	**34.7**	**42.**	**0.016**	**13.89**	**10.07**	**11.98**
	Petit Gulf	8.5	5.8	2.7	32	68.2	31.8	26.	0.020	....	....	....
	Peerless	2.2	1.5	0.7	20	68.1	31.9	22.	0.020	14.02	5.81	10.42
	Average of parents	....	....	....	....	....	....	27	0.024	....	....	....
	Mannoah	....	....	....	....	....	....	32.	0.032	18.75	10.20	13.93
146	**Mannoah X Rust Proof X Peerless**	**2 5**	**1.8**	**0.7**	**59**	**72.0**	**28.0**	**34**	**0 020**	**15.74**	**14.44**	**15 09**
	Rust Proof	....	....	....	....	70.8	29.2	40	0.014	9.40	6.62	8 03
	Peerless	2.2	1.5	0.7	20	68.1	31.9	22.	0.020	14.02	5.81	10.42
	Average of parents	....	....	....	....	....	....	**31.**	**0.022**	**14.07**	**7.54**	**10.79**
	Mannoah	....	....	....	....	....	....	32.	0.032	18.75	10.20	13.93

149	**Truitt X Cook X Afifi**	**4.8**	**3.4**	**1.4**	**43**	**71.4**	**28.6**	**44.**	**0 016**	**20.71**	**15.65**	**19 01**
	Truitt	1.5	1.02	0 48	9	68.0	32.0	23.	0.014	18 43	10.26	15.16
	Cook	3.1	2.2	0.9	12	70 9	29.1	38.	0 020	9.93	6.25	8.09
	Average of parents					**69 3**	**30.7**	**34.**	**0 017**	**13.66**	**8.95**	**11.57**
	Mit Afifi	2 9	2.0	0.9	63	69.0	31 0	42.	0.016	12.61	10 34	11.47
153	**Petit Gulf X Cook X Bamieh**	**5.6**	**4.0**	**1.6**	**49**	**71.6**	**28 4**	**38.**	**0.016**	**13.63**	**8.20**	**10.88**
	Petit Gulf	8.5	5.8	2 7	32	68.2	31.8	26	0 020			
	Cook	3.1	2 2	0.9	12	70.9	29 1	38	0.020	9 93	6.25	8.09
	Average of parents					**68.8**	**31.0**	**35.**	**0 019**			
	Bamieh	5.9	4.0	1.7	90	67.8	32 2	42	0.018	22.73	16 70	18 72
155	**Petit Gulf X Peerless X Bamieh**	**8.0**	**5 5**	**2.6**	**64**	**68.8**	**31 2**	**38.**	**0.016**	**12.44**	**9.30**	**11 12**
	Petit Gulf	8 5	5 8	2.7	32	68.2	31.8	26.	0 020			
	Peerless	2.2	1.5	0.7	20	68.1	31 9	22.	0 0.0	14.02	5 81	10.42
	Average of parents					**68. 0**	**32 0**	**30.**	**0 019**			
	Bamieh	5 9	4 0	1.7	90	67.8	32.2	42.	0 018	22.73	16 70	18 72
157	**Rust Proof X Peerless X Afifi**	**4.7**	**3 3**	**1.4**	**43**	**70.0**	**30 0**	**38.**	**0.018**	**9.83**	**6.26**	**7 72**
	Rust Proof					66.3	32.7	40.	0.014	9.43	6.62	8 03
	Peerless	2.2	1 5	0.7	20	68.1	31.9	22.	0.020	14 02	5 81	10 42
	Average of parents					**67.8**	**31 9**	**35.**	**0 017**	**12 02**	**7 59**	**9.97**
	Mit Afifi	2 9	2.0	0.9	63	69 0	31 0	42.	0.016	12.61	10.34	11.47
160	**Bamieh X Cherry Cluster X Cook**	**9.7**	**6.7**	**3.0**	**120**	**69.1**	**30 9**	**44.**	**0.008**	**13.68**	**9 48**	**11.58**
	Cherry's Cluster	1 6	1 1	0.5	13	68.7	31 3	23.	0.017	19 34	9 35	14.73
	Cook	3.1	2.2	0 9	12	70 9	29.1	38.	0 020	9.93	6 25	8 99
	Average of parents					**69 1**	**30 9**	**34.**	**0.018**	**17 33**	**10.77**	**13.85**
	Bamieh	5 9	4 0	1.7	90	67 8	32 2	42.	0 018	22.73	16 70	18 72
162	**Afifi X Allen's Staple X Peerless**	**5.6**	**3 9**	**1 6**	**120**	**70 5**	**29 5**	**44**	**0 008**	**13 68**	**9 48**	**11.58**
	Allen's Staple					69 8	30.2	33.	0.020	11 86	7.26	8.92
	Peerless	2.2	1.5	0.7	20	68.1	31.9	22.	0.020	14.02	5.81	10.42
	Average of parents					**69.0**	**31 2**	**32**	**0 019**	**12 83**	**7 80**	**10 27**
	Mit Afifi	2 9	2.0	0 9	63	69 0	31.0	42	0.016	12.61	10 34	11 47
165	**Barnett X Cook X Herbucco**	**7.8**	**5 4**	**2.4**	**61**	**69 2**	**30 8**	**36.**	**0.024**	**11 45**	**8.05**	**10 10**
	Barnett					67.9	32.1	26.	0 020	5.18	4.18	5.23
	Cook	3.1	2.2	0.9	12	70.9	29 1	38.	0.020	9.93	6.25	8.09
	Average of parents					**68.6**	**31.4**	**33.**	**0.019**	**9.23**	**5.25**	**7.31**
	Herbucco	10 9	7.3	3 6	82	67.0	33.0	36.	0.018	12.58	5.32	8.61

CONCLUSIONS:

1. The combination of the *Gossypium hirsutum* and *Gossypium maritimum* yield a cotton plant which produces fiber of the best grade in strength, maturity, twist, length, fineness and yield per acre.

2. The blending of small and large boll species is not desirable, as a rule, because the resulting forms are generally weak and inferior.

3. The *G. maritimum* is rather slow in maturing its bolls and frost is apt to catch the plant, in this climate, before 60 per cent. of the bolls are open. The hybrid procured by uniting *G. maritimum* and *G. hirsutum* is quicker in reaching maturity, and is more prolific.

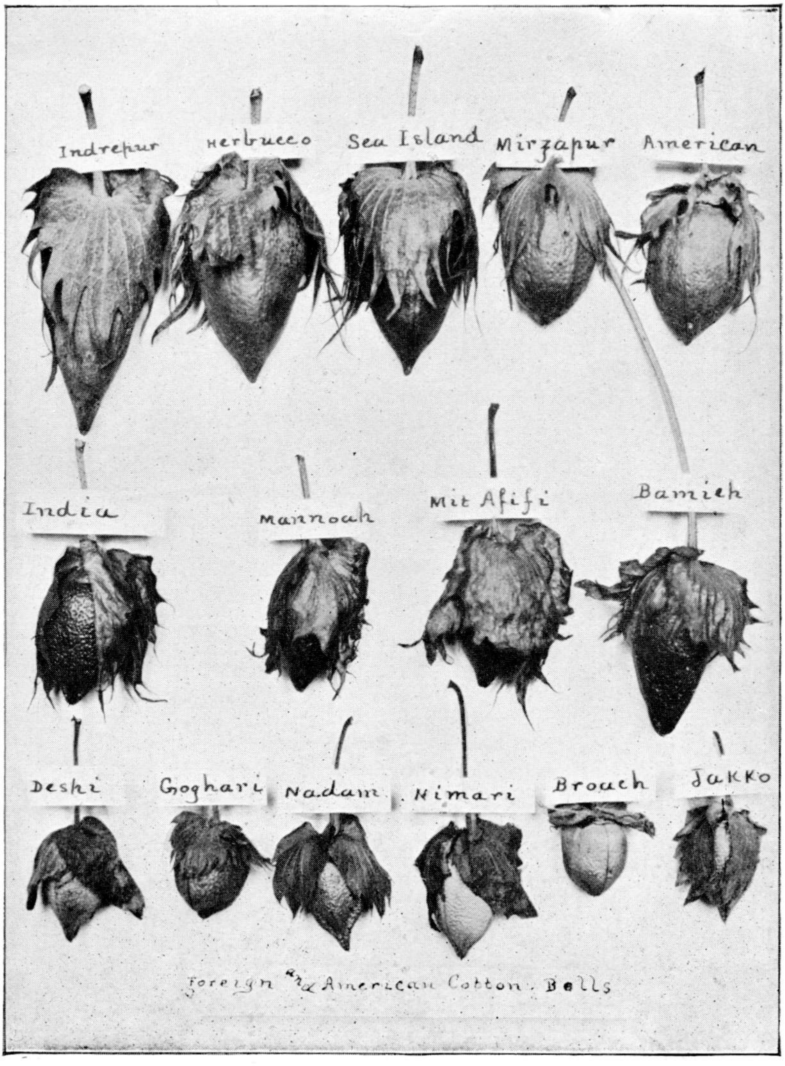
4. The black, smooth seeds are generally transferred into furry seeds of a dark brown color.

5. The Egyptian species are finer grades of cotton than those received from India, in length of strands, strength and texture. They unite, also more readily with the American species and the hybrids are generally equal to the parents in qualities.

6. The Sea Island cotton combines with the Afifi and Mannoah to produce superior grades of staple and the plant is rather prolific. There is a prospect in the present stage of the experiments of securing a variety which wlll be a healthy, long staple upland cotton.

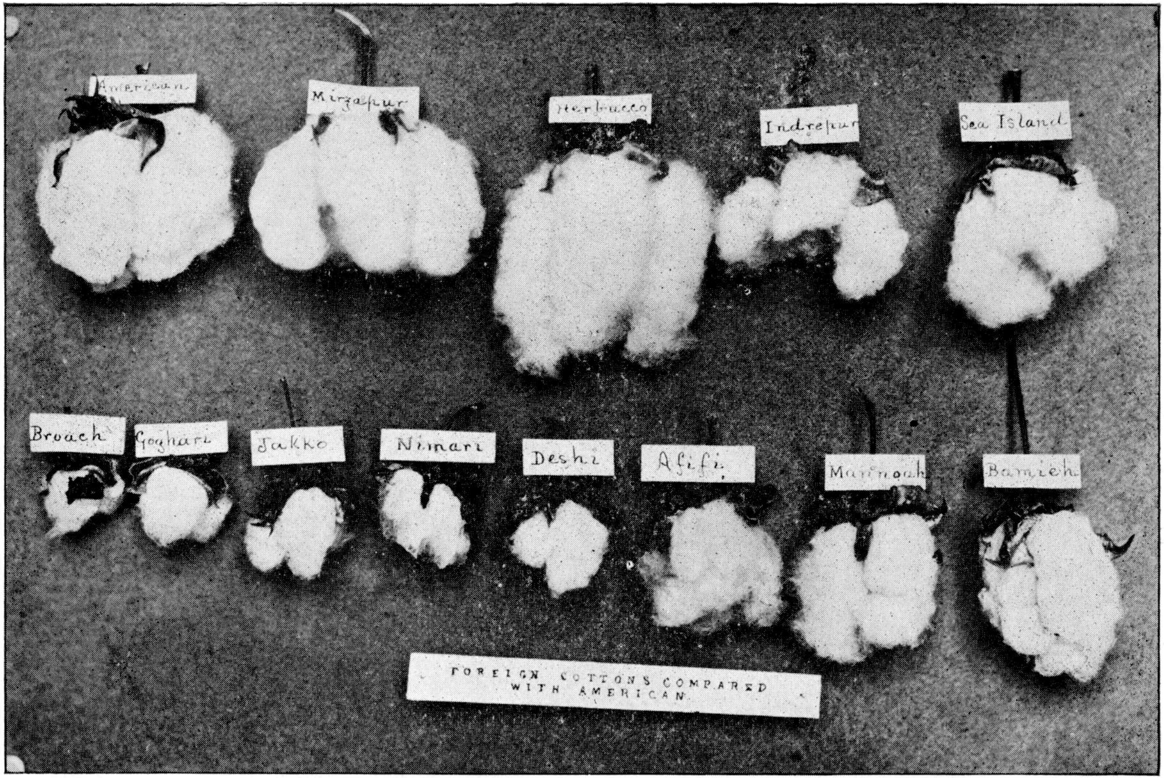
7. Numbers 119, 122, 129, 146, 149 (see Table III), give the best results in length of fiber, per cent. of lint and in degree of strength, in each case yielding results above the average produced by the parents. With the exceptions of 117, 157 and 160 all of the hybrids represented in Table II yielded results in degree of strength above the averages of the parents; and in every instance the length of the fiber was increased over the average of the parents. There is practically but little difference in the yield of lint between the parents and the hybrids.

PLATE XIII.



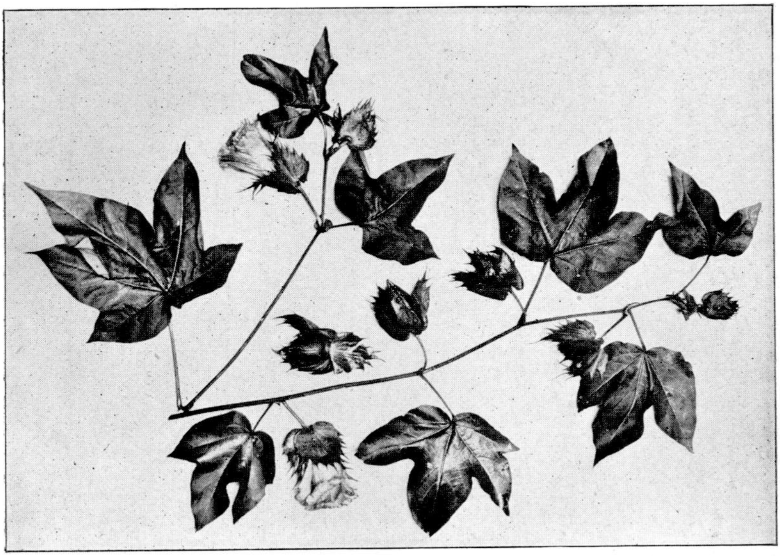
(Photographed by P. H. Mell.)

Foreign and American Cotton bolls exhibiting relative sizes and shapes. Reduced about ½.



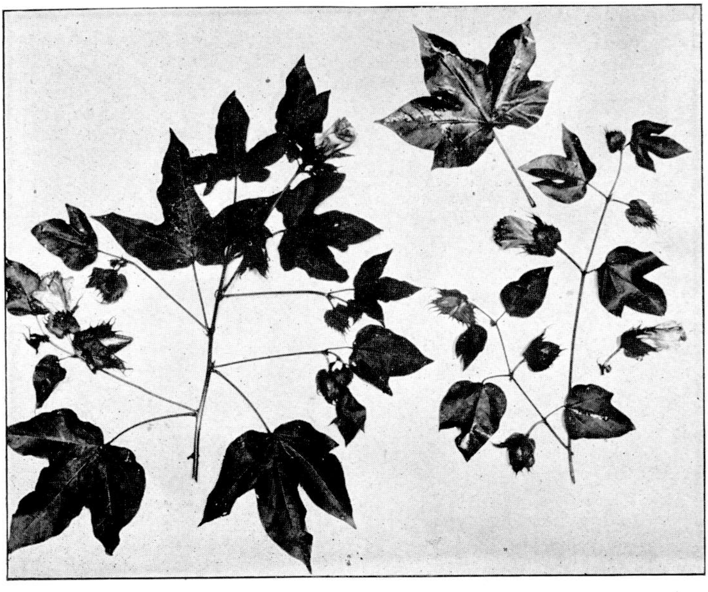
(Photographed by P. H. Mell.)

Open bolls of American and Foreign Cottons. Reduced about 1/3.



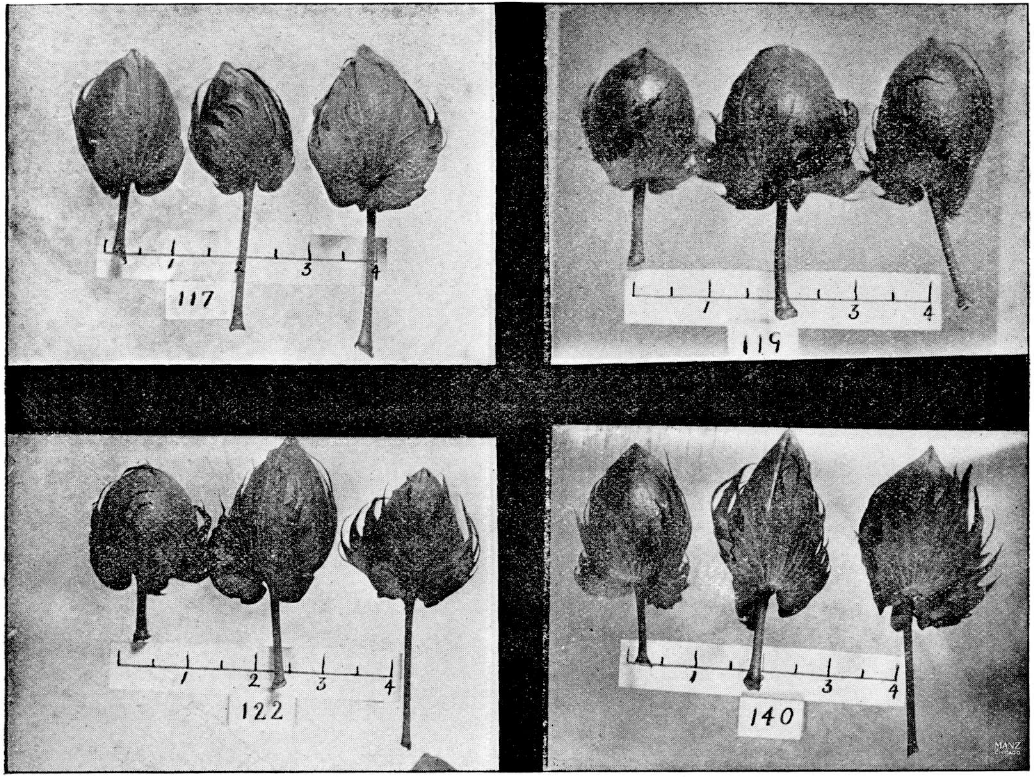
Mit Afifi or Egyptian Cotton.

1 2



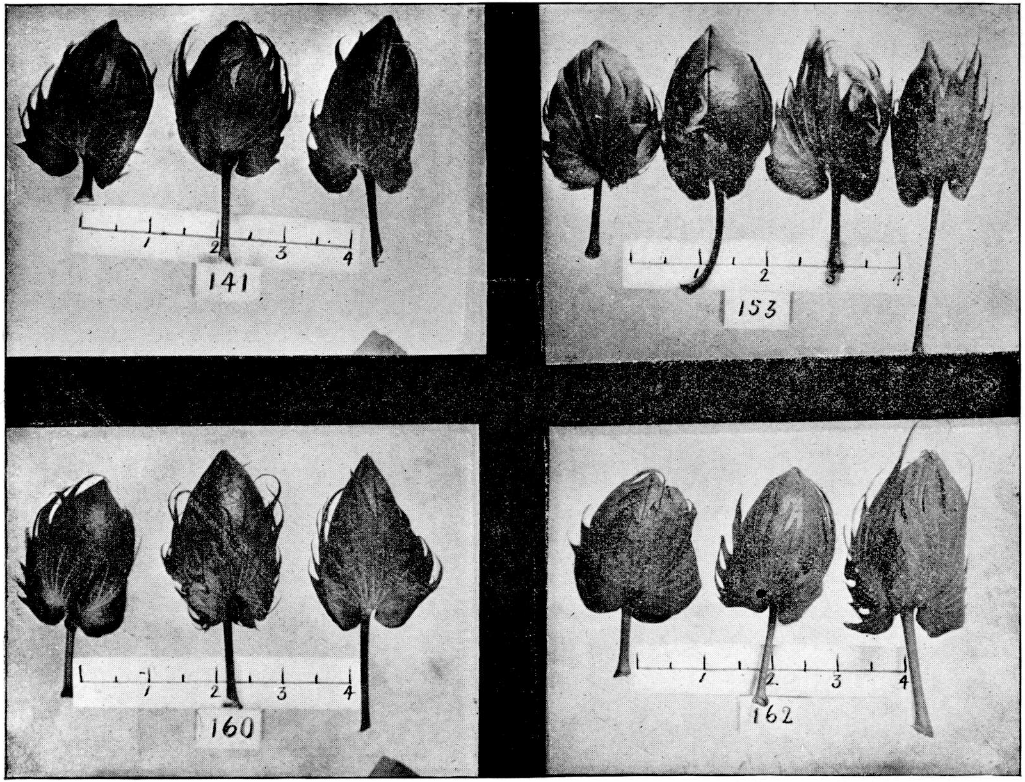
(Photographed by P H. Mell.)

1 Bamieh or Egyptian Cotton
2—Mannoah or Egyptian Cotton.

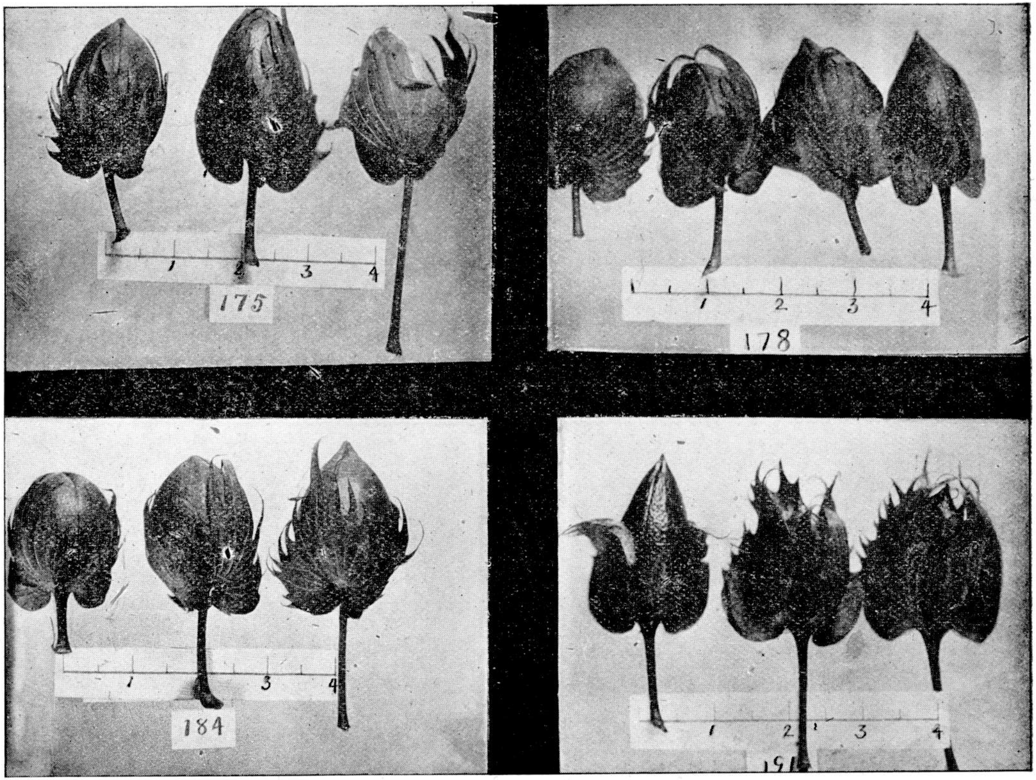


(Photographed by P. H. Mell.)

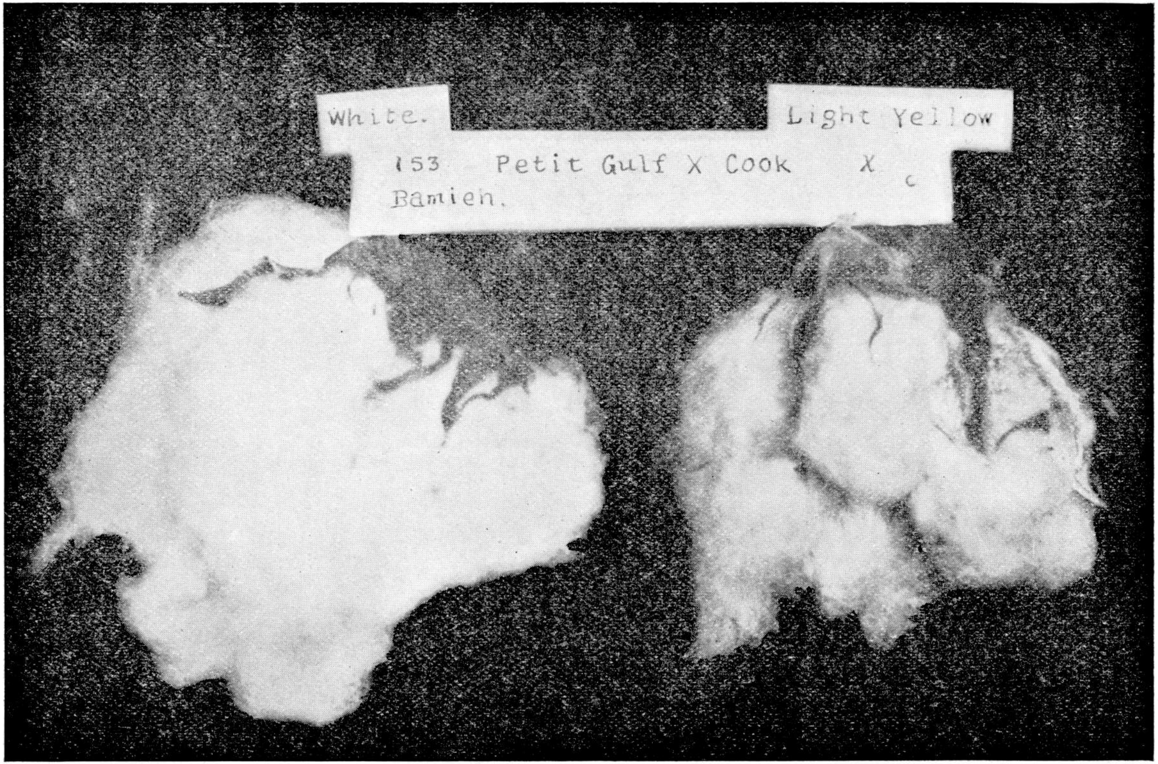
Each of the above groups represents bolls obtained from one plant. For explanation of numbers see table III, page 365. The scale is in inches.



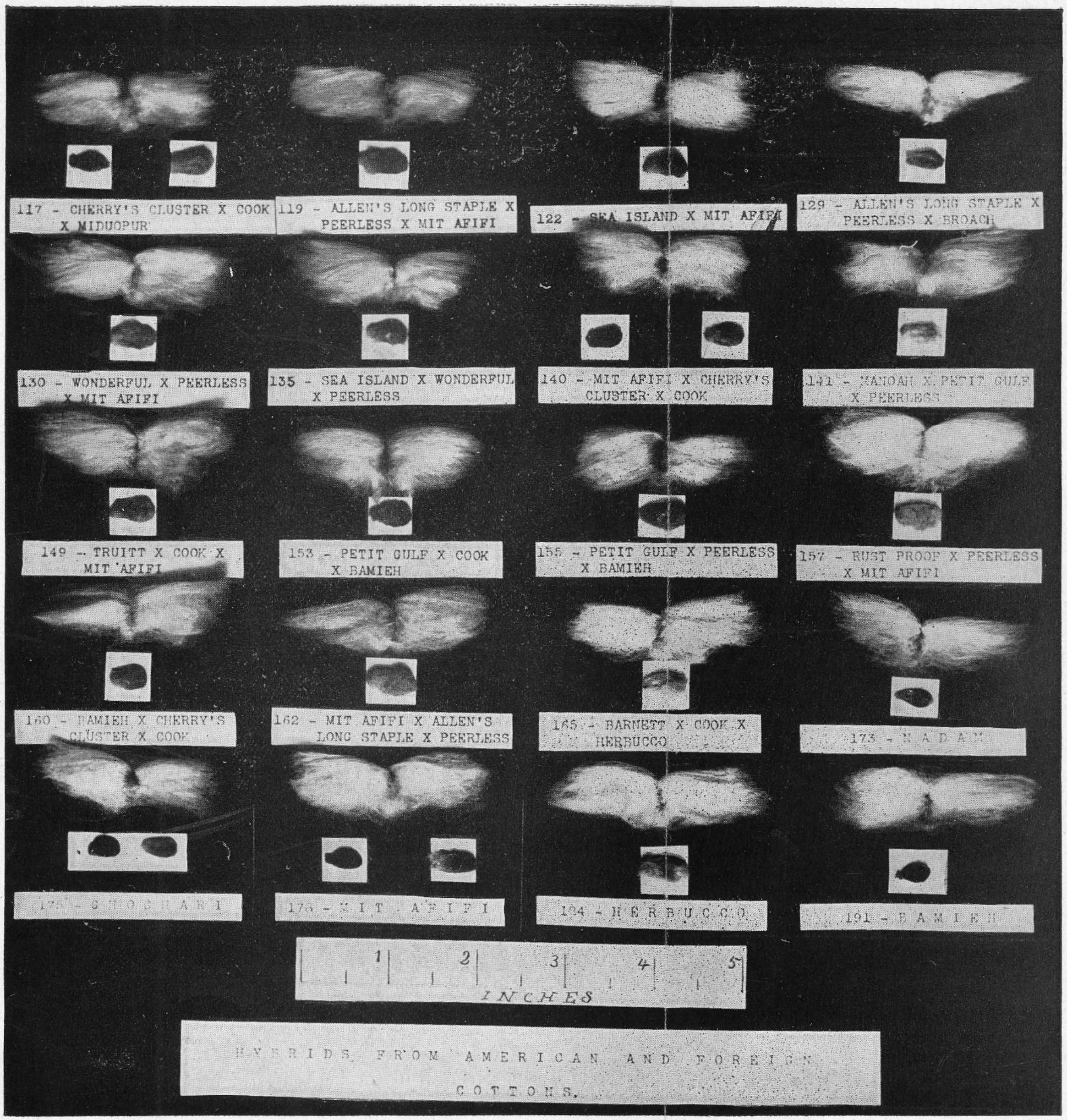
Each of the above groups represents bolls obtained from one plant. For explanation of numbers see table III, page 365. The scale is in inches. (Photographed by P. H. Mell.)



Each of the above groups represents bolls obtained from one plant For explanation of numbers see table III page 365 The scale is in inches (Photographed by P. H. Mell.)



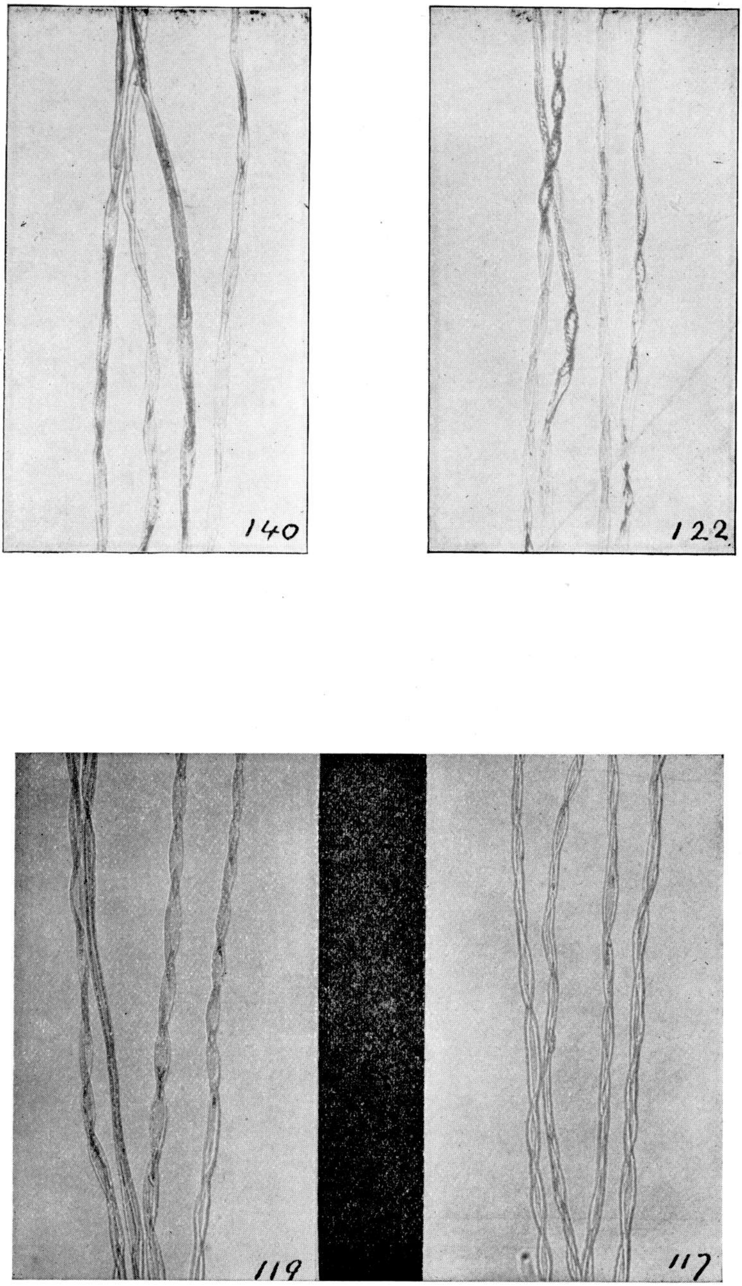
Open bolls obtained from the same plant Exhibiting both the Foreign and American parents.
Slightly reduced



Length and quantity of fiber produced by each seed resulting from hybridizing the American and Foreign Cottons. The illustrations show the seeds covered with fiber and also the seeds with the fiber extracted.

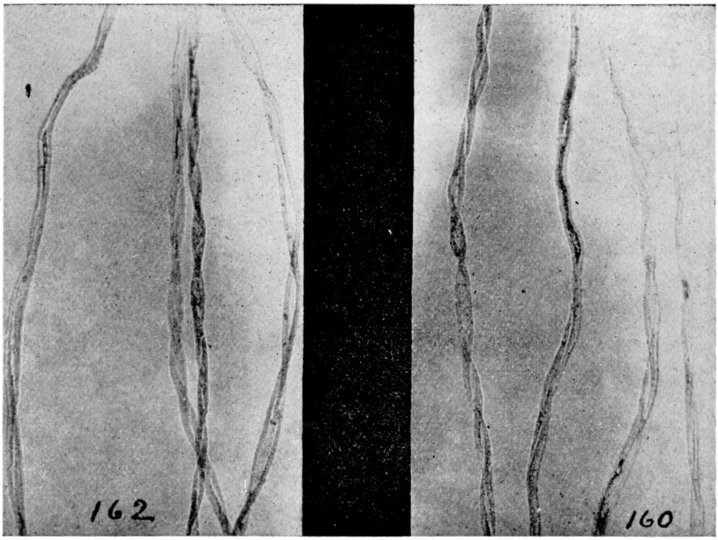
[Photographed by P. H. Mell.]

PLATE XXI.



Photomicrographs of Cotton fiber from hybrids. For explanation of numbers see table III, page 365. [Photographed by P. H. Mell.]

PLATE XXII.



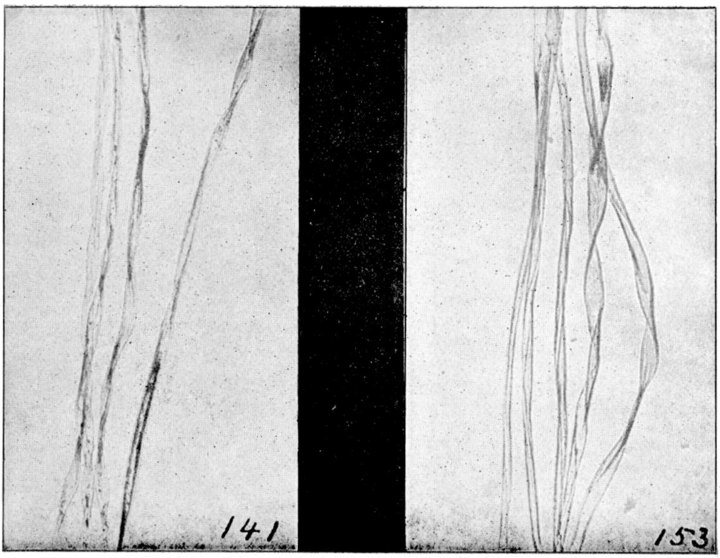


Photo Micrographs of Cotton fiber from hibrids. For explanation of numbers see table III, page 365. [Photographed by P. H. Mell.]

PLATE XXIII.

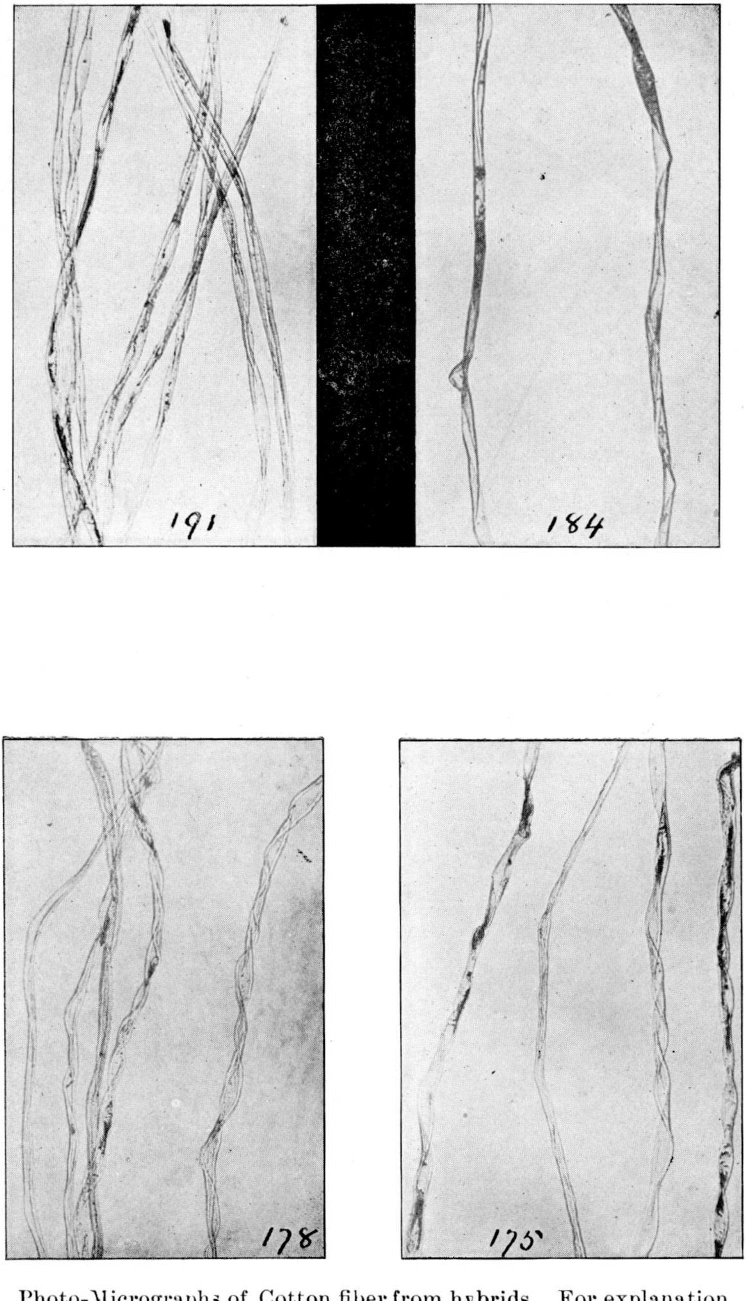


Photo-Micrographs of Cotton fiber from hybrids. For explanation of numbers see table III, page 365. [Photographed by F. H. Mell.]

THE COTTON PLANT CONSIDERED IN SOME OF ITS CHEMICAL RELATIONS.

BY B. B. ROSS.

ANALYTICAL STAFF:

DR. J. T. ANDERSON.

C. L. HARE.

J. Q. BURTON, JR.

THE COMPOSITION OF THE COTTON PLANT AT DIFFERENT STAGES OF GROWTH.

The importance of a careful and thorough study of the staple crops in their chemical relations has long since been appreciated and emphasized by the foremost agricultural scientists, and in recognition of this fact the chemical department of this station has given no little attention during the past few years to the study of the chemical composition of the cotton plant, its fertilizer requirements and other related questions of interest.

The work performed by this department in the study of the cotton plant in its chemical relations may be classified as follows:

A study of the chemical composition of the cotton plant at various stages of growth.

A study of the fertilizer requirements of the cotton plant as determined by the analysis of the plant grown on different soils by the aid of different fertilizing materials.

An investigation of the influence of cotton seed products in food rations upon the composition of butter.

Analyses of cotton seed products with reference to their fertilizing and feeding value.

Until a comparatively recent date, little chemical work of importance had been done with regard to the determination of the composition of the cotton plant at different periods of its growth, nor had there been made any very extended or accurate investigations as to the nutrition of the plant during various stages of its development.

In 1891, J. B. McBryde, of the Tennessee Experiment Station, published a bulletin in which were embodied the results of complete analyses of all parts of the cotton plant, the specimens examined being collected during the two preceding seasons. Up to the date of the appearance of this bulletin, the literature upon the subject of the composition of the cotton plant was exceedingly meagre, and little information of value was procurable outside of analyses by Ville of France, Dr. White of Georgia, and Prof. Jackson of Boston. The comprehensive contribution of Prof. McBryde to the stock of information relating to this subject was supplemented a year later by a bulletin issued by W. L. Hutchinson and L. G. Patterson, of the Mississippi Experiment Station, in which were reported results of analyses of all parts of the cotton plant collected at frequent intervals during the period of growth, and the value of the results were further enhanced by reason of the fact that the investigation extended over two seasons.

The analytical work reported included determinations of the proximate organic, as well as individual inorganic, constituents of the different parts of the plant, and much valuable information was secured with regard to the distribution of the plant constituents at different periods during the progress of growth of the plant.

According to the statement of the experimenters, the investigations at the Mississippi Station were made with a view to determining whether any peculiarities of nutrition existed in the cotton grown on the soils in that section of the State, as the plant, in general, showed an abnormal stalk and leaf development, while at the same time it was quite deficient in fruiting capacity.

In view of the abnormal growth and development of the cotton plant upon the Mississippi soils referred to, and on account of the fact that climate and season, as well as soils, may affect the composition of the plant, it was deemed desirable to conduct a series of experiments at this Station with a view to determining the composition of the cotton plant under the conditions of climate and soil existing in this section. These experiments, while conducted along different lines, were also designed to supplement, to a certain extent, the investigations conducted by Dr. J. T. Anderson, Associate Chemist, several years ago, in which the chief object in view was to determine the influence of varying quantities and forms of the chief fertilizing constituents upon the composition of the plant as regards these particular constituents. Owing to the limited time at the disposal of this department, it was impossible to make complete determinations of all individual constituents of the plant at all stages of its growth, but complete proximate analyses have been made of all portions of the plant and determinations were made of the chief fertilizing constituents, including nitrogen, phosphoric acid, potash and lime, while a complete analysis of all parts of the mature plant was also made.

The soil of the plots upon which the experiments were conducted was a light sandy one, with a somewhat thin subsoil, and was fairly typical of the upland soils in this immediate section. Owing to an unavoidable delay attendant upon the collection of the first sample of the plant for analysis, this particular sample was taken from a different plot from the remaining four samples, but the soil was also of a light sandy character and it is not believed that the composition of the young plant, as grown on this soil, would differ materially from that of the plant produced on the other soil.

Samples of the plant were taken at five different periods of growth, the earliest sample being taken five weeks after planting, and the latest sample being collected after fruiting had ceased.

The plants selected for analysis were as nearly representative as possible of the crop on the plat on which the experiments were conducted, and accurate weighings of the sample were made immediately after the individual plants had been collected. The plants were carried to the laboratory without loss of time, and were at once re-weighed, and any loss in weight noted. The different portions of the plant were now separated, carefully weighed and exposed to the air in thin layers in order to effect a thorough air-drying.

The drying of the material was completed in a large drying chamber by the heat of low pressure steam, and the samples were then reduced to a fine state of division by grinding.

In the first two experiments the plant was divided into three portions, for the purposes of analysis, the roots, stalks and leaves being analyzed separately, while in the case of the last three samples the bolls were also subjected to a separate analysis.

In the analysis of the sample representing the fifth stage of growth, complete analyses of roots, stalks, leaves, bolls, lint and seed are given, and the ratio of the weights of different parts of the plants to each other has been carefully noted. The loss in weight of the plants and their different parts during the process of drying was also accurately determined so that it is quite possible to arrive at the composition of the plant in its original fresh condition.

During the earlier and later stages of growth of the plants on the experimental plots, the weather was quite dry, but in the middle of the season there was a considerable amount of rain, and the growth of the plant between the times of collecting samples 3 and 4 was quite rapid and vigorous.

In reporting the results of analysis, the composition of all parts of the plant at all stages of growth is given, and in addition, the composition of the whole plant in both the fresh and dry condition is presented in tabulated form.

In the analysis of the different parts of the plant, and of the plant as a whole, the results reported are for the completely dried substance, except where specified to the contrary.

TABLE I.

Fertilizing constituents of cotton roots—
(in the water free substance.)

No. of Sample.	Ash	Nitrogen.	Phosphoric Acid.	Potash.	Lime.
I	8 32	1.82	0 50	3 26	1.70
II	4.34	1 06	0 41	1.82	0.43
III	4.18	0.93	0 38	1 53	0 43
IV	4.32	0 61	0 25	1 26	0.47
V	3.72	0 48	0.26	0 90	0.45

Proximate constituents of cotton roots.

No. of Sample.	Ash.	Protein.	Fibre.	Fats.	Carbo-hydrates.
I	8 32	11 38	43.68	1.50	27.80
II	4 34	6 63	39 06	2.31	47.66
III	4 18	5.81	38 47	2 92	48.62
IV	4.32	3 81	43.17	2 70	46.00
V	3 72	3 00	40 62	2 78	49 88

An examination of the figures showing the composition of the roots of the plant indicates a sharp falling off in the mineral constituents of the plant between the first and second periods of growth, and a very slight variation in the ash content during the remaining periods of the plant's development.

The lime and potash particularly show an abrupt decrease between samples 1 and 2, after which the content of the former becomes nearly constant, while the latter shows a gradual falling off up to the period of full maturity. The decline in the phosphoric acid content with the progress of the plant growth is more gradual than in the case of the lime and potash, while the nitrogen follows the potash closely in its ratio of decrease.

The fiber in the roots showed considerable variation during the various stages of growth, being unusually high in sample No 1, and exhibiting alternate decreases and increases in the remaining samples.

The fat shows a tendency to increase until the third period is reached, after which the proportion remains nearly constant, while the carbo-hydrate content exhibits a similar rate of variation.

TABLE II.

Fertilizing constituents of cotton stalks.

No. of Sample.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.
I	13 30	2 61	0.65	2.55	3 68
II	7.70	1 66	0.51	2.03	1.49
III	5.41	1.40	0.38	1.83	1.26
IV	5 65	0.82	0.28	1.67	1.35
V	3.09	0.64	0.21	0 85	0.78

Proximate constituents of cotton stalks.

No. of Sample.	Ash.	Protein.	Fibre.	Fat.	Carbo-hydrates.
I	13.30	16.31	38 70	1 43	30.26
II	7.70	10.38	35 41	1.13	45.38
III	5.41	8.75	39.51	0.93	45.40
IV	5.65	5.13	40 22	1.07	47.93
V	3.09	4.00	45 31	1.11	46 49

The composition of the stalks showed variations somewhat similar to those of the roots at the various stages of growth, there being a marked falling off in the proportions of mineral constituents in sample No. 2 as compared with sample No. 1, while the decrease from sample 2 to sample 5 was more gradual.

There is a somewhat sharp decline in the amount of total ash constituents in passing from sample 4 to sample 5, the decrease in the proportions of potash and lime in this period being particularly marked. The decrease in the phosphoric acid content as the growth of the plant progressed was quite gradual and uniform.

The falling off in the proportion of nitrogen is most noticeable in the second and fourth periods of growth the decline being quite gradual in the other periods.

The crude fiber showed a marked increase with the progress of the development of the plant, although a slight fluctuation was noted between the first and third periods of growth. The fat content after the first period showed little variation, but the proportion of carbohydrates showed a steady, though not regular increase, as the plant approached maturity.

TABLE III.

Fertilizing constituents of cotton leaves.

No. of Sample.	Ash.	Nitrogen.	Phosphoric Acid	Potash.	Lime.
I	21.60	5.11	1.04	4.68	8.81
II	16.63	4 33	0.78	2.66	7.40
III	15.98	3 60	0.57	2.27	6.42
IV	15.20	3.16	0.66	2.26	7.12
V	12.55	2 25	0.48	1.09	5 28

Proximate constituents of cotton leaves.

No. of Sample.	Ash.	Protein.	Fiber.	Fat.	Carbo-hydrates.
I	21.60	31.94	7.26	3.39	35.81
II	16.63	27.06	8.69	4.66	42.96
III	15.98	22.50	9.04	8 74	43.74
IV	15.20	19 75	8.99	8.33	47.73
V	12 55	14 06	8.71	9.49	56.19

A reference to the table of analyses of the leaves shows that this particular part of the plant contains a higher average proportion of fertilizing constituents than any other part, until the bolls commenced to mature. The large amount of fiber in the burrs and lint, of course, tended to decrease the proportions of phosphoric acid, potash, nitrogen, etc., in the whole boll, notwithstanding the fact that the seed contains good percentages of these constituents. The proportion of ash in the dry matter of the leaves decreased steadily as the growth of the plant progressed, the most abrupt declines being noted in samples 2 and 5, as compared with samples 1 and 2.

The potash content decreased somewhat in the same ratio as the proportion of ash, though more rapidly, while phosphoric acid and lime showed a more gradual, though not uninterrupted, decrease as the plant developed, there being a slight increase in the two latter constituents in the fourth period of growth.

Nitrogen decreased with comparative regularity during the different periods of growth, the most marked decline being noted in the last period. It will be noted that the potash content in sample No. 5 is less than one fourth that of sample No. 1, while the phosphoric acid content falls off only about one-half between the same periods.

The falling off of all of these constituents was much more marked than in the experiments reported from the Mississippi Station, there being an actual gain in phosphoric acid in the case of the Mississippi tests.

The fiber in the leaves showed a slight gain in the earlier stages of growth, and fluctuated very slightly during the remainder of the period covered by the experiments.

TABLE IV.

Fertilizing constituents of cotton bolls.

No. of Sample.	Ash.	Nitrogen.	Phosphoric Acid.	Potash	Lime.
III	9.15	3.24	1 06	2.25	2.16
IV	5.78	2.27	0 72	2.54	0.87
V	4.74	1 83	0.78	1 60	0.51

Proximate constituents of cotton bolls.

No of Sample.	Ash.	Protein.	Fiber.	Fat.	Carbohydrates.
III	9.15	20.25	23.09	3.29	44.22
IV	5.78	14.19	42.31	7.17	30 55
V	4.74	11.44	45 21	9.81	29.07

There was a marked increase in fat as the plant approached maturity, and there was quite a considerable increase in carbohydrates also, although the increments were not at all uniform.

The term "boll," as used in this connection, applies to the complete boll, including capsule, seed and lint, and is not restricted to the burrs, as is the case in some other bulletins relating to this subject.

Between the third and fourth periods of growth, there was a marked falling off in the ash constituents of the bolls, and a somewhat moderate decline in passing from the fourth to the fifth period. The phosphoric acid content showed a sharp decrease in the fourth period as compared with the third, and a very slight increase is noted in the last period of growth. Potash increased slightly in the fourth period and exhibited a marked falling off in the fifth period, while lime, on the other hand showed a very abrupt decrease in the fourth period, and a much smaller relative diminution in the last stage of growth.

Nitrogen also declined sharply in the fourth period, and exhibited a moderate decrease in the fifth period, of the plant's development.

Crude fiber increased very rapidly in the fourth period and showed only a fair increase in the last period, while carbohydrates showed a corresponding decrease.

The fat showed a marked increase in the fourth and fifth periods owing to the rapid formation of seed during that stage of the plant growth. In like manner, the large increase in fiber in the bolls is due to the accelerated production of lint as the plant approached maturity. The increase in these constituents of course, caused a decline in the relative proportions of several of the fertilizing constituents.

Analysis of Burrs—(water free.)

Ash.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.
9.06	0.82	0.48	3.09	1.14

A reference to the above table of analysis of the burrs reveals the fact that in an air dry or water free condition, quite fair proportions of the essential fertilizing constituents are present, the proportion of potash being particularly high, while lime and nitrogen are also contained in good quantities.

COMPLETE ANALYSIS OF ENTIRE MATURE PLANT.

The following table gives the results of a complete analysis of the entire mature plant collected on October 3rd, 1899.

Under normal conditions, it would be expected that the water content would be somewhat lower in the plant at maturity than at the next preceding period of growth, but the weather for several weeks before the taking of this sample being extremely dry, there was quite a considerable falling off in the proportion of water as compared with sample No. 4. There was also noticed quite a considerable loss of leaves from the plant during the last period, the proportion of the weight of the leaves to the weight of the stalk being much lower than in any of the preceding samples.

TABLE No. V.

Complete analysis of the entire mature plant.

	Nitrogen.	Phosphoric Acid	Potash.	Lime.	Magnesia.	Oxide of Iron.	Soda.	Sulphuric Acid.	Silica.	Ash.	Protein.	Fiber.	Fat.	Carbohydrates.
Roots	0.48	0.26	0.90	0.45	0.44	0.25	0.44	0.14	0.64	3 72	3.00	40.62	2.78	49.88
Stalk......	0.64	0.21	0.85	0.78	0.28	0.21	0.30	0 14	0 16	3.09	4.00	45.31	1.11	46 49
Leaves.....................	2.25	0 48	1.09	5.28	0.94	0 43	0 66	1.05	1 70	12 55	14.06	8 71	8 49	56.19
Bolls	1 83	0.78	1.60	0.51	0.55	0.15	0 23	0.42	0.21	4.74	11 44	45.21	9.81	29 07
Seed........................	3.54	1.40	1.13	0.32	0.30	0.03	0 28	0 11	0.02	3.65	22 13	11.91	23 05	39 26
Lint..........................	0.18	0.09	0.59	0.07	0 14	0 16	0 07	0 09	0 07	1 25	1.12	87.02	0.61	10 00

The following table shows the composition of the plant, as a whole, at the several stages of growth, the results being given for the thoroughly dried plant, as well as for the fresh plant at the time of taking the samples.

TABLE VI.

Analyses of plant for fertilizing constituents at different stages of growth.

A—Analysis of plant in water-free condition.

No. of Sample.	Ash.	Nitrogen	Phosphoric Acid.	Potash.	Lime.
I	18 09	4.12	0.88	3 96	6.74
II	11.53	2.85	0.63	2.30	4.15
III	8.70	2.24	0.55	1.98	2.68
IV	8.25	1.96	0.54	2.11	2.72
V	4 78	1.43	0 56	1 30	0.94

B.—Analysis of plant in fresh condition.

No. of Sample.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.
I	2.76	0 63	0 13	0.61	1.03
II	2.76	0.68	0 15	0 55	0.99
III	2 56	0 66	0.16	0 58	0.79
IV	1.81	0.43	0 12	0.46	0.60
V	1.85	0 55	0.22	0 50	0.36

These results were secured by consolidating the analytical data reported in the preceding tables, the proportional distribution of the different parts of the plant having been carefully determined.

A reference to Table No. VI-A shows a heavy decline in ash constituents in the second period, a somewhat less marked decrease in the third period, only a slight loss in the ash content in the fourth, and another large decline in the last stage of growth.

Nitrogen exhibits a steady and continued decrease from the first to the last period of growth, the largest decline being noted in the second period.

Phosphoric acid decreased up to the third period and then remains almost absolutely constant during the remainder of the growth of the plant. Potash and lime decline steadily up to the third period, a slight increase being noted in the fourth period, while a sharp falling off is observed in the last stage of growth of the plant.

The great decrease in the proportion of lime in the last period is no doubt due largely to the extensive shedding of leaves by the plant at this period, the leaves being particularly rich in this constituent at all stages of growth.

In Table No. VI-B, illustrating the composition of the plant in its original fresh condition, it will be noted that the variation in the proportions of the leading constituents is much less than in the table of results for the completely dried plant.

The ash content for the first two periods, on this basis, is the same, while a decline is noted in the third and fourth periods, after which it becomes nearly constant again. Nitrogen shows only slight fluctuations during the first three periods of growth, but exhibits a sharp falling off in the fourth period and an almost equally marked gain in the last stage of growth. Phosphoric acid exhibits only slight variations during the first four periods and markes a marked gain during the fifth period. In the case of potash, only slight variations are noted throughout the whole period of growth, while the lime content exhibits a continued but somewhat irregular decline, the most noteworthy decreases being observed in the third, fourth and fifth periods.

The falling off of nitrogen, phosphoric acid and potash in the fourth period is doubtless due largely to the fact that there had been an abundance of rain prior to the taking of this sample, in consequence of which the plant had grown rapidly and had taken up a large proportion of water, thus reducing the apparent proportion of the constituents named.

It was [illegible] above that there had been a considerable loss of leaves from sample No. 5 prior to the collection of the plants for analysis, and on this account, it is deemed desirable to make compensation for this loss in calculating the composition of the plant taken as a whole. In sample No. 4, there had been only a slight loss of leaves, and the proportion of the weight of the dry matter of the leaves to the dry matter of the stems was .937 to 1. Assuming that this ratio would have continued to hold good in the case of sample No. 5, if no loss of leaves had occurred, we find that the weight of the dry matter of the leaves in sample No. 5 should have been 3.65 times greater than it actually was under the conditions obtaining at the time the sample was taken. Upon this basis the composition of the plant as a whole would be as follows, calculated to a water free condition, the composition of the plant being also given in the dry and fresh condition, without compensation for the leaves lost in the last period.

TABLE VII.

Analysis of entire mature plant.

CONDITION OF PLANT.	Ash.	Nitrogen.	Phosphoric acid.	Potash.	Lime.	Magnesia.	Oxide of iron.	Soda.	Sulphuric acid.	Silica.
Water-free.......	4.78	1.43	0.56	1.30	0.94	0.49	0.19	0.30	0.37	0.33
Fresh............	1.85	0 55	0 22	0 50	0.36	0.19	0.07	0.12	0.14	0.13
Water-free, with compensation for loss of leaves.	6.07	1.56	0 55	1.26	1.65	0.56	0 23	0.36	0.48	0.56

From the data thus secured, it is easy to ascertain by calculation the amount by weight of the plant, and of the chief plant constituents required to yield a crop of 300 pounds of lint cotton per acre. It will be noted that the proportion of seed to lint in sample No. 5 is smaller than under normal conditions, owing to the fact that a considerable number of the bolls were not fully matured at the time the sample was taken. In the immature bolls, the proportion of lint to seed is generally above the normal, and in the case of this sample, the lint constituted 36.56 per cent. of the air dried seed cotton, a per centage much above the usual proportion of lint. Making due compensation for the loss of leaves from the plant in the fifth period, it is ascertained by calculation that the proportions of fertilizing constituents indicated in the following table would be required to produce a lint crop of 300 pounds per acre under the conditions governing the series of experiments described.

The weights of nitrogen, phosphoric acid, potash and lime contained in a crop producing 300 pounds of lint are given, and the relative distribution of these constituents through different parts of the plant is also presented. The weights of the different parts of the plant in a thoroughly dried condition are also given, and it will be noted that the total dry weight of the crop required to yield 300 pounds of lint is 2,470.9 pounds.

TABLE VIII.

Amounts of fertilizers constitueuts in pounds required to produce a crop of 300 lbs. of lint.

	Nitrogen.	Phosphoric acid.	Potash.	Lime.
Lint—300 lbs............	0.54	0.27	1.77	0.21
Seed—507.1 lbs...........	17 95	7.10	5.73	1.52
Burrs—363.1 lbs	2.99	1.74	11.22	4.14
Leaves—566.2 lbs.......	12 64	2.70	6.13	29.90
Roots—130.2 lbs..........	0.62	0·34	1.17	0 59
Stems—604.2 lbs..........	3.87	1.27	5.14	4.71
Total—2470.9 lbs.....	38 61	13 42	31.16	41.07

It appears from this table that to produce 300 pounds of dry lint there are required 38.61 pounds of nitrogen, 13.42 pounds of phosphoric acid, 31.16 pounds of potash and 41.07 pounds of lime.

The total weight of the crop is somewhat smaller than the weight of the crop in the experiments of McBryde, and the distribution of the various parts of the plant by weight varies considerably from the results reported by him.

The amounts of nitrogen and potash found in the crop required to produce 300 pounds of lint, are somewhat belowthe amounts given in the tables of McBryde, while the amount of phosphoric acid is slightly above the figures which he reports.

The plant is also less rich in fertilizing constituents than the plants reported in the Mississippi experiments, but this may be due to the fact that the past season was somewhat unfavorable to the growth and development of the plant, as well as to the fact that the soil upon which the crop was grown was not so fertile as the Mississippi soil.

Nevertheless, the yield of bolls and lint in proportion to the total weight of the plant was quite good, and it is quite possible that where considerably larger proportions of phosphoric acid, nitrogen and potash than those reported above, are found in the plant, the crop has taken up larger amounts of these constituents than are actually required for its normal development.

It is a well known fact that upon some soils the development of stalk and leaf is out of all proportion to the yield of fruit, and so it is not at all surprising that, upon soils where the stalk and leaf development is not so vigorous, and where, at the same time, the yield of lint in proportion to the weight of the whole plant is good, the amount of fertilizing constituents contained in the plant should be smaller than in the former case.

McBryde and others have called attention to the small amount of fertilizing constituents contained in the lint, and a reference to the tables previously given will show that 300 pounds of lint will remove only .54 pound of nitrogen, .27 pound of phosphoric acid, 1.77 pounds of potash and .21 pound of lime from the soil, and if the remainder of the plant and the seed were returned to the soil, the loss of fertilizing constituents would be almost inappreciable.

In actual practice, it would be quite difficult to secure the thorough incorporation of the plant into the soil, and yet a considerable amount of fertilizing material could be thus stored up and placed at the disposal of the next crop.

It will be noted that the amount of phosphoric acid in the fully matured plant is much less than that of nitrogen and potash, and this fact is of especial interest when it is considered that practically all cotton fertilizers supply much larger proportions of phosphoric acid than of nitrogen and potash. The fact that the quantities of phosphoric acid supplied in cotton fertilizers are relatively much larger than those of nitrogen and potash, notwithstanding the occurrence of smaller proportions of phosphoric acid in the plant, might warrant the conclusion that owing to the rapid reversion of soluble phosphates in the soil in the presence of oxide of iron and alumina, it becomes necessary to supply an amount of phosphoric acid largely in excess of the actual requirements of the plant.

The following table shows the relative distribution of the different portions of the plant at the various stages of growth, the results being given in percentages of the completely dried plant, as well as of the plant in its original fresh condition. In the column headed 5-a is given the results for the plant under the conditions obtaining at the time the sample was taken, while in column 5-b are presented the figures for the plant after making compensation for the leaves lost during the last period.

TABLE IX.

Percentage ratios of different parts of the plant to the whole plant during the different periods of growth.

A.—Plant in fresh condition.

	I.	II.	III.	IV.	Va.	Vb.
Roots............	7 27	11.61	10.85	4 67	5 45	4.61
Stems...........	37.59	35.33	34 96	22.08	26.78	22.05
Leaves	55 14	53.06	24.10	21.87	7 51	22.88
Bolls...........	....	....	30 09	51.38	60 17	50.46

B.—Plant in water free condition.

	I.	II.	III.	IV.	Va.	Vb.
Roots..........	8.94	10 57	12.29	7.60	6.32	5.27
Stems...........	27.95	42 55	43.13	29.71	29 34	24.46
Leaves..........	63.11	46 88	26 69	27.83	7.53	22.91
Bolls...........	....	....	16 89	34 85	56 81	47.36
Lint...........	....	....	....	....	14 56	12.14
Seed...........	....	....	....	....	24.62	20.52
Burrs...........	....	....	....	....	17 63	14.70

A reference to this table shows that in the fresh plant, that the percentage of roots to the weight of the total plant increases in the second period, and then declines throughout the remainder of the experiment. The leaves and stems fall off continuously in the proportion they bear to the weight of the whole plant, while the percentage weight of the bolls increases rapidly until in the last period, this part of the plant constitutes more than 60 per cent. of the weight of the entire plant.

The water content in the fresh plants in the various periods of growth was as follows:

1st period, 84.72 %; 2nd period, 76.08 %; 3rd period, 70.53 %; 4th period, 78.10 %; 5th period, 63.72 %.

FERTILIZER REQUIREMENTS OF COTTON, AS DETERMINED BY THE ANALYSIS OF THE PLANT.

Condensed from Bulletin 57, issued by Dr. J. T. Anderson.

Some years prior to the experiments just described, an extended series of experiments was conducted by Dr. J. T. Anderson, Associate Chemist of the Station, with a view to determining the influence of various fertilizer constituents upon the composition of the plant, and the substance of Dr. Anderson's report is herewith presented in a condensed form.

For the purposes of the experiments, two plots of ground were selected, whose soils were of the same general type, but widely different in point of fertility. One of the plots selected is designated the "Drake field," while the other plot was located in the Station garden. The soil of the Drake field was too poor for the profitable culture of cotton, while that of the Station garden had, by proper management, been brought to a high state of cultivation. The former plot had stood idle the preceding year, while the latter had produced two crops. In the preparation of the land, all the stubble and roots were removed as completely as possible after the ground had been thoroughly broken up.

Each piece of ground was divided into ten small plots, each 10x10, arranged in a continuous line, and 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 chief fertilizing constituents were applied, singly and in combination, as is set forth in Table I.

Table 1.

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 86	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 and acid phosphate	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

The first set of samples for analysis was 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.

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.

TABLE 1.

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 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 % 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.

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 %.

To ascertain the effect of the addition of fertilizing constituents to the soil upon the relative proportions of these constituents in the plants themselves, a detailed reference to Table 1 is necessary.

In the results from the Drake field soil it is seen 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.

The Station garden soil being in a high state of cultivation to begin with, 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 soils. 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 percentags of these ingredients.

An average of the experiments in which potash was supplied to the Drake field plots, shows a considerable gain for the potash content of the plants grown thereon, as compared with the plots to which potash was not furnished, and a slight gain is noted in the Station garden plot. The average of the phosphoric acid plots in the Drake field shows a slight decrease in the phosphoric acid content of the plant as compared with that of the plant grown on plots from which phosphoric acid was withheld, and only a slight increase is noted in the case of plants grown on phosphoric acid plots in the Station garden. Plants grown on nitrogen plots, both in the Drake field and Station garden, show quite a fair increase in the nitrogen content, as compared with the plant grown on plots to which nitrogen manures were not supplied.

The results that have hitherto been considered 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 was 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, immature seed in the sample for analysis, and they were accordingly rejected. The results of the analysis are given in Table 2 following, which is constructed after the model of Table 1. Here, as in the other, the results are calculated to the dry substance.

TABLE 2.

Analysis of plant in the bolling stage.

		DRAKE FIELD.				STATION GARDEN.			
Plots.	FERTILIZERS USED.	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 and phosphoric 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.

A reference to the table shows that in the Drake field, the lowest percentages of potash in the plant are in 5 and 7, where potash was not supplied, while the highest potash content is in No. 9, where there is complete fertilization, and where there is, also, the highest yield of cotton. In this plot, however, the plant has quite a low nitrogen content, but the other nitrogen fertilized plots bring up the average to a point above that of the nitrogen content of plants grown on non-nitrogen plots.

In the case of the garden plot, it is noted that the average effect of the potash fertilization is to increase the percentages of potash, while a similar increase in the nitrogen content does not follow from the application of nitrogenous fertilizers.

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 of 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.

While, as a rule, the percentages of fertilizing constituents are smaller in the bolling stage than in the flowering stage, it will be noted, that on plots 6, 8 and 9, in the Drake field, where potash was supplied, there is in the first case only a slight decrease in potash and in Nos. 8 and 9 there is a slight increase in the potash content, the largest yields of cotton being obtained from these plots.

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.

The decrease in the percentages of phosphoric acid and nitrogen between the flowering and bolling stage is quite marked, the decline in the amount of the latter constituent being particularly large.

A comparison of the figures in Tables 1 and 2 shows that where the plant has high percentages of two or more constituents in the flowering stage, and only a small decrease in those percentages in passing to the bolling stage, there is, as a rule, a large yield. With low, or medium percentages, in the early stage, followed by largely decreased percentages in the later stage, a relatively low yield is secured, and this would explain the low yield in plot 5, Drake field.

The soils upon which these experiments were conducted, while similar, from a geological standpoint, differ materially in composition, owing to the fact that the Station garden had been systematically improved, and an idea of the character of the soils can be secured from the following chemical analysis:

	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 inorganic matter	.647	.946
Humus silica	.:53	.353
Humus phosphoric acid	.020	.035

It will be noted that the proportion of Insoluble Silica in both of these soils is quite high, the field soil containing nearly two per cent. more than the garden soil. As regards lime, if the minimum limit assigned to this constituent in light sandy soils by writers on this subject be correct, both of these have a sufficiency of this valuable substance, 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.

CONCLUSIONS.

The following conclusions were drawn by Dr. Anderson as the result of the above experiments:

"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."

A comparative study of the results of these experiments in connection with those conducted during the past season would warrant the further conclusion that where no percentage increase in fertilizing constituents of the plant occurs during the progress of its growth, and even where an actual decrease is noted, there is still a large absolute increase of these constituents, and the result of the application of fertilizers may be manifested in the increased bulk of the plant and in the augmented yield of the crop.

THE EFFECT ON BUTTER FROM FEEDING ON COTTON SEED AND COTTON SEED MEAL.

Condensed from a bulletin prepared by Dr. N. T. Lupton in 1891, the analytical work being performed by Dr. J. T. Anderson.

An investigation was undertaken several years since at the Alabama Experiment Station to determine the effect of cotton-seed and cotton-seed meal on the composition of the butter fat, especially on the volatile acids, the melting-point, and the specific gravity of the butter produced.

Several chemists of late years have called attention to changes produced by the use of the feed stuffs mentioned, notably Prof. Harrington, of the Texas Experiment Station, and Dr. Wiley, of the Department of Agriculture, Washington, D. C. This subject was thought to be of sufficient scientific and practical importance to justify an extended investigation. For this purpose a herd of registered Jerseys was divided into two groups, one consisting of ten cattle and the other of a single cow. The cattle of the first group were fed for a preparatory period of ten days on the customary ration used at the station, excluding cotton-seed meal and hulls; the single cow was fed on the same ration. At the end of the preparatory period, samples of milk and butter were taken for one week, on Monday, Wednesday, and Friday, and carefully analyzed. The milk of the ten cattle composing the first group was mixed and churned as a whole—that of the single cow was kept separate and churned by itself. The first preparatory period was for ten days; after that the experimental and preparatory periods extended over seven days each.

The daily rations for the different periods, representing the kind and quantity of food actually consumed are given in the right hand column of the table of results. The nutritive ratios for the first three periods were: 1:5.8; 1:3.75, and 1:5.08.

During the fourth period the cattle were confined exclusively to raw cotton-seed and cotton-seed hulls, and during the fifth period to cooked cotton-seed and cotton-seed hulls. They were allowed as much as they would eat. The nutritive ratios mentioned above are calculated from analyses made of the feed stuffs in use at the station. In compounding the rations, the object was not so much to conform with strictness to the German standard as to bring the cows gradually under the influence of cotton-seed, cotton-seed meal, and hulls without injury to their general health.

Samples of milk and butter were taken after each milking and churning, and subjected to a thorough and careful analysis. In the following table, however, analyses of milk are omitted, and no individual analyses of butter are reported, the results given being the averages of individual analyses for each period.

During the progress of these experiments it was noted that there was a marked falling off in the quantity of milk, and a corresponding increase in the amount of butter produced during the first three periods, as the cattle were getting more under the influence of the cotton-seed meal.

During the remaining periods the quantities of both milk and butter diminish, the ration being confined to cotton-seed and cotton-seed meal, without reference to having it well balanced as a milk ration.

Average composition of butter for each period.

Period. Group I	Volatile acids.	Melting-point.	Specific gravity at 100° C.	Rations.
I.....	29 8	35·6°	0·90284	5 lbs. each ground oats, ground corn, and bran.
II.....	30 5	36·1°	0·90280	Cotton seed meal 3 lbs.; ground oats, 4 lbs.; bran, 5 lbs. ensilage, 11 lbs.
III.....	27 5	37·4°	0.90194	Cotton seed meal, 4 lbs.; cotton seed hulls, 9 lbs.; ensilage, 4½ lbs
IV.....	22·1	43·6°	0 89899	Raw cotton seed meal and cotton seed hulls.
V.....	22·5	42·7°	0 90262	Cooked cotton seed meal and cotton seed hulls.
Group II.				
I.....	31·4	34·2°	0·90323	5 lbs. each ground oats, ground corn, and bran.
II.....	31·1	36·3°	0·90152	Cotton seed meal, 3 lbs.; ground oats, 4 lbs.; bran, 5 lbs.; ensilage.
III.....	25·45	39·4°	0·89995	Cotton seed meal, 4 lbs.; cotton seed hulls, 9 lbs.; ensilage, 4½ lbs.
IV.....	20·4	42·5°	0·89854	Raw cotton seed meal and cotton seed hulls.
V.....	21·9	43·5°	0·89857	Raw cotton seed and cotton seed hulls.

The general effects of these valuable feed stuffs, when used in carefully prepared rations, will hereafter be investigated; at present we are concerned only, as previously stated, with their effects on the volatile acids, melting-point, and specific gravity of the butter fat produced under their influence. For these effects attention is called to the above tabular statements, from which the following conclusion is drawn:

Feeding on cotton-seed and cotton-seed meal increases in a marked degree the melting-point of butter, the increase reaching in these experiments eight or nine degrees, and diminishes to a corresponding extent the volatile acids, while the specific gravity remains virtually the same.

The richness of cotton-seed meal in albuminoids renders it of prime importance to mix it with one or more feed stuffs poor in this nitrogenous compound, such as ensilage, hay, or cotton-seed hulls.

It may be stated in this connection that no change was observable in the color of the butter from feeding cotton-seed and cotton-seed meal. The samples, still in the laboratory, are all of a beautiful golden yellow.

INFLUENCE OF COTTON SEED PRODUCTS UPON THE COMPOSITION OF MANURE OF CATTLE.

It is a well known fact that a very large proportion of the total fertilizing constituents of feed stuffs is found in the excrements of animals, the proportion of fertilizing constituents thus recovered being governed by the age and condition of the animal. In the case of fully grown animals the percentage of fertilizing ingredients thus recovered is much higher than in the case of young and growing animals, and by the employment of a feed rich in fertilizing, as well as nutritive constituents, it is possible to secure a manure much richer than that obtained from an ordinary feed. A mixture of cotton seed meal and hulls is much employed in fattening cattle for the market, and if the manures, both solid and liquid, are carefully collected and preserved, a considerable proportion of the value of the original feed stuff will be recovered in the manure.

To illustrate the superiority in fertilizing value of manure obtained as a result of feeding animals on cotton seed meal and hulls, analyses are given in the following table of manures resulting from an ordinary mixed feed and also from cotton seed meal and hulls.

Analysis of manure from different feeds.

	Manure from ordinary feed.		Manure from cotton seed meal and hulls.	
	Sample 1 Cow	Sample 2. Horse.	Sample 3. Cattle.	Sample 4. Cattle.
Phosphoric acid..........	0.28	0.46	0.96	0.67
Nitrogen..................	0.29	0.63	0.88	0.93
Potash....................	0.21	0.31	0.73	1.13

The analyses represent the composition of the manures in the fresh or nearly fresh condition, although samples 3 and 4 were slightly drier than sample No. 1 at the time of analysis.

A reference to the figures given in the above table will serve to emphasize the advantages of the employment of such high grade foods as cotton seed meal and hulls, where it is desired not only to furnish nutriment and flesh to animal, but fertilizing constituents to the soil as well.

Special acknowledgement is due to Dr. J. T. Anderson, Associate Chemist, and to Messrs. C. L. Hare and J. Q. Burton, Assistant Chemists, for the careful, painstaking and laborious attention given by them to the analytical work connected with the chemical portion of this bulletin, and also for valuable assistance rendered in the tabulation of results.

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BULLETIN No 108 APRIL, 1900.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

TOMATOES.

By
F. S. EARLE.

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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, Alabama.

NOTICE.

Bulletin No. 107 was prepared especially for the Paris Exposition, to exhibit the extent and character of the experiments conducted by the Alabama Station on the cotton plant. It is termed: "Results of Experiments on Cotton in Alabama," and is a resume of all experiments made by the Station since its foundation, covering a period of more than a decade. The contents relate to

- The culture of cotton.
- The varieties of cotton.
- The fertilization of cotton.
- The diseases of cotton.
- A list of fungi growing on cotton.
- The improvement of cotton by hybridization and selection.
- The climatology of the cotton plant.
- The chemistry of the cotton plant.

This bulletin was issued in a limited edition and will be sent to those parties who are specially interested in the cultivation of cotton, and it is therefore not for general distribution. However, it will be mailed to any one who may apply for it until the edition is exhausted.

P. H. Mell,
Director.

TOMATOES.

Tomatoes are everywhere recognized as among the most important of garden crops. They are widely grown for home use and for local markets. They constitute one of the principal truck crops that are grown at the South for northern shipment, and in some regions farther north they are grown in immense quantities for canning. In this State they are found in almost every garden, but as a commercial crop they have so far been strangely neglected. A few have been grown for shipment at certain points, but so far as known to the writer not in sufficient quantity to load cars. Our conditions are all fully as favorable as in neighboring states, where tomato growing is a large and profitable industry, except for the fact that our people lack the technical knowledge required for successfully handling this crop on a large scale.

In the following pages it is proposed to give a brief outline of the methods employed by the best commercial growers in this latitude, and at the same time to record the more important results of the experiments with tomatoes made at this Station during the past four years. The topics discussed will include Soils and Fertilizers, Plant Growing, Cultivation and Training, Pruning, Diseases and Insects, Varieties and Marketing.

SOILS AND FERTILIZERS.

Any good cotton or corn land is suitable for tomatoes. Probably the best soil condition is where a red clay subsoil is overlaid by a mellow, sandy loam, but good results can be obtained on quite stiff land if deeply plowed and finely pulverized. It requires more skill to grow really fine tomatoes on very thin sandy lands than on clays, for in such locations the tendency is for the fruits to run small and to lack firmness and quality. Often the very best results are obtained in moist, but well drained branch bottoms, for while, like cotton, the tomato plant will endure drouth better than most cultivated plants, it needs a uniform supply of moisture to yield maximum crops.

There are few soils in this State rich enough to grow satisfactory crops of tomatoes without fertilization, but a less quantity of fertilizers is required than for such crops as cabbage and Irish potatoes. It should be remembered that with this crop the fruit is the valuable portion, not the modified stem or leaves, and that the fertilization should be such as will promote fruitfulness, rather than a too luxuriant growth of foliage. In other words, the fertilizer for the tomato should be rich in the mineral elements, phosphoric acid and potash, but it should also contain nitrogen enough to promote a free, but not an unduly luxuriant growth. The exact proportions of these ingredients that give the best result on any given soil can only be determined by experiment. On most of our soils the formula given in Bull. 79, page 95, for a general vegetable fertilizer, will give good results. This was three parts cotton seed meal, three parts acid phosphate and one part kainit. From 600 to 1,000 pounds per acre is as much as it will usually be profitable to use. In some localities it would doubtless be better to considerably increase the proportion of kainit.

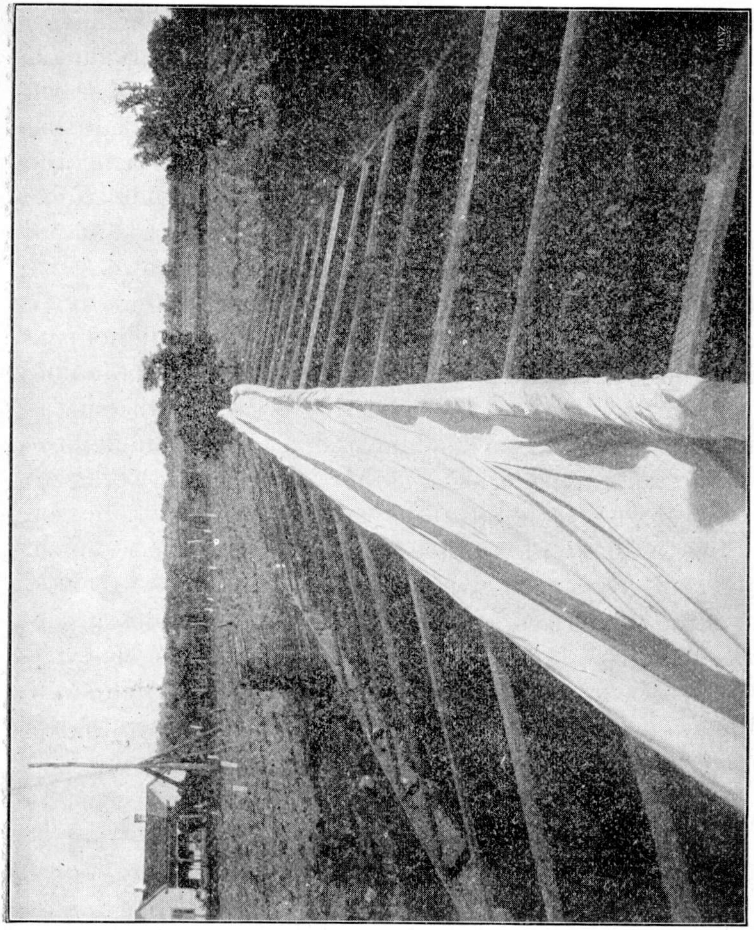
The land should be plowed quite deeply early in the spring, and should be harrowed thoroughly after every rain, so as to get it in the best possible condition of tilth before planting. Furrows should be opened and the fertilizers scattered and bedded on just as for cotton, but the beds should be run over with the harrow until they are nearly leveled down.

PLANT GROWING.

Seeds planted in the open field do not come on early enough in this latitude to yield profitable crops for shipment. It is therefore necessary to start the plants in hot beds and cold frames* and to move them to the field after danger of frost is over. At Auburn this is usually from the fifth to the tenth of April. Growing plants in cold frames requires some technical skill, and it is here perhaps that inexperienced persons would find most difficulty in producing a tomato crop. Seeds should be planted in a hot bed about the first of February. An ounce of good seed should give plants enough for one acre. The seed may be sown quite thickly, as the plants will be moved as soon as they begin to show a few rough leaves. It is best to plant the seed in drills four or five inches apart. When planted, cover the bed closely and do not open it till the plants are up. Then it will be necessary to ventilate carefully during the middle of every bright day or the young plants may be injured by too much heat. This is done by slipping the sash alternately up and down, so as to leave a three or four-inch crack first at the top and then at the bottom of the bed. Do not uncover entirely so as to expose the plants to cold winds. Glass sash are almost essential for the hot bed, but it will only take a few of them to cover plants enough for many acres. At this time of year very little water will be required. The beginner is likely to make the mistake of over-watering. This should be carefully guarded against, as it is likely to induce damping off. When it

*The methods of building and managing hot beds and cold frames were discussed in Bull. 79, pp. 99-103.

becomes necessary to use water it should be warmed to avoid chilling the young plants. If the disease known as damping off appears, stir the ground between the rows thoroughly and give more ventilation so as to dry out the top of the soil. Keep the bed covered closely at night and during cold cloudy days. Whenever the thermometer threatens to drop below freezing the glass must be covered with mats, sacks, corn stalks or pine straw, as any serious chilling is very injurious. In about a month, that is, by the first week in March, the plants should be big enough to transplant into cold frames. This is best done when they show two or three rough leaves. The little plants are dug up and the roots placed in a shallow dish of water to prevent drying and to cause the dirt to stick to them closely, when they are replanted. In the cold frame the plants are set five to six inches apart each way, taking care to keep them in straight rows. This is done by using a marker made from a stick as long as the frame is wide, with little pegs nailed on it at the right distance for the plants. By pressing these pegs into the soil an entire row is marked and by placing the end of the marker against the same side of the frame each time, the plants will row accurately in each direction. This is important in taking them up to move to the field. The little plants should be watered lightly when set and should be shaded for two or three days by keeping the cloth curtains down. After they have had time to strike root in their new location the curtains should be rolled up during every bright day to give the plants as much sun as possible, but they should be covered again before sun down. Water should be given very sparingly during cool, cloudy weather, but as the plants begin to grow rapidly and the weather gets warmer they will need much more frequent waterings. No specific directions can be given for the care of the plants. Watering and ventilation are the two important factors and these must be left to the judgment and watchfulness of the grower. It should be remembered that the tomato is a native of a warm climate, and that it should be protected from all chilling influences. In cool weather always water during the middle of the day so that the chill will be felt as little as possible. In freezing weather, of course, the beds must be kept tightly closed. Most commercial growers use cotton cloth for covering cold frames, as it is much cheaper than glass, and is much easier to handle in opening and closing the beds. Ordinary unbleached, double-width or ten-fourths wide sheeting is used. One side is nailed fast to the back side of the bed or in double beds to the ridge pole, and the other is nailed between two one by two-inch strips, thus making a square roller on which the curtain is rolled up when it is wished to open the bed. By starting with one short and one long piece, so as to break joints, such a roller can be made any desired length. It will be necessary to provide some extra cover for each cold frame to use on very cold nights, for the single thickness of cloth will not turn more than a slight frost. The beds should always be well banked at the ends and sides with earth.



Photograph of a double cold frame 12 ft. wide, showing the curtains partly rolled up.

The hot bed is usually located near the house or barn, where it will be easiest to give it proper attention, but the cold frames should be scattered about in the fields, in order to save labor in carrying out the plants when planting. A double bed, twelve by sixty feet wide, will hold plants enough for an acre of ground and if located in the center of an acre cut, none of the plants will have to be carried any great distance. Such a frame is shown in the accompanying photograph.

The soil for the cold frame should be covered one to two inches deep with well rotted stable manure, and should have a liberal dressing of acid phosphate and kainit, all to be well worked in and thoroughly mixed at least ten days in advance of planting. If the stable manure is not at hand fairly good results can be secured with commercial fertilizers alone in the cold frames. Use about two buckets of the complete mixed fertilizer to each double sixty-foot bed. It will be a saving of labor to plow the ground and thoroughly harrow in the fertilizer before building the frame.

If the plants have been successfully grown, by the first week in April they will be ten or twelve inches high and will be beginning to bloom. It is now necessary to rush them to the field as fast as possible. A few hours before each bed is needed, water it heavily, so as to thoroughly soak the ground. Take off the cloth covers and store for use another season; knock down the frames and haul off the lumber. With a long bladed butcher knife cut down between the rows of plants in each direction, thus checking the bed into six-inch squares with a plant in the center of each. Provide several light hand barrows made of two light strips seven feet long for handles with a platform of half-inch boards nailed across them. These boards should be cut thirty inches long and should cover the middle of the handles for about four feet. With a sharp spade the squares of wet earth with the plants are carefully lifted and are placed snugly together on this hand barrow. Two men now pick it up and carry it to the rows that are being planted. The ground having been previously fertilized and bedded, the beds are now opened deeply with a solid sweep or wide shovel, a few at a time, so that the plants may go in the fresh furrows. The bearers lift the plants with a flat shingle or a mason's trowel and place them about three feet apart in the furrows. Other hands follow with hoes and draw the earth carefully about the plants. When all is properly handled very few of the squares of earth will crumble enough to expose the roots and plants can be removed even in quite dry weather without wilting or scarcely checking their growth. It is not necessary to use water when planting, except in watering the beds, as already described.

CULTIVATION AND TRAINING.

Cultivation should begin as soon as the plants are set. Nothing seems to help them to strike root and begin to grow so much as an immediate stirring of the soil. A five-tooth cultivator is usually the best tool to use in the tomato field, though the cotton scrape is also useful. One of these tools should be run through the rows at least once a week from the time of planting till the crop is ripe. This, with an occasional hoeing to kill weeds and break any crust that forms in the row will be all the cultivation required.

In the garden various devices are resorted to for supporting the vines and keeping the fruit off the ground. In the field nothing has been found practical except a light stake driven in the ground near each plant at time of planting, to which the plant is tied.

Some growers keep the plants tied to these stakes from the start, tying them three or four times or more, as necessary. Others let them lie on the ground till the fruit is nearly grown, and then lift and tie them, claiming that besides saving labor the lifting and disturbing of the vines tends to make the fruits ripen faster. On clay soils this staking and tying is quite necessary as in rainy seasons much of the fruit will rot before ripening where it touches the ground. On sandy land there is much less trouble from this rot from contact with the soil, and it is quite permissible to save the expense of staking and tying and let the plants sprawl on the ground. Where the system of pruning to a single stem is followed that is described in the next paragraph, two plants are sometimes tied to a single stake, the two plants being set about eighteen inches apart, with wider spaces between each group of two. In all cases the stakes should be driven as soon after planting as possible. If this is delayed till the roots get started, some damage may be done to them.

PRUNING.

By pruning commercial growers mean the pinching out of all lateral branches as soon as they appear, thus confining the growth strictly to one stem. When about three clusters of fruit are set the vines are topped, thus stopping all farther growth of vine, and turning the energies of the plant entirely to the growth and maturing of the fruits that are already set. The advocates of this system claim that it greatly increases the size of the individual fruits and that the bulk of the crop ripens several days earlier than on unpruned plants. Of course each plant produces fewer fruits than when allowed to grow unchecked, but this is partly compensated for by increased size and by the closer planting that is possible on this system, thus allowing a greater number of plants to the acre. In several of the more important tomato growing regions this system is very widely followed. During 1897 and in 1899, pruning experiments were tried at this Station. In both years the crop was so much injured by the boll worm and by the black rot as to largely vitiate the results. In both seasons, too, the plants were injured by unfavorable weather. It is therefore not deemed expedient to publish the results in detail, but in both cases the pruned rows gave decidedly heavier early pickings, and the average weight of the fruits was from five to fifteen per cent greater. The few other stations * that have experimented with this method of pruning all report earlier maturity as the result, and the opinion of commercial growers who have practiced it is so unanimously in its favor that we must admit the fact as established that pruning is profitable and advisable wherever earliness and size are of more advantage than total weight of crop. It is perhaps still an open question whether or not under southern conditions pruning does not really increase rather than decrease the total yield aside from its other admitted advantages. In the first place it allows much closer planting, the increased number of plants per acre offsetting the supposed lighter yield per plant. Again, on lands that are infested with either the Bacterial Wilt or the Sclerotium Wilt the earlier maturity caused by the pruning may secure a partial crop before the death of the attacked vines, while without it the crop on such vines would be a total loss, and there are probably few tomato growing regions in the South where one or the other of these troubles is not present. It was hoped that the experiments mentioned above would throw some light on this question of the total yield of pruned and unpruned plants, but as in each case fully half of the crop was destroyed by the combined ravages of the black rot and the boll worm it seems unsafe to draw any conclusions from the results obtained. In fact, it is useless to attempt plot experiments with tomatoes until we learn

*See Tenn. Station Bull. for Nov. 1892 and Oct. 1893, and Also Louisiana Station Bull. 22.

how to better control these two seriously disturbing factors. If it were possible to make plots large enough to fairly equal commercial conditions then the losses from these sources could be safely ignored, but not otherwise, and this is beyond the means of most experiment station workers. Further experiments are greatly needed to determine the best distance to give pruned plants, in order to secure maximum yields per acre, and also to determining the results from topping at two, three or four clusters as compared with pruning, but not topping.

To secure the best results from pruning it is necessary to go over the plants as often as once in five or six days in order to remove the laterals before they get more than an inch or two long, and when they can be pinched out by the thumb and finger. If they are allowed to remain until they develop leaves and woody tissues, it is of course done at the expense of the other parts of the plant, and we have in part defeated the very purpose for which we prune. Furthermore, the removal of a considerable quantity of leaves by a belated pruning may derange the balance between root and leaf surface, thus causing injury. The effect of pruning can be very quickly noticed in the increased size and deeper color of the leaves and in the rapidity with which the fruits set and grow. There is often great complaint among tomato growers that the early clusters of flowers do not set fruit. This is very apt to be the case where plants are making a rapid growth and the weather is at all unfavorable. On pruned plants this loss is very largely avoided. The first clusters almost always set perfectly and this probably explains in part at least the heavier early pickings as the result of pruning.

The practice of pinching to a single stem seems to be a rather common one with experimenters on tomatoes.

under glass, but in field culture it has attracted less attention from experiment station workers than its importance deserves. Most of the references to tomato "pruning" in horticultural literature are found to refer to topping the vines to promote branching, or to some other practice than that now under consideration.

DISEASES AND INSECTS.

[Under this heading only the more important tomato insects and diseases that are known to occur in this State will be discussed.

Boll-worm (*Heliothis armigera Hubu*): This is the same insect so often found in ears of corn and that later in the season bores into and destroys the cotton bolls. It is the larva of a dull colored, inconspicuous, night flying moth. The eggs are laid on the leaves and young fruits. In a few days they hatch and the young worms for a few hours at least crawl and feed on the surface of the plant. During this time it is possible to kill some of them by spraying with Paris green or other arsenical poisons. To be effective such spraying must be done just as the eggs are hatching. No sufficiently careful experiments have been recorded to show what proportion of the worms can be killed in this way. Certainly not all of them, for they so soon bore into the young fruits, where they are safe from poisons. One or two properly timed sprayings will probably pay in combating this insect, but spraying alone can not be depended upon. In this latitude the worms begin hatching early in May. In 1899 the first were noticed on May 13th.

The piercing of the cuticle of the tomato by the worm in making his entrance to the fruit usually serves to introduce germs that sooner or later cause a wet rot. This is not pleasant to the worm, as he perfers sound to rotted fruits. He soon backs out and bores into another fruit, carrying, of course, the rot germs with him. This process is repeated again and again, so that one worm often destroys a dozen or more fruits. This indicates the necessity for picking and removing from the field all wormy fruits as soon as detected, thus preventing further injury on the part of the worms thus captured. This hand-picking, if faithfully done three or four times a week, will do more than anything else to minimize the loss from this pest, which frequently amounts to a half or more of the early crop. Planting corn as a trap crop is the remedy usually recommended for this worm in the cotton fields, as it is said the female will lay her eggs in fresh corn silks in preference to any other food crop. This is also sometimes recommended for tomatoes, but it is difficult to have corn far enough advanced to give much protection from this first brood, that is the one usually causing most loss to the tomato grower.

Tobacco Worm (*Phlegethontius Carolina*): These large green, repulsive larvæ are frequently seen on tomato plants. They are such gross feeders that if only a few are present they soon do very serious harm. They are so conspicuous that they are easily destroyed by hand picking, and this is usually the only remedy employed against them. When pruning the vines it is an easy matter to search out and kill these worms when evidence of their presence is observed. If Paris green is used for the boll worm it will be effective against these also.

Flea Beetle (*Phyllotreta vitata Fabr.*): This is a minute dark colored, actively jumping beetle that sometimes does considerable injury by feeding on the underside of the leaves. It eats minute pin holes in the leaves, sometimes fairly riddling them like lace. When the weather is favorable and the plants are growing rapidly they usually do but little damage, but in cold, cloudy weather early in the season they sometimes give the plants a very serious check. The most damage is usually done either in the cold frame or soon after the plants are set in the field. It is thought that their injuries to the leaves often serve to enable *Alternaria solani,* the fungus causing target board spots on the leaves, to gain a foothold. It has been observed that these beetles do not attack leaves that have been coated by a spray of Bordeaux mixture, so that this spray has come to be the recognized remedy for them. It does not kill the insect, but simply acts as a repellent.

Cut-worms (various species): Where the land is infested with cut worms they often do great damage by cutting down the plants when first set in the field. Occasionally they are also troublesome in the cold frames, but here it is an easy matter to dig them out and kill them. If it has not been discovered that the land is infested until the plants are set in the field this hunting out and killing the worms by hand will be the only recourse. The worms feed at night and seek shelter by burrowing into the ground by day. A worm seldom travels far from the place where he had his last meal, so when a freshly cut plant is found it is usually easy to locate the worm by a little digging. It is often necessary to go over the field of newly set plants every morning to search out and kill the cut worms.

Fall plowing is said to do much toward ridding the land of these pests, but in the South this is not always permissible on account of the increased washing and leaching of the soil during our heavy winter rains. Probably the best means for killing cut worms is by the use of poisoned baits scattered over the field a few days in advance of planting. Some cabbage leaves or other similar "greens" may be plentifully sprinkled with

Paris green and dropped over the field, or if nothing of this kind is at hand, a bran mash, poisoned with Paris green and sweetened with molasses may be used instead, dropping a spoonful at frequent intervals. To be effective this must be done in advance of planting, otherwise the worms will prefer the tomato plants to the baits.

Nematode Root Knot (*Heterodera radicicola*): This dreaded pest of southern fields attacks cotton, many kinds of garden vegetables and some fruit trees. It causes little knots or swellings on the roots, finally causing them to rot and thus killing or seriously injuring the plant. It is often found on tomato roots and frequently causes their premature dying. The tomato is, however, a plant of so much natural vigor that it usually succeeds in ripening at least a part of its crop before it succumbs to the nematode attacks. Pruned plants, on account of their earlier maturity, usually suffer less than unpruned ones.

Where the microscopic worm causing this trouble is established in a field no means is known for destroying it except by starving it out by not allowing any of its food plants to grow on the land for at least two years. For a further discussion of this subject see Bull. 107, under the head of cotton diseases.

Black Rot or Blossom-end Rot (*Bacillus* sp.): In this state this well known disease probably causes the loss of more fruits even than the boll worm and should be given first place among the enemies of the tomato grower. Spraying with Bordeaux mixture has been widely recommended as a remedy for this disease. In 1896 an elaborate experiment was undertaken in which certain plots of tomatoes were thoroughly sprayed as many as ten times with Bordeaux mixture, beginning when the first rough leaves were formed, and continuing till the ripening of the fruit. The treatment did not have the slightest effect in controlling the disease. As large a proportion of the fruits rotted on these excessively sprayed plants as on the checks that were not sprayed at all. This, and somewhat similar previous experiences led to the belief that the usually accepted theory, that the disease was caused by certain fungi frequently found in connection with it, was incorrect. A search was accordingly begun for other possible causes and as the result of studies extending over the past three years, it has been quite certainly proven that the disease is bacterial, not fungal, being caused by the growth of an undetermined species of *Bacillus*. The results of these studies were embodied in a paper read before the Botanical Club at the recent Columbus meeting of the American Association for the Advancement of Science. As this paper has not been printed, it is here reproduced in full, as giving my present views regarding this disease.

The "Black Rot" or "Blossom-end Rot" has been familiar to the writer since boyhood as a destructive disease of the tomato. The first careful account of it that we have seems to be by Galloway in his Annual Report, as Chief of the Division of Vegetable Pathology for 1888, pp. 339-343. He says that "specimens of this [disease] have been received from all parts of the United States where the tomato is grown." He gives a good description of the later stages of the disease with a colored plate; and states that *Macrosporium Tomato* Cooke. and *Fusarium Solani* Mart. are so constantly associated with the disease that they must be considered as the probable cause. His cultural experiments, however, showed that the latter species could not attack the healthy tissue of a green tomato, but that it developed abundantly on ripe fruit or on injured tissue of the green fruit. The *Macrosporium* was unable to penetrate the uninjured epidermis, but he found that it grew abundantly when the spores were inserted beneath the cuticle of either green or ripe fruits. In his report for 1889, p. 418, the same author gives some encouraging results in preventing this disease by spraying with Bordeaux mixture from some experiments at Greenville, S. C.

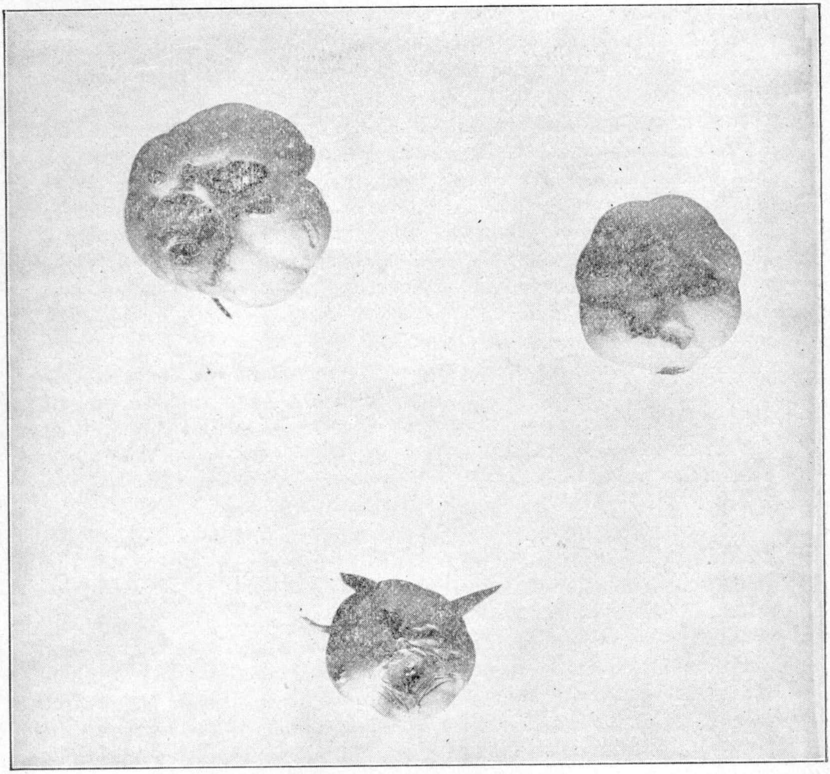
Since this time, brief mention of this disease has been made in the publication of many of the Experiment Stations. *Macrosporium Tomato* has been given as the cause except where through error *Macrosporium Solani* has been named instead; and spraying with Bordeaux mixture has been recommended as a remedy. In a rather hasty review of the literature, I find very few instances where the results of actual experiments with this disease are recorded. In fact no new light seems to have been thrown on the subject till the investigations of Jones and Grout, published in the Annual Reports of the Vermont Experiment Station for 1895 and 1896 and more in detail in Bull. Torr. Bot. Club 24: 254-258 (May, 1897). These authors show conclusively that the so-called *Mascrosporium Tomato* Cke. is only a form of a widely occurring saprophyte found on many kinds of decaying vegetable matter, and known under many names, *Alternaria fasciculata*, (C. & E.), Jones & Grout, being the one finally adopted for it by them. They state positively that this fungus is not the cause of the tomato rot, since when pure cultures of it are introduced under the skin of healthy green tomatoes it invariably fails to grow. Unpublished experiments of my own, made during 1897 and 1898 fully confirm this opinion. In no case have I succeeded in getting a growth of this fungus by inoculating sound green tomatoes with a pure culture.

When tomatoes are attacked by this disease in the field, the first stage to be noted is the appearance of a small, irregular watery area, usually, though by no means always, surrounding the remains of the pistil. This watery spot resembles somewhat the condition known as "Water Core" in apples. On making a cross section this watery condition is found to be confined to the portion immediately under the skin. It usually does not involve the tissues to any great depth even after it has extended so as to cover a considerable surface area. Growth of the fruit over the infected area stops so that after a few days the spot seems somewhat sunken. If the tomato is nearly ripe, maturity will be hastened and the watery spot may dry down so as to look as if the fruit had been slightly seared with a hot iron. The greater number of infections take place when the fruit is about an inch in diameter. Such fruits are utterly ruined. The disease may invade the entire surface, causing them to fall, or the premature ripening of the lower portion may arrest it, when the partially dried diseased portion often becomes blackened by a velvety growth of the *Alternaria*.

The peculiar watery appearance of the first stages of this disease long ago suggested to me the idea that it was possibly caused by bacteria, but no steps were taken to verify this hypothesis till June of last year (1898). One morning while walking through the tomato field while the plants were still moist with dew some half grown rotted fruits were observed that seemed to be smeared with a sticky exudation. On further examination, all the fruit showing the disease in about this stage of advancement, were found to show more or less abundantly drops of this sticky exudation. The appearance at once suggested the well known sticky exudate on blighting pear trees, and revived in my mind the theory of the bacterial nature of the disease. As the dew dried off the drops of exudate dried down to a hardly noticeable glaze. On taking specimens to the laboratory this exudate was found to be swarming with bacteria. As the writer was prepared for a somewhat extended absence, the rotted fruits were taken to the Veterinary Laboratory, where my colleague, Dr. C. A. Cary, kindly undertook to make some cultures for me. The exudate yielded an almost pure culture of a bacillus. The same germ was found abundantly within the diseased tissues. Sound green tomatoes under a bell jar were inoculated with a pure culture prepared from the exudate. In all cases they showed signs of rot in twenty-four hours. When Agar containing the germs was smeared on the surface of sound tomatoes, no rotting took place even after a number of days. Puncturing the skin through the Agar would promptly induce rot.

After my return the matter was not taken up till the middle of September, when an Agar tube of the pure culture from the exudate was secured from Dr. Cary and further inoculations were made under bell jars and in the field till no doubt remained that the bacillus in question was abundantly and promptly able to cause a destructive rot of tomatoes. At this time the disease was entirely absent in the fields as it was noted to be in the Fall of 1897.

The rot induced by inoculation did not in all cases exactly resemble that occurring naturally, the act of inoculating seeming to introduce the disease more deeply in the tissues. A very shallow scratching of the surface was resorted to and a few very characteristic cases were secured, though such shallow inoculations more often dried down and failed to take.



Three tomatoes inoculated with black rot germ from laboratory celtures kept over winter. Inoculated May 12, photographed May 15, 1899.

Fresh Agar tubes were prepared on November 8, 1898, and allowed to stand till May 8, 1899. Although completely dried down, the vitality of the germ was uninjured and fresh tubes were soon growing, inoculated from these old ones, that were used for further field and laboratory tests. Without going into details the following facts seem pretty well established.

The disease can not be contracted through the flowers as is the case in pear blight. The stigmas of many open flowers were smeared with cultures of the germ without inducing a single case. In no case were inoculations successful where the fruit was less than 1 centimeter in diameter. In 1898 the disease was very abundant and destructive and great numbers of some species of Thrips were observed running about over the diseased and healthy fruits, frequently smearing themselves with the sticky exudate. In 1899 comparatively few of the Thrips were to be seen and there was less rot than I have known for many years.

In my experience, extending over a number of years, Bordeaux mixture has always failed to give any marked result in controlling this disease.

It is a well known fact that when a larva of the boll worm eats its way into a tomato, the injury is often followed by a watery rot. The worm does not like this and backing out, he bores into another tomato, which rots in turn, and the process is repeated till the same worm may have destroyed a dozen fruits. This rot is caused by the same Bacillus that causes the blossom-end rot, and the injury is more like that produced by a deep inoculation in the laboratory. Where the rotting material from a wormy tomato drops on one below that is weather cracked, that will rot also.

These are the main facts observed in regard to the effect of this germ on the tomato. Owing to lack of time and the pressure of many duties its botanical characters have not been carefully worked out and no attempt has been made to decide whether or not it is a described species.

The following facts in regard to it have been noted:

It is an actively motile rod shaped Bacillus of medium size, with nothing peculiar in its appearance. It stains readily with all the usual stains. No spore formation has been detected. It grows readily on the flesh of sound green tomatoes, causing rot, but it can not penetrate the cuticle unaided. It grows on ripe tomatoes, but less readily than on green ones. It grows feebly and to a very limited extent on raw Irish potato, but it grows readily on boiled potato, soon covering the surface with a yellow slime. It fails entirely to grow on strawberries, apples, Kohl Rabi, cabbage, onions, and sweet peppers. It develops rapidly on the surface of ordinary peptone Agar, forming a white pelicle that becomes cream yellow and somewhat wrinkled with age. It seems to be strictly ærobic, developing only on the surface of the culture medium. It grows very slowly in litmus milk, after five or six days developing a slight acid reaction and finally separating the casine Its behavior on gelatine has not been determined.

These fragmentary studies seem to point to the following conclusions:

1st. That the cause of the "Black Rot" or "Blossom-end Rot" of the tomato is a Bacillus and not any of the filamentous fungi found associated with its later stages.

2nd. That the method of infection in nature has not been fully determined, but that the agency of some minute insect is probable, since infection cannot take place through the flowers, nor by the unaided action of the Bacillus on the cuticle of the tomato. A small, rather than a large insect, is indicated since the character of the disease is such as is produced by surface abbrasion, not by deep puncturing of the fruit. The strictly ærobic nature of the germ seems to confine its injury to the surface layers, except where air is admitted to the interior by deep wounds or punctures.

3rd. That some species of Trips has been observed in suspicious connection with the disease, but that its agency in spreading it has not been proven. Thrips

4th. That when this Bacillus is carried deeply into the tomato with an open wound, as is done by the Boll Worm, the result is a wet rot, quickly involving the entire fruit.

5th. It follows from the foregoing that in seeking a remedy for these rots, we should look among the insecticides, rather than among the fungicides, first determining fully what insects are instrumental in conveying the infection.

Experiments are planned for the coming season to demonstrate the agency of the Thrips in distributing the bacilli and inducing the disease; and the attempt will be made to control the rot by destroying or driving away the Thrips.

Bacterial Wilt (*Bacillus solanacearum*, E. F. Smith*): Also called Southern Tomato Blight and Bacteriosis. This serious disease of the tomato has so far only been observed in the southern part of the State. It is very destructive in Mobile and Washington counties. It is caused by a germ that grows and multiplies in the vascular bundles of the stem, finally plugging up the ducts so as to cut off the ascending water current and thus causing the sudden wilting of the entire plant. A plant that, to the casual glance, seems perfectly healthy today may be wilted and practically dead by tomorrow. A careful examination of such a plant will show a section of the stem usually just above the ground that looks watery and on cutting it open the water ducts of the vascular bundles will be browned and discolored. When

*A Bacterial Disease of the Tomato, Egg-plant, and Irish Potato, by Erwin F. Smith, Bull. 12, U. S. Dept. of Agr. Div. of Veg., Phys. & Path., Dec 1896.

once established in the soil the contagion persist from year to year so that each succeeding crop suffers worse than the last. A careful rotation of crops seems to be the only remedy for this disease and in regions where it prevails great care should be taken not to plant tomatoes on land where either tomatoes, peppers, eggplants or Irish potatoes grew the year before since all of these plants and some solanaceous weeds are subject to the disease. There are no exact experiments to determine how long the contagion can exist in the soil if none of these food crops are present. There is reason to believe, however, that more than one year must elapse before it is safe to plant these crops again on soil that is once infected. Dr. Smith has shown (l. c. p. 22) that the disease may be conveyed from plant to plant by insects, their bites or punctures serving to inoculate healthy plants with germs from the diseased ones. After describing some experiments where the disease was carried to healthy plants by allowing Colorado potato beetles to feed on them that had previously been feeding on diseased plants, he says: "Just what insects are most instrumental in disseminating this parasite in any particular locality can be determined only after a prolonged and careful study of the disease in the field. No experiments have been made with other insects, but it is likely that flea beetles, blister beetles, chrysomelids and many other leaf eating insects may act as carriers of the disease.

"No experiments have been made to determine whether this bacillus can gain entrance to the plant through an uninjured epidermis. Most of the infections probably occur above ground and as the result of insect injuries. Very likely there are some underground infections."

As this disease does not occur at Auburn, the writer has had no recent opportunity of studying it, but as the result of rather wide experience with it in Mississippi, I am of the opinion that direct underground infections do take place as suggested by Dr. Smith in the closing sentence quoted above, and that probably they are the usual mode by which it spreads. Contagion carried by winged insects may well be the means by which the disease first becomes introduced to new fields, but this method of infection can hardly account for the spread of the disease from year to year in somewhat regular concentric circles from such new centers, especially as it usually takes almost every plant in its path. Insect infection would not either account for the facts reported by me in the 6th Ann. Rept. of the Miss. Station, pp. 53-61, where, in a large tomato field that was under observation, the disease was very largely confined to a narrow strip of wet, seepy land, running diagonally through it, while the drier land on either side was nearly exempt.

As the disease is thus so markedly a soil disease, the possibility of soil treatment as a remedy at once suggests itself. Very few experiments are recorded in this direction. In the Mississippi experiments mentioned above in one case heavy applications of kainit seemed beneficial and in another case there was apparent benefit from the use of lime. Marked benefit also seemed to follow the use of lime in an experiment at Deer Park, Ala. (See Ala. Bull. 92:109.) These experiments, however, need confirmation. Sulphuring the soil does not seem to have been tried. Spraying the plants and the surface of the ground with Bordeaux mixture gives no result. (See also Rolfs in Fla. Bull. 47:135.)

There seems to be some slight difference among varieties in power to resist this disease. I have observed that

Dwarf Champion seems to have some power of resistance, and Rolfs (l. c. p. 134) notes the same thing of Dwarf Golden Champion and Ford Hook Fancy, also in a marked degree in a tomato-egg plant hybrid. This is an interesting field for further investigation.

Sclerotium Wilt (*Sclerotium sp.*): Also called Fungus Blight and Florida Blight. This disease manifests itself like the last one by a rather sudden wilting of the plant. Although the effect is much the same, the cause of the disease in the two cases is very different. Here we have to do with a filamentous fungus, the sterile mycelium of which lives on decaying vegetable matter in the soil and under certain conditions is able to attack the underground portion of living plants. If a plant attacked by this disease is pulled up the smaller roots will be found to have rotted away and the larger ones will be covered by a more or less conspicuous white mould-like coating. In wet weather, or when the diseased roots are placed in a moist chamber, numerous small brown balls as large as a pin head are formed on this white mycelium. These are the so-called sclerotia and consist of closely compacted fungus threads. They perform the function of reproductive bodies, and are very resistant to unfavorable conditions, retaining their vitality for long periods. In one case a rotted tomato fruit was found lying on the ground that was completely covered by these sclerotia. It was transferred to a four-inch pot filled with soil and was placed under a bell jar on my laboratory table, where it remained for over a year. The pot was watered occasionally so as to keep a moist atmosphere in the hope that the fungus might be induced to develope some other fruit form. The sclerotia remained entirely unchanged for twelve months, when a small Irish potato was placed in the pot in contact with them. Stimulated by the presence of this fresh food supply they promptly germinated and quickly enveloped the potato in a white coating of mycelial threads, which in turn, as the food supply became exhausted, developed a fresh crop of sclerotia.

This disease was first studied by Prof. P. H. Rolfs while connected with the Florida Experiment Station, and he has written practically all that has been published regarding it.* In his experience with the fungus, both in the laboratory and in the field, covering a period of several years, he never succeeded in detecting spores or reproductive bodies of any kind other than these sclerotia. Such sterile sclerotia-forming fungi are placed in the form genus *Sclerotium*, but this one seems never to have received a specific name.

This disease is by no means confined to the tomato. Rolfs has published a long list of hosts for it in Florida. In this State it has been detected on tomatoes, Irish and sweet potatoes, beans, cow peas, peanuts, beets and strawberries. It is doubtless conveyed direct from the soil to the roots of the plant. How long it may persist in the soil if deprived of any of its numerous host plants has not been determined. The fact that it attacks so wide a range of plants makes it difficult to arrange a proper rotation for soils infested by it. It does not, however, attack corn, sorghum or the small grains. Vetch, growing as it does during the winter and early spring while this disease is dormant, will probably escape and so far it has not been detected on the velvet bean.

While this is a very troublesome and probably quite a widely occurring disease in this State it does not usually wipe out entire fields as is the case with the bacterial wilt, but is scattered about in somewhat restricted areas. It seems to spread more rapidly in wet weather and where the vines are so rank as to completely shade the

*See particularly Annual Report for 1896, pp. 38-47; also Bulletins No. 21 and 47.

soil. Rolfs states that spraying the ground along the row with a soluble fungicide like potassium sulphide or ammoniacal carbonate of copper is effective in controlling it while the solid particles formed in Bordeaux mixture do not penetrate the earth deeply enough to do any appreciable good.

In 1896, supposing that we had the bacterial wilt to deal with, a rather elaborate experiment was planned that yielded some interesting results although the expected disease did not appear and this one was present to only a limited extent.

Eight plots were prepared as follows: All were fertilized alike with acid phosphate and cotton seed meal at the rate of 200 pounds of each per acre. Plots 1 and 5 received in addition kainit at the rate of 1500 lbs. per acre. Plots 2 and 6 received lime at the rate of 1500 lbs. per acre. In plots 3 and 7, Bordeaux mixture was poured along the furrows that were opened for planting. Plots 4 and 8 were checks and received no treatment. One row on each plot was planted to Irish potatoes, one to peppers and eggplants, one to Dwarf Champion tomatoes and one to Acme tomatoes. These plants were grown in specially prepared seed beds the soil in which had been treated with kainit, lime and Bordeaux mixture respectively. The plants in the seed beds had been sprayed with these substances at intervals from the time that they first came up and the sprayings were continued in the field so that each lot received in all ten sprayings with kainit solution, thin whitewash and Bordeaux mixture respectively. As stated above the Bacterial wilt did not appear but there were several cases of Sclerotium wilt especially in the potatoes. Black rot was abundant and the Alternaria leaf blight (see p. 32) was present in both tomatoes and potatoes so that an opportunity was offered for studying the effect of these treatments on these three diseases. As stated on page 20, no appreciable effect could be observed with the black rot, the fruits on all the plots rotting freely with the greatest impartiality. The Bordeaux mixture largely prevented the Alternaria leaf blight. On May 28, only $7\frac{1}{2}\%$ of the plants on these plots were affected by it while on the other plots there was an average of 19% affected.

On April 29, one or two potato plants were observed to be wilting on the first kainit plot. On May 5, there were 3 wilted potato plants on the first kainit plot and 4 on the second kainit plot and 1 on one of the checks. On May 21, one wilted tomato plant on one of the checks. On May 28, out of 104 hills of potatoes on the kainit plots 30 were wilted, while of 393 hills on all the other plots only 20 were wilted, or nearly 29% on the kainit plots and only slightly more than 5% on the others. On July 23, when the potatoes were dug, only 10% of the stalks were alive on the kainit plots and an average of 38% were alive on the others. The yield of tubers was 60% less on the kainit plots. At this date 43% of the potato plants on the Bordeaux plots were still alive, thus showing them to be slightly better than the average.

The predisposition on the part of the potato plants to take the disease on the plots that had been over fertilized with kainit was an entirely unlooked for result, especially as potatoes are supposed to require a fertilizer rich in potash. Curiously enough the tomatoes were not so affected. The following notes on their condition were taken on July 23.

"At this date the tomato plants are beginning to fail rapidly. A few have died from the wilt and a few from nematode root knot. The foliage of the lime, Bordeaux and check plots is in about equally poor condition. The kainit plots are decidedly the best, some of these plants still growing quite vigorously. Eggplant and peppers are all healthy."

"The three striking results of the experiment are the beneficial effect of the kainit on the general health and longevity of the tomatoes, the marked effect of the Bordeaux in controlling the Alternaria leaf blight on the potatoes, and the totally unexpected and unaccountable failure of the potatoes on the kainit plots."

Alternaria Leaf Blight (*Alternaria Solani* (E. & M.) Jones and Grout.) Also called Macrosporium Blight, Target-board disease and Early Blight. This well known disease of tomato and potato foliage causes circular deadened brown areas on the leaves that are usually marked by concentric circles of a darker color. This appearance has suggested the name of Target-board disease that is sometimes applied to it. In severe cases it causes the falling of the leaves and the consequent premature death of the plant. It has not been very troublesome at Auburn though traces of it have been observed almost every season. It was more conspicuous in 1896 than in any of the subsequent years. The injuries to the foliage caused by the flea beetle often seem to aid this fungus in gaining a foot hold on the leaves. Bordeaux mixture is the recognized remedy for this disease on either tomatoes or potatoes and three or four sprayings early in the season will usually protect the plants effectively.

Septoria Leaf Blight (*Septoria Lycopersici* Speg.): This is a comparatively new disease that first attracted attention about 1894. It appeared so suddenly and with such virulence as to practically destroy the crop in some of the Eastern trucking regions for two or three seasons. It has attracted less attention for the past two or three years. In this disease the leaves are thickly dotted with small irregular brown spots. These spots are not as large as in the Alternaria blight and lack the characteristic target-board markings of that disease.

During a prolonged period of cold, rainy weather in the Spring of 1897, this disease was so abundant in the cold frames at Auburn as to seriously check the growth of the young plants. As soon as it was observed the plants were sprayed with Bordeaux mixture. The one spraying served to check it entirely and the plants recovered. Later it appeared on some of the plants in the field but again it yielded readily to the Bordeaux treatment. It has not since been sufficiently troublesome to attract attention.

Leaf Mould (*Cladosporium fulvum* Cke.): Also sometimes called Leaf Blight and Mildew.

The cause of this disease is a fungus that does not make definite spots on the leaves as in the last two cases, but forms mold like, greenish brown, velvety patches on the under surface, causing the leaf to turn yellow and fall. It is often a serious trouble where tomatoes are forced under glass during the winter, and at the South it frequently attacks the plants in the field. It is more troublesome on the coast and in Florida than in the latitude of Auburn, but at times it has been rather troublesome here. It usually yields readily to spraying with Bordeaux mixture. A single spraying in the greenhouse has served to check a bad attack of the disease and to protect the plants for a number of weeks. This disease is largely dependent on weather conditions, being much more troublesome in moist than in dry weather. Although it usually yields so readily to the Bordeaux treatment a few cases have been reported to me where repeated sprayings failed to prevent it from defoliating entire fields. It is seldom fatal to the plants but keeps them too much enfeebled to mature their fruit.

VARIETIES.

The requisites for a market tomato are medium to large size, smoothness, solidity, earliness, productiveness and the freedom from surface cracks in wet weather. The last, however, is something not yet fully attained. Color too is a matter of importance. In most markets the light purplish red or "Acme color" is preferred to the bright scarlet red of the old fashioned varieties and any shade of red is preferable to yellow. It is not proposed to give here a detailed description of the many varieties of tomatoes now in cultivation in this country. Such information can be obtained from the better class of seed catalogues. For a discussion of the botanical relationships and the evolution of the cultivated varieties of the tomato the reader is referred to the admirable chapters on the subject in "The Survival of the Unlike," by L. H. Bailey.

The Acme was one of the first varieties to be introduced that satisfactorily fulfilled the requirements for a market tomato. It quickly became a general favorite and in regions where pruning is practiced it is still more planted than any other kind. Without pruning it often runs too small to be desirable especially toward the last of the season.

Livingston's Beauty and Ford Hook First are much like Acme and are preferred by some planters. In those parts of Florida where pruning is not practiced Stone and Belgino's Best, two of the bright red kinds, are much planted on account of their large size and productiveness. The Dwarf Champion and the more recently introduced similar kinds, all of which are sometimes spoken of as "tree tomatoes" are quite popular for the home garden on account of their stiff, erect, dwarfish growth, that largely obviates the need for staking. They have been grown to some extent for market but they are a little lacking in size and in shipping qualities and have not become general market favorites.

Lemon Blush has at this Station for the past three seasons been by far the most satisfactory variety for the mid-summer and fall crops. The plants are very vigorous and withstand heat and drouth remarkably. It is strongly recommended for home use as it is of delicate texture and fine flavor, but it cannot be recommended for distant markets on account of its yellow color and soft flesh.

Overly large kinds like Ponderosa and Mikado are seldom fully satisfactory. Individual specimens may be very fine but there are usually many irregular ones and the yield is often poor.

In planting for market it is much better to plant at least four or five of the best kinds rather than to rely on any one alone. The different seasons affect varieties differently and the kind giving the best result this year may fall from first place next year. More important than this, however, is the fact that with several varieties the average daily pick runs more evenly. No two kinds will give their biggest picking on the same day but one will be a little earlier or a little later than another thus distributing the greatest rush over a number of days.

MARKETING.

For a general discussion on marketing fruits and vegetables and of the methods of transportation, see Bull. 79, pp. 103-110.

There are two methods in vogue for handling the distant shipment of tomatoes. At most points in Florida the fruits are picked dead green, as soon as they reach full size and at least a week before they would begin to color. They are wrapped in paper and are packed in the well known six basket crate, the same that is used for handling the Georgia peach crop. These green tomatoes are shipped by fast freight in ventilated cars. The wrapping in paper prevents them from shriveling and by the time they reach market some of the more mature ones are usually beginning to color. The greatest drawback to this system is that when picked in that condition no one can tell the exact stage of maturity and it is impossible to so assort them that all in one package will ripen together. When opened on the market some of the fruits in a basket will be fully ripe while others are dead green. Such uneven packages are less saleable than where all are evenly ripened. Again if the weather is cool during transit ripening is delayed so that none are ripe on arrival and the consignment has to be stacked up in the store and held till ripening begins. In this way stocks often accumulate enormously, and if the weather suddenly turns warm, causing all to ripen at once the entire accumulation must be forced off at once or it will be lost entirely, thus causing a disastrous glut.

In Mississippi the usual plan is to allow the tomatoes to hang until they are slightly tinted. The fields are picked over every day so as to get as many as possible of them in this tinted condition. At the packing shed they are assorted into three grades as to color: ripes, mediums and greens. Usually firsts and seconds are made of each of these grades thus really making six grades besides a seventh cull grade that is not shipped but sold to canning factories or fed to stock. The tomatoes are packed without wrapping in flat, four basket crates, and are shipped in refrigerator cars. Where this plan is thoroughly carried out it ensures a very even quality of tomatoes in each package and as the goods are ripe when they arrive they can be sold at once thus avoiding the disastrous accumulation of stocks. The cost of refrigeration makes this method slightly more expensive than the other even though the cost of wrapping the tomatoes is saved. On the whole however, it is more satisfactory and there can be little doubt that for the latitude of Alabama it will on the the average yield larger net returns.

The growing of tomatoes on a large scale is an exacting business requiring constant personal care and attention from the time the seed is planted until the crop is harvested. It is not a crop that can be successfully handled by ignorant tenants. It has however, proven profitable at many localities in the past when intelligently handled and there is no reason to suppose that it will not continue to be profitable in the future. As has been stated on a previous page, there seems to be no reason why Alabama should not claim a respectable share in it. Her soils, climatic conditions and transportation facilities are all sufficiently favorable.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

STRAWBERRIES.

By
F. S. EARLE.

MONTGOMERY, ALABAMA.
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1900.

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STRAWBERRIES.

Bulletin No. 94, issued in June, 1898, gave our experience with strawberries up to that time.

Besides brief notes on varieties, general suggestions were given as to "Soils and Fertilizers," "Preparation of Soil and Planting," "Cultivation and Mulching," and on "Marketing." The reader is referred to that bulletin for a discussion of these topics. The chief purpose of the following pages is to record our experience with the different varieties that have been under cultivation at the Station during the past two years.

Before proceeding with this, however, a few further suggestions will be made as to the time and methods of planting strawberries best suited to different parts of the State.

In Bulletin 94, p. 144, late Summer and Fall planting was recommended for South Alabama, but the difficulty of securing a supply of well rooted plants as early as August or September and of getting freshly set plants to live during the hot weather prevailing at that season was mentioned; and the suggestion was made that moving the plants with a ball of earth by means of a transplanter would serve to obviate this difficulty. This plan was tried successfully at the Station during the summer of 1899. Fully 90% of the plants moved in this way during August lived and grew although showers were so light and infrequent that where the plants were shaken out and planted in the ordinary way nearly all died.

The following plan is suggested as being a cheap and practicable one for establishing a strawberry plantation in South Alabama. Plow and harrow the land thoroughly in February and lay off every fifth row of the proposed plantation. That is lay off rows fifteen to sixteen feet apart. Fertilize these rows heavily so as to insure a free growth of runners and set the plants in the ordinary way the last of February or first of March. Early in April lay off the other four rows, fertilize with potash and phosphate, only, and plant to the bunch or speckled pea. These will mature early and will not overrrun the strawberry row. Of course, cultivate the strawberry row frequently. Keep the runners cut off until rains begin in July. This will make the plants more stocky and vigorous and will considerably lessen the cost of cultivating. Besides, the runners that put out during dry weather seldom take root till it rains but grow and develop leaves at the expense of the parent plant. If runners are all kept off till about July 1, an abundant crop of them will be pushed out after the first rains and they will take root quickly during the showery weather that always prevails in mid-summer. By the middle of August they will be large enough to move to the best advantage. The peas should be watched closely and should be plowed under before they encroach on the strawberry row. They can probably occupy the land safely until some time in June and there will be time for them to become decomposed and for the soil to be somewhat compacted before setting the plants in August. Planting may begin as soon as the runners are well rooted. This will probably be early in August and it can be continued during showery weather until the middle rows are all filled out. The distance to move the plants being so small any of the cheap transplanters on the market can be used. Those with two curved blades on handles, hinged together so that when thrust into the ground on either side of a plant pressure on the handles will compress the ball of earth betwen the blades thus allowing it to be lifted out with the plant, will be found to work more rapidly than those in which bucket-like galvanized cylinders are used for lifting and carrying the plants. In the absence of a transplanter very good and fairly rapid work can be done with an ordinary garden trowel, care being taken not to crumble the ball of earth taken with the roots.

Plants moved in this way are in condition to grow off properly and if the ground is sufficiently enriched they will make good bearing stools the following spring. In this style of planting, all runners should be kept off from the young plants till after the crop is gathered, and the plantation will consist of one matted row to four rows in hills.

It is believed that this plan presents several advantages for South Alabama where Fall planting is so usually practiced. It can be used almost equally well in the other parts of the State but whether it will be advisable to adopt it or not will depend somewhat on the objects for which the berries are planted. In Middle and North Alabama plants set in the Spring and allowed to form matted rows in the way so commonly practiced farther north seem to adopt to a considerable degree the northern habit of ripening nearly all of their crop during a period of three to four weeks. Summer and Fall set plants, on the contrary, develop successive fruit clusters through a much longer period, often scattering the crop through eight or ten weeks, as is the habit of the strawberry farther south. Now for home use or for a local market, this longer fruiting season is a distinct advantage and for these purposes this method of summer planting is recommended. Where berries are grown for northern shipment the heavier early pickings from the spring set matted rows will be more profitable, since it is only the early berries that can be shipped at a profit. Where fields are kept over for a second crop, all will of course, be matted rows the second year.

It is not intended to imply that the fruiting habit or the length of the fruiting season can be entirely controlled by the Fall or Spring planting. Much will depend on the richness and character of the soil, on the habit of the variety, and on the seasonal distribution of rainfall. The tendency will be, however, as stated above for the spring set plants to yield the bulk of their crop early and to bear through a shorter season than those set in the summer or fall.

VARIETY NOTES.

Most varieties of strawberries are somewhat narrowly limited as to the conditions under which they will give the best results. A few, like the old Wilson, are able to adapt themselves to a wide range of soils and climates but most of them will only thrive under the conditions to which they are particularly adapted. A berry may thrive well on one farm and fail on another only a few miles away if the soil and cultural conditions are different. It must be understood then that the following notes apply only to the conditions prevailing at the Experiment Station farm. We are within the granitic area of eastern Alabama, but our soil is of the gray, sandy type. It is a thirsty soil, drying out quickly after rains, and crops of all kinds suffer from even short periods of drought. Comparatively few varieties succeed well on it, many dying badly from drought during the summer and others failing to grow and fruit normally in the spring. The red clay soils of this region which occur within a few miles of us are adapted to a much wider range of varieties. The conditions in North Alabama are very different and many kinds do admirably there that are failures here. The results obtained here will in a general way serve as a guide for planters in South Alabama, although the conditions are by no means identical. While the soils in that part of the State are usually quite sandy, they have remarkable water-holding capacity, and do not suffer from drought as badly as ours. On the other hand, strawberries rust worse there than here and it becomes more important to select varieties that are resistant to this disease.

In selecting varieties, planters should, of course, remember that the pistillate kinds will not bear if planted alone. Unless otherwise started the kinds that are recommended below for general planting all have perfect flowers and so can be planted alone safely.

In the following notes the term hardy is used to indicate the ability of the plant to live through the summer under our rather trying conditions.

Arkansas Traveler.—Hardy, a vigorous grower and quite productive. The plant is of the Crescent type. Fruits mid. season, medium size, good color, but too soft and has the serious fault of scalding and softening quickly on the vines. It would not ship well. Possibly worth a farther trial for home use.

Aroma.—Not hardy. The few plants surviving have given a fair crop of handsome berries but the fine high flavor supposed to be characteristic of this kind is lacking. As grown here, it is flat and insipid, and has no value.

Barton.—Hardy, fairly productive, medium early, good color and sufficiently firm. In many respects this is a very good berry. Perhaps its greatest fault is its length. Like most very long berries, it is often knotty and defective, and the tip ripens unevenly, especially early in the season. It is perhaps worthy of farther trial but it can not compete with such kinds as Lady Thompson and Michel.

Bismark.—One of the best of the very large kinds, but none of them are fully successful here. It is recommend for North Alabama, and for further trial here on moist well manured lands. The plant is hardier than Bubach, which is one of the best known of the very large kinds.

Brandywine.—This is another of the big ones and it has the reputation of doing well further south than any of the others. The plant is fairly hardy here, and it should be planted by all who want very large berries, but it should be given good soil and high manuring. It does not seem to be very productive here, but in quality it is one of the best.

Bubach.—This kind is probably more widely planted than any other of the very large berries but it is only partially successful here. It often dies badly during the summer and starts feebly in the spring, still with heavy manuring, some very fine berries may be obtained from it. The plant is not as well suited to our soil as either the Bismark or Brandywine. It is pistillate and must always be planted with other kinds.

Cloud.—This berry originated iu Louisiana aud is a favorite market berry in that region. It is only medium in size, but it is early, a good shipper and immensely productive. It does not seem to have attracted much attention in other parts of the country but it is particularly adapted to the coast region of Southern Alabama, and is strongly recommended for planting there. Here the plant is not quite hardy during the summer. It is a pistillate and should be planted with Michel as a pollenizer.

Clyde.—The plant is fairly hardy, making large stools but very few runners. It sets an immense load of fruit but on our light soil it does not ripen it properly. It is recommended strongly for rich, moist soils in Northern Alabama, but it should not be planted here.

Cobden Queen.—This berry originated in Southern Illinois, where it is becoming a favorite market kind. It is a complete failure here. The plants grow feebly and die badly during the summer and the fruit is small and poor.

Earliest.—This is very promising. It resembles Michel quite closely, seeming to have most of the good qualities of that valuable kind while the plant is even more vigorous and withstands rust better. It is about the same in season, ripening the first or main crop very early but continuing to throw up flower clusters and produce fruit through a long season. In color and firmness the fruit is much like Michel, perhaps averaging a little large in size.

Everbearing.—This variety was sent for trial by Prof. J. S. Newman of Clemson College, S. C. The plant is hardy and fairly productive, of medium size, bright red berries, of only medium quality. In season it is medium early and has the habit of throwing up additional flower clusters after the first main crop is over. This "everbearing" habit is but little more marked than in Michel, Earliest or Lady Thompson. While it is a kind of some merit, it is not as satisfactory here as the three kinds just mentioned.

Gandy.—This kind was reported as worthless for this region in Bulletin 94. It has since done much better. The plant is not fully hardy but on rich land with good culture it is a fairly satisfactory late kind. It is strongly recommended as a late berry for North Alabama.

Gardner.—This is one of the hardiest plants in the collection and will live under conditions of drought and sterility that are fatal to most other kinds. Unfortunately, the fruit is poor in color and flavor and scanty in quality. It cannot be recommended for market and is of doubtful value for home use.

Glen Mary.—This is a fine berry where it can be grown but the plant is not hardy here. We have never been able to get a respectable stand of it. It is possibly valuable for North Alabama, but is worthless on light soils in the Central and Southern parts of the State.

Haviland.—Fairly hardy but the plants are not vigorous and set more fruits than they can mature. It ripens very unevenly and like most very long berries is often knotty. It is of no value here.

Hoffman.—This well known kind has fully redeemed the partial failure reported in Bulletin 94. The plant is perfectly hardy, surpassing in this respect both Michel and Lady Thompson. It is not as productive as these kinds but is equally early and is a better shipper. The fruiting season is usually short, the bulk of the crop coming off very early. It is one of the best market berries for light sandy soils.

Howell.—Sufficiently hardy and makes many runners but plants lack vigor and rust very badly. The berries closely resemble Minor's Prolific, if indeed our plants are not of that variety. It has no value here.

Lady Thompson.—This valuable variety must still be accorded first place as a market berry for light soils in the Middle South. It does well in all parts of this State and should be much more widely planted both for home use and for market. While not of the largest size the berries average well, holding their size throughout the season, and they are remarkably smooth and free from defects. The color is a little light to suit some markets, but it is bright and attractive and the fruits usually color up evenly. It is a good shipping berry, for while not feeling as firm to the touch as some of the others, it has good keeping qualities, both on and off from the vines. The plant is a good grower and makes runners freely, and is sufficiently hardy to withstand any but the most extremely unfavorable conditions. Where only one kind is to be planted no mistake will be made in selecting the Lady Thompson.

Meek's Early.—This is in many respects a remarkable berry. In Bulletin 94, it was stated that "shy bearing must be set down as its greatest fault." This fault is so pronounced as to put it out of the question as a market berry. It is, however, of such rich, fine quality when fully ripe, and the vines are so vigorous and so remarkably hardy that it seems worthy a place in some odd corner of the home garden, where it can remain undisturbed from year to year as it seems to bear better under these half wild conditions than when given high cultivation. It is one of the few kinds hardy enough to hold its own with grass and weeds, and where once established will need no farther care except to pull or cut down the biggest weeds occasionally, and it will yield small annual crops for a number of years. It averages small in size and when first colored it is very sour but when fully ripe it becomes dark cherry red and develops a rich flavor that is unequaled.

Michel.—This well known kind continues to compete with Lady Thompson for first place as a general purpose home and market berry. Under favorable conditions it will probably out yield Lady Thompson but the fruits do not average quite so large and they are rather more acid. The plants on some soils are more subject to injury from rust. It is one of our earliest kinds, usually ripening slightly in advance of Lady Thompson and Hoffman, and its first or main crop lasts longer. On rich soils, when well cultivated, and especially on young or Fall-set plants, it has the habit of throwing up new fruit stems late in the season so that it is sometimes in continuous fruiting from March till July. It is strongly recommended for all parts of the State where the rust is not too serious a factor.

Murray's Extra Early.—This ripens as early as Michel. It is hardy and prolific but too small, and so hard and firm as to be of very poor quality. Possibly, heavy manuring would improve the size and quality but under ordinary conditions it has very little value here.

Nick Ohmer.—This celebrated berry is a complete failure here. It has been impossible to get a stand of the plants.

Patrick.—The plants are sufficiently hardy making large stools with but few runners, but they do not seem quite at home under our conditions. It is an abundant bearer of medium sized berries, season rather late. It is possibly of some value for north Alabama but cannot be recommended for the light soils of the central and southern portions.

Pride of Cumberland.- The plants are fairly hardy and in many ways it is a very good mid-season berry but it has nothing to especially recommend it, and there is no reason why it should be planted.

Rio.—We have no new planting of this kind. The few old plants have lived fairly well but it is not adapted to our conditions. It is possibly worthy of trial in north Alabama.

Ridgeway.—This is only half hardy here but it is a handsome shapely berry and is worth a trial further north.

Seaford.—This requires heavier land. It is not hardy here but it is a handsome berry and is worth trying on strong soils.

Sharpless.—This well known kind is a failure here and should not be planted. None of the very large kinds of which this is the best known type are fully successful here but either Bismark, Brandywine or Bubach will give better results than Sharpless.

Star.—This is a berry of the Sharpless type but the plant seems much hardier. It is not very productive but the quality of the fruit is very fine and it is perhaps worth a trial by those who want only the best. It requires a good soil and high cultivation.

Tennessee Prolific.—The vines are hardy and prolific. It approaches the Sharpless type but is decidedly promising for the richer soils of the State. In season it is medium to late.

Tubbs.—This is the most promising late berry for this region that we have tested. It is very hardy and productive. The fruit is of good size, shapely and of a bright rich color. It is two to three weeks later than Michel and Lady Thompson, coming in just as these kinds have passed their best pickings. When it once begins the crop comes on very rapidly so that it has a rather short bearing season. It should be planted by commercial growers to supplement these early kinds and round out the shipping season. The plant has something of the habit of growth and appearance of the Crescent but it is much better adapted to our conditions than that kind.

West Lawn.—This is fairly hardy and is in some respects a very good berry but it has nothing to particularly recommend it.

Wm. Belt.—We have only a few old plants of this kind. It is a rank grower, fairly hardy, late, large and productive. It deserves a farther trial especially in north Alabama.

Wilson.—This, the oldest of the widely known cultivated kinds, is quite hardy here and contrary to statements frequently seen in print it seems to have retained its former vigor. It can not, however, compete with such kinds as Michel and Lady Thompson for the main crop ripens two weeks later and the berries are far smaller and less abundant. The true Wilson is now seldom seen in cultivation as the variety has long passed its usefulness. The name still lingers in the South but it is applied to many widely different kinds by poorly informed growers.

Six or seven French varieties imported by the U. S. Department of Agriculture were sent to this station for trial. None of them prove to be suited to our conditions and all but three are dead. Of these only one shows any vigor, the Large Fruited Leon XIII (No. 16989). These bore a few rather pretty but very soft berries of only medium quality. It has no possible value here. The other two kinds are barely alive and are not likely to survive the present summer.

In conclusion I wish to strongly emphasize the fact that strawberries are too little grown in this State. In my judgment at the present time no fruit would be more profitable to the large commercial grower. It is, however, the manager of the home garden that I especially wish to interest in strawberries. Judging from rather wide observation in various parts of the State, I am certainly far within bounds in saying that not one garden in twenty-five in Alabama has a stiawberry bed. I should probably be nearer the mark in saying not one in a hundred. When such kinds as Lady Thompson, Michel, Hoffman and Tubbs can be grown so easily and cheaply in every part of the State there is no excuse for such neglect of what should be considered a necessity rather than a luxury in every household.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

GRAPES.

By
F. S. EARLE.
AND
C. F. AUSTIN.

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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, Alabama.

* Deceased.

GRAPES.

GENERAL CONSIDERATIONS.

BY F. S. EARLE.

SOILS AND PLANTING.

Grapes can be grown with considerable success in all parts of Alabama. Certain portions of the State seem to be particularly well adapted to them, being comparatively free from rot and mildew and producing a grape of fine flavor and appearance, and of exceptionally good shipping quality. This is a point of prime importance, since in this latitude grapes ripen in midsummer, when the weather is hot and frequently showery, conditions that make all fruits difficult to handle.

The best grape lands in the State are probably to be found in the high lying granitic region of Eastern Alabama. This extends from a little above Columbus, Ga., to within about seventy miles of the northern border and westward to a little beyond the Louisville & Nashville Rail Road in Chilton county. Almost equally good locations may be found among the high table lands of the coal measures lying to the north and west of the granitic region. In South Alabama the best grape lands are the red soils of the LaFayette drift which cover considerable areas extending as far south as Mobile county.

Grapes will grow freely on any of the sandier lands in South Alabama, but the vines are often short lived on account of the root rot (See p. 67), and the fruit does not ship well, being subject to the ripe rot. This causes the berries to mould in transit and also by attacking the stems and rendering them stiff and brittle causes the berries even when sound to "shell" or drop off the stems badly, thus presenting an unattractive appearance in market. These two enemies will be more troublesome in Southern Alabama, even on the red lands, than in the northern part of the State. And the number of varieties that will succeed even fairly well is much smaller. Such well known market kinds as Moore's Early, Worden and Catawba should not be planted in South Alabama, while in the central and northern portions almost any of the kinds usually found in the Eastern States will do at least fairly well.

Grapes can be successfully grown on land that is too steep, rocky and broken to admit of cultivation in ordinary field crops. It is doubtful, however, if such locations have any advantage for this crop over similar lands that lie sufficiently level to admit of easy and cheap cultivation, though such claims are often made. The greater expense attending the planting and caring for a vineyard on such lands makes their utilization for this purpose of doubtful expediency under present agricultural conditions.

No special preparation of the soil is necessary for planting grapes further than a good deep plowing and thorough harrowing. Rows should be run about ten feet apart. Unless the land is nearly level the rows should be carefully run on grade lines so that in cultivating the land each row will act as a terrace. These crooked rows circling the hill sides are unsightly and are somewhat troublesome in cultivating and trellace building, but it is the only way to prevent the wasteful washing of the land. On our light soils permanent rows running up and down the hills are certain to result in disastrous gullying and wasting of the soil.

Most of our grape lands are so thin as to require a small amount of fertilizer annually to produce the best results. This should be scattered along a furrow run on each side of the row in early Spring so that it will be covered by the first cultivation, or after the first season it may be broadcasted and cultivated in for the roots of the vines will occupy all parts of the land. For the first season it is best to use the side furrows, or still better, the fertilizer may be scattered along a deep central furrow run in advance of planting. The fertilizer requirements of our best grape lands are fairly uniform for all parts of the State and the following formulas will be found quite satisfactory: Either bone meal 4 parts and kainit 1 part, or if cheaper acid phosphate, 3 parts, cotton seed meal 1 part and kainit 1 part. About one pound of either of these mixtures per vine will be sufficient for the first three years. After the vineyard comes into heavy bearing a larger quantity will usually be profitable. The exact amount to use must be determined by the condition of the vines. They should be able to carry and ripen a full crop of fruit and at the same time make a free, but not extravagat growth of wood.

The distance between the vines in the row will depend to some extent on the variety. Short jointed, slow growing kinds like Delaware may be planted as close as 6 feet but Concord and similar free growing kind should have as much as 8 to 10 feet, while very rampant growers should be given even more room.

Grapes are usually propagated from cuttings and it is quite possible to grow a vineyard by simply sticking down one or more cuttings at the place where each vine is to stand permanently. Usually a better stand and more satisfactory results can be secured by planting nursery grown one year old vines. Some planters advocate using two year old vines, but usually fully as good results can be had with the one year old vines and the cost is considerably less. The vines should be planted about an inch deeper than they stood in the nursery row, and the dirt should be tramped firmly about the roots, then cut off the top leaving only one good bud above ground. This last is quite important for if too many shoots start the growth of all will be feeble.

Here at the South where there is little or no danger of heaving from the deep freezing of the soil planting may begin at any time after the leaves fall in autumn and can be continued whenever the ground is in fit condition throughout the winter. For best results all tree and vine planting in this latitude should be finished by the first of March. True later plantings are sometimes successful. At some of the colony towns in North Alabama, owing to delay in preparing the land, vines have been held in cold storage until May and have then been planted with fairly satisfactory results, but it is doubtful if such late planting is ever really advisable. It should be remembered that root growth normally begins much earlier than leaf growth and if vines are planted so late that the weather is warm enough to force the immediate unfolding of the leaves it is done at the expense of the reserve vitality of the vine since there is no sufficient root development to support them and if dry, hot weather sets in the result will almost certainly be the death or permanent injury of the vine.

TRAINING AND PRUNING.

After the vines begin to grow the first spring they should be gone over regularly once a week or once in ten days in order to remove any surplus shoots and to pinch out the young lateral branches that will be found form-

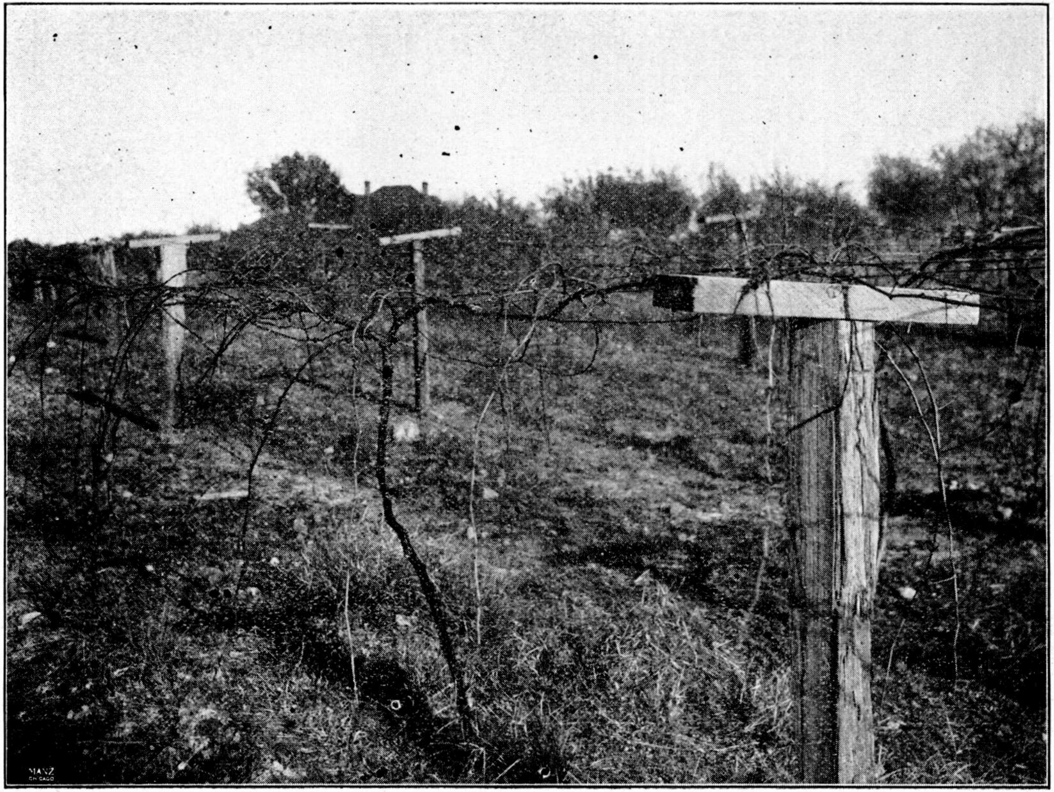


FIG. I, 3-YR. OLD DELAWARE VINE ON HORIZONTAL TRELLACE, UNPRUNED.

ing in the axil of each of the older leaves. It is very desirable to confine the growth to a single unbranched cane until this reaches a length of about four feet. Then the terminal bud should be pinched out and the two upper latteral branches which will soon appear should be saved thus bringing the vine to the form of the letter T. After this form has been secured, which with good cultivation should be by the first of July, the weekly pinching can be discontinued and the vine allowed to grow and branch at will.

During this first summer the vine may be allowed to sprawl on the ground or if preferred it can be tied to a light temporary stake. The permanent trellace should be built the following winter. For this latitude the horizontal or modified Munson trellace is strongly recommended. The method of training outlined in the preceding paragraph should be followed only where this trellace is to be adopted. It is made by setting ordinary fence posts along the row at intervals of about thirty feet. The tops are now sawed off at a uniform height of about four and a half feet, and cross bars twenty-six inches long are spiked on top of the posts so that they stand at right angles to the line of the row. Three wires are now stretched on top of these cross bars, one being stapled at the middle directly over the posts, the others about an inch from either end of the cross bars thus leaving the wires about twelve inches apart. The end posts should be braced as in fence building and the wires brought down and made fast to a "dead-man" buried two or three feet from the bottom of the post.

The vines are now lifted and the two arms of the T are tied to the middle wire. This first season the arms should be cut back to about a foot each and any side branches should be cut away. In pruning grapes it must be born in mind that every well developed bud on canes of the previous summer's growth will develop a fruiting shoot bearing on an average three clusters of grapes. This close pruning is therefore necessary to prevent over-bearing, since not only the arms but the main stem also are in this case of the last seasons growth and hence fruit bearing. Even this close pruning would still allow over-bearing if all the buds on the main stem were allowed to grow. All the lower ones should be rubbed off when they start in the spring, thus confining the growth to the buds on the arms and a few at the top of the stem. These shoots will grow rapidly and will for the most part fall over the side wires and be supported by them while their coiling tendrils will clutch the wires so firmly as to obviate the necessity for much summer tying. This is a great saving of labor over the vertical trellace system where each new shoot has to be tied one or more times during the summer. Its principal advantage lies however, in the fact that the leaves form a dense canopy sheltering the clusters of fruit which hang below from the sun and from rain and dew, yet leaving them freely exposed to the circulation of the air. This serves to a considerable extent to protect the fruit from fungus attacks, particularly from the "ripe rot" that is such a serious drawback, especially in the southern part of the State.

By this system no summer pruning or training is necessary except to rub off any shoots that start on the lower part of the stem and the tying up of such shoots as fail to support themselves on the side wires. The subsequent winter pruning is also very simple. The old stem is retained but the old arms are cut away saving only one good new shoot from near the base of each, which is bent down and tied to the middle wire as before thus again bringing the vine to the form of the letter T.

FIG 2. THE SAME VINE AS IN FIG. I, AFTER WINTER PRUNING.

Now, however, those arms must be left longer than before since the stem is no longer of young bearing wood and since the greater age of the vine will enable it to bear a larger crop. Where the vineyard is well cared for and the vines are in full vigor the arms may be left of such length that the end of one just meets the end of the one from the next vine thus providing a continuous line of bearing wood from one end of the row to the other. However, where vines are weak from any cause the arms should be cut proportionately shorter. The accompanying cuts are from photographs of a three year old Delaware vine that has been grown according to this system, one taken before and the other after the annual winter pruning.

This winter pruning can be done at any time after the leaves fall in autumn till about the middle of February. Later than this the vines become full of sap and they will bleed badly if cut.

CULTIVATION.

The vineyard should be cultivated sufficiently often to keep a surface dust mulch to hold moisture and also to prevent the growth of weeds. The cultivation should always be shallow since on most soils vines do not root deeply and deep plowing will break many roots, thus doing more harm than good. It may be necessary to use a one horse turning plow for the first working in the spring but for the later workings a five toothed cultivator is the best implement. The Planet Junior with attachments for regulating the depth is a useful form of this tool for vineyard purposes. Two or three hoeings or more will be necessary to remove grass and weeds from the row where they cannot be reached by the cultivator.

In most cases it will probably be well to discontinue cultivating the last of July and plant the middles to some of the bush field peas like the whipporwill. The running kinds are likely to make trouble by climbing on the vines and trellaces. The peas will make a useful mulch for the ground during the winter and will enrich the soil by supplying nitrogen so that all cotton seed meal may be omitted from the fertilizer. A still better winter protection to the soil is afforded by sowing to oats or rye in September. This of course must be plowed down early in the spring for if allowed to mature it would greatly injure the grapes. It requires some extra work in the spring to subdue a grain crop and it adds no nitrogen to the soil as do the peas but only serves to furnish a winter cover that prevents leaching and washing of the soil.

SPRAYING FOR INSECT AND DISEASES.

It is not intended in this place to give a detailed account of the different fungous and insect enemies of the grape. They are quite numerous and have been studied perhaps more than those of any other cultivated plant, so that there is an enormous literature treating of grape diseases. For practical purposes it is sufficient to know that the combined treatment with Bordeaux mixture and Paris green will serve to prevent serious injury from the greater part of those that are likely to be troublesome in this State. In fact, in most seasons, good crops can be grown in our best grape regions without treatment of any kind. In wet seasons like the present, however, unsprayed vineyards are liable to considerable injury from rot and mildew even in the most favored locations, so it will probably in the long run, always pay to give vineyards the following treatment.

First in early spring before the buds swell spray very thoroughly with Bordeaux mixture going up and down both sides of the row and so directing the spray that every part of the vine is coated with the bluish liquid. Printed directions for making Bordeaux mixture vary considerably but the following will be found convenient and effective. Put 6 pounds of bluestone (copper sulphate) in a loosely woven gunny sack (often called croker sack in Alabama) and suspend it just under the surface in a barrel half filled with water. In this way the bluestone will be dissolved in half an hour while if thrown in the bottom of the barrel it will take it all day. In another barrel slack 4 to 6 pounds of good lime and pour in enough water to make half a barrel of thin whitewash. Four pounds of lime, if fresh and unslaked, will be sufficient to combine with and neutralize the bluestone but the full six pounds does no harm and if to be applied when the vines are in leaf will be a little safer as regards burning the foilage. When the bluestone is all dissolved pour the whitewash slowly into the bluestone barrel with constant stirring. Let it stand two or three minutes to allow any heavy particles of lime to settle and the mixture is ready for use. A better mixture and one that stays longer in suspension is made by thus combining the dilute solutions than by combining while concentrated and then diluting. If the mixture stands for some time before using it will be necessary to stir it up thoroughly and then allow it to settle a few minutes before dipping it out of the barrel. If possible it should be used the day it is made as it deteriorates on long standing. For spraying vineyards some form of knapsack sprayer is often used but in large vineyards this is laborious and it is better to use a barrel pump mounting the barrel on a narrow sled that can be drawn along between the rows by one horse. If the pump is provided with two lines of discharge hose the sides of both rows can be covered by one trip through each middle and the work will be done about as fast as a horse will naturally walk. This requires three men, two to direct the spray nozzles and one to drive and pump.

A solution of the blustone, 2 pounds to the barrel without the lime is sometimes advised for this first spraying. It is perhaps a little more penetrating than the Bordeaux mixture but it is washed off by the first rain.

The great advantage of Bordeax mixture over other fungicides is that it adheres to the plant and withstands washing rains for so long a time.

If the vines have been previously diseased or if the locality is one where much trouble from black rot is to be expected the vines should be sprayed again when the shoots first start and the young leaves are the size of the thumb nail. In any case another spraying should be given after the flower buds are well formed but just before the flowers open. At this time $\frac{1}{4}$ pound of Paris green should be rubbed to a paste with a little water and mixed with each barrel of the Bordeax mixture. The next spraying should be given as soon as the flowers fall and the young grapes can be detected, and another and final spraying should follow in about ten days or two weeks, when the berries are the size of peas. Paris green should be used at both these later sprayings. After this time Bordeaux mixture should not be used till after the fruit is gathered as it is likely to presist on the clusters and disfigure them. If the season is wet another spraying will be advisable as soon as the fruit is picked in order to protect the foliage and hold it on the vines through the fall to properly ripen the wood for the next crop.

Where this treatment is faithfully carried out very little trouble will be had from the black rot or from any of the leaf destroying fungi or insects. Even the leaf roller will be largely held in check since the leaf surface will be covered with the poisoned spray before he draws it together with his protecting web. Any of these that escape should be picked off by hand and destroyed since they become very troublesome if allowed to multiply unchecked.

OTHER DISEASES.

The ripe rot (*Gloeosporium fructeguenum*) that has been mentioned as being especially injurious in South Alabama will not be fully controlled by this treatment. Much can be done to avert this trouble by using the horizontal trellace (see p. 59), whish furnishes a root of foliage to protect the fruit from the rain and dew and from the direct rays of the sun. It is probable that spraying just as the fruit is coloring with eau celeste, liver of sulphur or some other fungicide that could be used without staining the fruit would be useful in preventing loss from this disease, but no sufficiently accurate experiments in this line have been conducted.

Another serious trouble that will not be reached by spraying is the root rot. This disease was mentioned in Bull. 69, p. 272, where it was stated to be the same as the "Pourridie" of the French, which is caused by the growth of the fungus *Dematophora necatrix* on the roots. This is now believed to have been an error. Repeated attempts have been made to isolate and cultivate the organism causing the whitish discoloration under the outer bark of diseased roots, but so far without success. No fungus like the *Dematophora* has in any case developed and further observation on the behavior of this disease in the field shows that it works much more slowly than the European root rot, called "Pourridie," which usually kills infested vines in from one to two years.

The presence of this disease in the vineyard is usually first made manifest by the sudden browning of the margin of the leaves on certain vines in mid-summer, usually two or three weeks before the ripening of the fruit. This attack may be followed by the immediate death of the vine, leaving the fruit to dry and shrivel in the sun or the crop may mature and the vine linger along till fall, being found entirely dead at the winter pruning. In other cases only a part of the top will die, some branches putting out a feeble growth for two or three seasons longer. If an examination is made at the root of one of these vines a whitish mould-like coating will be found between the green inner bark and the shaggy outer-coating and the inner bark will be more or less browned and killed. This white coating can usually be traced several inches above the ground and down on to all of the larger roots. In severe cases the smaller fibrous roots will be rotted away, but they do not seem to be the original seat of the trouble, for in some cases the crown and large roots will be affected, while the smaller ones are mostly still healthy. This whitening of the inner bark is not confined to vines in which the foliage has given signs of the disease, but may frequently be found on vines that are still making a strong growth and on which the foliage is perfectly healthy. The failure of the leaves seems to come suddenly when the disease has progressed sufficiently far to cut off wholly or in part the water supply from the roots. The whitening can also often be found on old scuppernongs and on wild grapes in the woods, though these are seldom or never killed by it. Its presence on the roots of cultivated vines is by no means a sure sign of immediate death. A row of 38 Concord and Ives vines was examined in January, 1896, in which every vine showed its presence to a greater or less extent, and yet at this writing (November, 1900), 14 of those vines are still alive and at least half of these are quite vigorous. In January, 1898, in planting a lot of Delaware vines, this whitening of the roots was observed on some of the vines when received from the nursery. About forty of these were sorted out and were planted by themselves. These are now all alive but one, and seem as vigorous as their neighbors, but as will be shown below the Delaware is very resistant to this disease.

The following statistics of grape planting at the Station will show that the disease is a very serious one. From the early bulletins we learn that the two first vineyards planted nearly all died, presumably from this cause, and they had been rooted up before my connection with the Station (January, 1896). Delaware, Ives, Concord and Perkins had been found to live longer than the other kinds planted, and a third vineyard containing 338 vines of these four kinds was planted in 1886. In 1894 vacancies were replanted and another vineyard of 313 vines was planted. This contained a number of other kinds. The number alive in 1896 was 584. An examination showed only 83 vines in both lots that were free from this whitening of the bark. The following table shows the condition of the different varieties at the present time:

Kinds.	No. of vines planted 1886 to 1894.	No. alive Nov., 1900.	
Concord	68	12	17.6%
Ives	147	40	27.2%
Perkins	114	12	10.5%
Delaware	111	82	73.8%
Herbemont	5	5	100. %
Rulander	10	10	100. %
Niagara	15	2	
Wyoming Red	2	1	
Diana	11	1	
Brighton	4	0	
Lindley	14	1	
Wilder	11	0	
Humboldt	10	1	
Moore's Diamond	14	1	
Elvira	10	0	
Worden	6	0	
Total now alive		168	

Other kinds of which there were only two or three vines each are all dead. There is no proof that all these vines died from root rot, but certainly the great majority of them did die from this cause, and the loss of 483 vines in six years out of the 651 alive or planted in 1894 or a little over 75% is certainly a serious matter.

The most important thing to be noted in the above table are the complete exemption of Herbemont and Rulander from the disease and the comparative immunity of the Delaware. Ives alone of the pure *labrusca* varieties shows any power of resistance. The *labrusca* X *vinifera* hybrids also all seem very susceptible. It is a point of much importance to the future of Southern grape growing to learn which of the races and varieties of grapes now in cultivation are resistant to this disease.

In 1896 an experiment was planned to see if different methods of fertilizing or other soil treatment would have any effect in controlling this disease. Plots of two rows each were treated with different fertilizer formulas, including among other things heavy applications of kainit, lime, coal ashes and stable manure. This treatment was continued for three years, but with no marked result so far as the disease was concerned. At this writing the rows receiving a heavy mulch of coal ashes are in slightly the best general condition. The heavy applications of kainit, two to six pounds per vine in the different years, had an injurious effect on the fruit (Delaware), making it paler and causing somewhat uneven ripening. Stable manure was applied at the rate of a one horse wagon load to fifteen vines. This was considered excessive, but contrary to expectation no bad results followed and these rows have yielded more heavily than any others in the vineyard. The variety in this test was also Delaware.

This disease in a general way is worse in South than in North Alabama, and it is worse on sandy lands than on clays. Some black sandy soils in Southeast Alabama seem to be particularly subject to it, vines there usually dying after bearing one or two crops.

At present we can only say that the cause of the disease is entirely unknown and that the remedies so far tried have proved utterly ineffective. The fact, however, that the Herbemont and Rulander vines in the old vineyard have proved perfectly resistant, standing unharmed while other kinds died on all sides of them suggests a remedy that seems to offer a simple and practical solution for the difficulty. In soils subject to root rot why not graft susceptible kinds like Niagara on resistant roots as is being done with the *vinifera* varieties in France and California to resist the Phylloxera. It is probable that other varieties of the *Bourquiniana* and *rupestris* races to which the Herbemont and Rulander respectively belong will prove equally resistant, and experiments are planned to determine what varieties will make the best stocks for our leading market kinds using for the purpose the infected land now occupied by the old vineyard.

VARIETIES.

The varieties of grapes usually grown in this country for table use are descended from one of the following five species or they are hybreds produced by making crosses between them. These parents species are *Vitis Labrusca,* the Northeastern Fox grape; *Vitis vinifera,* the European grape, probably of Asiatic origin; *Vitis Bourquiniana,* a race of Southern grapes of which Herbemont is best known, probably of European origin; *Vitis Lincicumii,* the Texas Post Oak grape; and *Vitis rotundifolia,* the Muscadine or Bullace. The varieties descended from each of these kinds though differing widely among themselves, all have certain traits or characteristics in common, hence we often speak of them collectively as the Labruscas, the vinife as, the rotundifolias, etc.

For wine making descendants of other species as *vitis rupestris, V. vulpina and V. æstivalis* are also grown.

The most widely grown market grapes of the Eastern States belong to the *Labrusca* type. This includes such well known kinds as Concord, Ives, Perkins, Catawba and Niagara. As a rule they are resistant to the mildews and to phylloxera or root louse, but they are subject to black rot and as shown above they suffer seriously from root rot. We must, however, still depend largely on them for market grapes.

The *vinifera* grapes are largely grown in California and include such well known kinds as Muscat of Alexandria, Flame Tokay and Black Hamburg. Pure bred *viniferas* can not be grown in this State on account of their susceptibility to mildew and phylloxera. They are also subject to root rot and they start so early in the spring as to be often injured by late frosts. Some of the *Labrusca* x *vinifera* hybreds are fairly successful and include our highest flavored kinds, such as Brighton, Jefferson, Lindley and Wilder.

The *Bourquiniana* grapes include a few southern kinds, of which Herbemont is best known. They are fully resistant to root rot though somewhat subject to mildew and black rot. They are valuable wine grapes for the South, but most of them can hardly be considered among the market table kinds. The group is of importance and is introduced here principally because the Delaware is now supposed to belong here or at least to be a hybred between this species and *V. labrusca.* Its great resistance to root rot would seem to strengthen this view and from our present experience it must be considered the one best variety for general planting in this State. It is, however, a rather feeble grower and it requires heavy fertilizing, good cultivation and close pruning or it will not be satisfactory.

The varieties descended from *Vitis Lincecumii* or the Post Oak grapes are all new-comers but some of them like America, Carmen and Fern Munson are very promising and are worthy of a careful trial. In the able hands of Mr. T. V. Munson, of Denison, Tex., the descendants of this species are developing a remarkable number of valuable kinds well adapted to the South, some of which seem destined to supplant the kinds now generally cultivated in this region. They are resistant to mildew and black rot and probably also to root rot, but on this point we cannot yet speak with certainty. All interested in Southern grape growing should send to the Texas Experiment Station at College Station, Tex., for Bull. 56, in which Mr. Munson gives the history of his work in producing new varieties of grapes.

Vitis votundifolia includes the scuppernong and the wild muscadines. It belongs to a different division of the genus from the species discussed above, all of which are spoken of by the distinctive name of bunch grapes at the South. The rotundifolias are southern grapes, not being hardy at the North. They seem to be free from diseases of all kinds and are very easily cultivated, their only requirement being an arbor to climb on and keep them off the ground. No pruning is required except to pinch off side shoots during the first year. They are not suited to distant shipment but are very useful for the home market and for wine. The Scuppernong is the only kind that is really in general cultivation, but some of the black kinds like Thomas, Memory, Mish and Flowers are also desirable and should be more generally planted. Memory has proved decidedly more hardy to cold than any of the other kinds. (See Bull. 106, p. 170.)

A new vineyard of 100 varieties was planted at the station in January, 1898. It bore its first crop this season. Careful notes were taken on the different varieties by Mr. Austin and his report on them forms a part of this Bulletin. Some of the newer kinds seem very promising but we are as yet hardly justified in recommending them for general vineyard planting.

Rockwood deserves especial mention as the best of the very early black grapes. It resembled a small Concord but ripens with Champion.

Among the old well known kinds the following list includes the best for market purposes: Black; Concord, Ives. Red; Delaware, Brighton. White; Moore's Diamond, Niagara.

MARKETING.

Southern grown grapes are more perishable than the same kinds grown at the North, because they ripen during the heat of mid-summer. For this reason marketing must be expedited in all possible ways. Only a few hours can be allowed for wilting. Those picked in the morning should be packed in the afternoon and those picked in the afternoon packed early the following morning, and when packed they should be rushed into refrigerator cars as rapidly as possible. Prices for southern grapes are too low at present to justify express shipments and the business can only be permanently successful at those points where enough are grown to load refrigerator cars.

Grapes are best gathered in flat wooden trays or boxes. Twenty by thirty inches by six inches deep is a convenient size. The bunches are cut from the vines with clippers made for the purpose or with a sharp knife and are placed carefully two layers deep in these boxes. When full they may be hauled to the packing house on a spring wagon. The two layers of clusters will not fill them quite full so they may be safely piled one on top of another in hauling. At the packing house they should be stacked up in an open well ventilated space and should be crossed in piling so that the ends of each box are freely exposed to the air. In a few hours the stems will have wilted a little so that they will settle together limply. They are now ready for packing. The climax basket is more used than any other package for grapes and everything considered it is probably the best. It is an oblong basket with a board bottom, solid veneer sides, a solid veneer cover and a wooden hoop handle.

The usual sizes hold about 5 and 8 pounds. In packing it is placed in front of the packer endwise with the farther end elevated on a four-inch block. The clusters are carefully examined and all defective berries removed with sharp pointed clippers. All inferior or seriously defective bunches should be thrown out for the vinegar barrel or the wine press. The basket is filled beginning at the lower end in such a way that as smooth and compact a surface as possible is built up from the tips of the bunches, all stems being covered by the succeeding bunches. It is impossible to do this so nicely when the basket stands flat and is filled from the bottom upward. When full the grapes should stand from half to three-quarters of an inch above the top of the basket as they will give down without injury by carefully pressing the cover and if an occasional berry is mashed it is better than to have the basket seem slack filled when opened.

Quart strawberry baskets and crates and the six basket Georgia peach crate are both sometimes used for grapes and answer fairly well.

For methods of handling refrigerator cars and for a general discussion on methods of marketing perishable fruits and vegetables see Bull. 79, pp. 103-110.

NOTES ON THE VARIETIES OF GRAPES FRUITING IN THE STATION VINEYARD DURING 1900.

BY C. F. AUSTIN.

In discussing the varieties of grapes grown on the station grounds, we have given a few of the main points about each variety, and a note as to its value for planting. On further trial some of the varieties may give better results than is here indicated.

Under most of the varieties the name of the race or parent species is given. When the varieties are of hy bred origin the names of both, or all of the parent species are given connected by the X mark.

It should be stated that the only ground available for this variety vineyard was an old washed and gullied hillside where the soil conditions are far from uniform. This is unfortunate as some of the varieties have had a much poorer chance than others.

The season was late this year so that the dates of ripening given below are about a week later than in average seasons at this place.

AGAWAM, (Rodgers No. 15.) *Labrusca* X *vinifera.*—Vines strong and vigorous; clusters large, long, shouldered, only moderately compact; berries large, nearly round, reddish brown, skin thick; pulp tender, juicy, sweet, very pleasant; season first of August; fairly productive. A fine grape for home use.

AMERICA, *Lincequmii X rupestris.*—Vines very vigorous. Clusters large, well shouldered, compact; berries small, round, black, with blue bloom; pulp firm, acid, quality fair; season last of July. A very productive grape, and promises a fair market sort.

AMINIA, *Labrusca X vinifera.*—Vines small, weak. Clusters small; berries medium in size, black, with blue bloom; pulp tender, juicy, quality poor; season last of July. A grape of no value here.

AUGUST GIANT, *Labrusca X vinifera.*—Vines small. No fruit, worthless here.

BACCHUS, *Labrusca X vulpina.*—Vines fairly vigorous. Clusters small, compact; berries very small, round, black, with blue bloom; pulp quite firm, quality poor; season last of July; not productive; a grape of no value here.

BARRY. (Rodgers' No. 43), *Labrusca X vinifera.*

—Vines small and lacking in vigor. Clusters short, broad, compact, shouldered; berries very large, round, black, with thin blue bloom; pulp tender, juicy, quality fair; season middle of August; fairly productive. It is not a very promising grape.

BEACON, *Labrusca X Lincecumii.*—Vines strong and vigorous. Clusters large, long, compact; berries very large, round, acid, quality fair; season first of August; very productive. It is a fair market grape.

BELL, *Labrusca X Bourquiniana.*—Vines quite vigorous. Cluster small, compact; berries small, round, greenish white; pulp tender, juicy, quality very poor; season last of July; not productive. A grape that is worthless here.

BETRAND.—Vines strong. Clusters very large, long, moderately compact; berries very small, round, black, with blue bloom, skin thick; pulp tender, juicy, slightly acid; season last of August; very productive. It gives indications of little value other than for wine.

BIG EXTRA, *Lincecumii X Labrusca X vinifera.*—Vines large and very strong. Clusters large, long, compact; berries large, round, black with blue bloom, skin thick; pulp firm, acid, quality fair; season last of July. It is not productive enough for a market grape.

BIG HOPE, *Lincecumii X Labrusca X vinifera.*—Vines very vigerous. Clusters large, long, moderately compact; berries large, round, very dark red; pulp tender, juicy, quality fair; season middle of August; very productive. A promising market grape.

BRIGHTON. *Labrusca X vinifera.*—Vines small and only fairly vigorous. Clusters medium in size, compact, shouldered; berries medium, round, dark red when fully ripe, skin thin; pulp tender, juicy, rich, sweet, quality extra good; season last of July; fairly productive. An excellent grape for home use here. To insure perfect pollenation, it must be planted next to other varieties.

BRILLIANT, *Bourquiniana X Labrusca X vinifera.*—Vines small, fairly vigorous. Clusters medium in size, moderately compact, shouldered; berries medium, red, skin thin; pulp tender, juicy, sweet, quality very good; season last of July; productive. A very fine grape for table use.

CAMPBELL'S EARLY—Vines strong, vigorous. Clusters large, long, loose; berries very large, globular; black, with thin blue bloom; pulp tender, juicy, very pleasant, quality good; season last of July; fairly productive. A very promising grape for home use.

CARMEN, *Lincecumii X Labrusca X vinifera.*—Vines vigorous. Clusters usually very large, and compact; berries large, round, black, with blue bloom; pulp firm, quality fair; season first of August; very productive; a fair market grape.

CATAWBA, *Labrusca*—Vines small, but rather thriftty. Clusters small, compact, but withered before ripening. This grand grape is out of its place here.

CENTENNIAL.—Vines very strong growers. Clusters large, long, moderately compact; berries large, oval, black, skin thick; pulp tender, juicy, soft, quality fair; season last of July; very productive. A fair market grape.

CHAMPION, *Labrusca.*—Vines fairly vigorous. Clusters medium in size, very compact, well shouldered; berries medium, round, black; pulp tender, juicy, quality very poor; season middle of July; very productive. Its principal value as a market grape lies in its extreme earliness and productiveness.

CLINTON, *vulpina X Labrusca.*—Vines quite vigorous. Clusters medium in size, very compact; berries small, round, black, with blue bloom, skin thick; pulp half tender, juicy, quality fair; very productive. A grape of very little value here; season last of July.

COLLIER, *Lincecumii X Labrusca*—Vines vigorous and strong. Clusters large, compact, shouldered; berries medium to large, round, black, with blue bloom; pulp tender, juicy, pleasant, quality very good; season first of August; fairly productive. One of the best grapes for general use.

DELAGO, *Bourquiniana X Labrusca X vinifera.*—Vines only fairly vigorous. Clusters small, loose; berries medium, round, reddish; pulp tender, juicy, sweet, quality good; season first of August; not very productive. A fair grape for home use.

DELAWBA, *Labrusca X*—Vines small, lacking in vigor. Clusters medium in size, compact; berries medium, round, red, skin thick; pulp tender, juicy, sweet, very pleasant, quality very good; season middle of August; productive. This grape resembles the Delaware very much only later. It is an excellent grape for both home use or market.

DELAWARE, *Bourquiniana or Bourquinana X Labusca.*—Vines fairly vigorous, with slender short-jointed wood. Clusters medium to large in size, well shouldered, very compact; berries medium, round, red, skin thin; pulp tender; juicy, rich, sweet, very pleasant, quality extra good; very productive; season last of July. It is one of the most valuable grapes for both home use, and commercial planting.

DELICIOUS., *Lincecumii X Bourquiniana*—Vines quite vigorous. Clusters medium in size, moderately compact; berries medium, round, black, with blue bloom; pulp half tender, quality poor; season middle of August; not productive. A grape of no value here.

DIANA, *Labrusca X vinifera*—Vines vigorous, Clusters medium in size, compact; berries medium, round, pale red, skin thick; pulp tender, juicy, sweet, pleasant, quality very good; season middle of August; productive. A very good grape for home use, but one and market.

DUCHESS, *Labrusca X vinifera*—Vines fairly vigorous. Clusters small, compact; berries very small, round, greenish white, skin thick; pulp solid, quality very poor; season last of August; productive. A very poor grape here.

EARLY VICTOR, *Labrusca.*—Vines small, lacking in vigor. Clusters small, moderately compact; berries small, round, black; pulp tender, juicy; slightly acid, quality poor; season last of July; not productive. A grape of very little value here.

EATON, *Labrusca*—Vines strong, vigorous. Clusters large, long, shouldered, quite compact; berries very large, round, black, with blue bloom; pulp half tender, juicy, quality fair; season last of July; very productive. A promising grape for market.

ELVICAND, *Labrusca X candicans.*—Vines vigorous. Clusters small, compact; berries medium in size, round, dark red, skin thick; pulp tender, juicy, acid, quality poor; season middle of August; productive. The indications for this grape are not promising.

EMPIRE STATE, *Labrusca X vinifera*.—Vines small, weak. Clusters small, compact; berries small, round, yellowish white; pulp firm; season last of July; not productive. A grape of no value here.

ESTHER.—Vines small, weak, no fruit.

ETTA, *Labrusca X vulpina.*—Vines fairly vigorous. Clusters medium in size, compact; berries small to medium, round, pale yellow, skin thick; pulp tender, juicy, soft, sweet, pleasant; season last of August; fairly productive. A promising grape for home use.

EXCELSIOR, *Labrusca X vinifera.*—Vines vigorous. Clusters medium in size; moderately compact; berries small, round, pale red, skin thin; pulp very tender, juicy, pleasant, quality good; season middle of August; productive. A promising grape for general use.

GENEVA.—Vines small, weak; no fruit.

GOLD COIN, *aestivalis X Labrusca.*—Vines large, vigorous. Clusters large, very compact, broad; berries medium to large, round, yellowish, skin thick; pulp half tender, juicy, sweet, very pleasant, quality extra good; season first of August; very productive. One of the best yellow grapes for both home use or market.

GOETHE, (Rodgers' No. 1), *Labrusca X vinifera.*—Vines quite vigorous. Clusters medium to large, shouldered, moderately compact; berries large, oblong, pale red, skin thin; pulp tender, juicy, sweet, very pleasant, quality extra good; season middle of August; productive. One of the best late grapes for both table use or market.

GREEN MOUNTAIN, (Winchell), *Labrusca X vinifera.*—Vines vigorous. Clusters small, shouldered, very compact; berries small, round, greenish white, skin thin; pulp tender, juicy, sweet; season middle of July; very productive. It is an excellent early grape for home use, but skin is too thin to be of any value as a market sort.

T. B. HAYES, *Labrusca*—Vines small, weak. Clusters medium in size, loose; berries small, white, skin thin; pulp tender, juicy, quality poor; not productive; season last of July. A grape of no value here.

HERBEMONT, (Warren), (Neal), *Bourquinniana*—Vines strong, vigorous; clusters medium in size, compact; berries medium, round, dark red, with blue bloom, skin thin; pulp tender, juicy, sweet, soft, very pleasant;

season last of August; productive. A promising garden grape.

HERBERT, (Rodgers' No. 41.) *Labrusca X Vinifera* Vines quite vigorous. Clusters large, moderately compact; berries very large, round, black, with blue bloom; pulp tender, juicy, pleasant, quality medium; season last of July; productive. A good grape for commercial growing.

HERMAN JAEGER, *Lincecumii X. Bourquiniana.* Vines large, strong and vigorous; clusters very large, long, compact; berries small, round, black, with blue bloom, skin thick, pulp firm, seeds free easily, season first of August; very productive. A grape of very little value other than for wine.

HIGHLANDS, *Labrusca X vinifera.*—Vines small, but fairly strong. Clusters medium in size, moderately compact, unevenly ripened; berries large, round, very dark red, with blue bloom, skin tough; pulp tender, juicy, soft, slightly acid, pleasant; season last of August; fairly productive. A fair grape for home use.

HOPKINS, *Lincecumii X aestivalis.*—Vines large and vigorous. Clusters very large, long, compact; berries small, round, black, with blue bloom; pulp firm, acid; productive. A grape of no value other than for wine.

IONA, *Labrusca X cinifera.*—Vines small, weak. Clusters small, moderately compact; berries small round, pale red; pulp tender, juicy, quality poor; season middle of August; not productive. A grape of no value here.

IONA, *Labrusca X vinifera.*—Vines small, weak. ters large, shouldered, compact; berries medium, round, black, with blue bloom; pulp firm, quality medium; season last of July; very productive. A fair market grape if left hanging on the vines until fully ripe.

ISABELLA, *Labrusca.*—Vines small, lacking in vigor. Clusters medium in size, compact; berries medium, slightly oval, black, skin thick; pulp tender, juicy, quality fair; season first of August, productive. It is not a promising grape here.

JACQUEZ, *Bourquiniana.*—Vines very vigorous and strong. Clusters large, long, compact; berries very small, round, black, with heavy blue bloom; pulp tender, juicy, slightly acid; season middle of August; very productive. Its chief value is for wine.

JEFFERSON, *Labrusca X vinifera.*—Vines vigorous. Clusters medium in size, shouldered, moderately compact; berries medium, roundish oval, pale red, skin thick; pulp tender, juicy, sweet, very pleasant, quality extra good; season middle of August; productive. A very promising grape for general use.

JEWELL.—Vines small, fairly vigorous. Clusters small, moderately compact; berries small, round, black, with blue bloom; pulp tender, juicy, pleasant; season last of August; not productive. A grape of very little value here.

DR. KEMP, *Lincecumii X Bourquiniana*—Vines very strong and vigorous. Clusters large, long, moderately compact; berries medium, round, black, with blue bloom, skin thick; pulp firm, acid, quality fair; season middle of August; very productive. A grape of very little value other than for wine.

LADY WASHINGTON, *Labrusca X vinifera.*—Vines small, lacking in vigor. Clusters medium in size, compact; berries medium, round, pale yellow; pulp tender, juicy, quality poor; season first of August; fairly productive. A grape of very little value here.

LAUSSEL, *Lincecumii X Labrusca æstivalis.*—Vines vigorous. Clusters medium in size, moderately compact; berries medium, round, very hark red, skin thick; pulp firm, quality poor; season last of August; fairly productive. A grape of no value for general planting.

LINDLEY, (Rodgers' No. 9), *Labrusca X vinifera.* Vines quite vigorous. Clusters large, long, compact; berries medium to large, nearly round, brick red; pulp tender, juicy, sweet, quality very good; season first of August; productive; a promising grape for both home use or market.

LONG JOHN.—Vines very large and vigorous. Clusters large, long, loose; berries large, round, black, with blue bloom; pulp tender, juicy, quality poor; productive; season first of August. A fair market grape.

MARGUERITE, *Lincecumii X Bourquinana.*—Vines strong growers. Clusters medium in size, very compact, broad; berries medium, round, reddish, with a thin blue bloom, skin thin; pulp tender, juicy, soft, slightly acid, quality fair; season last of August; very productive. A promising late grape for general use.

MERIMACK, (Rodgers' No. 19), *Labrusca X Vinifera.*—Vines very small, weak, no fruit. A grape of no value.

MARTHA, *Labrusca.* —Vines small but thrifty. Clusters small, shouldered, compact; berries small, round, pale yellow, skin thin; pulp tender, juicy, sweet, very pleasant, quality very good; season first of August; fairly productive. It is an excellent grape for home use.

MASSASOIT, (Rodgers' No. 3), *Labrusca X vinifera.*—Vines small, lacking in vigor. Clusters small, shouldered, moderately compact; berries medium, roundish, light red; pulp tender, juicy, pleasant, quality good; season last of July; not very productive. A fine grape where it does well, but of little value here.

McPIKE, *Labrusca.*—Vines quite vigorous. Clusters large, compact; berries medium to lage, round, black, with blue bloom, skin thick; pulp tender, juicy, pleasant, quality very good; season first of August; very productive. A grape resembling the Worden in flavor and color, and a very promising late variety for both home use or market.

MILLS.—Vines all died.

MOORES DIAMOND, *Labrusca X vinifera.*—Vines strong and vigorous. Clusters medium in size, well shouldered, very compact; berries medium, round, white, skin thick; pulp tender, juicy, quality fair; very productive; season middle of July. A very fair white grape for both home use or market.

MOORES EARLY, *Labrusca.*—Vines small, lacking in vigor. Clusters small to medium, shouldered, compact; berries medium, round, black with thin blue bloom; pulp tender, juicy, pleasant, quality fair; season middle of July; not very productive. The indications for this grape are not very promising.

MO. RIESLING, *Labrusca X vulpina.*—Vines fairly vigorous. Clusters medium in size; compact; berries medium, round, white, skin thin; pulp tender, juicy, soft, pleasant, quality good; season last of August; productive. A fair grape for both home use or market.

MONARCH.—Vines vigorous and a strong grower. Clusters large, compact; berries large, round, black with blue bloom, skin thick; pulp half tender, pleasant, quality good; season last of August; productive. A promising market grape.

MONTIFIORE, *Labrusca X vulpina.*—Vines vigorous. Clusters very small, loose; berries small, round, black with blue bloom; pulp firm, quality poor; season last of July; not productive. A grape of no value here.

MOYER, *Labrusca X* ———.Vines small, weak. Clusters small, loose; berries small round, reddish; pulp tender, juicy, soft, quality poor; not productive; season last of July. A grape of very little value here.

R. W. MUNSON, *Lincecumii X Labrusca X vinifera.* Vines large, and a strong grower. Clusters medium to large, fairly compact; berries large, round, black, with blue bloom, skin thick; pulp tender, juicy, quality good; season first of August; fairly productive. A grape promising to become a fair market sort.

MRS. MUNSON, *Lincecumii X Bourquiniana.*—Vines strong and vigorous. Clusters large, long, fairly compact; berries large, round, black, with blue bloom; pulp tender, juicy, quality good; season first of August; fairly productive. This variety resembles the R. W. Munson very much and it is doubtful if any marked distinction can be made between them.

FERN MUNSON, *Lincecumii X Labrusca.*—Vines strong and vigorous. Clusters large, long, compact; berries large, round, very dark red, with blue bloom, skin thick; pulp tender, juicy, slightly acid, quality good; season last of August; very productive. A very promising late grape for general use.

NAHAB.—Vines lacking in vigor. Clusters medium in size, compact; berries medium, round, white, skin thin, pulp tender, juicy, slightly acid; season middle of August; not productive. A grape of little value here.

NIAGARA,*Labrusca.*—Vines vigorous and a strong grower. Clusters large, very compact, well shouldered; berries large, round, greenish, or yellowish white, skin rather tough; pulp tender, juicy, rich, musky, very pleasant, quality extra good; season last of July; very productive. A very promising grape here. The Niagara is one of the best, if not the best white grape for both home use or commercial growing.

NORFOLK, *Labrusca.*—Vines vigorous. Clusters large, compact; berries very large, round, dark red; pulp tender, juicy, pleasant, quality good; season last of July; productive. A fair market grape.

NORTON, *æstivalis.*—Vines very vigorous. Clusters large, long, shouldered, compact; berries very small, round, black, with blue bloom; pulp half tender, slightly acid, quality fair; season middle of August; very productive. Its chief value is for wine.

OZARK.—Vines small, weak, no fruit.

PALLIAT.—Vines vigorous and a strong grower. Clusters large, long, shouldered, compact; berries small, round, black, with blue bloom, skin thin; pulp tender, juicy, soft, slightly acid; season last of August; fairly productive. Its chief value is for wine.

PERKINS, *Labrusca.*—Vines very strong and vigorous. Clusters large, long, shouldered, compact; berries large, round, yellow, skin thick; pulp tender, juicy, sweet, pleasant, quality good; season last of July; very productive. A very good grape for home use, but one which shells too much for market purposes.

PRENTIS, *Labrusca X vinifera.*—Vines very small, and weak. A grape of no value here.

PRESLEY, *Labrusca X vulpina.*—Vines only fairly vigorous. Clusters small, moderately compact; berries very small, round, dark wine color; pulp tender, juicy, quality poor; season last of July; not productive. A grape of no value here.

ROCKWOOD, *Labrusca.*—Vines slow growers, but fairly vigorous. Clusters large, long, shouldered, compact; berries medium, round, black with thick blue bloom; pulp tender, juicy, pleasant, quality fair; season middle of July; fairly productive. A grape of some promise for both garden and market planting; ripens with Champion but of much better quality.

ROMMEL, *Labrusca X vulpina X vinifera.*—Vines strong and vigorous. Clusters large, compact; berries medium, round, greenish white, skin thin; pulp tender, juicy, quality fair; season last of July; productive. A fair grape for garden planting.

SALEM, (Rodgers' No. 22), *Labrusca X vinifera.* Vines very vigorous. Clusters large, long, loose; berries large, round, dark dull red, skin thick; pulp tender, juicy, pleasant, quality very good; season first of August; fairly productive. It is one of the best for the home garden.

TRIUMPH, *Labrusca X vinifera.*—Vines strong and healthy. Clusters large, shouldered, long, compact; berries medium, round, white, skin thick; pulp tender, juicy, pleasant, quality good; season middle of August; fairly productive. A very promising grape for general planting.

ULSTERS PROLIFIC, *Labrusca X* ——.Vines very small, weak. A grape of no value.

VERGENNES, *Labrusca.*—Vines very small, weak.

WILDER, (Rodgers' No. 4), *Labrusca X vinifera.* Vines vigorous and strong. Clusters large, long, shouldered, moderately compact; berries large, round, black, with thin blue bloom; pulp tender, juicy, soft, pleasant; quality very good; season first of August; productive. A valuable grape for home use.

WORDEN, *Labrusca.*—Vines only fairly vigorous. Clusters large, long, moderately compact; berries large, round, black, with heavy blue bloom, skin thin; pulp tender, juicy, rich, pleasant, quality very good; season first of August; productive. One of the best for home use, but does not ripen even enough to make a good grape for market growing.

WYOMING, *Labrusca X vinifera.*—Vines small, slender, fairly vigorous. Clusters medium in size; compact; berries medium, round, dark wine color; pulp tender, juicy, sweet, quality good; season last of July; fairly productive. A fair grape for home use.

SCUPPERNONGS (*Vitis rotundifolia*.

MEMORY.—Vines large, strong, vigorous; berries large, round, dark brown, with white specks over the surface, skin very thick; pulp tender, juicy, soft, pleasant; season later part of August; very productive. This is the earliest variety here, and a very fine one for eating out of hand.

SEEDLING.—Vines rather small and not very vigorous. Berries very large, smooth, nearly round, very dark red; pulp tender, juicy, pleasant, slightly acid; productive; season first of September.

JETER.—Vines strong and vigorous. Berries large, round, dark brown, skin very thick; pulp tender, juicy, soft, pleasant; season later part of July; very productive.

THOMAS.—Vines somewhat lacking in vigor. Berries medium in size, very dark red, smooth, slightly oblong, skin medium; pulp very tender and juicy, nearly sweet, rich; very productive; season last of July. It is a choice fruit for home growing.

FLOWERS.—Vines very strong and vigorous, berries medium, round, smooth, shinny black, skin leathery;

pulp firm, acid, quality poor; very productive, and hangs on the vine a long while; season middle of September.

MISH.—Vines large and strong growers. Berries small, nearly round, smooth, black with very small brown specks over the surface, skin medium; pulp tender, juicy, soft, very sweet; exceedingly productive; season early September. This is the only variety we have which has a distinct sweet taste. It is very fine for eating out of hand.

TENDERPULP.—Vines very large and vigorous. Berries medium, round, smooth, black, skin leathery; pulp tender, very juicy and soft, seeds free easily, quality very poor; very productive; season middle of September. A variety of very little value.

Of the above kinds the following list seems worthy of farther trial for market and general purposes while the second list are of especially fine quality for home use.

VARIETIES WORTHY OF FARTHER TRIAL FOR MARKET.

America, Delawba, Herbert, Monarch, Beacon, Diana, Jefferson, R. W. Munson, Big Hope, Eaton, Lindley, Fern Munson, Carmen, Excelsior, Long John, Norfolk, Centennial, Gold Coin, McPike, Rockwood, Collier, Goethe, Mo. Riesling, Triumph.

VARIETIES OF VALUE FOR HOME USE.

Agawam, Etta, Highland, Rommel, Brilliant, Green Mountain, Martha, Salem, Delago, Herbemont, Riqua, Wilder, Wyoming.

BULLETIN No 111. DECEMBER, 1900.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

CORN CULTURE.

By

J. F. DUGGAR.

MONTGOMERY, ALABAMA.
THE BROWN PRINTING CO.
1900.

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

CORN CULTURE.

By J. F. Duggar.

SUMMARY.

During the last five years thirty-six varieties of corn have been tested from one to five years. In no two of these five years did the same variety stand at the head of the list.

Of the varieties tested five years, Mosby made the highest average yield; among those tested four years, Shaw led; of the varieties tested three years Cocke was most productive; at the head of the list of those tested two years, stand Renfro and Higgins.

Mexican June corn did not afford a satisfactory yield of grain.

In five years tests seed corn from Illinois afforded yields averaging .45 of a bushel more than seed from the Gulf States region. Satisfactory yields were obtained with seed from both the South and the North. Late varieties from the North made good yields at Auburn, but the smallest yields obtained were from early varieties of northern origin.

Seed corn from Virginia gave an average yield of 4 bushels per acre higher than seed corn of the same varieties from the Gulf States and Georgia.

No material difference was found as the result of planting kernels from the middle, butt, or tip portion of the ear.

In the wet season of 1900 planting corn in the water furrow decreased the yield.

Corn planted late or after small grain failed to make a satisfactory yield.

Relatively thick planting was most advantageous with an early, small-stalked variety.

Frequent rains obscured the results of cultivation experiments made in 1900 with late corn, but the slight differences in yields were in favor of

(1) Making first cultivation deep.

(2) Continuation of cultivation late into the season.

(3) Frequent cultivation.

There was a reduction in the yield of corn in 1900 as the result of either stripping the blades, or cutting the tops, or cutting and shocking the entire plant. This loss was greater when topping or cutting was done than when the blades were stripped. The total value of grain and harvested forage was greatest when the stalks were cut and shocked.

Lime was useless on sandy upland poor in humus; it was apparently slightly effective, but not profitably so, on soil where there was considerable vegetable matter.

The stubble alone of velvet beans proved an affective fertilizer for corn. Still more effective was the plowing under of the entire growth of velvet bean vines, the corn crop following the vines yielding 11.9 bushels per acre more than the corn on the plot where only the roots and stubble of velvet beans were used as a fertilizer for corn.

Beggar weed, used as fertilizer, increased the yield of corn, but in this respect proved decidedly inferior to velvet beans.

Cowpea vines, from which the peas had been picked, increased the yield of corn by 17 per cent. in spite of the fact that nitrate of soda was applied to the corn.

The fertilizing effect of cowpea vines and velvet bean vines was more permanent than was the fertilizing effect of the stubble of these two plants. The average increase in the yield of the corn crop of 1900, grown two years after these legumes, was 3.2 bushels per acre on the plots where the vines had been plowed in and only .9 of a bushel on the plots where only the roots and stubble of cowpeas and velvet beans had been left on the land in 1898.

In a second experiment the residual fertilizing effect of velvet beans, grown in 1898, was represented by an increase of 7.5 bushels of corn in the crop of 1900. In this test the residual effect of velvet bean stubble was considerable, but less than that of the entire growth of the same plant.

Hairy vetch, hairy vetch stubble, rye, and rye stubble were compared as green manures for corn. Corn planted June 16, which was more than a month after harvesting the vetch and rye hay, yielded 8.4 bushels per acre where the entire rye plant was plowed under and 17.5 bushels where vetch had been used as a green manure. This is an increase of 98 per cent. attributable to vetch. When the fertilizing effects of the stubbles of these two plants are compared the differences are somewhat less, but decidedly in favor of vetch stubble.

Vetch vines and stubble were nearly on an equality as fertilizers if measured by the yield of corn following these crops in the same year; however, the benfit from plowing in the vines was more permanent, as indicated by the increase in the second corn crop on the same land.

It was more profitable to harvest vetch for hay and utilize only the stubble as fertilizer.

Two hundred pounds of cotton seed meal and 434 pounds of cotton seed produced practically equal increases in the yield of corn, that is, a pound of nitrogen was of equal value in cotton seed and in cotton seed meal.

Unfavorable weather rendered inconclusive the results of experiments with nitrate of soda and cotton seed meal applied to corn at different dates.

Cowpea stubble afforded sufficient nitrogen for corn planted late in the season.

On exceedingly poor, gray sandy soil at Auburn fertilizer tests, or soil tests, with corn were repeated for three years. Phosphate gave no increase, kainit an inconsiderable one, and cotton seed meal an increase of only 2.3 bushels per acre, or not enough to be profitable.

On a slightly better sandy soil at Auburn the average results of an experiment repeated for two years show no gains from the use of phosphate or kainit and only a moderate increase with cotton seed meal.

On "mulatto" land in Big Wills Valley, DeKalb County cotton seed meal was highly effective and profitable, increasing the yield 7.9 bushels of corn per acre; phosphate and kainit were useless.

Commercial fertilizers are not so well adapted to corn as to cotton. If used for corn the amounts should not be large. A formula for corn should contain a smaller portion of phosphoric acid and potash and a much larger percentage of nitrogen than a formula for cotton growing on the same land. That is, it should be made up largely, if not entirely, of some nitrogenous material, like cotton seed meal. Cowpeas, velvet beans, vetch and other leguminous plants and coarse home-made manures are safer and better for corn than are commercial fertilizers.

TESTS OF VARIETIES OF CORN.

Results of variety tests of corn made by the writer in 1896 and 1897 were published in Bulletins Nos. 75 and 88 of this Station. The results for 1898, 1899, and 1900 are presented in the tables below. The figures are the actual yields of shelled corn. There was an equal number of plants on all plots, except in 1900, when on a few plots there was a slight deficiency in the stand. The varieties are arranged in order of yield.

Yields of varieties of corn in 1898.

Variety.	Yield per acre. Bushels.
Higgins	20.0
Shaw	17.5
Baden	16.9
Mosby Prolific	16.3
St. Charles (from Ill.)	15.5
Experiment Station Yellow	14.9
Farmer's Pride	14.0
Golden Beauty	13.3
Cocke Prolific (from Ga.)	12.9
Cuban Giant	11.8
Hickory King (from Ga.)	11.4
Blount Prolific (from Ga.)	11.0
Hickory King (Av. Ill. and Ga. seed)	10.9
Blount Prolific (Av. Ill. & Ga. seed)	10.8
Blount Prolific (from Ill.)	10.5
Hickory King (from Ill.)	10.4

Yields of varieties of corn in 1899.

Variety.	Yield per acre. Bushels.
Experiment Station Yellow	19.5
Jones Pearl Prolific	18.2
Mosby	18.0
Golden Dent	17.9
Blount Prolific (Ga.)	17.1
Evans	16.7
Blount Prolific (Av. Ill. and Ga.)	16.2
St. Charles (from Ills.)	16.1
Red Cob (from Jones)	16.0
Shaw	15.8
St. Charles (Av. Ala. and Ill.)	15.7
St. Charles (from Ala.)	15.3
Blount (from Ill.)	15.2
Hickory King (from Ga.)	14.9
Champion White Pearl	14.5
Hickory King (Av. Ga. & Ill.)	14.2
Hickory King (Ill.)	13.5

Yields of varieties of corn in 1900.

Variety.	Yield per acre. Bushels.
Cocke Prolific (from Va.)	41.7
Mosby	40.1
Arnold	39.6
Bradberry	39.1
Cocke Prolific (from N. Ga.)	38.6
Cocke Prolific (from S. Ga.)	38.4
Cocke Prolific (av. 4 plots)	37.8
Blount Prolific (from Va.)	36.8
Sanders	36.5
Expt. Sta. Yellow (av. 4 plots)	35.0
Red Cob	34.8
Blount Prolific (av. 3 plots)	34.3
Cary Klondyke	34.0
Farmer's Pride	33.7
St. Charles (av. 3 plots)	33.7

Shaw	33.2
St. Charles (from Ill.)	33.1
Giant Broad Grain	32.9
Cocke Prolific (from S. Ga. [J.])	32.6
Blount Prolific (from S. Ga.)	32.2
Early Mastodon	31.9
Poor Man	31.3
Hickory King (from Del.)	30.4
Hickory King (from Va.)	29.8
Golden Beauty	28.9
Evans	28.4
Hickory King (av. 3 plots)	28.2
White Sheep Tooth	26.2
Creole	25.9
Hickory King (from Ill.)	24.5
Champion White Pearl	24.4
Leaming	19.9

RELATIVE PRODUCTIVENESS OF VARIETIES.

Since all five of the variety tests of corn made during the last five years have been on a uniform plan and continuously under the same management and since fertilization and culture have been substantially the same each year, we are able to use these data in determining the relative productiveness of varieties.

However, available land and other considerations have made it impracticable to test the same list of varieties each year. Instead, we have in all tests used the variety Experiment Station Yellow as a standard with which the yields of all other varieties may be compared.

First let us ascertain how this variety, our standard, compares in productiveness with the other four varieties, that have entered into all of our recent tests.

Yield of varieties of corn tested for 5 years at Auburn.

	Yield of shelled corn per acre.					
	1896	1897	1898	1899	1900	Average 5 years.
Mosby	15.5	25.4	16.3	18.0	40.1	23.1
St. Charles (av of seed from S. & N)	25.1	18.1	15.5	15 7	33.7	21.6
Experiment Station Yellow	16.9	18.4	14.9	19.5	35.0	20.9
Blount (av. of seed from (S. & N.)	22.3	19.0	10.8	16.2	34.3	20.5
Hickory King (av. of seed from S. & N.)	20.7	13.2	10 9	14 2	28 2	17.4

From this table we see that Experiment Station Yellow, though a safe variety, has not given the highest average yield for the five-year period. It has been surpassed by Mosby, averaging 23.1 bushels, and even by Saint Charles, which gives 21.6 bushels, against 20.9 bushels for Experiment Station Yellow. Blount closely follows with a record of 20.5 bushels, while Hickory King falls considerably below the other varieties, averaging only 17.4 bushels per acre for the five-year period.

Since it is not permissible to compare even the average yield of one variety with that made by another variety in different years, we are led to adopt some means of comparison which will eliminate the influence of varying seasons and place all varieties on the same basis, whatever may be the years in which they were tested. This can be done by representing the yield in any year of our standard, Experiment Station Yellow, by the member 100. The yield of any other variety can then be calculated in percentages of this number.

By this means the figures in the following table are obtained; the figures are percentages, and if greater than 100 show that the variety opposite the figure afforded a larger yield for a given year than did the Experiment Station Yellow. A figure smaller than 100 indicates a yield less than that of the standard variety just referred to.

Relative yields of varieties of corn at Auburn, taking the yield of Experiment Station Yellow as 100.

	1896	1897	1898	1899	1900	Average.
Tested 5 years.						
Mosby	91	138	109	92	115	109
St Charles	148	98	104	81	96	105
Experiment Stat on Yellow	100	100	100	100	100	100
Blount	132	103	72	83	98	98
Hickory King	122	72	73	73	80	84
Tested 4 years.						
Shaw	....	99	117	81	95	98
Champion White Pearl	126	79	...	74	70	87
Tested 3 years.						
Cocke	....	129	87	....	108	108
Farmers' Pride	.	101	94	....	96	97
Jones' Pearl Prolific	99	97	...	93	..	96
EarlyMastodon	134	60	....	...	91	95
Tested 2 years.						
Renfro	86	128	...	....	....	107
Higgins	72	....	134	..	....	103
Red Cob	....	....	.	82	99	91
Golden Beauty	....	....	89	...	83	86
Evans	....	....	....	86	81	84
Tested 1 year.						
Golden Giant	125	...	....	....	....	125
Cade Prolific	....	124	....	....	....	124
Yellow Dent	117	....	....	....	....	117
Arnold	....	....	....	....	113	113
Baden	....	....	113	....	....	113
Bradbury	....	....	....	....	112	112
Peabody	108	....	....	....	....	108
Sanders	..	....	..	....	104	104
Cary Klondike	....	....	....	....	97	97
Strawberry	....	97	....	....	....	97
Giant Broad Grain	....	....	....	....	94	94
Chester Co. Mammoth	93	....	....	....	....	93
Golden Dent	....	..	...	92	....	92
Poor Man	....	....	....	...	89	89
Welborn	...	87	....	....	....	87
Cuban Giant	....	....	79	..	.	79
Sheep Tooth	....	....	....	..	75	75
Creole	....	....	...	....	74	74
Leaming	....	..	...	..	57	57
SilverMine	..	48		..		48

Among the varieties tested for 3 or more years in this series of experiments, Mosby and Cocke take first rank, their yields exceeding those of the standard by 9 and 8 per cent. respectively. Both are prolific varieties, having usually two or more small ears per plant. They are desirable varieties for bottom lands or for rich unlands provided the supply of moisture is abundant. They are not to be recommended for rather poor or dry upland, where there is a tendency to make nubbins instead of ears. Varieties with larger ears and a smaller number, as Experiment Station Yellow, Farmer's Pride, Shaw, Higgins, etc., are probably safer, or less likely to make an occasional failure on such lands, and the three last named are also suitable for bottom land.

No early variety has averaged well here, though a medium early kind has sometimes given a large yield. The late varieties contain less weevil eaten corn when harvested. The late date at which frost occurs in the Gulf States makes earliness a consideration of no special importance for corn planted at the usual time.

THE RELATION OF THE RAINFALL TO THE YIELD OF VARIETIES.

It will be noticed that the relative rank of varieties differs greatly in each year. Weather conditions, and especially rainfall, may be one year in favor of one class of varieties, and the next in favor of another type.

For example, in 1896 the early varieties as a rule surpassed the late varieties. In 1897 the opposite condition occurred, the late varieties leading. In 1898 and 1899 the influence of season was less marked. In 1900 weather conditions were decidedly favorable to the late varieties.

The chart of the rainfall (see opposite p. 108), during the past five years was prepared to throw light on the relation between the distribution of the rainfall and the yields of the early and of the late varieties.

The dates of planting of all varieties were as follows:

March 28, 1896; April 8, 1897; April 1, 1898; April 3, 1899, and April 6, 1900.

This makes the period between planting time and the beginning of the relatively abundant rains of midsummer 100, 74, 96, 107, and 112 days respectively.

Those interested in such problems and with sufficient leisure for such investigations may, by the use of the chart, trace other important relations between the rainfall and the yield of each variety.

Here we need only observe that the distribution of the rainfall is the most important climatic factor in determining the yield of corn in the Gulf States. Since this is beyond control we must depend for uniformly satisfactory yields of corn on frequent, well timed and judicious shallow cultivation of corn and on so preparing the soil and supplying it with decaying organic matter by rotations embracing cowpeas and other humus-forming crops, that the soil will be enabled to retain a sufficiency of moisture during periods of drought.

The rainfall chart was prepared under the writer's direction by T. Bragg, a student of the agricultural course, from the weather records at Auburn kept by Dr. J. T. Anderson.

This chart shows the rainfall for the six months from April to September inclusive.

The rainfall in the other six months has less influence on the yield of corn. However it is given below.

Rainfall in inches.

	1896	1897	1898	1899	1900
January	....	3.47	1.60	7.17	2.20
February	....	6.34	1.25	....	**11.09**
March	....	**10.68**	3.88	3.69	4.45
April	1.74	5.82	5.06	**2.52**	5.48
May	2.55	**1.09**	**.26**	3.06	**1.62**
June	**1.77**	3.46	**1.18**	**1.92**	**8.95**
July	**9.29**	5.01	**6.79**	**8.74**	3.22
August	2.26	6.37	**10.13**	4.78	6.69
September	5.78	**.44**	1.93	**.14**	3.50
October	1.51	2.31	**11.73**	3.42	4.87
November	7.37	2.09	6.74	2.39	5.17
December	2.38	1.91	6.08	4.75	4.73

MEXICAN JUNE CORN.

This variety has been highly recommended for very late planting, especially for occupying a field after a crop of small grain is cut. We have grown it for several years, but the late date of planting has made it impracticable to compare the yields with those of other varieties. It may be said, however, that the average yield of Mexican June corn planted late has been less at Auburn than that of the most other varieties planted earlier. For example in 1899 it was grown on soil that would easily have produced 20 to 25 bushels of the standard varieties planted early. The yield of the Mexican June was only 9 bushels per acre and it was scarcely dry enough for harvesting October 19, although planted April 21. In 1900, it was planted July 3 and yielded far less than other varieties planted early.

It makes an immense growth of stalks and leaves. On poor or medium land there is a tendency to produce only nubbins, though the shucks are of full length. It is probably valuable for forage, if fed green. We have not found much use for it.

WHERE TO GET SEED.

The Alabama Experiment Station has no seed for sale or distribution. With many varieties growing near together we could not keep varieties pure.

We refer inquirers wishing any of these varieties to the parties from whom we obtained seed, as follows:

Curry-Arrington Seed Co., Rome. Ga.: Shaw, Cade, Hickory King, Farmer's Pride, Golden Dent, Cocke, Higgins.

Alexander Seed Co., Augusta, Ga.: Cocke, Bradberry, Poor Man's, Mexican June.

H. P. Jones, Herndon, Ga.: Jones Pearl, Red Cob, Cocke, Blount, Welborn.

E. G. Packard, Dover, Del.: Chester, Hickory King, Early Mastodon ,White Sheep, Tooth.

J. C. Suffern, Woorhees, Ill.: Champion, White Pearl, St. Charles, Hickory King, Blount, Golden Beauty, Leaming, Cuban Giant, Silver Mine.

T. W. Wood & Sons, Richmond, Va.: Cocke, Hickory King, Blount, Giant Broadgrain, Klondyke.

W. H. Arnold, Thompson Station, Tenn.: Arnold, Red Cob.

Mississippi A. & M. College., Starkville, Miss.: Mosby and Evans.

Louisiana Experiment Station, Andubon Park, La.: Creole.

W. S. Sanders, Danielsville, Ga.: Sanders.

Dr. J. O. Boykin, Talladega, Ala.: Baden.

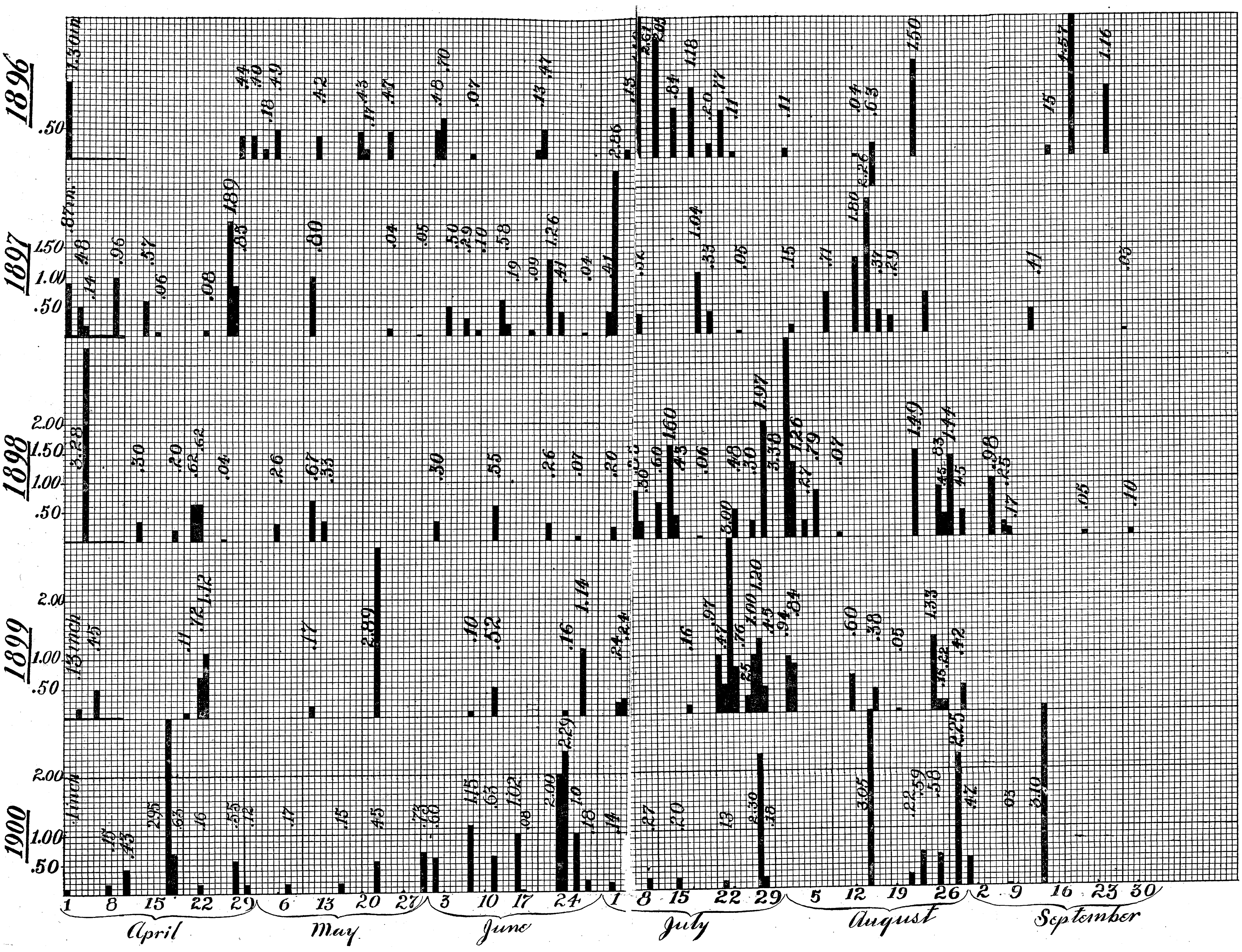
SEED CORN FROM DIFFERENT LATITUDES.

The following table gives the yields obtained in five years experiments in planting at Auburn seed corn from different latitudes.

The Georgia seed were from Curry-Arrington Seed Co., at Rome, in North Georgia and from Alexander Seed Co., Augusta, and P. H. Jones, Herndon, Ga., seed from both the latter sources being designated as from South Georgia.

Seed corn from different latitudes.

Year.	Variety.	Seed from	Yield per acre.			Increase per acre from	
			Seed from Ill.	Seed from Gulf Region.	Seed from Del. & Va.	Gulf Reg'n over Ill. seed	Va. & Del over Ill. seed.
						Bus.	*Bus.*
1896	Hickory King	Alabama. . .	....	16 5	....	—2.8	......
do	do	Illinois. . . .	19.3	....	....	......	......
do	. ...	Delaware..	. . . ..	.....	15 6		—3 7
1896	Blount Prolif	Ga. (South)	....	13.1	....	—1.1	......
	do	Illinois . .	14 2	......			
1897	Hickory King	Alabama ...	.....	12.1	....	—2.2	......
do	do	Illinois. . .	14 3		....		......
1897	Blount Prolif.	Ga (South)	....	18 9	....	— .2	.....
do	do	Illinois. . . .	19.1	....	....	. . ..	.
1898	Hickory King	Ga. (North)	.....	11.4	....	1 0	......
do	do	Illinois . . .	10 4	.....	..	. .	.....
1898	Blount Prolif.	Ga. (North)	.. ..	11.0	....	.5	......
do	do	Illinois.	10 5	....	....	....	.....
1899	Blount Prolif.	Georgia. . . .	....	17.1	....	1 9	......
do	do	Illinois. . . .	15.2	....	....	......	......
1899	St. Charles. . .	Alabama. . .	.. .	15.3	....	.8	... ..
do	do	Illinois. . .	16.1	... .	.. .	....	.....
1900	St. Charles. .	Ala. (1 year)	. ..	34.2	....	1.1	......
do	do	Illinois. . . .	33 1	. . .	....	....	......
1900	Blount Prolif.	Ga. (South)	....	32.2	....	1.9	......
do	do	Illinois.	34.1	....	....	.....	......
do	do	Virginia. . . .		....	36 8	..	2.7
1900	Cocke Prolif..	Ga. (South; J.)	....	32.6	....	....	......
do	do	Ga. (South; A.)	....	38.4 Av 36.5	....	.....	......
do	do	Ga. (North)	....	38.6	....	......	......
do	do	Virginia. . . .	. .....		41.7	....	5.2
1900	King Hickory	Virginia. . . .	.....	....	29.8	.....	5.4
do	do	Delaware. . .	. .	....	30 4	....	5.9
do	do	Illinois. . . .	24 5	....	.....	......	...



1896
1.30 in
.50
1897
.87 in.
1.50
1.00
.50
1898
2.00
1.50
1.00
.50
1899
2.00
1.00
.50
1900
2.00
1.00
.50
1 8 15 22 29
April
6 13 20 27
May
3 10 17 24
June
1 8 15 22 29
July
5 12 19 26
August
2 9 16 23 30
September

In six separate tests seed from Illinois afforded a slightly larger crop than seed corn from the latitude of the Gulf States; the average excess in these tests in favor of Northern seed was 1.5 bushels pr acre. In four tests seed from the far South proved superior to Illinois seed, the average excess being 1.1 bushels.

Averaging the ten comparable tcsts in which Illinois corn was compared with the same varieties from Alabama and Georgia, we have an average difference of only .45 of a bushel per acre in favor of Northern seed, thus placing them practically on an equality with Southern seed.

The data in the preceding table enable us to compare Illinois and Delaware seed in two instances, the variety being Hickory King. Illinois seed in 1896 gave an excess of 3.7 bushels per acre, but in 1900, a much more valuable season for corn on the Station farm, seed of the same variety from Delaware proved superior to Illinois seed to the extent of 5.9 bushels per acre, making the average for the two tests 1.1 bushels in favor of Delaware seed.

In a comparison of Illinois seed corn with that from Virginia, the latter afforded larger yields with both varieties, averaging 4 bushels per acre in excess of Illinois seed under the favorable conditions of 1900.

Seed from Alabama and Georgia has been compared with seed from Virginia several times and in the case of both varieties, Cocke Prolific and Hickory King, there has been a large advantage with the seed from Virginia; its average superiority was 4 bushels per acre. There is further confirmation of the apparent superiority of Virginia seed of these varieties in the fact that in none of the four instances where comparison was possible did the Georgia or Alabama seed closely approach the seed from Virginia in the yield afforded.

On the whole our experiments relative to the effect of climate on corn seem to favor seed from Virginia as more productive here in the case of Cocke, Blount and Hickory King than seed from any other source. However, numerous repetitions will be necessary before this tentative conclusion can be accepted as positive. Meantime the results suggest that, with suitable varieties, seed from any latitude, from Illinois southward, can be made to afford satisfactory crops in Alabama. Doubtless purity of seed is even more important than climate and it is quite possible that some of the rather poor showings made by Alabama and Georgia seed may be due to impurity of variety, the result of the seed having been grown in fields adjacent to fields of common corn, where mixing or cross fertilization would naturally occur.

BUTT, MIDDLE AND TIP KERNELS FOR SEED.

In 1898, kernels from the middle of the ear of the variety Experiment Station Yellow, from a space of about one inch at the butt end, and from an equal space at the tip end of the ear were planted, April 1, on six plots. The yields follow:

Yield obtained from planting middle, butt and tip kernels.

Kind of seed.	Yield of shelled corn per acre.
	Bus.
From middle kernels, (average of two plots)	16.3
From butt kernels, (average of two plots)	15.4
From tip kernels, (average of two plots)	16.8

The differences in yield are too slight to indicate any real superiority of seed from any particular portion of the ear. The same thing was true in our test of this matter in 1896. We feel justified in repeating the conclusion reached in Bulletins Nos. 75 and 88, as the result of a careful study of the experiments made on this point, both in Alabama and in other States.

"Taken as a whole, the experiments thus far made in several widely separated States fail to show any decided advantage in planting kernels from any special portion of the cob. This has been true even when the tip, butt and middle kernels planted had been propagated for several generations from tip, butt and middle kernels respectively."

In these experiments the tip kernels used were all sound. In the tip of the ear there is often a larger percentage of weevil eaten or defective kernels than elsewhere and in such cases the tip kernels should be rejected.

PLANTING CORN IN WATER FURROW VERSUS ON A LEVEL.

Only two plots were used, lying adjacent, on a deep sandy soil, where sorghum had grown in 1899. April 5, 1900, on one plot beds five feet wide were formed by using a one-horse turn plow. On the same date the other plot was flushed, or plowed level with the same plow. On the same day, April 5, Evans corn, a rather early variety, was planted in rows 5 feet apart, the complete fertilizer having first been applied in the drills where corn was to be planted and mixed with soil by means of a scooter plow. On the plot which had been bedded fertilizers and corn were placed in the water-furrow. On the other plot planting was done by opening a furrow in the level, flushed ground.

The plots were so thinned as to leave an equal number of plants on each. The yield of shelled corn per acre was 19 bushels when planting was done in the water furrow and 22.2 bushels when on a level.

Planting in the water furrow is common in this locality and it is thought to increase the ease of cultivation and to enable the plants to better resist drought. There was so much rain in April and June, 1900, that this method was at a disadvantage and the result under these abnormal conditions cannot be accepted as conclusive. Planting corn in the water furrow lengthens the period during which cultivation with the harrow is possible. It is practicable to plant corn in the water furrow only in well drained, light soil.

TIME FOR PLANTING CORN.

No direct experiments have been made here to determine this point. Our first planting is usually about the middle of March and extending up to the middle of April, most of it being done about the first of the last named month. A smaller amount of injury from the bud worm that preys on the root is noticed when planting is very early or very late than when done in mid-season.

Our experimental work here has been almost entirely on poor upland. On such soils very late planting, after the removal of wheat or oats, has resulted in almost entire failure of the crop except in 1898, when St. Charles planted June 16, a month after plowing in vetch vines or stubble, afforded a satisfactory yield.

In 1900, Experiment Station Yellow corn planted May 1 on ordinary upland averaged nearly 30 bushels of corn per acre, but this is apparently an unusual result, arising from the peculiar distribution of the rainfall in 1900.

Overflows late in June in 1900 made it necessary to plant considerable corn in July in numerous localities in Alabama. Such reports as we have received of these plantings have been chiefly from the bottom lands of the western part of the State. As a rule failure seems to have attended these efforts, whether the common late kind or one of the early varieties from the North has been employed.

To ascertain whether any variety would succeed when planted very late, we planted the following list of varieties July 13, 1900, on good branch-bottom soil: St. Charles, Evans, Mosby, Hickory King, Blount, Golden Dent, Champion White Pearl, Cocke & Experiment Station Yellow.

All proved to be absolute failures, making low, slender stalks, no large ears, and few and poorly filled nubbins. Smut was unusually abundant and this excessive injury from smut we have every year observed in most of our late planted corn. Corn planted after small grain has generally proved a failure, except, perhaps, on very fertile land, and even on rich soil cowpeas or sorghum grown as forage usually pays better than corn planted very late.

DISTANCE FOR UPLAND CORN.

In 1898 on a sandy loam soil, containing numerous rather small flint stones, three varieties of corn were used in a test of thick planting as compared with ordinary distances. All rows were 4 feet 8 inches apart. In the plots where the corn was "rather thick," the intervals between single plants in the row was 2.5 feet, giving 11.6 square feet per plant, which is really considerably closer than farmers usually plant corn on thin upland of this character, with a productive capacity of 12 to 20 bushels per acre. The corn designated as "thick planting" was left in thinning at average intervals of 18 inches along the row, or practically 50 per cent. thicker than in the other case. Planting was done April 1.

Experiment Station Yellow is a rather large southern variety. St. Charles seed for this test was obtained from

Illinois; the stalks are rather small, but considerably larger than those of Golden Beauty, and the variety is intermediate in earliness between the other two varieties. Golden Beauty is well known as a very early yellow variety, with very small stalks. The seed was from Illinois. The following table gives the results:

Medium versus thick planting of corn.

	Yield of shelled corn per acre.		
	Medium thickness	Thick planting.	Increase with thick planting.
	Bus.	*Bus*	*Bus*
Experiment Station Yellow. . .	21.2	22 8	1 6
St. Charles	16 4	17 7	1.3
Golden Beauty.	10 5	12 8	2.3
Average, 3 varieties.	16.1	17 8	1 7

With all varieties there was an advantage in close spacing. This benefit was naturally most marked in the case of Golden Beauty, the variety having the smallest plants, best able to bear crowding. No cowpeas were grown between the corn rows, though this double cropping is generally advisable on thin land where wide rows are a necessity.

The following quotation from Alabama Experiment Station Bulletin No. 88 gives the results of our earlier work relative to the best thickness for corn; the experiments of 1896 and 1897 were made on sandy, poorer land than was the test detailed above, and in that sandy land there were no stones.

"Yield of corn when plants stood at different distances apart.

DISTANCE		Number of plants per acre.	YIELD PER ACRE		
Between rows.	Between plants.		1896	1897	Average 2 years.
			Bus.	*Bus.*	*Bus.*
5 feet	4 feet	2,178	12.4	15 3	13.9
5 seet	3 feet	2,904	12.9	15 7	14 3
5 feet	2 feet	4,356	9.8	16.7	13.3
6 feet	2 feet 6 in.	2,904	13.1	15 5	14.3
4 feet 10 in.	3 feet 1½ in.	2 904	15 6	16.7	16.7
4 feet	3 feet 9 in.	2,904	16.9	17.8	17.4

In both seasons the yield was largest when the constant area devoted to each plant approached a perfect square in shape. In other words, a plant having 15 square feet of space was most productive when so planted that the distance in the drill nearly equaled the distance between rows.

This distance of 4 feet by 3 feet 9 inches affords the largest average yield for two years, but for cheapness of cultivation rows 5 feet wide, with plants about 3 feet apart, are to be preferred to narrower rows on such soil as that used for this test. On poor land a row of cow peas should usually be planted between the corn rows, which was not done in this experiment. With a row of cow peas between the corn rows the distance should be at least 5 feet on such lands as this."

In none of these seasons was there a sufficiency of rain. Doubtless if cultivation had been somewhat neglected, or delayed long after a rain, the corn that was planted close together would have made a less favorable showing. Thin planting of corn is safest, so far as making a medium yield, but somewhat thicker planting than usual seems advisable where a maximum yield is desired and where cultivation is prompt and thorough.

CULTIVATION EXPERIMENTS.

Two series of experiments with cultivation were conducted in 1900, one with corn planted early, the other with corn planted late. The results of the test with early corn were rendered worthless by want of uniformity in the soil, and are omitted here.

The experiment here reported was made with Experiment Station Yellow corn planted May 1, on a field where cowpea roots and stubble had been plowed in a few weeks before this date. The fertilizer per acre consisted of 209 pounds of acid phosphate and 24 pounds of muriate of potash. The same number of plants, in rows 4 feet 3 inches apart, was left on all plots.

Deep versus shallow first cultivation. Three plots (Nos. 37, 40, 41) were cultivated deep May 17, which required 5 trips per row,—2 with a scooter running near the plants and 3 with a straight shovel, breaking the middles to a depth of about 4 inches. All subsequent cultivations, given at the same time as in the other plots mentioned in this paragraph, were shallow.

Plots 42 and 48 received shallow cultivation throughout, using, as in all shallow culture plots, the heel scrape. The dates of cultivation of both series were May 17, 3 furrows (5 for deep culture plots); June 2, 2 furrows; June 6, 2 furrows; June 15, 2 furrows; June 20, 2 furrows; June 30, 2 furrows; July 11, 2 furrows.

There were 15 cultivation furrows for the shallow culture plots and 17 for the deep. The unusually frequent cultivation was due to the frequent rains, the aim in this series of plots being to stir the soil whenever a crust should begin to form. Rain fell immediately after the cultivation of June 2 and June 6, and almost immediately after that of June 15, thus requiring their repetition, in other words causing us to give several cultivations in excess of what is necessary in ordinary seasons.

The following table gives the yields in bushels of corn per acre:

First cultivation deep, others shallow.		All cultivation shallow.	
	Bus.		*Bus.*
Plot 37	27.4	Plot 42	30.7
" 40	30.1	" 48	27.3
" 41	31.8		
Average	**29.8**	Average	**29.0**

The average difference is .8 bushel per acre in favor of making the first cultivation deep. This is no greater than the error which may arise from slight variations in the fertility of the plots. We must conclude that in a season of frequent rains deep cultivation when confined to the first working of corn was not notably injurious. It should be said, however, that on the Station farm, both on light gray and stiffer reddish soils, we cultivate shallow from the first, and think that in so doing we get better results than by the deep "running around" with a scooter, which is so customary.

Effects of late cultivation.—Plots 39 and 43 were cultivated in the same manner and at the same dates as plots 42 and 48 in the preceding section, except that they were "laid by" June 30, while the latter received one additional cultivation, July 11.

The following table gives the yields of corn in bushels per acre:

Last cultivation, June 30.		Last cultivation, July 11.	
	Bus.		*Bus.*
Plot 39	27.5	Plot 42	30.7
Plot 43	27.4	Plot 48	27.3
Average	**27.5**	Average	**29.0**

Here is a gain of 1.5 bushels per acre apparently attributable to the last cultivation of 2 furrows per row. This is the more noteworthy in view of the absence of any considerable rain after the early "laying by" and before the late "laying by."

Observation suggests that corn is frequently laid by too early. We doubt that the appearance of tassels is an indication that cultivation, in all cases, should cease. We do not hesitate to cultivate tasseled corn if a crust is forming. Of course late cultivation is only advisable when the work is very shallow.

Frequency of cultivation.—This experiment embraced four series of plots, all cultivated shallow from the beginning, the heel scrape being the only implement used. The plan, from which rains, and the writer's occasional absence, made some deviation necessary, was as follows:

Plots.	To be cultivated	Actually cultivated.
42 & 48	When crusting	M. 17; J'e. 2, 6, 15, 20, 30; J'y 11
45 & 50	Every 7 days	M. 17, 23, 30; J'e 6, 15, 20, 30; J'y 11
44 & 49	Every 14 days	M. 17 & 30; J'e 20; J'y 4
46, 47, & 51	Every 14 days, in alternate middles only.	M. 17 & 30; J'e 6 & 15; J'y 11

On all plots the cultivation of May 17 required 3 furrows, and each subsequent cultivation 2 furrows per row. The total number of furrows per row during the entire season was as follows:

15 furrows for cultivation when crusting; 17 for weekly cultivation; 9 for cultivation every 2 weeks; and 6 for working of alternate middles every 2 weeks.

Effects of frequency of cultivation of corn.

Plots.	When cultivated (approximately.)	No trips per row.	Separate yields. respectively.	Average yield per acre.
			Bus	*Bus.*
42 & 48....	When crusting..	15	30.7—27 3	**29.0**
45 & 50 ..	Weekly	17	31 0—29.5	**30.3**
44 & 49	Every 14 days ...	9	30 4—27.0	**28.7**
46, 47 & 51.	Every 14 days in alternate middles	6	26.0—25.9—29.1	**27.3**

The best yield was made with the greatest number of furrows, that is with weekly cultivation. Working only when a crust was forming saved 2 furrows and apparently lost 1.3 bushels of corn. Cultivation at intervals of about two weeks lacked 1.6 bushels of affording the same yield as weekly working. The loss when only alternate middles were stirred infrequently was 3 bushels as compared with the stirring of entire soil areas at the same dates.

No experiments in methods of cultivation can be expected to be conclusive in a wet year like 1900, for the effect of frequent rains is to equalize all plots, effecting for both poorly and well tilled plots just what judicious cultivation ordinarily does, viz. providing an adequate supply of moisture.

While awaiting the results of a repetition of these experiments we may infer that since the effects of good cultivation were apparent in a wet year that they would be much more marked in a dry or even in an ordinary season.

NUMBER OF FURROWS PER ROW FOR CORN.

Lest some should misunderstand the preceding experiment and assume that we ordinarily give as much cultivation to corn as 15 furrows, we give the number of furrows per row in other fields of corn, planted at the usual time. Let it be remembered that the several yields given do not represent differences due to the frequency of cultivation, because soils, fertilizers, dates of planting, etc., vary.

Seven furrows per row during the entire season, in 4 cultivation, 1 rolling and 1 harrowing before planting, 1 harrowing after corn came up, and 1 hoeing and thinning, constitute the work of cultivating the corn in the "methods of harvesting" experiment of 1900, where the yield averaged 45.3 bushels per acre on upland.

The number of furrows in some other experiments was,—7 (in 4 cultivations) in the variety test in 1900, where the yields ranged between 19.9 and 41.7 bushels per acre; 7 in the test of cowpeas as fertilizers for corn, where the yields ranged from 18 to 28.9 bushels of corn; and 9 (in 4 cultivations) for the corn grown in the rotation experiment in 1900. In all these cases the harrow was used for the first cultivation, thereby decreasing the number of furrows with one-horse implements.

In 1899, with a very different season, the number of furrows per row required by corn averaged higher. For example the corn in the variety test that year had 12 furrows (distributed through 6 cultivations), besides 1 harrowing.

It is false economy to omit a cultivation when the ground is crusting; it pays to be liberal in the number of cultivations, even though six be required. But it pays to be sparing in the number of trips per row at each separate cultivation. Never, except possibly at the first cultivation, use an 18-inch scrape where a 24-inch or larger one will do equally effective work. As for the use of the scooter and narrow straight shovel as cultivating implements, they are time killers and profit consumers, even if the injury to the roots is repaired by seasonable rains. With the heel scrape for mellow land, shallow working wing shovels for hard soils, and among more expensive implements a vast array of cultivators, we fail to find the reason for employing the scooter and its kind in cultivation.

METHODS OF HARVESTING CORN.

The experiment described below had two ends in view, (1) to ascertain the productive capacity of sandy, stony upland for corn when the corn was highly fertilized and the crop worked in the best possible manner, and (2) to compare the yields of grain and forage resulting from stripping the blades, topping the stalks, cutting and shocking the entire growth, and leaving all the forage in the field, harvesting only the ears.

Let us first consider the productive capacity under favorable conditions of this grade of land, the average yield of which in this vicinity is usually less than 12 bushels per acre. In the years immediately preceding this test it had been used for various experiments, as follows:

In 1896 it was quite poor, having been in constant cultivation for many years. At that time it was overrun with Bermuda grass. The chief aim in the treatment of this land during the next few years was to destroy Bermuda grass, and incidentally to use the land for experiments with small grain and cotton. The improvement of the soil was kept in view, but was subordinated to the aims just mentioned.

In January, 1896, this field was sown to oats, which, with the aid of 240 pounds of commercial fertilizer, yielded only 10.4 bushels per acre, which may serve as a measure of the productiveness of the land at that time. Cowpeas were sown broadcast after the oats, making but a poor growth. The peas were picked and the vines plowed under, and rye sown in November, 1896. The rye was cut and threshed and in the summer of 1897 broadcast cowpeas were again grown, this time making a luxuriant growth. After the peas were picked, cattle grazed on the vines.

Twice in the early months of 1898 the land was plowed, using scooters both times in preference to turn plows so as to leave the Bermuda roots exposed on the surface of the ground.

In 1898 cotton was the crop, and there was used a mixture of acid phosphate, cotton seed meal, and kainit, the mixture being employed at the rate of 480 pounds per acre, applied by various methods. The average yield of seed cotton was 1,270 pounds per acre, the best plot making 1,454 pounds. In 1899 cotton was again grown and the cultivation of these two cotton crops, with the winter treatment adopted, exterminated the Bermuda grass. The fertilizers used under this piece of cotton in 1899 averaged per acre 212 pounds of phosphate and 1,792 pounds of stable manure. The average yield was 1,329 pounds, or nearly a bale, of seed cotton per acre.

The preparation of the land for corn in 1900 and the fertilization of the corn, which was several times heavier than is our custom, were as follows: March 22 the land was plowed with a one-horse turn plow to a depth of 4 inches. A Chattanooga subsoil plow, drawn by two mules, followed in this furrow, loosening the soil to an additional depth of 6 inches. The subsoil plow left undisturbed strips of hard soil between each pair of subsoil furrows. Cotton seed, which had been killed, was scattered broadcast at the rate of 732 pounds per acre, and after the first rain was cultivated in. Just after the land was subsoiled it was rolled and harrowed and the harrowing was repeated after every rain to hold the moisture. Just before planting there was applied in the drill and thoroughly mixed with the soil 256 pounds of acid phosphate per acre, an equal quantity of cotton seed meal, and 64 pounds of muriate of potash. April 9 Mosby corn was planted about 2½ feet apart in rows 4 feet 4½ inches apart. Before covering the corn nitrate of soda was dropped about 8 inches from the hill of corn, using it at the rate of 100 pounds per acre.

Cultivation consisted of one harrowing across the rows, April 26, of 4 cultivations with a heel scrape, the total number of furrows per row being 7, and of one hoeing, which also served for thinning.

The cultivation was so timed as to come soon after a rain, thus preventing the long continuance of a surface crust, which would have wasted the moisture. The average yield of shelled corn was 45.3 bushels per acre. The corn was grown under field conditions,—that is solid, or without any spaces between plots or any outside rows.

This yield of 45.3 bushels of corn per acre on high sandy, rocky soil was obtained only by exceptionally favorable weather conditions, thorough preparation, timely and judicious shallow cultivation, and what would generally be excessive fertilization.

On every fourth row the corn plants were stripped of their blades August 8, when in the late "fodder-pulling" stage.

August 16 the tops just above the ear were cut from every fourth row, the lower leaves (then badly "fired") being undisturbed, and the corn was pulled September 22.

August 18, on every fourth row the entire plants were cut and immediately shocked. The shocks were left in the field until September 22, when the ears were pulled. The stalks, which showed some dampness towards the lower end which had been in contact with the ground, weighed 1,759 pounds per acre.

September 22 the ears were pulled from another set of rows on which neither leaves nor top nor stalk had been harvested, and also on the same date the ears were pulled from the topped stalks standing in the field and from the shocked corn.

Let us consider first the yield of forage obtained by the different methods of harvesting.

The blades, or "fodder," pulled August 8 were cured in fair weather in the usual way, the green blades being immediately tied into "hands," and these tied into bundles and weighed on August 10, the actual number of hours of sunshine required in curing being 12. The yield of this *cured* "fodder," weighed in its fresh condition, or just after being bundled, was 615 pounds per acre.

The tops, cut August 16, were weighed immediately after curing, which consisted in leaving them exposed in small loose piles or "hands" to 15 hours of actual sunshine. Their weight was 711.4 pounds per acre. As stated above the yield of cured stover (entire plant after the ear is removed) was 1,759 pounds per acre.

Negro laborers, not in any way pushed, "pulled fodder" at the rate of one acre in 19.8 hours, or practically half an acre a day. With thinner, smaller, less leafy corn, and more active laborers about twice this area can be stripped in a day.

One of these same hands, entirely unaccustomed to handling shocked corn, pulled the ears, about 45 bushels, from the shocked corn at the rate of one acre in 10 hours and 8 minutes. It is probable that with practice this speed could be considerably increased.

The time required in topping,—much less than in stripping,—in cutting corn, in "tieing fodder," in pulling the ears in the field and in hauling was not recorded. Apparently the labor of cutting corn required no more time than topping, and less than fodder pulling.

The following table gives the yields of corn in 1900 accompanying the several treatments of the corn forage.

Yield per acre of corn and forage from different methods of harvesting in 1900.

METHOD OF HARVESTING.	Corn per acre.	Forage per acre.
	Bus.	*Lbs.*
Only ears harvested	46.9	00
Tops cut and ears harvested	44.2	711 (tops)
Entire stalks cut and ears afterwards harvested	44.3	1759 (stalks)
Blades stripped and ears harvested	45.9	615 (blades)

In 1900, with a luxuriant growth and an abundance of moisture, there was a reduction of only one bushel per acre in the yield of corn as the apparent result of stripping the blades. Contrary to the results of previous experiments here and elsewhere the yield of grain was slightly less when the plants were topped or cut and shocked than when stripping was practiced. The apparent effect of all these methods of utilizing corn forage was to slightly reduce the yield of grain, stripping by 1 bushel, cutting by 2.6 bushels, and topping by 2.7 bushels per acre.

The following table gives the yield per acre both of grain and forage for 3 years on the plots differently treated:

Yield per acre of corn and forage from different methods of harvesting.

METHOD OF HARVESTING.	Corn per acre.				
	1896	1897	1900	Average. 3 yrs.	Average. Loss
	Bus.	*Bus.*	*Bus.*	*Bus.*	*Bus.*
Only ears harvested	34.4	31.0	46.9	37.6	.....
Tops cut and ears harvested	30.2	29.2	44.3	34.6	3.0
Entire stalks cut and ears afterwards harvested	29.2	29.5	44.3	34.3	3.3
Blades stripped and ears harvested	......	. .	45 9	....	.....

Our average results for three years show a loss of 3.3 bushels per acre when corn is cut and shocked, and 3 bushels per acre when it is topped, taking as a standard the yield of corn where no forage is harvested.

The yields of forage are given in the following table:

Yields of cured corn tops, stover, and blades.

	Yield per acre.				Assumed value of forage per 100 lbs.	Value forage per acre.	Value forage and corn.*
	1896	1897	1900	Aver'ge 3 yeas.			
	Lbs	*Lbs*	*Lbs*	*Lbs.*	*Cents.*	$	$
Tops	312	509	711	511	40	2.04	19.34
Stover	2103	1355	1759	1739	30	5.22	23.22
Blades, or fodder	....	...	615	....	60	......	....
No forage harvested	...	....	....	....	....	......	18 80

* Corn estimated at 50 cents per bushel.

The average yield for three years is 511 pounds of cured corn tops per acre against 1,739 pounds of cured stalks or stover. Assuming—in the absence of exact experiments in feeding tops and stalks,—that tops are worth 40 cents, stalks 30 cents per 100, and corn 50 cents per bushel, we find that the topped acre gives a combined value of tops and corn only 54 cents above the value of the corn alone on the acre from which no forage was harvested. This makes topping unprofitable under these conditions, for the labor of topping would cost more than 54 cents per acre and the tops if left uncut would have some slight value when eaten by cattle turned into the corn fields after corn is harvested.

Comparing cutting and shocking with harvesting only the ears, we find the value of the cut stalks and ears borne by them give a total value of $23.22 per acre, against $18.80 when only the ears are pulled. The difference in favor of cutting the stalks is therefore $4.42 per acre. This is sufficient, after defraying the cost of cutting, shocking, and hauling the stalks and the extra expense of pulling the ears from shocked corn, (which we find to be a slower operation than pulling ears from the standing stalks),—to leave a balance in favor of cutting the stalks.

Where a shredding machine capable of removing the ear by machinery is available, there is a decided advantage in cutting the stalks over any other method of handling corn. It should also be borne in mind, in any comparison of cutting corn with the more usual methods of harvesting the crop, that there is a decided advantage in the matter of convenience in cutting corn. This can be done before cotton picking begins, a merit that will be generally recognized. Moreover the cutting of the stalks leaves the land in better condition for plowing, and enables the farmer to begin the plowing for small grain at an earlier date than is practicable when the ears are allowed to cure slowly on the living plants. The removal of the stalks is somewhat more exhaustive to the land than is burying them with the plow, but this is on most soils more than counterbalanced by the greater convenience of preparing and cultivating land that is free from stalks.

The single experiment made here in 1900 relative to the effect of stripping the blades from the corn plant is not sufficient to show the usual effect of that process. In this case the yield was reduced by only one bushel per acre when the blades were stripped off, while the average of many experiments made in the South gives an average loss of nearly three bushels per acre when "fodder" is pulled.

LIME AS A FERTILIZER FOR CORN.

March 11, 1898, on plowed land 2,000 pounds of lime per acre was applied broadcast and harrowed in. The above figure refers to the weight of the quicklime, which was water-slacked before being applied, so that the actual amount of slacked lime employed was much greater. An adjacent plot was not limed. Both received the same fertilizer, viz.: 231 pounds of acid phosphate and 78 pounds of cotton seed meal per acre. The land had grown up in broom sedge and bore also a rather light growth of Japan clover or *Lespedeza striata* in 1897.

Corn was planted March 21, 1898, and at the next to the last cultivation Wonderful cowpeas without fertilizers were drilled in the "middles" between the corn rows.

The yields per acre were as follows:

Corn on limed plot......................10.8 bushels.
Corn on plot not limed..................11.8 bushels.

With cowpeas growing between the corn rows the results were even more unfavorable to the application of lime, the yield of peas without lime being 11.1 bushels and with lime only 8.7 bushels per acre.

The soil on which the above experiment was conducted was a sandy loam, containing many small flint stones.

This field was selected for the experiment with lime because it was thought that the presence of the vegetable matter in the broom sedge and lespedeza would allow the lime to exert its maximum effect. However, it might be claimed that the application of this amount of lime was made too late and that the apparent injury was the result of caustic action which would have been avoided if the lime had been applied some months before planting.

In a second experiment with lime the application was made to very sandy gray soil 17 months before the corn was planted and the amount used was only 1,200 pounds per acre of air slacked lime. This was spread broadcast on plowed ground in November, 1898, and harrowed in. The ground remained practically bare all winter and the following summer was planted with beggar weed and drilled velvet beans, fertilized with acid phosphate and muriate of potash. On some plots the entire growth of velvet beans was used as a fertilizer, on others only the light second growth of bean vines, and on others only the stubble.

March 31, 1900, all plots were plowed and on April 5 Mosby corn was planted and fertilized with 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre. The soil is very sandy, free from stone, and naturally poor and thirsty. It occupies an elevated hilltop. The following table is arranged in such a way as to show the effect of lime (applied 17 months before planting corn) in connection with the different amounts of vegetable matter that had accumulated in the soil after the application of the lime and before the planting of corn.

Effects of lime on corn, with various amounts of vegetable matter in the soil.

Amount and kind of vegetable matter plowed under in March, 1900.	Yield of corn per acre.		
	Not limed.	Limed 17 mos. before	Increase on limed plots.
	Bus.	*Bus.*	*Bus.*
Very little; stubble of velvet beans	15.5	15.7	0.2
Little; 2nd growth of velvet beans.	16 8	15.7	1.1
Medium amount; beggar weeds..........	20 2	17.2	3.0
Large amount; velvet bean vines, entire....	28.9	26.1	2.8

The results show that where only small amounts of vegetable matter were present the effects of lime were very slight. When there was present a considerable amount of vegetable matter there was an average increase of 2.9 bushels of corn per acre on the limed plots.

The benefit derived by corn from lime, applied nearly two years before, may have been due to the fact that lime favored the growth of velvet beans, (as the record for 1899 plainly shows), thus leaving for the corn plants a larger amount of vegetable matter on the limed plots. Or it may have been due to more rapid and complete decay and nitrification of the vegetable matter effected by the lime that remained in the soil.

On the whole these experiments suggest that corn is not especially a lime-loving plant and that only when large amounts of vegetable matter are present is it a desirable fertilizer for corn on our sandy upland soils, which are not sour.

Stubble versus vines of velvet beans as fertilizers for corn.—The first experiment mentioned below is the same as one of the tests discussed under the head of liming. (See p. 129). On a very sandy soil there was planted in the late spring and early summer of 1899 velvet beans in drills on certain plots and beggar weed, sown broadcast, on others. The beggar weed and a portion of the velvet beans was used exclusively for fertilizer. On other plots velvet beans were cut once, the light second growth being left for fertilizer. On still other plots two cuttings of velvet beans were made, thus leaving only the stubble as fertilizer for corn. These various fertilizing materials were all plowed under March 31, 1900, and Mosby corn planted April 5, using per acre 240 pounds of acid phosphate and 40 pounds of muriate of potash. As stated elsewhere, half the plots had been lightly limed 17 months before the corn was planted.

Vines versus stubble of velvet beans as fertilizer for corn in 1900.

Plots	Material used for green manuring.	Yield of corn per acre.	Increase over stubble plot.
		Bus.	*Bus.*
4 & 9	Stubble of velvet beans	15.6	....
5 & 10	Second growth of velvet beans	16.8	1.2
3 & 8	Entire growth of velvet beans	27.5	11.9
2 & 7	Entire growth of beggar weeds	18.7	3.1

The entire growth of velvet beans afforded a yield of corn greater by 11.9 bushels per acre than the yield where only the stubble was employed as fertilizer. In this case it was more profitable to use velvet bean vines for fertilizers than to harvest them for hay, for the average yield of hay in 1899 was only 2,800 pounds per acre, and this was cured with great difficulty and considerable cost, and the hay was not of good quality in this particular instance.

Unfortunately there was not room for a plot entirely without green manure, that might serve as a basis for ascertaining the extent of the fertilizing effect of both the stubble and vines. However the yield of a plot similarly fertilized and on similar soil, about 100 yards away, was less than 5 bushels per acre, and though the varieties were different (but of nearly equal productiveness in the variety test of 1900) we are able to conclude that even the stubble of velvet beans greatly increased the yield, probably about 8 bushels per acre and that the vines of velvet beans enormously increased the yield, probably by about 20 bushels.

COWPEAS AS A FERTILIZER FOR CORN.

In 1897, on reddish loam soil, a test was made of the Wonderful or Unknown, Clay and Whippoorwill varieties of cowpeas, planted in drills and cultivated. On one plot soja, or soy, beans were planted, but as no stand of soy beans was obtained this plot was cultivated without a crop, that is, kept clean or fallow.

The varieties of cowpeas occupied five comparable plots lying on both sides of the fallow plot. The peas were picked at the usual time and in April, 1898, the vines were plowed in as fertilizer for corn.

The yields of corn on the five plots where pea vines had been plowed in did not vary widely and the average yield of these plots was 20.1 bushels per acre. The corn having no cowpeas preceding it,—the plot having been cultivated but kept bare in the summer of 1897,—yielded 17.1 bushels. This is an increase of 3 bushels per acre, or 17 per cent., attributable to the use of peavines as fertilizer. The increase would doubtless have been still greater but for the fact that nitrate of soda at the rate of 67.5 pounds per acre was used on corn on all plots.

RESIDUAL FERTILIZING EFFECTS OF VELVET BEAN AND COW-PEA STUBBLE AND VINES.

We are concerned not only with the fertilizing effect exerted by cowpeas and velvet beans on the crop of corn which immediately succeeds them, but also with learning whether this beneficial effect extends to a crop grown the second year after these soil-improving plants. Naturally the permanency of the improvement effected by plowing under leguminous plants varies with the kind of soil, the most lasting effect being obtained on stiff soils and the least permanent benefit occurring where the soil is sandy.

The soil on which the following experiment was made belongs at neither extreme. It is a sandy loam, containing many small flint stones, and is a little stiffer than the soil on which the first-year effects of velvet beans as a fertilizer for corn were tested in 1900. (See p. 130).

In 1898 eight uniform plots, separated by alleys 3½ feet wide, were planted, 2 plots with velvet beans, 5 with Wonderful cowpeas (most plots broadcast), and 1 with drilled Orange sorghum. The growth of the several plots was either cured for hay or used as a fertilizer, as indicated in the next table.

March 9, 1899, all plots were plowed and in due time sorghum was planted in drills on all plots, and this crop at the proper season was cured for hay.

March 17, 1900, the sorghum stubble was turned with a one-horse plow and March 29 corn was planted on all plots. The fertilizer for corn consisted of 240 pounds of acid phosphate and 32 pounds of muriate of potash per acre. No nitrogenous fertilizer had been used here on any plot during 1890, 1899, or 1898, except on one plot in 1898, where 125 pounds of cotton seed meal per acre was used as a part of the fertilizer for sorghum.

With this exception the fertilization of each of the plots has been uniform during all of the last four years, consisting of phosphate and potash, as mentioned above.

Fertilizing effects in 1900 of stubble and vines of cowpeas and velvet beans grown in 1898.

Plot.	Crop in 1898.	Portion used for fertilizer.	Corn per acre in 1900.		
			Yield.	Increase over sorghum plot of 1898.	Increase, vines over stubble.
			Bus.	*Bus.*	*Bus.*
8	Sorghum.....	Stubble..............	24.1	....	....
4 & 7	Cowpeas.	Stubble.............	25.7	1.6	....
3 & 6	Cowpeas.	Vines, after picking.	27.7	3.6	2.0
2	Velvet beans.	Stubble.............	23.9	0.2	....
1	Velvet beans.	Entire growth	26 8	2.6	2.4

Let it be noted that the heavy growth of sorghum in 1899 did not utilize all of the fertility derived from the preceding crop of legumes. Although sorghum is a plant that is especially exhaustive to soil fertility, there still remained for the corn crop of 1900 a residue of nitrogen from the cowpea and velvet bean vines of 1898 sufficient to increase the yield of corn to the extent of 3.6 bushels per acre where cowpeas had grown two years before, and 2.6 bushels where velvet beans had grown. This is an average of 3.2 bushels per acre as the residual fertilizing effect of these legumes.

The fertilizing effects, of the stubble and roots of these two plants was far more transitory, the first succeeding crop, sorghum, practically exhausting them, leaving sufficient in the soil to increase the corn crop of 1900 by only an inconsiderable amount, viz.: 1.6 bushels and .2 bushel, an average of .9 bushel per acre. This accords with other experiments which we have made, in showing that on our sandy soils the fertilizing effects of the stubble and roots of leguminous plants, while highly favorable to the immediately succeeding crop, do not extend in any considerable degree to subsequent crops. This fact has an important bearing on the question of rotation.

RESIDUAL EFFECTS OF VELVET BEAN STUBBLE AND VINES AS FERTILIZERS FOR CORN; SECOND EXPERIMENT.

An experiment similar to the preceding was made by growing velvet beans in 1898 on soil similar to, but somewhat poorer than that on which the last-mentioned test was made, and planting adjacent and similar plots in cotton in 1898.

In 1899 cotton, fertilized uniformly, was grown on both sets of plots and the average yield following velvet beans was 1,578 pounds of seed cotton per acre against only 918 pounds where cotton followed cotton. Here was a gain of 660 pounds of seed cotton per acre as the immediate, or first-year, result of using velvet bean vines as a fertilizer.

The residual, or second-year, effects were tested on corn planted March 29, 1900, without any nitrogenous fertilizer.

Where cotton had grown in 1898 the yield of corn in 1900 was 18 bushels per acre; on the next plot, where velvet beans had been grown for fertilizer in 1898, the yield of corn in 1900 was 25.5 bushels. This gain of 7.5 bushels per acre represents the residual or second year effect of using the entire growth of velvet beans as a fertilizer.

As a fertilizer the entire growth of velvet beans of the crop of 1898 proved superior to the stubble and vines to the extent of 112 pounds of seed cotton per acre in 1899 and to the extent of 2.2 bushels of corn per acre in 1900.

Vetch versus small grains as green manure for corn.

In the fall of 1898 on gray sandy soil, a number of plots, each one-twelfth acre, were sown with hairy vetch, rye, oats, and a mixture of vetch and oats. In April and May, 1898, certain of these plots were cut so as to compare the yield of forage made by these different plants. We are concerned here not especially with the yields of hay, but rather with the fertilizing effect of the vetch vines, vetch stubble, rye, rye stubble, etc.

The following table gives the data for the crops sown November 4, 1897, as fertilizers for the corn crop of the following summer, and also the yields of hay on plots harvested, and of the two succeeding corn crops on each plot, both in 1898 and in 1899. A clearer presentation of the fertilizing effects of the several crops is afforded in a shorter table following the one below.

No nitrogenous fertilizer was used on any plot in the fall of 1897, but all plots except the two vacant ones and except Nos. 15 and 16, received at that time 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre.

In 1898 St. Charles corn from Illinois was planted June 16 and fertilized, on all plots, with 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre. The corn that was planted March 20, 1900 (variety St. Charles) was fertilized with 200 acid phosphate and 100 pounds of cotton seed meal per acre.

Yields of corn following vetch, vetch stubble, rye, rye stubble, etc.

Plot	Seed sown Nov. 4, 1897. Am't per acre.	Seed sown Nov. 4, 1897. Kind.	Portion used as fertilizer.	Yield of hay in April & May, 1898.	Yield of corn per acre. In 1898	Yield of corn per acre. In 1899
	Qts.			*Lbs.*	*Bus.*	*Bus.*
1	36	Rye	Stubble	1980	11 4	18.8
2	36	Rye	Whole plant	....	8.4	21 0
3	30	Hairy vetch	Whole plant.	....	16.6	22.9
4	......	Left bare, & fall plowed.	Weeds	....	15.0	18 2
5	{ 21 30	Hairy vetch Turf oats	Stubble	3000	11.1	19.9
6	30	Hairy vetch	Stubble	2784	16.8	21 7
7	60	Turf oats	Stubble	1920	6.1	18.7
8	30	Hairy vetch, not inoculated	Whole plant (failure.)	....	14.2	19.6
9	30	Hairy vetch	Whole plant.	....	15 8	21.7
10	30	Hairy vetch	Stubble.	3180	14.5	19 2
11	30	Hairy vetch, not inoculated	Stubble (failure.)	564	18 0	19.7
12	30	Hairy vetch	Stubble.	3350	19 1	22.6
13	30	Hairy vetch	Whole plant.	....	17.2	24.1
14	.....	Left bare, & fall plowed.	Weeds	....	15.4	18.6
15	30	H. vetch; ½ fertilizer.	Stubble	2604	16.2	18.6
16	30	H. vetch; no fertilizer	Stubble	2244	15.9	19 6

In the following table the preceding one is summarized so far as concerns the fertilizing effects of the several plants used as green manures, as determined by the yield of corn in 1898, that is, by the corn crop immediately following the green manuring plants.

Average results from use of vetch, etc., as green manure for corn.

Plots.	Green manuring plant. April and May, 1898.	Corn per acre, in 1898. Yield.	Corn per acre, in 1898. Increase over P. 2, rye.	per cent. Increase
		Bus.	*Bus.*	
1	Rye stubble	11.4	3 0	36
2	Rye, entire plant	8.4	....	....
7	Oat stubble	6 1	2.3	27
5	Oats and vetch stubble mixture	11.0	2.6	31
4 & 14	Left vacant & fall plowed, weeds	15.2	6.8	81
6, 10, 12	Hairy vetch stubble	17.5	9.1	108
3, 9, 13	Hairy vetch, entire plant.	16.6	8.2	98

The above table shows that vetch was superior to rye as fertilizer to the extent of 8.2 bushels of corn per acre, an increase of 98 per cent.; that vetch stubble afforded a still larger yield of corn the first season, or 9.1 bushels more than was obtained on the rye plot. If it be asked why the stubble of both vetch and rye was more favorable to the succeeding corn crop than was the entire growth, the answer would seem to be found in the statement that the stubble of the vetch afforded sufficient nitrogen for the corn and that the plowing in of large masses of vegetable matter in May into a sandy soil may have made the ground too loose and dry, interfering with the capillary movement of moisture in the soil.

Notice, in this connection, that there was a smaller yield of corn after oat stubble and after rye than after rye stubble. There is every reason for assuming that these smaller yields were due to dryer soil, resulting from the fact that the oats and uncut rye continued to exhaust the moisture of the soil up to the time when the land was plowed, May 10, while the rye on the "rye stubble plot" was removed a month earlier, thus checking the loss of moisture from this latter plot by removing the plants which would have exhausted it in transpiration.

If we take as a basis the yield of corn in 1898 on the plot where rye stubble was plowed in, we have this yield increased by 54 per cent on the "vetch stubble plots" and by 46 per cent on the plots where the entire growth of *vetch* was used as green manure. On page 206 of Bulletin No. 96 is a statement of the amounts of nitrogen in the green manuring material on an acre in this experiment, viz: 26 pounds in the entire growth of rye, 105.5 pounds in the entire growth of vetch, and 19.9 pounds in the roots and stubble of vetch.

Residual, or second-year, fertilizing effects of vetch and rye.—It was desired to ascertain whether the various plants (vetch, rye, etc.) used as green manures had exhausted their fertilizing effect the first year, or whether the second corn crop would also be helped by any unused fertilizing material which they might leave in the soil. To ascertain the full amount of this residual effect no nitrogenous fertilizer should have been used on the second corn crop, planted March 20, 1899. However, we were dependent on that field for part of the corn needed to feed the farm teams and could not well afford the low yield of corn which would undoubtedly have been obtained on some plots if nitrogenous fertilizers had been withheld. Hence, in 1899 there was used on all plots 100 pounds per acre of cotton meal as well as 200 pounds of acid phosphate per acre.

The yields of the second crop of corn after vetch, etc., that is of corn in 1900, averaged as follows:

After rye stubble .. ..18.8 bushels per acre.
After rye plowed in, May, '98....21.0 bushels per acre.
After vetch stubble..............21.2 bushels per acre.
After vetch, plowed in, May, '98...22.9 bushels per acre.

The use of cotton seed meal on the corn obscures the results, making the superiority of vetch as a fertilizer less than it would otherwise have been. However, even at this disadvantage, the plots on which the entire growth of vetch had been plowed in yielded 1.9 bushels of corn more than did the plot where at the same time the entire rye plant had been used as green manure.

All plants, whether vetch or rye, that supplied much vegetable matter in 1898, were advantageous to the corn crop of 1899, after the rotting of this organic matter. The residual effect of vetch was superior to that of rye, in spite of the fact that the use of cotton seed meal on the corn crop doubtless made the difference in yield considerably smaller than it would have been had none of the corn plots received nitrogenous fertilizer. The residual fertilizing effect of the entire vetch plant was greater than that of vetch stubble.

COTTON SEED VERSUS COTTON SEED MEAL AS FERTILIZER FOR CORN.

On poor sandy soil, abounding in small stones, cotton seed and cotton seed meal were compared as fertilizers for corn in 1900. Preceding crops were cotton in both 1899 and 1898, and in 1897 oats, followed by broadcast cowpeas, of which only a thin stand was obtained; the peas were cut for hay. In 1896 corn, (with drilled cowpeas between the rows), occupied these plots.

On all plots in 1900 a mixture of 240 pounds of acid phosphate and 32 pounds of muriate of potash per acre was applied. On plots 1 and 4 cotton seed meal at the rate of 200 pounds per acre was employed. On Plot 2 cotton seed at the rate of 434 pounds or 13 bushels per acre were used, first taking the precaution to kill the germs without loss of fertilizing material.

All fertilizers were applied in the drill immediately before planting corn—that is in the planting furrow, and mixed with the adjacent soil by the use of a scooter plow. The date of planting and fertilizing was March 29, 1900, and the variety used was Experiment Station Yellow, of which 3,168 plants per acre were allowed to reach maturity, there being the same number of plants on every plot.

The 200 pounds of cotton seed meal and the 434 pounds of cotton seed contained equivalent amounts of nitrogen. Plot 3 received no nitrogen.

The results follow:

Cotton seed and cotton seed meal as fertilizers for corn in 1900.

Fertilizer (plus minerals.)	Yield of corn per acre.	Increase per acre.
	Bus.	Bus.
No nitrogenous fertilizer	15.4	....
434 lbs. cotton seed (killed) per acre........	18.3	2.9
200 lbs. cotton seed meal per acre...........	18.5	3.1

The differences in yield are so slight that we may say that in this test a pound of nitrogen in cotton seed was just as valuable as in a pound of cotton seed meal. The average increase with these fertilizers was 3 bushels per acre, which is not quite sufficient to balance the cost of the fertilizer. It does not follow that nitrogen was not needed, but the results suggest that too much nitrogen was used for profit.

Cotton seed meal versus nitrate of soda; intercultural fertilization.

It was on this same portion of this same field that the special nitrogen experiment referred to on page 34 of Bulletin 75, for 1896, was conducted, the crop being ruined by drouth.

In 1896, the soil, the variety, the date of planting and the mineral portion of the fertilizer were practically the same as in 1900. The great difference in the yields is due almost entirely to the difference in the rainfall of the two years.

Cotton seed versus nitrate of soda; and intercultural application of each. (1896.)

Plots.	Fertilizer per acre, (plus minerals.)	Yield corn per acre.
		Bus.
2 & 6	180 lbs. c. s. meal at planting	7.9
4 & 8	80 lbs. nitrate of soda at planting	8.4
3 & 7	90 lbs. c. s. meal at planting 40 lbs. of nitrate of soda at planting	8.7
1 & 5	90 lbs. c. s. meal at planting 90 lbs. c. s. meal at 3d plowing, June 20	6.9

The failure of the crop due to drought prevents the drawing of conclusions.

DOES COWPEA STUBBLE FURNISH SUFFICIENT NITROGEN FOR CORN?

The corn for this experiment was not planted until May 1, 1900. The variety was Experiment Station Yellow. The preceding crop drilled cowpeas, cut for hay. It was known that a very small quantity of nitrate of soda, 20 to 40 pounds per acre, gives early corn a prompt start and rapid growth, thus serving to shorten the time during which the bud worm can injure the root of the young plant and destroy the stand.

We desired to ascertain whether this undoubted advantage of nitrate of soda would hold good with corn planted very late and also whether the cowpea roots and stubble had furnished enough nitrogen for the needs of the corn plant. Hence after drilling and mixing the phosphate and muriate of potash and after dropping the corn, a little nitrate of soda was dropped in the open furrow about five or six inches away from the seed corn, the nitrate being used at the rate of 36 pounds per acre.

The average yield on the two plots receiving no nitrogen in the fertilizer was 29 bushels per acre; on the other two plots it was 29.1 bushels.

This practical equality in yield indicates that nitrate of soda was not needed with corn where the preceding pea crop had left in the soil the nitrogen that was contained in its roots and stubble. Nitrate of soda was at a further disadvantage here by reason of the excessive rainfall in June, which doubtless leached out much of the nitrogen of this fertilizer. On silage corn and on all of the small grains we have had a considerable increase from the use of nitrate of soda.

Its value when employed at the rate of about twenty pounds per acre for the purpose of causing early planted corn to grow off promptly and rapidly has been demonstrated elsewhere. The pea stubble, under these conditions, furnished sufficient nitrogen.

FERTILIZER EXPERIMENTS WITH CORN.

The fertilizer experiments, or soil tests, with corn presented below have been made on three farms: (1) On the Experiment Station Farm at Auburn on a hilltop where the soil consists of a deep bed of gray sand nearly free from stones and pebbles.

(2) On the farm of J. D. Foster, just south of his house and on a sandy soil not quite so poor or coarse as the preceding; the Foster Experiment at Auburn is distant about one mile from the fertilizer experiment on the Station Farm.

(3) On "mulatto" soil, with deep red subsoil, on the farm of W. F. Fulton, Larimore, DeKalb County, Ala.

Fertilizer experiments with corn on Experiment Station Farm in 1898, 1899, 1900.

During all the three years the experiments were conducted on the same character of soil, a deep gray sand, selected on account of its extreme poverty. Each year (except 1898) the fertilizer applied on any plot was exactly the same as that applied to the same plot (but to a different crop), the preceding year. Hence the experiments, except that of 1898, are really a test, not only of the immediate or first-year effects of each fertilizer, but also of the cumulative effect, (if any on this porous soil), of similar applications in 1898 and 1899.

Every year the same variety of corn, Experiment Station Yellow, was employed.

The dates of planting were March 25, March 27, and April 7 respectively for the several years. In 1898 and 1899 the stand was uniform and perfect, 2790 plants per acre on each plot. In 1900 the stand was uniform on most plots, but slightly defective on Plots 7, 10, and 5. The percentages of missing plants on these plots are too small to materially affect the results or to make any corrections necessary.

All fertilizers were applied in the drill and mixed with the soil by means of a scooter plow. No cowpeas were planted between rows of corn.

This field had borne no leguminous or nitrogen-collecting plants since 1895, when it was used for a variety test of cowpeas, the vines of which were plowed under. In 1896 and 1897 the crops were small grains fertilized with a moderate amount of a complete commercial fertilizer.

Corn in 1898 followed oats; in 1899 and 1900 it was preceded by cotton, which had received the same fertilizers as were applied to corn on the corresponding plots.

Fertilizer experiments with corn on Experiment Station farm, in 1898, 1899 and 1900.

Plot No.	Am't per acre	Kind of Fertilizers.	Yield of corn per acre.			Increase per acre, over unfertilized plots.			
			1898	1899	1900	1898	1899	1900	Average.
	Lbs.		*Bus.*	*Bus*	*Bus*	*Bus*	*Bus.*	*Bus*	*Bus.*
1	200	Cotton seed meal.....	15.2	14.1	13 4	.9	—.8	6.4	2.2
2	240	Acid phosphate.......	12.5	15.8	6.2	—.8	.9	—.8	—.2
3	00	No fertilizer..........	14.3	14.9	7.0		....	....	....
4	200	Kainit................	16.6	12.9	5.6	2.9	3.3	-1.2	1.7
5	200 240	Cotton seed meal..... Acid phosphate.......	16 2	18.4	12.7	3.0	.9	6.2	3.4
6	200 240	Cotton seed meal..... Kainit................	16.0	19.2	10.3	3.4	.4	4.0	2.6
7	240 200	Acid phosphate....... Kainit................	12.7	19.4	4 3	.6	—.5	-1.7	—.5
8	00	No fertilizer..........	11.5	21.5	5.8	....	....	....	....
9	200 240 200	Cotton seed meal..... Acid phosphate....... Kainit................	15.2	24.1	11.5	2.7	2.6	5.7	3.7
10	200 240 100	Cotton seed meal .... Acid phosphate....... Kainit................	....	....	12.0	....	....	6.2	....

The following figures give an analysis of the average results for 3 years:

Increase of shelled corn per acre when cotton seed meal was added.

To unfertilized plot.........................2.2 bushels.
To acid phosphate plot ....1.9 bushels.
To kainit plot .... .9 bushels.
To acid phosphate and kainit plot.........4.2 bushels.

Average increase with cotton seed meal, . 2.3 bushels.

Increase of shelled corn per acre when acid phosphate was added.

To unfertilized plot ....— .2 bushels.
To cotton seed meal plot.................1.2 bushels.
To kainit plot ....—2.2 bushels.
To cotton seed meal and kainit plot ....1.1 bushels.

Average increase with acid phosphate, . . 0. 0 bushels.

Increase of shelled corn per acre when kainit was added.
To unfertilized plot .. ..1.7 bushels.
To cotton seed meal plot .... .4 bushels.
To acid phosphate plot ....— .3 bushels.
To cotton seed meal and acid phosphate plot. .3 bushels.

Average increase with kainit, ... 0.5 bushels.

In 1898 with an excedingly dry May and June there was very little increase with any fertilizer, the average increase for each fertilizer applied under four different conditions being as follows:

Cotton seed meal, 1.8 bushels;
Acid phosphate, *decrease,* .5 bushel.
Kainit, 1.6 bushels.

In 1898 none of the fertilizers, in the amounts used, were profitable.

In 1899 there was a greater yield on all plots (except Plot 4) than the preceding year, but the increase from commercial fertilizers was no greater than before, averaging under four different conditions as below:

Increased yield with cotton seed meal, 1.9 bushels.
Increased yield with acid phosphate, 1.8 bushels.
Decreased yield with kainit, .5 bushel.

In 1900 there was almost a complete failure of the corn crop on deep sandy land, every plot falling below its yield in previous years. And yet the increase attributable to cotton seed meal in 1900 is far greater than in any previous year, this fertilizer reclaiming the plots to which it was applied from absolute failure. The average increase in 1900, with four different combinations for each fertilizer, is stated below:

Increase with cotton seed meal, 6.5 bushels.
Increase with acid phosphate, .1 bushel.
Decrease with kainit, 1.2 bushels.

In 1900 cotton seed meal at the rate of 200 pounds per acre paid a profit. This favorable result occurred in a year when the rainfall in the first half of the growing season was excessive, and when doubtless much of the nitrogen was leached out and lost to the crop. It is an open and interesting question whether the very low yields of the plots receiving no cotton seed meal were due to the peculiar season and consequent exhaustion through leaching of the small supply of nitrogen of the soil, or whether the absolute failure on these plots was attributable to the nitrogen removed in the two preceding crops, viz: cotton in 1899 and a light crop of spring oats in 1898. The experiments on these same plots, with corn, cotton and oats, which have already been under way for three years, will be continued and future results will doubtless throw light on this question.

The main practical conclusion to which we wish now to direct attention is the unprofitableness of large applications of *commercial* fertilizers to corn on land deficient in humus and hence unable to resist extremes of drought and leaching. Note, in contrast the very large increased yield of corn where rotting velvet beans furnished the humus and nitrogen (see p. 130) and recall that the two experiments were on the same hilltop, a few yards apart, and that weather condition did not ruin the crop fortified by an abundance of humus.

Fertilizer experiments on Foster farm at Auburn, in 1899 *and* 1900. Both experiments were made in the same field, which has a soil that is apparently uniform. The soil is sandy but somewhat less so and somewhat richer than the Station soil on which similar tests were conducted. In both these Foster experiments there is no test of the cumulative effect of fertilizers, since no fertilizer experiment on this soil had preceded the test of 1899 or 1900.

The tests were made by J. D. Foster in accordance with detailed written directions from the Agriculturist of the Experiment Station. The weighing of fertilizers, the harvesting of the crop, and the shelling of the corn were performed by T. U. Culver, of this department of the Station.

Common corn of the usual type in this locality was used. The dates of planting were March 27, 1899, and March 31, 1900. The stand was good and practically uniform. It was noted that the corn on Plots 5, 9, and 10 was later in tasseling and maturing than on the other plots.

In 1898 the crop on this field was corn, very lightly fertilized, with drilled cowpeas between the corn rows; the peas were picked, and the vines grazed. In 1899 cotton was the crop on the entire field, and fertilization was then uniform and moderate on the portion of the field which the following year was used for the fertilizer experiment with corn.

Results of fertilizer experiments with corn on Foster farm, Auburn, in 1899 *and* 1900.

Plot No.	Am't per acre	Kind of fertilizers.	1899 Yield.	1899 Increase.	1900 Yield.	1900 Increase.	Av. Increase.
	Lbs.		*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*
1	200	Cotton seed meal	13 6	2.2	15.4	9 6	5.9
2	240	Acid phosphate	11.6	.2	6.4	.6	.4
3	00	No fertilizer	11.4	......	5.8	......	.....
4	200	Kainit	10.8	.0	7.2	1.5	8.
5	200 240	Cotton seed meal Acid phosphate	16.0	5.8	8.0	2.4	4.1
6	200 200	Cotton seed meal Kainit	12.0	2.4	10.0	4.5	3.5
7	240 200	Acid phosphate Kainit	9.6	.6	4.2	.8	.7
8	00	No fertilizer	8.4	......	5.3	.....	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	8.8	4.	7.1	1.8	1.1
10	200 240 100	Cotton seed meal Acid phosphate Kainit	11.0	2.6	9.0	3.7	3.2

In 1899 this soil, though poor, failed to respond to acid phosphate or kainit when these fertilizers were applied to corn. The yield was somewhat increased, but not to a profitable extent, by cotton seed meal, the true value of which, however, was doubtless obscured by the cowpeas grown between the corn rows in 1898.

In 1899 the average increase for fertilizers, each applied in four different combinations, was as follows:

Increase with cotton seed meal, 2.5 bushels.

Increase with acid phosphate, .6 bushel.

Decrease with kainit, 1.2 bushels.

In 1900 the results are similar, a complete failure of corn to respond to acid phosphate and kainit, and a slight, though usually unprofitable, increase with cotton seed meal.

In 1900 the average results for each fertilizer were as follows:

Increase with cotton seed meal, 3.8 bushels per acre.
Decrease with acid phosphate, 2.5 bushels per acre.
Decrease with kainit, 1.0 bushel per acre.

An analysis of the average increase for both years is given below:

Increase of shelled corn per acre when cotton seed meal was added.

To unfertilized plot . . . . 5.9 bushels.
To acid phosphate plot . . . . 3.7 bushels.
To kainit plot . . . . 2.7 bushels.
To acid phosphate and kainit plot . . . . .4 bushels.

Average increase with cotton seed meal, . . 3.2 bushels.

Increase of shelled corn per acre when acid phosphate was added.

To unfertilized plot . . . . .4 bushels.
To cotton seed meal plot . . . . —1.8 bushels.
To kainit plot . . . . — .1 bushel.
To cotton seed meal and kainit plot . . . . . . —2.4 bushels.

Average decrease with acid phosphate, . . 1.0 bushels.

Increase of shelled corn per acre when kainit was added.

To unfertilized plot .8 bushels.
To cotton seed meal plot . . . . —2.4 bushels.
To acid phosphate plot . . . . .3 bushels.
To cotton seed meal and acid phosphate plot . . . . —3.0 bushels.

Average *decrease* with kainit, ... 1.1 bushels.

Fertilizer experiment in DeKalb County. This experiment was made in a most careful manner by W. F. Fulton, at Larimore, near Collinsville, with fertilizer materials furnished by this Station. The composition and amount of fertilizer was the same as in both of the Auburn experiments.

The soil was reddish, or mulatto, with a deep red subsoil. It was the characteristic stiff red soil of Big Wills Valley, and was deficient in vegetable matter, and doubtless amply supplied with lime. The original forest growth was poplar, oak, hickory, and mulberry. Cotton in 1898 and corn in 1899, both without fertilizers, constituted the preceding crops.

Corn was planted April 5, the fertilizers having been drilled in and mixed as usual with the soil a few days before planting time.

The very full notes recorded by the experimenter indicate that between July 2 and 17 the lower blades "fired," or dried up, on all plots receiving acid phosphate. August 10, the corn on Plot 1 was green "from top to bottom, and on Plot 6 nearly so," while on the other fertilized plots all blades up to 3 or 4 feet were then dead. "The season was the wettest ever known, frequent and heavy rains falling in April and from May 8 to the middle of July. It was impossible to do justice to crops and yet the corn flourished and pushed on ahead of grass and weeds."

The blades were stripped from the plants at the usual time and the yields in lbs. per acre of cured blades or fodder, are given below, beginning with Plot 1: 296, 448, 440, 376, 440, 520, 408, 448, 544 and 592.

The table gives the yields and the increase attributable to fertilizers.

Fertilizer experiment with corn in 1900 at Larimore, DeKalb County.

Plot No.	Am't per acre	Kind of fertilizers.	Yield of shelled corn per acre.	Increase over unfer-tilized plots.
	Lbs.		*Bus*	*Bus.*
1	200	Cotton seed meal	29.4	11.8
2	240	Acid phosphate	18.2	0.6
3	00	No fertilizer	17.6	....
4	200	Kainit	18.6	0.4
5	200 240	Cotton seed meal Acid phosphate	27.0	8.2
6	200 200	Cotton seed meal Kainit	26.7	7.3
7	240 200	Acid phosphate Kainit	22.8	2.8
8	00	No fertilizer	20.7	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	26.7	6.0
10	200 240 100	Cotton seed meal Acid phosphate Kainit	30.8	10.1

The lessons of the preceding table are made plainer below:

Increase of shelled corn per acre when cotton seed meal was added

To unfertilized plot ....11.8 bushels.
To acid phosphate plot .. .. 7.9 bushels.
To kainit plot .. .. 6.9 bushels.
To acid phosphate and kainit plot........ 5.4 bushels.

Average increase with cotton seed meal, . . 7.9 bushels.

Increase of shelled corn per acre when acid phosphate was added.

To unfertilized plot .... 0.6 bushels.
To cotton seed meal plot .... 3.6 bushels.
To kainit plot .. .. 2.4 bushels.
To cotton seed meal and kainit plot ...... —1.3 bushels.

Average decrease with acid phosphate, . . 0.5 bushels.

Increase of shelled corn per acre when kainit was added.

To unfertilized plot .... 0.4 bushels.
To cotton seed meal plot .. .. —4.5 bushels.
To acid phosphate plot .... 2.2 bushels.
To cotton seed meal and acid phosphate plot .. .. 2.2 bushels.

Average decrease with kainit, ... 1.0 bushels.

In whatever combination cotton seed meal was applied it greatly increased the yield, the average increase with this fertilizer being 7.9 bushels, which affords a fair profit. Apparently leaching did not to any great extent occur on this stiff soil, notwithstanding the phenomenal rainfall of April, May and June.

Neither acid phosphate nor kainit was needed by corn on this red calcareous soil.

Conclusions from fertilizer experiments on three farms.

(1) Heavy applications of acid phosphate or kainit were useless.

(2) Cotton seed meal was the only commercial fertilizer tested that ever paid a profit when applied to

corn, and in the large amount used, 200 pounds per acre, this was not always profitable.

(3) A fertilizer for corn should contain much more nitrogen, and much less phosphoric acid and potash than a fertilizer for cotton on the same land.

(4) Leguminous plants, whether only the roots and stubble or the entire growth of vines are plowed under, constitute a safer and more profitable fertilizer for corn than do commercial fertilizers, or even cotton seed meal. A similar superiority of stable manure for corn may be reasonably expected.

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ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

ORCHARD NOTES.

BY
F. S. EARLE.

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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, Alabama.

ORCHARD NOTES.

The season of 1900 has been on the whole a favorable one for the orchardist. At Auburn the earliest blooming plums and peaches were killed by a sharp freeze on Feb. 18, when the thermometer dropped to 12°. The latest blooming plums like Wayland and Golden Beauty were injured by continued cold rains during the last of March that prevented pollination, causing the first nearly complete failure of the crop on these kinds in five years. The medium blooming plums and peaches set heavy crops notwithstanding a cold snap on March 17, when the thermometer dropped to 28°. It was 30° the morning of the 16th and had dropped to 32° by 9 p. m., so that the open flowers were exposed to a freezing temperature for at least ten hours. Many blossoms were killed but as stated, enough survived to make a very full crop. Unusually rainy weather during June and July caused serious loss from brown rot in peaches and plums, the falling of grape foilage from the attacks of downy mildew, and a more than usually heavy loss from summer rot of apples.

APPLES.

The condition of the new orchard (planted 1897-1900) continues to be very satisfactory. Our experience proves that it is entirely possible even on such thin drouthy land as ours to grow thoroughly thrifty, vigorous apple trees. Part of the land was seeded to hairy vetch in the Fall of 1898 and the remainder was seeded to vetch and oats in Oct., 1899. In March a strip three or four feet wide was plowed on each side of the row and was cultivated after every rain so as to keep a dust mulch about the trees. The middles were not plowed till the first of June in order to allow the vetch to ripen its seed so as to re-seed the land. Frequent cultivations were continued till the middle of July when peas were broadcasted and cultivated in. The peas made a good growth during the late Summer and Fall and have been allowed to lie and rot on the ground. As the peas begun to die down the self-sown vetch seed began coming up and by spring the orchard will be a solid vetch field. The same treatment will be continued another year, plowing strips next the trees in March, allowing the vetch to stand in the middle till the seed is ripe and then cultivating the entire land thoroughly till middle of July and again broadcasting to peas. By this method two crops of rich leguminous vegetable matter are added to the soil each year so that it is rapidly gaining in fertility. The mechanical condition is already greatly ameliorated. Last Spring each tree was given two pounds of fertilizer consisting of a mixture of five parts each of cotton seed meal and acid phosphate to one part of muriate of potash. The soil is now so much improved and the trees are growing so rapidly that no more fertilizer will be required until the orchard comes in to heavy bearing.

The bearing orchard received the same treatment as the growing orchard except that each tree was given ten pounds of the mixed fertilizer and it was sprayed twice with Bordeaux mixture, once on April 13 and again on April 28. At the last spraying one-half pound of Paris green per barrel was added to the Bordeaux mixture. At the time of the first spraying many of the trees were in full bloom and a number of the flowers were killed, showing that it is not advisable to spray during the blooming season. The first spraying should have been done earlier but pressure of other work prevented. The treatment served to lessen the number of wormy apples very noticeably and it held the rot in check till about the first of July. After that owing to continued rains it developed rapidly and finally destroyed a large proportion of the crop on many of the trees. Two or three additional later sprayings would probably have partially prevented this trouble but it seems doubtful if, in unfavorable seasons like the present, it would have entirely prevented it. This rotting of the fruit on the trees before maturity seems to be the most serious problem that confronts the apple grower in this latitude. It will probably have to be met by more frequent sprayings than are necessary at the North, and especially by the selection of resistant varieties. Among the kinds fruiting at the Station this year, the following were comparatively free from rot: Carter's Blue, Horse, Pine Stump, Red June, Steven's Winter, Thornton's Seedling, and Terry's Winter. Those noted as rotting very badly were American Golden Russet, Ben Davis, Elgin Pippin, Golden Pippin, Kittageskee, Oconee Greening, Romanite, Shannon Pippin, Summer Red and Winesap.

Apple Leaf Rust (*Roestelia*): Notes taken on Aug. 1, show the following varieties to be more or less effected by this disease.*

Carter's Blue, slightly.
Chattahooche, slightly.
Cooper's Red, moderately.
Dam, slightly.
Equinettelee, slightly.
Ey. Red Marguerite, badly.
Family, very badly.
Hames, slightly.
Horse, moderately.
Jonathon, very badly.

* For these notes and for other help in preparing this Bulletin, I am indebted to my assistant, Mr. C. F. Austin.

Mamma, slightly.
Red June, slightly.
Rhodes' Orange, slightly.
Rome Beauty, moderately.
Sabadka, slightly.
Santa, badly.
Senator, badly.
Shockley, moderately.
Texas Red, slightly.
Thornton's Seedling, slightly.
Wealthy, slightly.
Winesap, slightly.
Yahor, slightly.
Yopp' Favorite, slightly.

The following kinds were entirely free from rust: Aikin, American Summer, Apple of Commerce, Arkansas Black, Babbitt, Benoni, Ben Davis, Black Ben Davis, Bledsoe, Bradford, Buncomb, Champion, Carolina Greening, Cooper's Early, Duchess, Early Harvest, Elgin Pippin, Fall Pippin, Fanny, Grimes' Golden, Gravenstein, Hews' Crab, Jefferson Everbearing, Jennings, Julian, Kinnard's Choice, Limbertwig, Maiden's Blush, Mam. Black Twig, Mangum, Mavarack Sweet, Moultries, Oszi-vaj, Pear (or Palmer), Rawls' Janeton, Red Astrachan, Red Beitigheimer, Red Limbertwig, Saxon Priest, Sekula, Selymes, Shackleford, Summer Cheese, Summer King, Summer Queen, Sweet Bough, Taunton, Tuscaloosa, Yates, Yellow English, Yellow Horse, Yellow Transparent, York Imperial.

This agrees very well with last year's experience (See Bull. No. 106, p. 168) but American Summer and Moultries that showed rust last year escape, while fourteen kinds are affected this year that escaped last. A few of the Hungarian kinds are slightly affected this year for the first time, but in the main native American kinds are more susceptible than foreign kinds. This is rather anomalous since the disease is indigenous, occurring freely on our wild crab apples.

Green Aphis of the Apple—In Bulletin No. 106 p. 166, it was noted that after being very abundant and troublesome the aphids suddenly disappeared during a period of heavy rains in August. The circumstances were such as to suggest that they had been carried off by some epidemic disease, but unfortunately no proof of this was secured. In any event the disappearance was so complete that in the Spring of 1900 the trees were almost clear of them and they have caused less damage than at any time in five years. Their numbers gradually increased so that by Fall they were again quite abundant but as the growing season was over they did comparatively little harm.

A new treatment was tried this season that proved much more satisfactory than the strong kerosene emulsion used last year, since it was equally effective in killing the insects and did no harm whatever to the foliage. Though home made decoctions of tobacco were unsatisfactory (See Bulletin 106, p. 164), the commercial product known as "Rose Leaf" proves to be by far the best insecticide yet tried for controlling this aphis. It is best used at a strength of one part to fourteen of water and should be applied as a very fine spray. Since it is impossible to reach all the lice at a single spraying on account of the shelter furnished by the crumpled leaves it is always best to spray two or three times at intervals of four or five days, since in that time those that escaped the first spraying will have moved out of their shelter seeking a fresher food supply. Three such sprayings within two weeks time should clear even badly infested trees. Whether it will pay to go to this expense must be determined by the condition of the trees and the abundance of the lice.

It was hoped that spraying the trees with crude petroleum in winter might destroy the eggs of this insect. On March 12, a number of young trees that had been badly infested the year before were thoroughly sprayed with crude petroleum taking pains to direct the spray against the ends of the twigs where the eggs are usually deposited. The buds were still quite dormant. No injury resulted to the trees. The effect on the lice, if any, was obscured by the general scarcity of them during the early part of the season. By the first week in May a few lice could be found on each of these treated trees though none of them were badly infested. It was much later than this before they became numerous in any part of the orchard, so the treatment seems to have had no result so far as the aphids are concerned.

The question of varietal resistance to this pest is still an open one but as was noted last year, kinds with thick, hairy twigs seem to be less infested than those in which the young twigs are slender and comparatively smooth. Notes taken on Aug. 1, show the following kinds to have been more or less infested with aphis:

Apple of Commerce, badly.
Bledsoe, badly.
Chattahooche, slightly.
Jennings, badly.
Mamma, moderately.
Maverack Sweet, moderately.
Oszi-vaj, moderately.
Pear (or Palmer), moderately.
Red Beitigheimer, moderately.
Rhodes Orange, badly.
Summer Queen, badly.
Sweet Bough, moderately.
Tuscaloosa, badly.
Yellow English, badly.

By Nov. 10, the following additional kinds were more or less infested: Black Ben Davis, Bradford, Buncomb, Carolina Greening, Carter's Blue, Early Harvest, Equinettelee, Family, Fall Pippin, Gravenstein, Hominy, Jeffries, Limbertwig, Magnum, Mam. Back Twig, Moultries, Nickajack, Pasman, Rawl's Janeton, Santa, Senator, Shackleford, Shockley, Summer Cheese, Tull, Winesap, Yakor, Yates, Yopp's Favorite. Of these kinds 21 have smoothish twigs, 16 are medium, and 10 rather hairy. Of the kinds not infested with aphids, 8 have smoothish twigs, 18 medium and 28 hairy twigs.

This list does not coincide very closely with that given last year, showing that infestation or immunity is in part at least accidental.

A List of Hardy varieties.—The following kinds have been entirely free from rust, aphis and leaf spot and have made a perfectly satisfactory growth both in 1899 and 1900. Aiken, Babbitt, Hyari Piros, Magyur, Maiden's Blush, Metel, Ponyike and York Imperial. It is interesting to note that of these eight kinds four are among the new Hungarian varieties sent out by the Department of Agriculture that have not yet fruited in this country. Of the other kinds in last years' select list, Arkansas Black, Duchess, Fanny, Haywood, Milalyfi, and Thornton's Seedling lost some foliage from leaf spot late in the season, while Carolina Greening was slightly attacked by aphis, and Hames developed a little rust. Among the kinds not included in the above list that are in very satisfactory condition this Fall may be mentioned Battyani, Benoni, Bledsoe, Buda Summer, Carter's Blue, Champion, Elgin Pippin, Hames, Herschal, Cox, Horse, Julian, Keskemet, Kinnard's Choice, Limbertwig, Red Astrachan, Red June, Saxon Priest, Summer Wafer, Texas Red and Yellow Transparent.

Promising New or Little Known Varieties. For the last three years an effort has been made to secure trees or grafting wood of all promising local seedlings in the hope of finding kinds better suited to our conditions than those now in general cultivation. A number of such kinds have been secured and the Station earnestly request all who are interested in apple growing in this State to co-operate by reporting any promising kinds that may come to their notice.

Among little known kinds deserving of special mention are the Hackworth and Herschal Cox. The Hackworth originated in North Alabama and has been grown there locally for twenty or thirty years. It is a vigorous, erect growing tree with large, healthy leaves. The fruit ripens in August. It is large subconic yellowish white, heavily striped with red. It seems to be free from rot and to be a very desirable late Summer apple. Herschal Cox is of the Romanite type, small and not of the best quality, but the latest keeper we have in North Alabama, surpassing even the Shockley in this respect. The tree is a better grower than Shockley and it should perhaps replace that variety for general planting.

Revised List of Apples for General Planting in Alabama:—The following list named in the order of ripening will give a good succession of fruit from the first of June till early winter. Yellow Transparent, Early Harvest, Red June, Red Astrachan, Horse, Hackworth, Carter's Blue, Thornton's Seedling, Kinnards Choice, York Imperial, Yates, Shockley, Herschal Cox. Unfortunately few, or perhaps none, of the above are fully satisfactory under our conditions and it is hoped that in the future better kinds may be substituted for them. Yellow Transparent is a poor grower and the foliage is somewhat subject to leaf spot. It is an abundant and early bearer and the handsome yellow fruit is free from scab and rot. For market it is the most promising of the very early kinds. Early Harvest is rather better quality than the above and is nearly as early. It is to be preferred for home use. The tree is a fairly good grower but often suffers severely from aphids, and it is not free from leaf spot. Red June is a strong growing thrifty tree but unfortunately late in coming in to bearing and subject to rust. The fruit ripens through a long season and it is one of the most desirable for family use. On young trees and with good care and cultivation it is a fine market apple but with age and neglect it is too small for market. It should be in every family orchard. Red Astrachan is a vigorous, healthy, strong growing tree that comes early into bearing. The fruit is large and showy but too acid to suit most tastes, and is inclined to rot badly. Where this trouble can be controlled it is one of the most profitable of the early market apples. At Auburn it begins ripening about June 10 though some specimens can be gathered earlier. It does not all ripen at once like the Yellow Transparent but the trees need to be picked over several times. The Horse is a well known kind doing well in all parts of the South. The tree is healthy and a free grower. The large greenish yellow fruits are too sour for eating out of hand but are excellent for cooking. At Auburn it begins ripening early in July. The Hackworth has been mentioned on a previous page. It is unknown outside of Alabama, but seems very promising here. It ripens through a long season beginning the last of July and continuing throughout August. The tree is very thrifty and the large handsome fruits are of good quality and attractive. It is recommended for both home use and market. Carter's Blue is also an August apple, but averages a little later than Hackworth. It is a large green apple with dull red stripes and a heavy white bloom. It does not rot badly. The tree is healthy and a vigorous grower.

It is one of the few kinds that succeeds well at the far South. Thornton's Seedling is a good sized greenish apple with red stripes ripening in September. It is of good quality and its comparative immunity from rot marks it as valuable for an apple ripening at this season. The tree is healthy and productive. Kinnard's Choice has not been fruited at the Station but in North Alabama it is one of the most satisfactory kinds for late Fall and early Winter. The trees in the young orchard here are remarkably strong and healthy. York Imperial has also not been fruited here but it has made a good record in North Alabama and it is one of the few kinds in the young orchard that have been spotless and free from enemies of all kinds during the last two seasons. It is confidently expected that this will prove one of our very best late market apples. Yates is a favorite apple with many growers especially in Chambers, Tuscaloosa and Clay Counties. It is a good keeper and of the best quality but is too small for general market purposes. The tree is only a medium grower and is subject to leaf spot and to injury from green aphis. Shockley; this well known kind is valued chiefly for its keeping qualities. The apple is small and of rather poor quality and the tree is apt to be rather short lived. It is attacked badly by both rust and aphis and is only retained in the list for the want of something better that will keep as long. Herschal Cox is included here with some doubt. It is a better tree than Shockley but the fruit is about equally poor. However it keeps perfectly all winter in North Alabama which is a point of prime importance. It has not been fruited here.

It will be noted that Ben Davis Winesap and Limbertwig have been omitted from the above list although included in the list given in Bulletin 98, p. 265. It is thought that Kinnard's Choice and York Imperial will fully take their places and be better suited to our conditions.

As a result of several years observation and study it seems prudent to strongly urge the increased planting of apples in Middle and Northern Alabama. It must be fully understood, however, that apples will succeed here only with the best and most intelligent care and cultivation.

FIGS.

The following eleven kinds fruited on the Station grounds this season:

Adriatic. Large, yellowish white, flesh light red, late, beginning to ripen middle of August and continuing till frost; tree vigorous, fairly hardy, starting rather late in Spring. While not as sweet as Celeste it is pleasant in flavor and its large size makes it very attractive. It should be more widely planted.

Black Ischia. Large roundish, shinning black, flesh deep red, season last of August. Of no special value.

Brown Turkey. Small, light brownish, sweet, ripening during a long season. A fairly good fig but not equal to Celeste. With us the tree is feeble and a poor grower.

Brunswick. Large, pyriform, greenish yellow, nearly overspread with dark brown, flesh reddish brown, rich, season middle of August till frost, tree fairly vigorous and productive. With us this year the last of the crop did not ripen well. Not fully satisfactory.

Celeste (or Celestial). Small, pyriform, light brown, often with purplish tinge, flesh reddish, soft, very sweet, season July, tree thrifty, very hardy, starts early in Spring. This is by all odds our best early fig and the one in most general cultivation. On vigorous trees it often sets a small late crop but these late fruits are inferior and many of them fail to ripen.

DuRoy. Small, much like an inferior Celeste. This much advertised kind has nothing to recommend it. Our trees were from Mr. Normand, the introducer.

Green Ischia. Medium size, rounded, yellowish green, skin thin, flesh deep rich red, sweet, high flavor, tree thrifty, fairly hardy, very productive, season last of August till frost. This is our best and most reliable late fig and should be widely planted. It does not begin ripening till the main crop of Celeste is entirely over.

Madeline. Large, light yellow, flesh yellowish white, rather soft, sweet, rich, reason last of July and August, trees fairly vigorous and productive. This is a good fig and is valuable as ripening between Celeste and Green Ischia.

New French. Small, rounded, white, of medium quality, rather firm, tree a fairly good grower. It will take farther experience to decide whether or not this kind has any special merit.

White Nerii. Large, roundish, greenish yellow, flesh reddish, rather soft, good quality, begins ripening middle of August, tree feeble, not very productive.

White Smyrna. Medium and large, somewhat flattened, greenish white, overspread with a tinge of brown, flesh light red, firm, sweet, rich, season middle of August till frost, tree only moderate grower but fairly productive. This is a good fig and keeps remarkably well after picking.

Recommended for General Planting: Celeste, Green Ischia, Adriatic, White Smyrna and Madeline.

KAKI (JAPANESE PERSIMMON).

As was noted in Bulletin 106, p. 171, the freeze of February, 1899, killed these trees all to the ground. Part were killed outright and part sprouted from the crown. The following kinds were sufficiently recovered to bear some fruits this season: Tabors No. 23, Tabors No. 72, Tabors No. 129, Tane Nashi, Yeddo Ichi.

This fruit is well adapted to the conditions in South Alabama and should be more generally planted in that region. The trees often begin bearing the year after they are planted and the crop is a very sure one. The fruits are large and handsome. Though too rich for some tastes most people are fond of them and they are gradually winning a place in the large markets.

ORANGES.

Mr. H. J. Webber of the Department of Agriculture, Washington, has succeeded in making a number of hybreds between the cultivated sweet oranges and the hardy, deciduous hedge orange, *Citrus trifoliata*. His hope, of course, is to find among them some kinds that will combine the hardness of the one parent with the desirable fruit of the other. As these interesting productions have not yet reached bearing age it is impossible to foretell the result. Wishing to test their hardiness in this latitude the Department sent trees of fifty-one of these hybreds to this Station last Spring. They have nearly all made a very vigorous growth during the Summer but at this writing (Jan. 3) there has been no cold sufficient to test their hardiness. It is interesting to note that of these kinds three have died, thirty have small trifoliate, deciduous leaves like the hedge orange, only nine have large simple, evergreen leaves like the sweet oranges, while nine have larger, variously modified trifoliate leaves that are evergreen. Their continued behavior will be watched with great interest.

PEACHES.

The co-operative experiment orchard planted in 1898 bloomed abundantly but for some reason set a very light crop. The few older trees planted in 1896 bore heavily but the fruit rotted very badly on account of continued wet weather during the ripening season. Owing to the exceptional character of the season, it is thought best not to express an opinion as to the merits of the different varieties at this time. Notes on the season of blooming are given below. This subject is not as important with peaches as it is with plums as all the varieties are supposed to be self-fertile, but since a difference of even a very few days in the blooming period may decide the safety or loss of the crop from cold it is a matter worthy of consideration.

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17. Thermometer 28°.	March 25.
Matthews' Beauty..	....	....	buds pink......	first blooms....	....	full bloom .....
McKinney	Buds of all varieties slightly swollen except as noted below.		nearly dormant.	buds pink......	Over half the open flowers killed except as noted. When petals have fallen they are killed as badly as the freshly open flowers. No unopened buds killed. No striking difference in the different varieties or races.	first bloom....
Marks..			nearly dormant.	buds pink......		full bloom.....
Ovido		first blooms. ...	nearly full bloom	full bloom and falling.....		mostly fallen.
Gray...............			buds pink......	first blooms ..		past full b oom.
Reeves			buds swollen .	first blooms ..		full bloom.....
Carmen			buds swollen..	first blooms ...		full bloom.....
Chinese Cling ..			buds swollen, some pink......	first blooms ..		full bloom....
Elberta.			buds pink......	first blooms ..		past full bloom.
Mamie Ross.........			buds pink	first blooms....		full bloom.. ..
Pallas			buds pink......	first blooms .		full bloom......
Tabor			buds pink......	blooming.......		full bloom......
Honey..............	much swollen, not show'g pink	first blooms.....	nearly full bloom...	full bloom.....		mostly fallen...

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17.	March 25.
Peento	full bloom		leaves 1 in. long			
Angel	first blooms	blooming	full bloom, ¼ crop left	bloom falling.		leaves half grown
Waldow	first blooms	blooming	full bloom, nearly full crop.	bloom falling		leaves half
Old Mixon Free			buds swollen	first blooms		full bloom
Mt. Rose			buds swollen	first blooms		full bloom
Alexander			nearly dormant	buds hardly pink		first blooms
Onderdonk		first blooms	blooming	blooming		past full bloom
Cobler's Indian			buds pink	first blooms		full bloom
Imperial			first blooms	full bloom		past full bloom.
Victoria			first blooms	blooming		full bloom
Triumph			buds swollen	buds pink		nearly full bloom
Sneed			buds pink	first blooms		nearly full bloom
Old Orchard—Lady Ingold			swollen, some pink	first bloom	buds ⅓ open. flowers 50 % k'd	

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18, Thermometer 12°.	March 6.	March 10.	March 14.	March 17.	March 25.
Tillottson	....	....	swollen, some pink.	first blooms	buds ¼ open. flow's 10-20% k'd	....
Early Crawford	....	....	swollen, some pink	first blooms	1% open, flowers half killed	....
Hale's Early	....	....	buds swollen.	buds hardly pink	none opened, none killed	....
Mt. Rose	....	....	swollen, some pink	first blooms	buds ¼ open, flowers 40 % k'd	....
Alexander	....	....	nearly dormant	buds hardly pink	none open, none killed	....
Stump	....	....	swollen, some pink	first blooms	very few open, 40-50 % killed	....
Elberta	....	....	swollen, some pink	blooming	buds ¼ open, flow's 20-40% k'd	....

Classified according to the season of blooming we have the following:

Earliest Blooming:—Peento, Angel, Waldow, all of the Peento type.

Very Early Blooming:—Ovido, Honey, Onderdonk, of the Honey and Spanish types.

Early Blooming:—Imperial, Victoria; Spanish type.

Medium Blooming:—Matthews Beauty, Gray, Reeves, Carmen, Chinese Cling, Elberta, Mamie Ross, Pallas, Tabor, Old Mixon Free, Mt. Rose, Coblers Indian, Sneed, Lady Ingold, Tillottson, Ey. Crawford, Stump; including all of the North China type, most of the Persian and representatives of the Spanish and Honey types..

Late Blooming:—McKinney, Marks, Triumph, all Persian.

Very Late Blooming:—Alexander, Hales Early, both Persian.

The varieties of the Peento race all bloom so early as to be practically worthless for planting in any part of this State. They are the best peaches for the orange belt but should not be planted much farther North. Some at least of the varieties of the Honey and Spanish types bloom late enough to be comparatively safe and there is no question but what in South Alabama the trees will be found thriftier and better adapted to the soil and climate than most varieties of the North China and Persian types. Unfortunately as yet we have no varieties among them fine enough to compete in market with Elbertas and Crawfords and none as early as Alexander. A race of peaches combining the thriftiness and fruitfullness of the Honey with the late blooming of Alexander and the fine market qualities of the Elberta would indeed be a boon to the Southern fruit grower. Such a combination of characters is not beyond posibility to the skillful plant breeder and our originators of new varieties should set themselves the task of producing it.

PEARS.

Kieffer pears in the old orchard bore a heavy crop, while the LeContes made less than half a crop. Only a portion of the trees in the new orchard fruited.

In Bull. 106, p. 173, it was noted that one result of the February freeze (1899), which killed all the bloom buds was almost complete immunity from blight during that season. This immunity was so complete that the disease seemed to have entirely disappeared from the Station orchard. This Spring the Kieffers and LeContes although blooming very heavily were entirely free from blight. A few Bartlett trees blooming two or three weeks later received the contagion from some source and nearly all the flower clusters developed the blight so virulently that notwithstanding repeated prunings the trees were nearly killed before it could be checked. These blighting Bartletts caused a few "growing tip" infections in the Kieffers and caused the blighting of some clusters of apple blossoms.

PLUMS.

Most of the varieties of plums in the Station orchard bore a full crop this year and it is now possible to form an estimate as to their value for this region. Some light has also been obtained on the vexed question of the nomenclature of the Japanese varieties. The trees for this orchard were obtained from a number of prominent nurseries in different parts of the West and South and in Bulls. 98 and 106 the names under which they were purchased were used in all cases. It now appears that as represented here (trees purchased in Jan. 1896), the following are all Abundance:

Botan from T. V. Munson & Son, Denison, Tex.

Yellow Fleshed Botan, P. J. Berckmans Co., Augusta, Ga.

Berger, from Stark Bros., Louisiana, Mo.

The following while differing slightly among themselves are for all practical purposes the same as Chabot. This kind like Abundance is quite variable and seems to be represented by more or less distinct strains.

Babcock, from G. L. Tabor.

Baileys Japan, from G. L. Tabor.

Hattankio, from T. V. Munson & Son.

Munson, from P. J. Berckmans Co.

Yellow Japan, from G. L. Tabor.

Red Nagate, from G. L. Tabor seems to be the same as Red June from Stark Bros; and Botan of Tabor is the Berckmans.

As plums are now usually classified our varieties belong to five different races or types, the Japanese and four natives. These are the Americana type, the Wild Goose type, the Wayland type and the Chicasaw type. The domestica type which includes the European plums and prunes does not succeed here and none were planted.

The Americana Plums: The plums of this type have been developed from the wild plum of the North and East. They are useful for planting at the far North on account of their great hardiness to cold but they are not at home here. So far as we have tried them the trees are poor growers, very short lived and unproductive.

At present they are represented in the orchard only by Hawkeye and Rockford though several other kinds were planted that have since died. Although blooming very late long after danger from frost is over, they bore no fruit at all this season. The planting of varieties of this type is not advised for this State.

The Wild Goose Plums: The ancestry of this group of plums is still a matter of doubt. Some authorities have supposed them to be hybreds between the Americanas and Chicasaws but there is no proof of this theory except their somewhat intermediate characters, and on the whole it seems more probable that they are descended from some of the Southern wild plums. The native plums of our Southern woods have been strangely neglected by botanists and as yet we have very little knowledge of their number or relationships. It is certain that in the red clay soil of the granitic hills north of Auburn, a wild plum occurs abundantly that has all the characteristics of this group of cultivated kinds. Botanists to whom specimens of it have been submitted unite in pronouncing it *Prunns hortulana,* the supposed bybred parent of the Wild Goose plums, but there is no conceivable reason for supposing that this commonly occurring native plum is a hybred. It has so far been impossible to determine its true botanical position.

Before the introduction of the Japanese kinds this race of plums was our chief dependence at the South for market sorts. While they have been largely supplanted in popular favor by these new introductions they have some very good qualities and should not be overlooked in planting for home use and local markets. For distant shipment they are doubtless inferior to the best of the Japs, still they are likely to long continue to hold a recognized place in the market. As a rule they bloom rather late so as to be comparatively free from injury from frost. They succeed admirably in Middle and North Alabama, but are not so well adapted to the coast region. The following kinds are in the Station orchard: Charles Downing.—This is a medium sized plum of very fine quality, fairly productive, late, ripening July 10 and a very late bloomer. Unfortunately the tree is rather a feeble grower and it does not seem quite at home. It would succeed better farther North. It is worth planting for home use on account of its fine quality and because it extends the season for this class of plums.

Milton: This is a fine plum blooming a day or two later and ripening three or four days earlier than the Wild Goose. This season the first picking was on June 9. It is an oblong plum, darker, richer red than Wild Goose and marked with large white dots. The flesh is firmer and it hangs on the tree better than the Wild Goose. It is clearly superior to that well known kind and is, every thing considered, the best variety of its class that we have tested. It was one of the very few kinds carrying a full crop in 1899.

President Wilder: This is a high flavored, medium sized red plum, ripening late in June. It does not seem to be very productive and like Charles Downing would probably do better farther North. It can not be recommended here except, perhaps, to keep up a succession and fill the gap between Wild Goose and Charles Downing.

Whitaker: This is much like Wild Goose and ripens at about the same season, possibly averaging two or three days later. It is hardy and productive, bearing a full crop in 1899 and also this season, but it is so much like Wild Goose that there is no need to plant both kinds. It will take farther experience to decide which of the two is preferable.

Wild Goose: Too well known to require extended comment. It succeeds well in Central and North Alabama and is very prolific when planted near other kinds. It requires cross pollination and does not bear well if planted by itself. It begins ripening here early in June in ordinary seasons and continues in season for nearly three weeks. It failed to bear in 1899 though others of this class carried a full crop.

Wooten: A small oblong red plum, ripening ten days later than Wild Goose. It has little to recommend it except hardiness and productiveness as the quality is poor. It ripened a full crop in 1899.

The Wayland Plums: These resemble the Wild Goose type somewhat closely but they bloom later and ripen decidedly later than most of those kinds and seem adapted to a range of country a little farther South. What wild species they are descended from is uncertain. They cannot be recommended for shipment but are desirable for the home orchard on account of the sureness of the crop, an entire failure being almost unknown, and because of their late ripening which will prolong the plum season till the first of September. In quality they are not equal to the best kinds of the Wild Goose type, but they are useful for canning, jellies and preserves. They are represented in the Station orchard by two kinds, Wayland and Golden Beauty. The former is bright cherry red, and rather milder in flavor and is probably preferable where only one is to be planted but the Golden Beauty is very prolific and it is a few days later. Both kinds ripen in August, often lasting to early September. The crop was lighter this year than it has been in five years owing to heavy and continued rains during the blooming season that prevented pollintion. A failure from Spring frosts is almost or quite unknown.

The Chicasaw Plums: The varieties of this type in cultivation are simply selections from the best of our native "old field" plums and have little to recommend them for general planting. They mostly bloom so early as to be in great danger from Spring frosts and they are too soft and small to be of much value for shipment. A few trees of the earliest kinds may be useful in the home garded as they ripen before the other kinds. They are represented in the Station orchard by the following three kinds:—Emerson: A small red plum, very early but of no great value. This season the crop all rotted when half grown. Lone Star: Much like Emerson of no value. Transparent: A medium sized yellow plum of nice sweet, delicate flavor. It is the best of the lot bupt cracks badly in wet weather.

The Japanese Plums: This is by far the most important type of plum for this region. For commercial orchards they are second in value only to peaches and with properly selected varieties the crop is surer than peaches, being less liable to injury from Spring frosts and from rot. There has been much confusion in regard to the names of the varieties and as noted on page 175, several of the supposed kinds in the Station orchard prove to be identical. The following sixteen kinds seem to be sufficiently distinct. They are mentioned in alphabetical order.

Abundance (this equals Botan of some, Yellow fleshed Botan, and in our orchard Berger): This is the best known and most widely planted of any of the Japanese plums. It blooms with peaches but usually holds a number of buds in reserve that open if the first blooming is killed so that an entire failure of the crop is rare. It is a handsome red plum with clear transparent skin that is yellow under the red, of very fine sweet flavor, the flesh becoming soft and juicy when fully ripe. Picked when still firm it ships well. It began ripening this year the middle of June and lasted two weeks. It it usually free from rot. Perhaps its greatest fault is a tendency to overbear, making it necessary to thin freely to secure good sized fruit. It is the best plum of its season and is strongly recommended for general planting.

Berckmans (Botan of some): This is another large red plum very similar to Abundance in tree and fruit. It was formerly confused with it under the name of Botan. The color is a little duller, being underlaid with green instead of yellow, the size averages a little larger, but the quality is not so good. It ripens at about the same season. It is a plum of some merit but not so good as Abundance.

Burbank: This contests with Abundance for the first place in popularity as a market plum. It is a little larger and even richer in color, has firm, high flavored flesh and ripens an average of a week to ten days later than Abundance, although occasional specimens ripen nearly as early as that kind. The tree is thrifty with a spreading habit of growth quite different from that of most of the Japanese plums. Like Abundance it is a great bearer and needs heavy thinning. In some seasons it rots badly which is its only fault. It is recommended for general planting.

Blood plum No. 4: This is of the Satsuma type but inferior to that kind. It is not worth planting.

Chabot (Babcock, Bailey, Hattankio, Munson and Yellow Japan of our orchard belong here): This is a large red plum with yellow under-color. It is late, ripening here about July 10. It is a good shipper, having firm flesh of fairly good quality and it is usually free from rot. The tree is a good grower. It is recommended for general planting though possibly it should be replaced by Orient.

Hale: Young, only two years planted, but they did not fruit well this season. The few fruits secured were rather disappointing. Final judgment will have to be suspended.

Kelsey: This is the largest and in some respects the finest of the Japanese plums but it has two such serious faults that its planting cannot be advised in this State.

It blooms so early that the crop is usually killed, and it rots very badly. Its season is late, middle to last of July.

Kerr: This is a remarkably good plum whose valuable qualities seem to have been overlooked by nursery men and orchardists. It is the earliest of our really good plums ripening here about the first of June. It is large, rich yellow, with firm flesh of high quality. It blooms rather late and the tree is a good grower. It is strongly recommended for both home use and market.

Long Fruited: This is a small red plum with very firm flesh. It ripens a few days earlier than Kerr. The tree with us has not been thrifty. The quality is fairly good but the size is too small for market.

Maru: This is a red plum about the size of Abundance and ripening a few days later. The quality is poor and it rots very badly. It is not worth planting.

Normand: This is a large yellow plum of good quality, ripening the last of June or first of July, between Burbank and Chabot. Its color is somewhat against it for market, but it is useful in filling the gap between these two kinds, and it is in every way worthy of planting.

Orient: This is very much like Chabot but it seems to be distinct, and to be an improvement on that kind, being brighter colored, slightly larger and two or three days earlier. It is strongly recommended especially for market planting.

Red June (Red Nagate of some): This is a very showy, handsome red plum ripening at least a week earlier than Abundance. It is a good shipper and very free from rot. It is not as good in quality as the Abundance but it combines more desirable qualities for a market plum than any of the others. It blooms late and the tree is vigorous and productive.

Satsuma: This is a large plum with dull red mottled skin but bright blood red flesh. When fully ripe the quality is very fine. It cannot be recommended for market on account of its early blooming habit which makes the crop too uncertain, but it should be included in plantings for home use on account of its superior quality especially when cooked. It is one of the finest fruits grown for canning and for jelly on account of its brilliant color and peculiarly rich, pleasant flavor. It ripens about the first of July.

Willard: This plum has nothing to recommend it but earliness. With us it is no earlier than Kerr and not nearly as good. The tree here is a poor grower and unproductive.

Yosebe: This is the earliest Japanese plum we have tested, ripening a few days earlier than Keer and slightly in advance of Longfruited. It is a small bright red plum with firm flesh, free from rot and of very fair quality. The tree blooms late and is thrifty and productive. It is probably too small for a profitable market fruit, yet its earliness, high color and other good qualities make it at least worth a farther trial.

Hybred Plums: The following kinds are hybreds between the Japanese plums and some of the other races. While they are very interesting and suggest great possibilities for future improvement it cannot be said that any of them fully come up to the standard for a market plum.

Golden (Gold of Stark Bros.): This is a hybred between the Japanese and the Chicasaw plums. It turns golden yellow long before it is ripe and the loaded trees are very showy and beautiful. When ripe it is a light bright red at least on the side toward the sun. The quality is poor and watery, and this season much of the crop was lost through sunburn and rot. On the whole it is a disappointment.

Excelsior: Said to be a hybred between the Japanese and Wild Goose races. It is a good sized, early, dull red plum of better quality than Golden. The tree is a fine grower and very productive. It is said to do well at the far South. It is perhaps worthy of farther trial. The Wild Goose characteristics seem to predominate in the fruit of this plum as the Chicasaw does in that of Golden.

Wickson: A hybred between Kelsey and *Prunus Simmoni*, which latter parent the tree greatly resembles. This is truly a magnificent plum, larger and handsomer than any of those mentioned above. Its one great fault is that it blooms too early for safety. It ripens about the first of July, but this year there were only two or three specimens to the tree. In fact we have never secured a full crop from it.

Lists of Plums for General Planting in Alabama. As a short list including only the very best plums for market we suggest the following mentioned in the order of ripening. They will cover the period from the first of June to the middle of July with a short break about the first of July. Kerr, Red June, Abundance, Burbank, and Orient. A large orchard of these five plums, if properly managed, could hardly fail to be profitable. Abundance and Burbank bloom together and should be planted near each other in order to secure cross pollination, while Kerr, Red June and Orient all bloom about together but a few days later. For a longer list add Yosebe for very early, Berckmans, Normand and Chabot.

For a full list for home use and local market, plant all of the above and add Transparent, Milton, Wild Goose, Satsuma, Wickson, Wayland and Golden Beauty.

The Blooming Season of Plums: As has been noted in previous Bulletins the blooming season of plums is especially import since many, or perhaps most, of the varieties are infertile to their own pollen and require cross pollination in order to bear fruit. For this reason plums should not be planted in large blocks of one variety but rows of one kind should be alternated with rows of one or more others, taking care to mate together kinds that bloom at approximately the same season. The notes given below on the blooming season for 1900 show a rather close agreement in the sequence of varieties with observations recorded for other seasons at this place, indicating that there is but little variation in this respect from year to year, although the actual season of blooming varies quite widely in different seasons. The sequence observed here however is not the same that is recorded for the same varieties in more northern localities, (see particularly the Vermont Bulletins and Reports). It is hard to see what should cause this difference in the comparative behavior of varieties in the two sections.

Notes on the blooming of plums in 1900.

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Abundance		buds white	full bloom	Mostly fallen		
Babcock*		buds separated	full bloom	falling		
Bailey*		buds separated	full bloom	falling		
Berckmans		buds white	full bloom	falling		
Berger †		buds white	full bloom	mostly fallen		
Blood No. 4	first blooms	nearly full bloom	flowers falling	fallen		
Botan (Tabor) ‡		buds white	full bloom	falling		
Botan (Munson) †		buds white	full bloom	mostly fallen		
Burbank		first blooms	blooming	falling		
Chabot		buds separated	blooming	falling		
Chas. Downing		nearly dormant	buds separating	buds separated	first blooms	full bloom
Earliest of all		dormant	nearly dormant	first blooms	nearly full bloom	
Emerson	first blooms	full bloom	falling	fallen, fruits setting		
Excelsior		first blooms	full bloom falling	fallen		

Golden—(Gold)	....	buds separated.	blooming.......	mostly fallen...	....	....
Golden Beauty......	....	dormant........	buds separating	buds separated.	buds white.. .	blooming.......
Hale...............	....	first blooms....	nearly full bloom .	mostly fallen...	....	....
Hattankio*...	....	buds separated	blooming	mostly fallen .	....	....
Hawkeye	....	dormant.	dormant	dormant	dormant	nearly dormant....
Kelsey.............	first bloom badly killed in Feb.	nearly full bloom......	nearly full bloom........	fallen.........	....	....
Kerr...	....	buds separated	nearly full bloom ...	full bloom	....	....
Lone Star	....	buds white ...	full bloom......	fallen....	....	....
Long fruited......	....	dormant ..	dormant....	first blooms many buds still dormant	first blooms ..	full bloom .. .
Maru...............	....	dormant	dormant...... .	nearly dormant...	first blooms, most buds not separat'd	nearly full bloom........
Milton	....	nearly dormant	buds separating	first blooms....	full bloom .. .	....
Munson *..........	....	buds separated.	blooming.	....	....	....
Normand	....	buds white.....	full bloom .	falling	....	....
Orient	....	buds separated	first blooms ...	mostly fallen..	....	....
Pres. Wilder.... ..	....	nearly dormant.. ..	buds separating	first blooms....	blooming.. ..	full bloom .. .
Red nagate	....	nearly dormant. ...	buds white....	full bloom.	full bloom .. .	first blooms ..

Notes on the blooming of plums in 1900.—Con'd.

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Rockford	dormant	dormant	dormant.	dormant	nearly dormant	first blooms ..
Satsuma	first blooms badly killed in Feb.	nearly full bloom.	full bloom and falling ..	leaves half grown......	.. ..	.. ..
Transparent... . ..	....	buds separated	first blooms ...	mostly fallen...	.. ..	.. ..
Wayland	....	buds separated	buds separated.	first blooms ...	first blooms ..	full bloom .. .
Whitaker ...	....	buds separating.	buds separated.	nearly full bloom ...	full bloom .. .	.. ..
Wickson	first blooms badly killed in Feb.	....	full bloom	fallen..........	.. ..	.. ..
Wild Chicasaw	first blooms ..	nearly full bloom	full bloom and falling.	....	.. ..	.. ..
Wild Goose	....	buds separating	buds separated.	nearly full bloom....	full bloom .. .	.. ..
Willard......	....	nearly dormant...	nearly dormant. ...	nearly dormant. ...	first blooms ..	blooming.....
Wooten	... .	buds separating	buds separated	nearly full bloom ...	full bloom .. .	.. ..
Yellow Botan †	....	buds white....	nearly full bloom	falling	.. ..	.. ..
Yellow Japan *...	....	buds separated.	blooming	falling.	.. ..	.. ..
Yosebe.	....	dormant......	dormant.......	first blooms, most buds not separ'ted	first blooms ..	nearly full bloom.......

* Equals Chabot.
† Equals Abundance.
‡ Equals Berckmans.

SAN JOSE SCALE.

In Bulletin 106 it was noted that in the plum orchard planted in 1896 two trees proved to be infested with scale, and that from this center of infection it was slowly spreading to other trees in the orchard. At the close of the growing season of 1899 it had developed sufficiently to conspicuously whiten large areas on the trunk and larger branches. It had not spread to the twigs and smaller branches and it had so far interfered but little with the growth and vigor of the trees. During February, 1900, this entire orchard was thoroughly sprayed with a 20% mechanical mixture of kerosene and water. A little later one of the originally infested trees was again sprayed with undiluted crude petroleum. The crude petroleum was also applied to two infested peach trees and to a number of apple trees. In no case did it do any injury.

The result of this treatment simply goes to confirm the truth of the following two propositions: 1st, that when a tree is once infested with scale it is almost impossible to entirely eradicate it. 2nd, that by spraying with kerosene or crude petroleum its numbers can be so reduced that it does the trees no harm. The spraying has probably not exterminated the scale on a single tree where it had gained a lodgment, but there are left only a few scattered individuals on any of the trees. These facts have come to be quite widely recognized and they should be made the basis for the treatment of every outbreak of the scale. When it is first discovered in a new locality, if it is confined to a few trees or even to one or more entire orchards, by all means cut them out at once and burn them, for this is the only sure way of stamping out the pest. On the other hand in communities where it is known to occur somewhat widely it is needless to cut down infested trees for if taken in time the scale can be so controlled by annual or even biennial sprayings that it will do little if any harm. Of course the spraying is a rather heavy expense and the occasion for it should be avoided by taking every precaution to keep the premises clear of this pest.

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By J. F. DUGGAR, Agriculturist.

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C. L. HARE ....First Assistant Chemist.

J. Q. BURTON .... Second Assistant Chemist.

H. S. HOUGHTON ....Third Assistant Chemist.

T. U. CULVER .... Superintendent of Farm.

R. W. CLARK....................................Assistant Agriculturist.

C. F. AUSTIN ....Assistant Horticulturist.

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

CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1899 and 1900.

BY J. F. DUGGAR.

These experiments were conducted under the direction of the Agricultural Department of this Station in 1899 and 1900. These tests in 1899 were made by farmers in nineteen localities; the tests made in 1900 were conducted in eighteen localities, not including in this count the few experimenters who failed to report results.

The method of conducting the experiments was the same as in former years. The plots were each one-eighth acre in area.

The following is the list of those who made experiments in 1899 and 1900 and who reported results.

Name.	Post Office.	County.	Page
Agricultural School	Hamilton	Marion	50
Autrey, A.	Berneys	Talladega	50
Ballard J. L.	Jackson	Clarke	40
Bevill, W. C.	Bevill	Choctaw	38
Borland, T. M.	Dothan	Henry	46
Chappell, C. A.	Dillburg	Pickens	51
Chism, W. T	Vick	Bibb	20
Culver, J. W.	Jackson	Clarke	40
Cunningham, E. L.	Furman	Wilcox	11
Cory, A. F.	Evergreen	Conecuh	52
Daffin, E. J.	Tuscaloosa	Tuscaloosa	17
Duncan, J. S.	Maple Grove	Cherokee	13
Experiment Station	Auburn	Lee	24
Foster, J. D.	Auburn	Lee	27
French, J. W.	Gordo	Pickens	15

Name	Post Office	County	Page.
Fulton, W. F	Collinsville	DeKalb	7
Funke, F	Tuscumbia	Colbert	50
Freeman, G. W	Maple Grove	Cherokee	13
Harris, Jno. T., Jr	Oak Bowery	Chambers	51
Ingram, W. N	Marvyn	Russell	51
Ingram, W. N	Opelika	Lee	32
Jarrett, R. H	Sterrett	Shelby	51
Jones, T. K	Greensboro	Hale	51
Mason, C. H	Wilson	Escambia	44
McClure, G. L	Garland	Butler	43
Melton, E	Hugent	Fayette	19
McAlpine, J. R	Boligee	Greene	50
McIntyre, P. M	Abbeville	Henry	52
Purifoy, W. M	Snow Hill	Wilcox	10
Rivers, C. E	Hurtsboro	Russell	35
Rouse, D. H	Greenville	Butler	52
Slaton, J. P	Notasulga	Macon	21
Thomason, T. J	Kaylor or Ranburn	Randolph	29
Troyer, A. M	Calhoun	Lowndes	36, 52
Watkins, J. C	Burn Corn	Monroe	33
Weems, J. A	Union Springs	Bullock	52

THE FERTILIZERS USED.

These consisted of high grade acid phosphate guaranteed to contain at least 14 per cent. of available phosphoric acid.

The following table gives the plan of the experiment and the composition of the fertilizers employed:

Pounds per acrk of fertilizers, nitrogen, phosphoric acid, and potash used, and composition of each mixture.

Plot No.	FERTILIZERS.		MIXTURE CONTAINS.			Cost of mixture, per ton.
	Amount per acre.	KIND.	Nitrogen.	†Available phosphoric acid.	Potash	
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	
1	200	Cotton seed meal.....	13.58	5.76	3 54	
		In 100 lbs s. c. meal. *	6.79	2 88	I 77	$ 19.00
2	240	Acid phosphate...	....	36 12	....	
		In 100 lbs. acid phos	....	**15.05**	....	12.50
4	200	Kainit	....	....	24 60	
		In 100 lbs kainit.	....	....	12.30	13.75
5	200 240	Cotton seed meal.... Acid phosphate ...	13.58	41.88	3.54	
		In 100 lbs. above mixt.	**3.09**	**9.52**	**.80**	15.45
6	200 200	Cotton seed meal.... Kainit	13.58	5.76	28 14	
		In 100 lbs. above mixt	**3.39**	**1.44**	**7.03**	16 38
7	240 200	Acid phosphate ... Kainit	....	....	....	
		In 100 lbs. above mixt	....	**8.21**	**5.59**	13.09
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit	13.58	41.88	28.14	
		In 100 lbs above mixt	**2.12**	**6.54**	**4.39**	14 94
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	13 58	41 88	15 84	
		In 100 lbs. above mixt	**2.59**	**7.75**	**2.93**	15 11

* Average of many analyses.

† Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by $1\frac{3}{14}$.

The phosphate and cotton seed were purchased at market prices. Most of the kainit was donated by the German Kali Works.

In determining the increase over the unfertilized plots, the yield of the fertilized plots, Nos. 4, 5, 6 and 7, is compared with both unfertilized plots, lying on either side, giving to each unfertilized plot a weight inversely proportional to its distance from the plot under comparison. This method of comparison tends to compensate for variations in the fertility of the several plots.

It should be remembered that seasons, as well as soils, determine the effects of fertilizers, so that to be absolutely reliable a fertilizer experiment should be repeated for several years on the same kind of soil. Abnormal weather conditions in 1899 and 1900 resulted in an unusually large proportion of inconclusive experiments.

THE WEATHER IN 1899 and 1900.

The following data are taken from the records of the Alabama Section of the Weather Bureau for 1899 and 1900 and give average results of a number of stations:

	1899.	1900.
Rainfall for April, inches	2.80	9.06
Rainfall for May, inches	2.03	2.64
Rainfall for June, inches	2.54	11.80
Rainfall for July, inches	6.76	4.93
Rainfall for August, inches	3.68	2.89
Rainfall for September, inches	.66	4.00
Rainfall for October, inches	2.18	5.64
Rainfall for November, inches	3.04	3.88

It will be seen from the above that the spring and early summer of 1899 were very dry. Complaints of drought in that year were general. In 1900 an excessive precipitation in April and June greatly injured crops, and in addition there was in many localities a severe drought in August.

Two more unfavorable seasons in immediate succession seldom occur.

EXPERIMENTS MADE BY W. F. FULTON, LARIMORE OR COLLINSVILLE, DEKALB COUNTY.

Dark gray, mulatto, or reddish, stiff soil; subsoil red clay.

An experiment with cotton has been conducted on this farm in Big Wills Valley for three years in succession on land cleared about three-quarters of a century ago. The crop preceding the cotton experiments of both 1899 and 1900 was corn. The early part of the summer of 1899 was rather dry; in 1900 "from the time the cotton was planted until it was laid by my notes show almost continuous rain,—the wettest season in the knowledge of the oldest inhabitant."

The results for 1898 were printed in Bulletin No. 102. Those for 1899 and 1900 are given in the following table:

Larimore or Collinsville experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899 Yield seed cotton per acre.	1899 Increase over unfertilized plots.	1900 Yield seed cotton per acre.	1900 Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	648	208	544	0
2	240	Acid phosphate........	760	320	880	336
3	00	No fertilizer...........	440	....	544	....
4	200	Kainit	648	205	666	107
5	200 240	Cotton seed meal.... Acid phosphate......	880	434	1120	550
6	200 200	Cotton seed meal.... Kainit	736	287	920	337
7	240 200	Acid phosphate...... Kainit..............	856	404	1064	468
8	00	No fertilizer...........	456	....	608	....
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit..............	976	520	1208	600
10	200 240 100	Cotton seed meal.... Acid phosphate..... Kainit	912	456	1032	424

Increase of seed cotton per acre when cotton seed meal was added:

	1899	1900
To unfertilized plot	208 lbs.	0 lbs.
To acid phosphate plot	114 lbs.	214 lbs.
To kainit plot	82 lbs.	230 lbs.
To acid phosphate and kainit plot.	116 lbs.	132 lbs.
Average increase with cotton seed meal.........................	**130 lbs.**	**144 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	320 lbs.	336 lbs.
To cotton seed meal plot	126 lbs.	550 lbs.
To kainit plot	233 lbs.	263 lbs.
To cotton seed meal and kainit plot	233 lbs.	263 lbs.
Average increase with acid phosphate	**219 lbs.**	**378 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	205 lbs.	107 lbs.
To cotton seed meal plot	79 lbs.	337 lbs.
To acid phosphate plot	84 lbs.	132 lbs.
To cotton seed meal and acid phosphate plot	86 lbs.	50 lbs.
Average increase with kainit	**116 lbs.**	**157 lbs**

The principal need of this soil, clearly shown in each of three tests, is for phosphate, which has paid a large profit, whether employed alone or in combination with any of the other materials. The increase attributable to phosphate in each of the three years is respectively 464, 219, and 378 pounds of seed cotton per acre. Cotton seed meal usually increased the yield more than enough to cover its cost, the averages for the 3 years being respectively 152, 130, and 144 pounds of seed cotton. Its relatively slight effect suggests the advisability of reducing the amount of cotton seed meal, of which about half as much as of phosphate might be used for cotton.

Kainit was the least beneficial on this soil of the ingredients of the complete fertilizer and the figures indicate that its addition to the mixture of phosphate and kainit was not profitable.

EXPERIMENT MADE BY W. M. PURIFOY, 2 MILES NORTH-EAST OF SNOW HILL, WILCOX COUNTY.

White bald prairie; subsoil, white rotten limestone.

This experiment was made in 1899 on land especially favorable to the development of black rust of cotton. The land was not broken until May 25, when it was bedded with a one-horse plow. "Many stalks had nothing on them on account of coming up too late. Extreme drought ruined the experiment."

The table on page 11 gives the yields and the subjoined analysis of results of Mr. Purifoy's tests, both in 1898 and 1899, shows the increase attributable to each fertilizer, when used alone or in combinations under cotton growing on poor white prairie soil.

Increase of seed cotton per acre when cotton seed meal was added:

	1898.	v899.
To unfertilized plot	128 lbs.	144 lbs.
To acid phosphate plot	27 lbs.	16 lbs.
To kainit plot	227 lbs.	144 lbs.
To acid phosphate and kainit plot.	141 lbs.	128 lbs.
Average increase with cotton seed meal.........................	**131 lbs.**	**100 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	200 lbs.	208 lbs.
To cotton seed meal plot..........	99 lbs.	48 lbs.
To kainit plot..	209 lbs.	240 lbs.
To cotton seed meal and kainit plot.	123 lbs.	224 lbs.
Average increase with acid phosphate.......................	**158 lbs.**	**180 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	27 lbs.	0 lbs.
To cotton seed meal plot.........	72 lbs.	0 lbs.
To acid phosphate plot	18 lbs.	32 lbs.
To cotton seed meal and acid phosphate plot	96 lbs.	176 lbs.
Average increase with kainit......	**41 lbs.**	**52 lbs.**

In the above paragraphs the results of Mr. Purifoy's experiment in 1898 are republished to show the close correspondence between the results of the two years, both tending to indicate that the phosphate was more beneficial than cotton seed meal and that kainit was of least effect.

Snow Hill and Furman experiments with cotton on white bald prairie.

Plot No.	Fertilizers.		Snow Hill 1899.		Furman. 1900.	
	Amount per acre	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	144	144	480	80
2	240	Acid phosphate........	208	208	480	80
3	00	No fertilizer...........	00	....	400	....
4	200	Kainit.................	00	0	376	—27
5	200 240	Cotton seed meal... Acid phosphate......	192	192	664	258
6	200 200	Cotton seed meal.... Kainit	144	144	488	79
7	240 200	Acid phosphate...... Kainit..............	240	240	616	204
8	00	No fertilizer	00	....	416	....
9	200 240 200	Cotton seed meal... Acid phosphate...... Kainit..............	368	368	624	208
10	200 240 100	Cotton seed meal.... Acid phosphate ..... Kainit..............	416	416	616	200

EXPERIMENT MADE IN 1900 BY E. L. CUNNINGHAM, 6 MILES EAST OF FURMAN, WILCOX COUNTY.

White prairie, the surface dark gray; sub-soil white rotten limestone.

The original growth, cleared about 30 or 40 years ago, is reported as oak and hickory with some short-leaf pine. The field was in cotton in 1897 and 1898 and uncultivated in 1899.

The depth of plowing was 5 or 6 inches. On Plot 5 there was considerable black rust, but very little on Plots 9 and 10, where a complete fertilizer containing kainit was used. The stand was full and uniform. There was too much rain.

The yields are given in the table above.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	80 lbs.
To acid phosphate plot	178 lbs.
To kainit plot.....	106 lbs.
To acid phosphate and kainit plot............	4 lbs.

Average increase with cotton seed meal, - - 92 lbs.

Increase of seed cotton per acre when acid phosphate was used.

To unfertilized plot	80 lbs.
To cotton seed meal plot	178 lbs.
To kainit plot	231 lbs.
To cotton seed meal and kainit plot..........	129 lbs.

Average increase with acid phosphate, - - 130 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—27 lbs.
To cotton seed meal plot	—1 lbs.
To acid phosphate plot	124 lbs.
To seed cotton meal and acid phosphate plot	—50 lbs.
Average increase with kainit,	**12 lbs.**

Mr. Cunningham's experiment, like both of the tests made by Mr. Purifoy, on the same class of land, white prairie, indicates that phosphate was most needed. The largest yield was made with a mixture of cotton seed meal and phosphate. Kainit did not increase the yield, though it did seem to somewhat restrain the rust on Plots 9 and 10.

It should be noted that white prairie soil was not very responsive to commercial fertilizers and that none of these paid a very large profit.

Although phosphate was undoubtedly useful in each of these experiments, its effects were far less notable than the favorable influence that is exerted by adding suitable vegetable matter to this class of soils. We cannot yet recommend the use of phosphate on these soils, believing that the same money invested in the seed of melilotus or of other renovating plant would be more profitably spent.

EXPERIMENTS MADE BY J. S. DUNCAN ON G. W. FREEMAN'S FARM, 1½ MILES SOUTHWEST OF MAPLE GROVE, CHEROKEE COUNTY.

In 1899 the test was made on gray sandy upland, with red subsoil; in 1900 on light alluvial second bottom of a dark gray color, with red subsoil. Both fields had been cleared for more than a quarter of a century. The cotton experiment of 1899 was preceded by cotton, that of 1900 by corn.

In 1899 the summer was excessively dry, in 1900 excessively wet.

Maple Grove experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Maple Grove. 1899. Yield seed cotton per acre.	Maple Grove. 1899. Increase over unfertilized plots	Maple Grove. 1900. Yield seed cotton per acre.	Maple Grove. 1900. Increase over unfertilized plots
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	800	176	1036	220
2	240	Acid phosphate........	752	128	932	116
3	00	No fertilizer..........	624	....	816	....
4	200	Kainit	616	—43	920	106
5	200 240	Cotton seed meal.... Acid phosphate......	960	266	992	181
6	200 200	Cotton seed meal.... Kainit	904	175	1032	223
7	240 200	Acid phosphate...... Kainit....	776	12	1024	218
8	00	No fertilizer..........	800	....	804	....
9	200 240 200	Cotton seed meal ... Acid phosphate...... Kainit.....	1024	224	1080	276
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit.....	992	192	1032	228

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	176 lbs.	220 lbs.
To acid phosphate plot...........	138 lbs.	65 lbs.
To kainit plot	218 lbs.	117 lbs.
To acid phosphate and kainit plot.	212 lbs.	58 lbs.
Average increase with cotton seed meal.........	**186 lbs.**	**115 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.	116 lbs.
To cotton seed meal plot	90 lbs.	—39 lbs.
To kainit plot	55 lbs.	112 lbs.
To cotton seed meal and kainit plot	49 lbs.	53 lbs.
Average increase with acid phosphate	**81 lbs.**	**61 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—43 lbs.	106 lbs.
To cotton seed meal plot	—1 lb.	3 lbs.
To acid phosphate plot	—116 lbs.	102 lbs.
To cotton seed meal and acid phosphate plot	—42 lbs.	95 lbs.
Average increase (or decrease[—]) with kainit	**—51**	**77 lbs.**

In both years cotton seed meal was the most important fertilizer for cotton; phosphate afforded a small increase, possibly because of abnormal weather conditions; kainit was useless on upland in 1899 and scarcely profitable in 1900 on second bottom land.

EXPERIMENT MADE BY J. W. FRENCH, 3 MILES NORTH OF GORDO, PICKENS COUNTY.

This test was conducted in 1899 on gray upland, and in 1900 on dark sandy upland, both having red subsoils, rather retentive of water. The cotton experiment of 1899 was preceded by corn, that of 1900 by cotton. In both cases the tests were on old fields, cleared of pines and reclaimed four to seven years before the experiments began.

The former season was exceedingly dry; the latter, "the most unfavorable ever known, first too wet and then too dry." The stand was reported as excellent.

Gordo experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	536	200	696	312
2	240	Acid phosphate........	848	512	568	184
3	00	No fertilizer...........	336	....	384	....
4	200	Kainit.................	360	38	400	11
5	200 240	Cotton seed meal .... Acid phosphate......	944	637	728	335
6	200 200	Cotton seed meal ... Kainit	528	235	584	186
7	240 200	Acid phosphate ..... Kainit..............	736	458	552	149
8	00	No fertillzer.........	264	....	408	....
9	200 240 200	Cotton seed meal.... Acid phosphate ..... Kainit...............	1032	868	888	480
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	928	664	818	440

Increase of seed cotton per acre when cotton seed meal was added:

	1899..	1900.
To unfertilized plot	200 lbs.	312 lbs.
To acid phosphate plot..........	125 lbs.	151 lbs.
To kainit plot.......	197 lbs.	175 lbs.
To acid phosphate and kainit plot....	410 lbs.	331 lbs.
Average increase with cotton seed meal,	**238 lbs.**	**242 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	512 lbs.	184 lbs.
To cotton seed meal plot	437 lbs.	23 lbs.
To kainit plot	420 lbs.	138 lbs.
To cotton seed meal and kainit plot ...	633 lbs.	294 lbs.
Average increase with acid phosphate,	**501 lbs.**	**160 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	38 lbs.	11 lbs.
To cotton seed meal plot	—35 lbs.	—126 lbs.
To acid phosphate plot.............	—54 lbs.	—35 lbs.
To cotton seed meal and acid phosphate plot	231 lbs.	145 lbs.
Average increase with kainit, - -	**63 lbs.**	**—1 lb.**

Phosphate was the material of most importance for the gray soil and it was also needed on the darker soil. Cotton seed meal was first in importance in 1900 and second in 1899. Kainit was useless except in a complete fertilizer, in which combination it was slightly profitable, but never so important as phosphate or cotton seed meal.

EXPERIMENT CONDUCTED BY E. J. DAFFIN, 3 MILES S. OF TUSCALOOSA, TUSCALOOSA COUNTY.

This test was made in 1900 on the F. S. Moody farm. The soil is described as second bottom, sandy, and of a reddish gray color; the subsoil, as red clay. The original growth, removed more than half a century ago, is sweet gum, black gum, persimmon, and sassafras. The preceding crop was cotton.

June and July brought an excessive rainfall, interfering with cultivation and August was very dry. There were 1,065 plants per eighth-acre plot. "Red rust" was reported as injurious alike on all plots.

Both cotton seed meal and acid phosphate, whether used alone, or in any combination, greatly increased the yield and afforded a good profit. Kainit was practically ineffective except in combination with the other two fertilizers, where it seems to have increased the yield to a profitable extent; the complete fertilizer, containing kainit (Plot 9) affording an increase greater by 236 pounds of seed cotton per acre than the increment where only phosphate and meal were used together. (Plot 5.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	216 lbs.
To acid phosphate plot	356 lbs.
To kainit plot	259 lbs.
To acid phosphate and kainit plot	529 lbs.
Average increase with cotton seed meal	**340 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152 lbs.
To cotton seed meal plot	292 lbs.
To kainit plot	189 lbs.
To cotton seed meal and kainit plot	459 lbs.
Average increase with acid phosphate	**273 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	26 lbs.
To cotton seed meal plot	69 lbs.
To acid phosphate plot	63 lbs.
To cotton seed meal and acid phosphate	236 lbs.
Average increase with kainit	**99 lbs.**

Mr. Daffin also conducted similar tests in 1897 and 1898 on red sandy upland, with red clay subsoil, two and one-half miles east of Tuscaloosa. In both years phosphate was by far the chief need of that soil, but both cotton seed meal and kainit afforded considerable increase, so that the greatest profit was obtained by the use of a complete fertilizer containing all three of these materials.

EXPERIMENT MADE IN 1899 BY E. MELTON, ONE MILE WEST OF HUGENT, FAYETTE COUNTY.

Dark or "mulatto" soil, with red clay subsoil.

The original growth, removed about 50 years ago, is reported as short-leaf pine, oak, and hickory. The three preceding crops were corn. The plants were free from rust.

As shown in the detailed statement below, phosphate was the fertilizer chiefly needed by this soil, and its use, alone and in every combination, was highly profitable, the average increase attributable to phosphate being 364 pounds of seed cotton per acre. Cotton seed meal was next in importance, affording an average increase of 168 pounds per acre.

The most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Kainit was not needed.

Increase of seed cotton per acre when cotton seed meal was used:

To unfertilized plot	128 lbs.
To acid phosphate plot	160 lbs.
To kainit plot	176 lbs.
To acid phosphate and kainit plot	208 lbs.
Average increase with cotton seed meal	**168 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	400 lbs.
To cotton seed meal plot	432 lbs.
To kainit plot	296 lbs.
To cotton seed meal and kainit plot	328 lbs.
Average increase with acid phosphate	**364 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	72 lbs.
To cotton seed meal plot	120 lbs.
To acid phosphate plot	—32 lbs.
To cotton seed meal and acid phosphate plot	16 lbs.
Average increase with kainit	**44 lbs.**

EXPERIMENTS CONDUCTED BY W. T. CHISM, 1 MILE SOUTHEAST OF VICK, BIBB COUNTY.

Both experiments were conducted on dark gray sandy or loamy branch bottom soil, rather retentive of moisture. The earlier experiment was preceded by corn, the later one by cotton.

The field had been cleared about 75 years and the original growth is reported as sweet gum, red and white oak, hickory, ash, poplar, cucumber tree, and a few short-leaf pines, and chestnuts.

The latter part of the season of 1899 was dry and unfavorable and in 1900 there was almost continuous wet weather during the season of cultivation. The soil was worked June 25, 1900, when too wet, by which the experimenter reports that the crop was greatly damaged.

Increase of seed cotton per acre when cotton seed meal was used.

	1899.	1900.
To unfertilized plot	256 lbs.	62 lbs.
To acid phosphate plot	96 lbs.	77 lbs.
To kainit plot	244 lbs.	100 lbs.
To acid phosphate and kainit plot	92 lbs.	15 lbs.
Average increase with cotton seed meal	**172 lbs.**	**64 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	104 lbs.	24 lbs.
To cotton seed meal plot............	—56 lbs.	39 lbs.
To kainit plot	116 lbs.	78 lbs.
To cotton seed meal and kainit plot ..	—24 lbs.	—7 lbs.
Average increase with acid phosphate,	**35 lbs.**	**34 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—24 lbs.	—1 lb.
To cotton seed meal plot	—32 lbs.	37 lbs.
To acid phosphate plot	—12 lbs.	53 lbs.
To cotton seed meal and acid phosphate plot	—16 lbs.	—9 lbs.
Average increase with kainit..........	**—20 lbs.**	**20 lbs.**

In 1900 cotton seed meal was the only fertilizer that was very effective. In 1899 none of them were decidedly beneficial. On account of the extremely unfavorable weather in both years, it is probable that neither experiment indicates the real needs of this soil, so that we must place these tests in the class of inconclusive experiments.

Experiment made in 1899 by J. P. Slaton, 7 miles south of Notasulga and 7 miles N. E. of Tuskegee, Macon County.

Gray sandy upland, with retentive red clay subsoil.

The field was originally cleared about 75 years ago, and cleared of the second growth about 12 years ago. The original growth was long leaf pine and oak. The preceding crop was cotton.

The cotton did not come up until the first of June and this late start may have kept the fertilizers from exerting their full effect. The stand was good.

As shown in the table on page 23 and in the detailed statements below, phosphate and cotton seed meal were both effective in nearly every combination. Kainit was not needed.

Mr. Slaton conducted an experiment in 1898 (see Bulletin No. 102) on similar soil. In that year acid phosphate and cotton seed meal were even more profitable than in 1900 and kainit was useless. It seems that this gray soil, with a clay subsoil near at hand, needs only a mixture of acid phosphate and cotton seed meal to produce a profitable cotton crop.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	192 lbs.
To acid phosphate plot	43 lbs.
To kainit plot	110 lbs.
To acid phosphate and kainit plot	123 lbs.
Average increase with cotton seed meal	**117 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	176 lbs.
To cotton seed meal plot	27 lbs.
To kainit plot	145 lbs.
To cotton seed meal and kainit plot	158 lbs.
Average increase with acid phosphate	**127 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	20 lbs.
To cotton seed meal plot	—62 lbs.
To acid phosphate plot	—11 lbs.
To cotton seed meal and acid phosphate plot	69 lbs.
Average increase with kainit	**4 lbs.**

Tuscaloosa, Hugent, Vick and Notasulga experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Tuscaloosa. 1900. Yield seed cotton per acre.	Tuscaloosa. 1900. Increase over unfertilized plots	Hugent. 1899. Yield seed cotton per acre.	Hugent. 1899. Increase over unfertilized plots.	Vick. 1899. Yield seed cotton per acre.	Vick. 1899. Increase over unfertilized plots.	Vick 1900. Yield seed cotton per acre.	Vick 1900. Increase over unfertilized plots.	Notasulga. 1899. Yield seed cotton per acre.	Notasulga. 1899. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	680	216	464	128	992	256	526	62	592	192
2	240	Acid phosphate....................	616	152	736	400	840	104	488	24	576	176
3	00	No fertilizer....................	464	......	336	......	736	.....	464	....	400	....
4	200	Kainit............................	496	26	400	72	668	—24	452	—1	544	20
5	200 240	Cotton seed meal................. Acid phosphate..................	984	508	880	560	848	200	544	101	724	219
6	200 200	Cotton seed meal................. Kainit...........................	768	285	560	248	824	220	532	99	616	130
7	240 200	Acid phosphate................... Kainit...........................	704	215	672	368	652	92	500	77	632	165
8	00	No fertilizer....................	496	.....	296	......	516	.....	412	.....	448	......
9	200 240 200	Cotton seed meal................. Acid phosphate.................. Kainit...........................	1240	744	872	576	700	184	504	92	736	288
10	200 240 100	Cotton seed meal .... Acid phosphate................... Kainit....	1040	544	752	456	840	324	496	84	744	296

Auburn Experiments in 1898, 1899, & 1900, on Experiment Station Farm.

These tests were made on three adjacent areas set apart for permanent fertilizer experiments with cotton, corn, and oats. The soil is of the same character on all three areas, as was also the previous fertilization of each plot.

All three of the cotton crops were preceded by oats fertilized like the corresponding cotton plot.

In 1900 each plot received the same fertilizer as in 1898 and 1899. Hence the results should show not only the immediate effects of fertilizers, but the residual on cumulative effects, if there are any on this light soil.

Contrary to our usual custom, cowpeas were not sown after the oats, but instead a thin growth of crabgrass, rag weed, and poverty weed covered the ground during the summer and fall following the harvesting of each oat crop.

Commercial fertilizers, chiefly acid phosphate, had been liberally, though not lavishly, employed annually for a number of years before the experiment began.

The soil is a deep sand bed nearly free from stone or gravel, and the plots occupy the crest of a hill.

The dates of planting were April 15, 1898; April 11, 1899; and April 24, 1900. The stand was nearly perfect except in 1900, when there was some slight want of uniformity, so that the figures for 1900 represent the yields after being corrected on the basis of an equal number of plants on each plot.

The Peerless variety was used each year. In 1898 black rust was quite injurious. September 23 it was estimated that the plants on the plots on which kainit had been used had shed 50 to 70 per cent. of their leaves while the plants receiving no kainit had shed 75 to 92 per cent of their leaves.

The prevalence of black rust probably accounts, at least in part, for the very favorable showing made by kainit in 1898, for numerous experiments recorded in the bulletins of this Station show that kainit generally decreases the injury from black rust.

Fertilizer experiments with cotton at Auburn, 1898, 1899 and 1900 on Experiment Station farm.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1898. Yield.	1898. Increase.	1899. Yield.	1899. Increase.	1900. Yield.	1900. Increase.	Average increase 3 years.
	Lbs.		*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*
1	200	Cotton seed meal......	889	214	1008	234	379	35	161
2	240	Acid phosphate........	853	178	819	145	266	—78	82
3	00	No fertilizer..........	675	...	774	..	344	...	......
4	200	Kainit....	783	122	1049	262	360	46	143
5	200 240	Cotton seed meal.... Acid phosphate	1013	346	1029	231	393	109	229
6	200 200	Cotton seed meal.... Kainit.....	1192	529	1075	265	434	180	325
7	240 200	Acid phosphate...... Kainit	1145	486	1051	229	246	22	246
8	00	No fertilizer.........	655	....	833	....	194	...	......
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit	1177	522	1152	319	435	241	361
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	....	....	1055	422	....	....	......

Increase in yield from cotton seed, acid phosphate, and kainit on Experiment Station Farm in 1898, 1899 and 1900.

	Increase; lbs. seed cotton per acre.			
	1898.	1899	1900.	Average, 3 years.
Increase of seed cotton per acre where cotton seed meal was added	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
To unfertilized plot.....................	214	234	35	161
To acid phosphate plot..................	168	86	187	147
To kainit plot...........................	407	3	134	181
To acid phosphate and kainit plot	36	90	219	115
Average increase with **cotton seed meal.**	206	103	144	**151**
Increase of seed cotton per acre where phosphate was added				
To unfertilized plot.....................	178	145	—78	82
To cotton seed meal plot................	132	—3	194	80
To kainit plot...........................	364	—33	—24	102
To cotton seed meal and kainit plot......	—7	54	61	36
Average increase with **acid phosphate**...	167	41	38	**82**
Increase of seed cotton per acre where kainit was added				
To unfertilized plot.....................	122	262	46	143
To cotton seed meal plot................	315	31	145	164
To acid phosphate plot	308	84	100	164
To cotton seed meal and acid phos. plot..	176	88	132	132
Average increase with **kainit**...........	235	116	106	**152**

In 1898 the greatest increase in yield was obtained by the use of a mixture of cotton seed meal and kainit. This mixture was a close second to the complete fertilizer in 1899 and 1900 and its average increase for the three years lacked only 36 pounds of seed cotton per acre of equalling the increase due to a complete fertilizer.

Quite unexpectedly, acid phosphate has not been very effective. If this is due to the accumulation of a sufficient supply of phosphoric acid in the soil from the phosphate applied annually for many years before the beginning of the experiment, the value of applications of phosphate should become more marked in future as this supply is exhausted.

It would be safe to estimate the amount of phosphate applied annually during the decade before the test began at 200 pounds per acre or less. Results on most soils seem to indicate that phosphate is the most important single fertilizing material for cotton.

EXPERIMENTS CONDUCTED BY J. D. FOSTER, 1 MILE SOUTH OF AUBURN, LEE COUNTY.

Light sandy loam, gray upland; subsoil yellowish clay or loam, not compact.

The experiments of 1899 and 1900 were conducted in different parts of the same field, on identical soil.

The field, on which the original growth was reported as long-leaf pine, had been in cultivation for a great many years.

The crop preceding the experiment of 1899 was corn, with drilled cowpeas between the rows. The peas made only a moderate growth and were grazed in the fall of 1898.

The stand of cotton was uniform. In 1900 cotton was planted May 25. The cotton experiment in 1900 occupied the plots that had been used in 1899 for a similar fertilizer experiment with corn, (having no cowpeas between the rows.) Hence the results of the cotton experiment of 1900 should show not only the immediate effects of each fertilizer, but also the residual or second-year effects, if there were any lasting benefit from commercial fertilizers used on this light soil.

Auburn experiment with cotton on J. D. Foster farm.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	616	280	600	240
2	240	Acid phosphate........	528	192	488	128
3	00	No fertilizer..........	336	....	360	....
4	200	Kainit................	520	183	432	79
5	200 240	Cotton seed meal.... Acid phosphate......	744	405	744	397
6	200 200	Cotton seed meal.... Kainit	648	307	688	347
7	240 200	Acid phosphate...... Kainit............	568	225	528	194
8	00	No fertilizer..........	344	....	328	....
9	200 240 200	Cotton seed meal.... Acid phosphate ..... Kainit............	664	320	726	398
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit............	656	312	688	360

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	280 lbs.	240 lbs.
To acid phosphate plot	213 lbs.	269 lbs.
To kainit plot	124 lbs.	268 lbs.
To acid phosphate and kainit plot....	95 lbs.	204 lbs.
Average increase with cotton seed meal,	**178 lbs.**	**245 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

	1899.	1900.
To unfertilized plot	192 lbs.	128 lbs.
To cotton seed meal plot	125 lbs.	157 lbs.
To kainit plot	42 lbs.	115 lbs.
To cotton seed meal and kainit plot ..	13 lbs.	51 lbs.
Average increase with acid phosphate,	**93 lbs.**	**113 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	183 lbs.	79 lbs.
To cotton seed meal plot	27 lbs.	107 lbs.
To acid phosphate plot	33 lbs.	66 lbs.
To cotton seed meal and acid phosphate plot	—85 lbs.	1 lb.
Average increase with kainit	**39 lbs.**	**63 lbs.**

The figures for the two years agree closely and show that a larger increase was afforded by cotton seed meal than by any other single material. The most profitable of all the fertilizers was a mixture of cotton seed meal and phosphate. Kainit was unprofitable.

EXPERIMENT CONDUCTED BY JUDGE T. J. THOMASON, 2 MILES SOUTH OF RANBURNE (NEAR KAYLOR), RANDOLPH COUNTY.

This experiment was made in 1899 on gray land, with yellow subsoil. The soil is described as table land rather retentive of moisture. The preceding crop was cotton.

This is the third experiment on a uniform plan conducted by Judge Thomason. (See Bulletin No. 107; p. 274). If we take the average increase of each fertilizer under all conditions we have for the entire period of three years an average increase of 187 pounds of seed cotton per acre attributable to cotton seed meal, 197 to phosphate, and only 31 to kainit. The inference is plain that a mixture of cotton seed meal and phosphate was all that cotton needed on this soil, and that the addition of kainit, at the rate of 200 pounds per acre, was usually unprofitable. The results for 1899, when kainit afforded a slight profit, were more favorable to potash than were the results of the two previous tests on this soil.

The following statements show the average increase in yield for the entire period of three years.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	217 lbs.
To acid phosphate plot	137 lbs.
To kainit plot	156 lbs.
To acid phosphate and kainit plot	238 lbs.
Average increase with cotton seed meal	**187 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	264 lbs.
To cotton seed meal plot	184 lbs.
To kainit plot	128 lbs.
To cotton seed meal and kainit plot	210 lbs.
Average increase with acid phosphate	**197 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	90 lbs.
To cotton seed meal plot	29 lbs.
To acid phosphate plot	—80 lbs.
To acid phosphate and cotton seed meal	54 lbs.
Average increase with kainit	**31 lbs.**

EXPERIMENT CONDUCTED BY T. T. MEADOWS ½ MILE NORTH OF CUSSETA, CHAMBERS COUNTY.

Soil, red, stoney; subsoil red clay.

This test, made in 1899, is the third experiment conducted on similar soil by Mr. Meadows. (See Bulletin No. 107, p. 274.)

Giving attention to the average results for the three years we find that the principal need of this soil was for acid phosphate, which gave an average increase of 202 pounds of seed cotton per acre. Cotton seed meal was added to the phosphate with profit, but kainit was not needed.

The red clay soils of the Metamorphic Region in this part of the State seem to contain sufficient potash for the ordinary needs of the cotton crop, though when black rust is prevalent kainit is beneficial even here.

Statements of the average increase in yield for the *three years* follows:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	109 lbs.
To acid phosphate plot	156 lbs.
To kainit plot	164 lbs.
To acid phosphate and kainit plot	128 lbs.
Average Increase with cotton seed meal	**139 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	192 lbs.
To cotton seed meal plot	239 lbs.
To kainit plot	217 lbs.
To cotton seed meal and kainit plot	189 lbs.
Average increase with acid phosphate	**202 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—8 lbs.
To cotton seed meal plot	43 lbs.
To acid phosphate plot	15 lbs.
To cotton seed meal and acid phosphate plot	—9 lbs.
Average increase with kainit	**10 lbs.**

EXPERIMENT CONDUCTED IN 1900 BY W. N. INGRAM, 8 MILES EAST OF OPELIKA, LEE COUNTY.

The description of the land seems to indicate that the soil was a yellowish loam, with subsoil of somewhat the same character, and not compact. The original growth is reported as oak and hickory, which had been removed about forty years before. The rainfall was excessive in June. The preceding crop was corn.

The results are not entirely conclusive, but on the whole they show that cotton seed meal was profitable and that the returns from the other fertilizers this wet year were not satisfactory.

Increase of seed cotton per acre when cotton seed meal was added:
added:

To unfertilized plot	248 lbs.
To acid phosphate plot	—30 lbs.
To kainit plot	242 lbs.
To acid phosphate and kainit plot	180 lbs.
Average increase with cotton seed meal	**160 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	96 lbs.
To cotton seed meal plot	—182 lbs.
To kainit plot	87 lbs.
To cotton seed meal and kainit plot	25 lbs.
Average increase with acid phosphate	**7 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	29 lbs.
To cotton seed meal plot	23 lbs.
To acid phosphate plot	20 lbs.
To cotton seed meal and acid phosphate plot	230 lbs.
Average increase with kainit	**75 lbs.**

Kaylor, Cusseta and Opelika experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Kaylor. 1899. Yield seed cotton per acre.	Kaylor. 1899. Increase over unfertilized plots.	Cusseta. 1899 Yield seed cotton per acre.	Cusseta. 1899 Increase over unfertilized plots.	Opelika. 1900. Yield seed cotton per acre.	Opelika. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...	888	112	296	104	1000	248
2	240	Acid phosphate.....	848	72	456	264	848	96
3	00	No fertilizer.......	776	......	192	...	752	......
4	200	Kainit.............	804	49	152	--45	800	29
5	200 240	Cotton seed meal. Acid phosphate...	1084	350	504	302	856	66
6	200 200	Cotton seed meal. Kainit...........	944	232	304	97	1080	271
7	240 200	Acid phosphate ... Kainit...........	872	182	472	260	944	116
8	00	No fertilizer........	663	......	216	......	848	......
9	200 240 200	Cotton seed meal. Acid phosphate... Kainit...........	1124	456	640	424	1144	296
10	200 240 100	Cotton seed meal. Acid phosphate... Kainit...........	1140	472	560	344	1112	264

Experiment Conducted by J. C. Watkins 1½ miles north of Burnt Corn, Monroe County.

The experiments of 1899 and 1900 were made on poor yellowish or chocolate-colored upland sandy soil, with red subsoil. This soil bakes badly.

The rainfall in 1900 was excessive. There was no black rust in either year.

The table on page 34 gives the yields for 1899 and 1900. This is the fourth experiment made by Mr. Watkins according to the present plan. (See Bulletin No. 197, p. 274). Most of the tests have shown that phosphate was more important than cotton seed meal and that kainit only increased the yield; however in 1900 kainit was the most effective fertilizer.

The average results for 4 years show that phosphate gave an average increase of 207, cotton seed meal of 151, and kainit of 70 pounds of seed cotton per acre.

Burnt Corn experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal......	480	216	348	—60
2	240	Acid phosphate........	556	292	456	48
3	00	No fertilizer...........	264	....	408	....
4	200	Kainit...............	280	27	528	128
5	200 240	Cotton seed meal.... Acid phosphate......	768	526	492	100
6	200 200	Cotton seed meal.... Kainit..............	524	293	588	204
7	240 200	Acid phosphate...... Kainit..............	684	465	476	100
8	00	No fertilizer...........	208	....	368	....
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit..............	828	620	648	280
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit..............	944	736	532	164

The following figures refer only to the results obtained in 1900, similar statement for other years having been previously published:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ....—60 lbs.
To acid phosphate plot .... 52 lbs.
To kainit plot .... 76 lbs.
To acid phosphate and kainit plot ....180 lbs.

Average increase with cotton seed meal......... 62 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	48 lbs.
To cotton seed meal plot	160 lbs.
To kainit plot	—28 lbs.
To cotton seed meal and kainit plot	76 lbs.
Average increase with acid phosphate	**64 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	128 lbs.
To cotton seed meal plot	264 lbs.
To acid phosphate plot	52 lbs.
To cotton seed meal and acid phosphate plot....	180 lbs.
Average increase with kainit...................	**155 lbs.**

EXPERIMENT MADE BY C. E. RIVERS, 6½ MILES S. OF HURTSBORO, RUSSELL COUNTY.

Dark sandy soil, with yellow subsoil.

This test was made in 1900 on flat land that might be designated as second bottom.

The land had been cleared about 40 years ago of its original growth of long leaf pine, but for many years before the experiment began it had been uncultivated and had grown up in broomsedge. The date of planting was late and it was noted that many bolls, especially on Plots 9 and 10, did not mature.

Phosphate under all conditions was highly profitable. The average increase with cotton meal was not quite sufficient to yield a profit; this poor showing of cotton seed meal is probably due to the fact that considerable vegetable matter and nitrogen must have accumulated on the land while it was uncultivated. On fields in constant cultivation some cotton seed meal would doubtless have been profitable. Kainit was slightly helpful and as a part of a complete fertilizer, containing all three materials, kainit paid a fair profit.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	154 lbs.
To acid phosphate plot	30 lbs.
To kainit plot	14 lbs.
To acid phosphate and kainit plot	27 lbs.
Average increase with cotton seed meal	**56 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	240 lbs.
To cotton seed meal plot	116 lbs.
To kainit plot	274 lbs.
To cotton seed meal and kainit plot	287 lbs.
Average increase with acid phosphate	**229 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	83 lbs.
To cotton seed meal plot	—57 lbs.
To acid phosphate plot	117 lbs.
To cotton seed meal and acid phosphate plot	114 lbs.
Average increase with kainit	**64 lbs.**

Experiment made in 1899 by A. M. Troyer, ¾ of a mile N. of Calhoun, Lowndes County.

The soil is described as a loam fairly retentive of water and as being of a very light reddish color, with bright red subsoil. The second growth of trees, removed about 5 years ago, was short leaf and old field pine. In 1896 and 1897 this field was not cultivated, and in 1898 the crop was oats.

Under all conditions acid phosphate was highly profitable, the average increase attributable to phosphate being 434 pounds per acre. Cotton seed meal was generally profitable, but not to the same extent as phosphate. Kainit was not needed. By far the larger profit was obtained on the plot containing both acid phosphate and cotton seed meal.

Mr. Troyer also conducted an experiment in 1900 on similar soil, the results of which were entirely inconclusive. They may be found in the table on page 52.

In 1900 he also tested the most promising combinations of fertilizers on an adjoining farm, on very sandy soil.

The fertilizer for this last test was not furnished by the Experiment Station and a detailed report of the amounts of fertilizer used is not at hand.

The following is Mr. Troyer's statement of the increase in yield in 1900 on his sandy soil, where the unfertilized land yielded 384 pounds of seed cotton per acre:

	Increase per acre in lbs. seed cotton.	Net profit.
Cotton seed meal	144	$2.40
Acid phosphate	48	.16
Kainit	112	2.88
Cotton seed meal and phosphate	176	1.76
Cotton seed meal, phosphate and kainit	320	5.28

Apparently on this sandier soil a complete fertilizer was needed, kainit, as well as other materials, yielding a profit.

The increased yields obtained in the experiment at Calhoun in 1899 are given below:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	312 lbs.
To acid phosphate plot	267 lbs.
To kainit plot	187 lbs.
To acid phosphate and kainit plot	—138 lbs.
Average increase with cotton seed meal	**157 lbs.**

Increase of seed cotton per acre when acid phosphate was added.

To unfertilized plot	482 lbs.
To cotton seed meal plot	437 lbs.
To kainit plot	571 lbs.
To cotton seed meal and kainit plot	246 lbs.
Average increase with acid phosphate	**434 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	107 lbs.
To cotton seed meal plot	—18 lbs.
To acid phosphate plot	196 lbs.
To cotton seed meal and acid phosphate plot	—209 lbs.
Average increase with kainit	**19 lbs.**

EXPERIMENT MADE BY W. C. BEVILL IN 1899 NEAR NAHEOLA, CHOCTAW COUNTY.

This experiment was made on upland soil of a "dark mulatto" color, with red clay subsoil. The three preceding crops were cotton. The field had been cleared about 50 years and the original growth is reported as long leaf pine, short leaf pine, oak, and gum.

There was no rust or other injury except from severe drought, which reduced the yield to about half a crop, and which probably makes the experiment nearly valueless as an indication of the needs of the cotton plant on this soil in normal seasons.

Under the conditions of this test no fertilizer was very effective, though the increase with cotton seed meal was sufficient to pay a small profit.

Mr. Bevill conducted an experiment in 1898 on what appeared to be similar soil. In that year cotton seed meal gave a large increase in yield, phosphate a smaller though profitable increment, and kainit an increase barely sufficient to afford a small profit. In 1898 as wel l as in 1899 unfavorable weather vitiated the experiment, and it is doubtful whether the results for either year show the full effect that any of the three fertilizers would exert in normal seasons.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	56 lbs.
To acid phosphate plot	178 lbs.
To kainit plot	114 lbs.
To acid phosphate and kainit plot	172 lbs.
Average increase with cotton seed meal	**130 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	32 lbs.
To cotton seed meal plot	154 lbs.
T o kainit plot	—25 lbs.
To cotton seed meal and kainit plot	33 lbs.
Average increase with acid phosphate	**49 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	13 lbs.
To cotton seed meal plot	71 lbs.
To acid phosphate plot	—44 lbs.
To cotton seed meal and acid phosphate plot	—50 lbs.
Average increase with kainit	**—3 lbs.**

Experiment made on the farm of the South East Alabama Agricultural School, Jackson, Clarke County.

Stiff, dark red, or "mulatto" soil; subsoil, red clay.

The experiment of 1899 was conducted by J. L. Ballard, that of 1900 by Prof. J. W. Culver. The field consisted of upland, cleared at least 10 years before the experiment began of its growth of long leaf and short leaf pine and oak. The land used for the experiment of 1900 had been pastured for two years. No report was made of crops preceding the experiment of 1900.

The results of the two experiments may be found in the table on page 42 and in the analysis of that table given below.

In 1899 phosphate was by far the most effective fertilizer, though both cotton seed meal and kainit, as well as phosphate, were profitable when employed in a complete fertilizer.

In 1900, on ground not fertilized for several years previous to the experiment, all three fertilizing materials were exceedingly effective, all being of practically equal importance. This soil is unusually responsive to commercial fertilizers. A complete fertilizer afforded much the largest profit, both in 1899 and 1900.

Increase of seed cotton per acre when seed meal was added:

	1899.	1900.
To unfertilized plot	136 lbs.	112 lbs.
To acid phosphate plot	—90 lbs.	179 lbs.
To kainit plot	—146 lbs.	356 lbs.
To acid prosphate and kainit plot	500 lbs.	855 lbs.
Average increase with cotton seed meal,	**103 lbs.**	**376 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	336 lbs.	176 lbs.
To cotton seed meal plot	110 lbs.	243 lbs.
To kainit plot	—7 lbs.	234 lbs.
To cotton seed meal and kainit plot	639 lbs.	733 lbs.
Average increase with acid phosphate,	**269 lbs.**	**347 lbs.**

Increase of seed cotton per acre when kainit was used:

To unfertilized plot	115 lbs.	79 lbs.
To cotton seed meal plot	—167 lbs.	323 lbs.
To acid phosphate plot	—228 lbs.	137 lbs.
To cotton seed meal and acid phosphate plot	362 lbs.	813 lbs.
Average increase with kainit	**21 lbs.**	**334 lbs.**

Several experiments had been made previously on this farm. That of 1898 showed acid phosphate to be the most valuable single fertilizer, but that both kainit and cotton seed meal afforded such an increase as to make the complete fertilizer—which contained all three—the most profitable of all applications.

In 1897, when drought prevailed, only cotton seed meal was very effective.

Clearly a complete fertilizer is profitable on this soil, which lends itself readily to intensive farming.

Hurtsboro, Calhoun, Naheola and Jackson experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Hurtsboro. 1900. Yield seed cotton per acre.	Hurtsboro. 1900. Increase over unfertilized plots.	Calhoun. 1899. Yield seed cotton per acre.	Calhoun. 1899. Increase over unfertilized plots.	Naheola. 1899. Yield seed cotton per acre.	Naheola. 1899. Increase over unfertilized plots.	Jackson. 1899. Yield seed cotton per acre.	Jackson. 1899. Increase over nnfertilized plots.	Jackson. 1900. Yield seed cotton per acre.	Jackson. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*
1	200	Cotton seed meal	512	154	548*	312*	536	56	960	136	552	112
2	240	Acid phosphate	608	240	718*	482*	512	32	1160	336	616	176
3	00	No fertilizer	368	....	236*	....	480	.....	824	....	440	....
4	200	Kainit	440	83	366	107	520	13	968	115	520	79
5	200 240	Cotton seed meal Acid phosphate	616	270	1030	749	744	310	1128	246	808	355
6	200 200	Cotton seed meal Kainit	432	97	598	294	688	127	880	—31	880	435
7	240 200	Acid phosphate Kainit	680	357	904	678	576	—12	1048	108	760	313
8	00	No fertilizer	312	....	350	...	616	....	968	....	448	....
9	200 240 200	Cotton seed meal Acld phosphate Kainit	696	384	890	540	776	160	1576	608	1616	1168
10	200 240 100	Cotton seed meal Acid phosphate Kainit	720	408	780*	430*	800	184	1440	472	1520	1072

* Defective stand.

EXPERIMENTS MADE BY G. S. MCCLURE, 2 MILES EAST OF GARLAND, BUTLER COUNTY.

Gray sandy land, with stiffer yellowish subsoil at depth of 6 inches.

The experiment in 1899 was made in a field cleared about 1880 and continuously in cultivation during each of the past six years. The test in 1900 was conducted on land that had been cleared about twelve years. The original growth was long-leaf pine, with a few black-jack oaks.

In both experiments oats was the preceding crop. There was practically no injury from "black rust" in 1900. In 1899 this disease caused considerable loss on Plot 2 and a smaller amount on plots 5 and 3, with practically no injury on other parts of the experiment.

The table on page 48 and the analysis of that table given below show the yield and amount of increase attributable to the fertilizers.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	272 lbs.	96 lbs.
To acid phosphate plot	492 lbs.	336 lbs.
To kainit plot	252 lbs.	168 lbs.
To acid phosphate and kainit plot	40 lbs.	344 lbs.
Average increase wilh cotton seed meal,	**264 lbs.**	**236 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152 lbs.	160 lbs.
To cotton seed meal plot	372 lbs.	400 lbs.
To cotton seed meal and kainit plot	154 lbs.	208 lbs.
Average increase with acid phosphate,	**261 lbs.**	**200 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	226 lbs.	48 lbs.
To cotton seed meal plot	206 lbs.	120 lbs.
To acid phosphate plot	440 lbs.	—80 lbs.
To cotton seed meal and acid phosphate plot	—12 lbs.	—72 lbs.
Average increase with kainit..........	**216 lbs.**	**—4 lbs.**

In both years the most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Both cotton seed meal and acid phosphate, whether applied alone, or in combination, were highly profitable. Kainit had no beneficial effect in the presence of a mixture of phosphate and cotton seed meal, but in 1899, kainit was quite effective when used alone or in combination with either one (but not both) of the other materials; this was the season when rust was injurious on certain plots receiving no kainit.

Two experiments made in the same region by G. O. Sellans, at Lumber Mills, (see Bulletin No. 102) accord with Mr. McClure's experiments in showing that these soils are highly responsive to acid phosphate and cotton seed meal and that kainit is decidedly beneficial only in seasons when black rust is severe.

Experiment made in 1899 by C. H. Mason, ½ mile N. of Wilson, Escambia County.

Light sandy loam; with red clay subsoil.

This field of upland was cleared of its growth of long-leaf pine two years before the beginning of the test and during these two years the land was occupied by cow-peas, presumably grown for hay.

For yields of cotton seed see the table on page 48.

The following analysis shows that the one conspicuous need of this fresh land was for phosphate. The indifference of this particular field towards cotton seed meal is due to the recent clearing and to the two preceding crops of peas, both of which conditions imply the presence of considerable nitrogen in the soil. The soils of this region after a few years cultivation usually respond profitable to both phosphate and cotton seed meal, and some of them to kainit. A test made at Wilson on "new ground" in 1898 by J. H. Wilcox, gave results similar to those obtained in this experiment.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	200 lbs.
To acid phosphate plot	—112 lbs.
To kainit plot	24 lbs.
To acid phosphate and kainit plot	208 lbs.
Average increase with cotton seed meal	**108 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	632 lbs.
To cotton seed meal plot	320 lbs.
To kainit plot	328 lbs.
To cotton seed meal and kainit plot	512 lbs.
Average increase with acid phosphate	**448 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	8 lbs.
To cotton seed meal plot	—168 lbs.
To acid phosphate plot	—292 lbs.
To cotton seed meal and acid phosphate plot	24 lbs.
Average *decrease* **with kainit**	**107 lbs.**

EXPERIMENTS MADE IN 1899 AND 1900 BY T. M. BORLAND, ½ MILE S. W. OF DOTHAN, HENRY COUNTY.

Gray sandy land; subsoil yellowish.

The land was cleared of the original growth of long leaf pine nearly 10 years ago. In both cases the preceding crop was corn. Mr. Borland writes that peanuts were grown in 1899 between the corn rows on the area where the cotton experiment of 1900 was conducted.

Very hot dry weather in the latter part of the summer of 1899, and lice and excessive rafall in 1900 damaged the crop. The experimenter reports that rust was absent.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	248 lbs.	56 lbs.
To acid phosphate plot	110 lbs.	20 lbs.
To kainit plot	119 lbs.	93 lbs.
To acid phosphate and kainit plot	123 lbs.	81 lbs.
Average increase with cotton seed meal,	**150 lbs.**	**63 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	208 lbs.	208 lbs.
To cotton seed meal plot	70 lbs.	172 lbs.
To kainit plot	227 lbs.	30 lbs.
To cotton seed meal and kainit plot	231 lbs.	18 lbs.
Average increase with acid phosphate,	**184 lbs.**	**107 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	106 lbs.	201 lbs.
To cotton seed meal plot	—23 lbs.	238 lbs.
To acid phosphate plot	125 lbs.	23 lbs.
To cotton seed meal and acid phosphate plot	138 lbs.	84 lbs.
Average increase with kainit,	**87 lbs.**	**139 lbs.**

In both experiments a complete fertilizer afforded the largest increase in yield. A showing almost as favorable was made by the mixture of cotton seed meal and kainit.

The slight benefit from cotton seed meal in 1900 is probably due to the fact that peanuts were grown between the corn rows the year before. The experiment of 1900 makes the fourth test of fertilizers on cotton made on this farm. All these results point toward the need of all three of the fertilizer materials tested, kainit giving the largest average increase for the four years, viz.: 168 pounds of seed cotton per acre per annum. A similar average shows the increase with cotton seed meal to be 134 pounds, and with phosphate to be 122 pounds.

It is not surprising that this land, which has been in cultivation less than 10 years should be less responsive to cotton seed meal than are most of the soils of regions that were settled earlier. It also seems less responsive to phosphate and more so to kainit than do most of the soils on which tests have been made.

Garland, Wilson and Dothan experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Garland. 1899. Yield seed cotton per acre.	Garland. 1899. Increase over unfertilized plots.	Garland. 1900. Yield seed cotton per acre.	Garland. 1900. Increase over unfertilized plots.	Wilson. 1899. Yield seed cotton per acre.	Wilson. 1899. Increase over unfertilized plots.	Dothan. 1899. Yield seed cotton per acre.	Dothan. 1899. Increase over unfertilized plots.	Dothan. 1900. Yield seed cotton per acre.	Dothan. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lcs.*	*Lbs.*
1	200	Cotton seed meal	664	272	504	96	280	200	840	248	424	56
2	240	Acid phosphate	544	152	568	160	712	632	800	208	576	208
3	00	No fertilizer	392	......	408	......	80	.....	592	......	368	......
4	200	Kainit	640	226	448	48	88	8	696	106	552	201
5	200 240	Cotton seed meal Acid phosphate	1080	644	888	496	600	520	904	318	560	228
6	200 200	Cotton seed meal Kainit	936	478	600	216	112	32	808	225	608	294
7	240 200	Acid phosphate Kainit	1072	592	456	80	416	336	912	333	528	231
8	00	No fertilizer	512	......	368	......	80	.....	576	......	280	......
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1144	632	792	424	624	544	1032	456	592	312
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1176	664	736	358	728	648	920	344	472	192

Inconclusive Experiments.

The three following tables give the yields obtained in tests that were altogether inconclusive:

The list on page 3 gives the names of the parties making the experiments at each of the localities referred to in the three tables that follow. In the case of some of these tests suggestions of value may reward a careful examination of the figures, but usually want of uniformity in the soil selected, or other vitiating condition, entirely destroys the worth of the experiments here tabulated.

Tuscumbia, Boligee, Berney and Hamilton experiments with cotton.

Plot No.	Fertilizers. Amount per acre	Fertilizers. Kind.	Boligee. 1899 Yield seed cotton per acre.	Boligee. 1899 Increase over unfertilized plots.	Berney's. 1899. Yield seed cotton per acre.	Berney's. 1899. Increase over unfertilized plots.	Berney's. 1900. Yield seed cotton per acre.	Berney's. 1900. Increase over unfertilized plots.	Hamilton. 1900. Yield seed cotton per acre.	Hamilton. 1900. Increase over unfertilized plots.	Tuscumbia. 1899. Yield seed cotton per acre.	Tuscumbia. 1899. Increese over unfertilized plots.	Tuscumbia. 1900. Yield seed cotton per acre.	Tuscumbia. 1900. Increase over unfertilized plots.
	Lbs		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...........	832	296	368	72	568	40	562	136	752	184	600	240
2	240	Acid phosphate.............	640	104	368	72	552	24	600	184	728	160	536	176
3	00	No fertilizer....	536	....	296	....	528	.....	416	.....	568	......	360	......
4	200	Kainit	512	—16	448	155	575	49	568	125	784	252	296	—24
5	200	Cotton seed meal..........	640	120	448	200	968	443	680	210	568	71	312	30
	240	Acid phosphate												
6	200	Cotton seed meal..	632	120	480	197	704	181	668	171	440	—22	272	28
	200	Kainit..................												
7	240	Acid phosphate...........	528	24	560	283	760	239	808	283	456	28	264	60
	200	Kainit..................												
8	00	No fertilizer..............	496	......	272	....	520	....	552	....	392	. ...	168	......
9	200	Cotton seed meal..........	448	—48	464	192	624	104	808	256	352	—40	480	312
	240	Acid phosphate...........												
	200	Kainit												
10	200	Cotton seed meal..........	278	—208	432	160	560	40	848	296	544	152	432	264
	240	Acid phosphate...........												
	100	Kainit.................												

Sterrett, Dillburg, Marvyn, Oak Bowery and Greensboro experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Sterrett. 1899. Yield seed cotton per acre.	Sterrett. 1899. Increase over unfertilized plots.	Sterrett. 1900. Yield seed cotton per acre.	Sterrett. 1900. Increase over unfertilized plots	Dillburg. 1900. Yield seed cotton per acre.	Dillburg. 1900. Increase over unfertilized plots.	Marvyn. 1899. Yield cotton seed per acre.	Marvyn. 1899. Increase over unfertilized plots.	Oak Bowery. 1900. Yield ssed cotton per acre.	Oak Bowery. 1900. Increase over unfertilized plots.	Greensboro. 1899. Yield seed cotton per acre.	Greensboro. 1899. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal............	752	328	928	—184	976	508	376	96	120	—160	392	—24
2	240	Acid phosphate..............	640	216	1128	16	872	504	264	—16	280	00	584	168
3	00	No fertilizer..	424	......	1112	......	......	......	280	......	280	.....	416	....
4	200	Kainit......................	528	82	1120	00	568	200	472	170	368	95	576	166
5	200 240	Cotton seed meal.......... Acid phosphate............	744	275	1128	199	816	448	400	75	384	117	688	285
6	200 200	Cotton seed meal.......... Kainit....................	712	221	1056	218	816	448	432	85	416	156	720	323
7	240 200	Acid phosphate............ Kainit....................	760	246	840	93	656	288	360	—10	408	154	504	114
8	00	No fertilizer...............	536	......	656	.....	368	......	392	......	248	.....	384	.....
9	200 240 200	Cotton seed meal.......... Acid phosphate............ Kainit....................	768	232	936	280	856	488	584	192	400	152	520	136
10	200 240 100	Cotton seed meal.......... Acid phosphate............ Kainit....................	760	224	912	256	680	312	688	296	240	– 8	536	152

Calhoun, Greenville, Evergreen, Union Springs and Abbeville experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Calhoun. 1900. Yield seed cotton per acre.	Calhoun. 1900. Increase over unfertilized plots.	Greenville. 1900. Yield seed cotton per acre.	Greenville. 1900. Increase over unfertilized plots.	Evergreen. 1899. Yield seed cotton per acre.	Evergreen. 1899. Increase over unfertilized plots.	Union Springs. 1899. Yield seed cotton per acre.	Union Springs. 1899. Increase over unfertilzed plots	Abbeville. 1899. Yield seed cotton per acre.	Abbeville. 1899. Increase over unfertilized plots.	Abbeville. 1900. Yield seed cotton per acre.	Abbeville. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	444	80	1016	568	882	270	576	152	760	320	276	152
2	240	Acid phosphate	300	—64	968	520	764	152	444	20	656	216	184	40
3	00	No fertilizer	364	.....	.....	.....	612	.....	424	.....	440	.....	144	.....
4	200	Kainit	408	—7	960	512	808	196	.....	.....	552	137	208	27
5	200 240	Cotton seed meal Acid phosphate	256	—210	1144	696	840	228	912	376	664	274	456	237
6	200 240	Cotton seed meal Kainit	640	123	848	400	896	284	496	—96	640	276	469	211
7	240 200	Acid phosphate Kainit	664	96	576	128	1016*	404*	568	—80	416	79	368	71
8	00	No fertilizer	620	.....	448	.....	904*	.....	704	.....	312	.....	336	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	624	4	880	432	1420*	516*	776	72	584	272	608	272
10	200 240 100	Cotton seed meal Acid phosphate Kainit	644	24	768	320	1376*	462*	944	240	712	400	568	232

* Not comparable with Plots 1—6, being in different part of field.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Feeding Experiment with Dairy Cows.

By J. F. DUGGAR AND R. W. CLARK.

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Feeding Experiments with Dairy Cows.

By J. F. Duggar and R. W. Clark.

Summary.

With cotton seed at $8 per ton, cotton seed meal at $20, cotton seed hulls at $4, and sorghum hay at $6.67, butter was produced at a lower cost per pound on a ration consisting chiefly of raw cotton seed and hay than on one made up principally of cotton seed meal and hulls.

The cows did not greatly relish cotton seed and hence ate less than was desirable of the ration containing this; hence on the larger amounts eaten the oil mill ration afforded a larger daily yield of both milk and butter than did the farm-grown ration.

In two experiments the average daily amount of milk per cow was 17.5 pounds from the cotton seed ration and 24.3 pounds from the cotton seed meal ration; the daily production of butter per cow averaged .93 of a pound with the cotton seed and 1.19 with the oil mill ration, this being an increase of 38 per cent in milk and 28 per cent in butter. Nevertheless the low cost of the cotton seed ration made it the more economical, the average cost of the food required to make a pound of butter being only 10.4 cents when this ration was given and 15.3 cents when the hulls and meal ration was employed.

On account of the larger amounts of food consumed, the cows while receiving the cotton seed meal ration gained nearly half a pound a day in weight, while the cows eating cotton seed in smaller amounts lost .8 of a pound per day.

The cheapest butter was made by a Jersey heifer with her first calf, the food to make one pound of butter costing in this case only 6.4 cents when cotton seed was fed and 11.2 cents when cotton seed meal was given.

The manure (liquid and solid) dropped during the 16 hours of each day which the cows passed in the barn was carefully saved, analyzed, and applied to various crops.

The amount of manure, including sawdust bedding, per cow per night (of 16 hours) averaged 33.9 pounds when cotton seed was fed and 48.3 pounds when cotton seed meal was fed.

The manure made from the cotton seed and sorghum hay ration contained 10.7 pounds of nitrogen per ton; that from cotton seed meal and hulls contained 16.6 pounds, an increase of 55 per cent. in the amount of nitrogen per ton.

In percentages of phosphoric acid and potash the two manures were practically identical.

For one or two days the cows were kept stabled during the entire 24 hours and the amount of manure thus obtained (exclusive of bedding) was about double the amount secured by stabling the cows for 16 hours per day.

About one-half the manure was dropped out of doors.

Green rye at the rate of 52 to 54 pounds per day proved a satisfactory substitute for either sorghum hay or cotton seed hulls.

While the cows ate green rye the amount of milk slightly increased but the milk was slightly poorer than during the preceding period when only dry food was consumed.

An upland corn field from which the ears had been harvested, and in which cowpeas had been drilled between the corn rows, was grazed first by milk cows and later by dry cows, the milk cows meantime receiving 3 pounds of cotton seed meal per day.

On this pasturage the yield of milk was 15.8 per cent greater and of butter 9.5 per cent greater than when the cows with the same grain feed ran on a good pasture of bermuda grass, carpet grass, lespedeza, etc.

The value of the product of butter and of the increase in live weight of the cows averaged $4.47 per acre of corn and pea field grazed, after deducting the cost of the cotton seed meal fed at the same time.

INTRODUCTORY.

Under some conditions it is practicable for the dairyman to purchase a considerable proportion of the food which his cows consume. However, the temptation is to rely to too great an extent on purchased foods. These can be profitably used to a certain extent but rather as supplements to foods produced on the farm than as substitutes for farm-grown food. It is believed that any marked development of dairying and of beef production in the South is conditioned on the increased reliance on the foods which the fields and pastures produce. The feeder who buys thin cattle at a low price and, after a few months feeding, sells them at a higher price per pound, relies almost wholly upon cotton seed meal and hulls, but the stock raiser cannot afford to make the oil mill his principal depot of supplies.

Bearing in mind this necessity for avoiding large expenditures for purchased foods, we have planned a line of experiments intended to ascertain the extent to which farm-grown foods can be relied on in the feeding of dairy cows and the best crops for use as food in effecting this end.

The first experiments here reported are preliminary to this investigation and involve a comparison of a ration made up chiefly of the most economical of all purchased foodstuffs, cotton seed meal and hulls, with one consisting chiefly of cotton seed and sorghum hay, both of which latter materials can be grown on every farm in the cotton belt.

PURCHASED VS. FARM-GROWN RATION IN 1900.

The farm-grown ration consisted of cotton seed and sorghum hay, with small amounts of wheat bran and corn meal added to improve the palatability and to increase the amount of cotton seed consumed. The endeavor was to make each cow eat daily at least 9 pounds raw cotton seed, 10 pounds sorghum hay, 3 pounds wheat bran, and 3 pounds corn meal; and the foods were mixed in these proportions. As much of the mixture was given to each cow as she would eat clean.

The purchased, or "oil mill" ration consisted of a mixture of 5.25 pounds of cotton seed meal, 10 pounds of cotton seed hulls, 3 pounds of wheat bran, and 3 pounds of corn meal. This mixture was also fed in amounts as large as the cows would eat and the quantity consumed was greater than had been expected when the experiment was planned.

The following prices for food stuffs used in calculating the cost of butter are assumed as average prices in this State for a series of years, except that sorghum hay, for which there is no market, is charged at a price somewhat above its average cost of production:

Cotton seed	$ 8.00	per ton.
Cotton seed meal	20.00	per ton.
Cotton seed hulls	4.00	per ton.
Wheat bran	18.00	per ton.
Corn meal	20.00	per ton.
Sorghum hay	6.67	per ton.

The cows used were as follows:

Name.	Breed,	Age.	Day sinces calving.	Weight when test began.
				Lbs.
Ada..........	Jersey......	8 years..	110	816
Queen........	Holstein....	8½ years..	81	980
Rozena.......	Holstein ...	8½ years..	119	1150
Hypatia......	Jersey......	4 years..	19	733
Annie......	Jersey	10 years..	80	762

The experiment was divided into two periods of four weeks each, each period being preceded by a preparatory period of one week during which the cows were accustomed to the food which they were to receive during the next period.

During the first period Ada and Queen received the cotton seed ration, Rozena and Annie meantime getting the ration of cotton seed meal and hulls. During the second period the rations were reversed, so that each lot of cows was fed for one whole period on each kind of food. Annie refused the cotton seed ration and hence in the second period it was necessary to substitute Hypatia.

Composite samples of the milk were tested weekly by the Babcock test and the amount of fat thus found was converted into butter by the usual method of multiplying by one and one-sixth.

Amount, kind and cost of food eaten.

Period. (each 28 days.)	Cow.	Pounds food in 28 days. Cotton seed.	Sorghum hay.	Cotton seed meal.	C. S. hulls.	Wheat bran	Corn meal.	Cost of food. In 28 days.	Per day.
									Cents.
I	*Jan. 16 to Feb. 12.*								
I	Ada....	287	286	......	......	95	95		
I	Queen..	246	233	......	......	72	72		
II	*Feb. 23 to Mar. 22.*								
II	Rozena.	290	270	......	.....	97	97		
II	Hypatia	193	212	......	... ..	64	64		
Total,	4 cows...	1016	1001	......	......	328	328	$13.57	12.1
II	Ada......	......	......	220	419	125	125		
II	Queen...	......	......	246	467	140	140		
I	Rozena...	......	......	251	478	143	143		
I	Annie....	......	......	161	307	92	92		
Total,	4 cows...	......	......	878	1673	500	500	$21.63	19.3

The cows receiving the "oil mill" ration ate much more heartily than the others, the cotton seed making the "farm-grown" ration relatively unpalateable. The amounts eaten daily per head were as follows, taking the average for four cows on each food:

	Lbs.		Lbs.
Cotton seed, raw......	9.07	Cotton seed meal	.7.83
Wheat bran	2.93	Wheat bran	4.38
Corn meal	2.93	Corn meal	4.38
Total concentrates..	14.93	Total concentr't's.	16.59
Sorghum hay	9.10	Cotton hulls	14.90
Total food	24.03	Total food.....	31.49

The average daily cost of food per day was 12.1 cents per cow with the farm-grown ration and 19.3 with the oil mill ration.

While it cost much more to feed the cows on the purchased ration, we may not pronounce this the least economical ration until we have noted the amount of butter produced by each.

Milk and butter produced by feeding a ration consisting largely of cotton seed and sorghum hay vs. one containing cotton seed meal and hulls.

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	*Lbs.*			*Lbs.*	*Lbs.*
I	Ada..........	582.1	24.36	II	Ada...........	639.0	29.90
I	Queen.	586.0	27.76	II	Queen.	914.1	36.30
II	Rozena.......	638.3	29.00	I	Rozena........	1179 5	46.16
II	Hypatia......	514.7	28.60	I	Annie.........	639.1	34.90
Total,	4 cows, 28 days	2321.1	109.62	Total,	4 cows, 28 days	3371.7	147.26
Av.	Per cow, per day........	**20.7**	**.98**	Av.	Per cow per day	**29.6**	**1.31**

The product obtained was greater with the oil mill ration, the increase in milk being 43 per cent and in butter 34 per cent. This increased production of milk and butter with the purchased ration is due largely, if not entirely, to the larger quantities of food consumed.

If we take 20 cents per pound as the value of the butter and assume that the manure and skim milk have sufficient value to pay for the labor of caring for the cows and making the butter, we have the following statement of the cost and profit on butter.

Financial statement.

	With farm grown ration.	With oil mill ration.
Value of butter from 4 cows, 28 days.........	$21.92	29.56
Cost of food, 4 cows, 28 days..................	13.57	21.63
Profit from 4 cows, 28 days	8.35	7.93
Cost of food per pound of butter, cents........	12.1	15.2
Daily profit per cow, cents........	7.5	7.1
Profit per pound of butter, cents...............	7.9	4.8

The butter was produced at a cost of 12.1 cents per pound when the cotton seed and hay ration was fed and of 15.2 cents per day when cotton hulls and meal were fed in maximum amounts. Yet the daily production was so much larger on the last mentioned ration that the average daily profit per cow is nearly the same with both rations, viz. 7.5 cents with farm foods and 7.1 cents with oil mill products.

SECOND EXPERIMENT; PURCHASED VS. FARM-GROWN RATION IN 1901.

In January and February 1901 the experiment of the preceding winter was repeated, with slight modifications in the rations.

The foods were mixed in the following proportions, and the cows were allowed to eat as much of each mixture as they would.

Farm grown ration.	*Purchased ration.*
9 lbs. raw cotton seed.	5.25 lbs. cotton seed meal.
3 lbs. wheat bran.	3 lbs. wheat bran.
10 lbs. sorghum hay.	10 lbs. cotton seed hulls.

Prices used in calculating the cost of butter are the same as in the former experiment.

The experiment extended over a similar period of time, two periods of 28 days each, both preceded by a week of preparatory feeding. The first period extended from January 1 to 28, 1901, the second from February 5 to March 4 inclusive.

Lot 1 consisted of two cows, and Lot II of three cows. The different number of cows in the two lots does not affect the accuracy of the results, for at the conclusion of the first period the rations were reversed, thus making each cow at different times during the experiment consume both rations.

The cows employed were as follows:

	Breed.	Age. Years.	Days since calving.	Weight when test began.
Ida.............	Jersey..........	5	110	810
Hypatia........	do	5	16	740
Annie...........	do	11	37	795
Ada............	do	9	48	830
Susan......	do	3 (1st calf)	141	610

Amount, kind, and cost of food eaten.

Period.	Cow.	Lbs. food in 28 days.					Cost of food.	
		Cotton seed.	Sorghum hay.	Cotton seed meal.	Cotton seed hulls.	Wheat bran	In 28 days.	Per day.
								Cents.
I	Ida............	258	207	......	......	86		
I	Hypatia.........	275	242	......	......	92		
II	Annie..........	175	135	......	......	58		
II	Ada...........	200	180	......	......	66		
II	Susan..........	168	162	......	......	56		
Total,	5 cows.........	1076	926	......	.....	358	$10.61	7.5
II	Ida...........	......	.....	235	449	134		
II	Hypatia	......	......	272	519	155		
I	Annie	......	.....	193	368	110		
I	Ada	......	....	256	490	147		
I	Susan.........	......	.....	189	360	108		
Total,	5 cows	......	......	1144	2186	654	$21.60	15.4

As in the former experiment we were unable to induce the cows to eat the desired amount of the cotton seed ration.

The food consumed per head daily averaged as follows:

	Lbs.		Lbs.
Cotton seed, raw ...	7.68	Cotton seed meal...	8.17
Wheat bran	2.56	Wheat bran	4.66
Total concentrates..	10.24	Total concentrates..	13.83
Sorghum hay	6.61	Cotton seed hulls...	15.60
Total food	16.85	Total food	29.43

The average daily cost of food was 7.5 cents per cow with the farm-grown ration and 15.4 cents with the oil mill ration. However, the more expensive ration gave the larger product, as appears below:

Milk and butter produced by feeding in 1901 a ration consisting largely of cotton seed and sorghum hay versus one containing cotton seed meal and hulls.

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	*Lbs.*			*Lbs.*	*Lbs.*
I	Ida..........	359.2	21.09	II	Ida.........	523.8	29.00
I	Hypatia.....	532.7	30.44	II	Hypatia.....	640.3	26.73
II	Annie.......	380.9	22.42	I	Annie.......	607.8	32.22
II	Ada	409.5	22.70	I	Ada.........	549.2	28.79
II	Susan........	318.6	26.39	I	Susan........	446.3	31.76
Total...	5 cows, 28 d'ys	2000.9	123.04	Total...	5 cows, 28 d'ys	2767.4	148.50
Av. per	cow per day	**14.36**	**.88**	Av. per	cow per day	**19.0**	**1.06**

The purchased ration afforded an increase over the farm-grown ration of 32 per cent. in milk and 21 per cent in butter. Of course this increase must be attributed chiefly to the fact that larger amount of the former were consumed on account of its greater palateability.

With butter at 20 cents per pound and food stuffs at same prices as in the former experiment we obtain the following:

Financial Statement.

	With farm-grown ration.	With oil mill ration.
Value of butter from 5 cows, 28 days......	$24.61	$29.70
Cost of food, 5 cows, 28 "	10.61	21.60
Profit from 5 cows, 28 "	14.00	8.10
Cost of food per pound of butter, cents.	8.6	15.4
Daily profit per cow, cents	10.0	5.8
Profit per pound of butter, cents	11.4	4 6

The farm-grown ration afforded a greater profit whether we use as a basis the daily profit per cow or the profit on each pound of butter; this latter profit was 11.4 cents when the cotton seed ration was fed. and 4.6 cent when the meal and hulls ration was employed.

Attention is called to the excellent record made by the Jersey heifer Susan.

Although she had calved nearly five months before her experimental feeding began, yet she averaged 1.14 pounds of butter per day during the 28 days while receiving cotton seed meal.

Average results of the two experiments.

Taking the averages of the figures in the two experiment we find:

	With cotton seed ration. Cents.	With oil mill ration. Cents.
Cost of food per pound of butter........	10.35	15.3
Daily profit per cow	8.75	6.45
Daily production of butter per cow, lbs...	.93	1.19
Daily production of milk per cow, lbs..	17.53	24.3

With the oil mill ration the daily production of butter was larger by 28 per cent and the daily flow of milk by 38 per cent. But the amount of food consumed, and hence the daily cost, was so much greater than with the farm-grown ration that the latter was decidedly more profitable.

EFFECTS OF RATIONS ON WEIGHT AND HEALTH OF COWS.

Effect of food on live weight.

	Period beginning.	Weight at beginning.	Weight at end of period.	Gain (+) or loss (—) in 28 days. On farm ration.	Gain (+) or loss (—) in 28 days. On oil mill ration.
Ada	Jan. 16, 1900.	816	832	+ 16	
Queen	do	980	970	— 10	
Ada	Feb. 23, 1900	862	861	....	— 1
Queen	do	1003	1072	....	+ 69
Rozena	Jan. 16, 1900	1150	1175	....	+ 25
*Annie	do	762	775	....	+ 13
Rozena	Feb. 23, 1900	1152	1165	+ 13	
*Hypatia	do	703	705	+ 2	
Ida	Jan 1, 1901	810	765	— 45	
Hypatia	do	740	700	— 40	
Ida	Feb. 5, 1901	790	795	....	+ 5
Hypatia	do	730	755	....	+ 25
Annie	Jan. 1. 1901	795	767	....	— 28
Ada	do	830	840	....	+ 10
Susan	do	610	610	....	0
Annie	Feb. 5, 1901	745	697	— 48	
Ada	Feb. 5. 1901	845	780	— 65	
Susan	Feb. 5, 1901	610	585	— 25	

Total net gain	—202	+ 118
Average per cow, per period of 28 days	22.4	13.3
Average per cow, per day	— .8	+ .5

* Hypatia substituted for Annie in 2d period.

The gains in live weight during the first two feeding periods are not of particular interest so far as the rations are concerned, but they seem to depend upon the individuality of the cows. Ada gained 16 lbs. on the farm-grown ration and practically held her own on the "oil mill ration" losing only 1 pound. Queen lost

10 pounds on the farm-grown ration and gained 69 lbs. on the "oil mill ration." With the other two cows there was a slight gain in both periods.

On an average the cows on cotton seed lost in weight .8 of a pound per day, while those on the meal and hulls ration, consuming more food, gained .5 of a pound daily. The rations fed during the second experiment were decidedly laxative and the cows showed it in the milk yield and in the loss of live weight. In 1900 the raw cotton seed fed constituted 37.7 per cent of the "home-grown ration," while in 1901 it constituted 45.50 per cent of the "home-grown ration."

In 1900 the cotton seed meal fed formed 24.8 per cent of the "oil mill ration" and in 1901 it formed 27.7 per cent.

The table of live weight shows that in the second experiment all the cows lost in weight when on the farm-grown ration, while only one fell off on the "oil mill ration." The effect of cotton seed and cotton seed meal varied with the different animals, the greatest scouring being with cotton seed. In the first experiment Rozena, a very large cow, consumed an average of 8.9 pounds of cotton seed meal daily and appeared well in every way, while in the second period she consumed 9.6 pounds of cotton seed and did not show the effects for three weeks, when she scoured very heavily and fell off in milk flow. This was undoubtedly due to the large amount of oil in the cotton seed. In the second experiment Susan, a small heifer, took 6 pounds of cotton seed per day for the first period and appeared at her best during the whole of the month, but six days after being on cotton seed meal in the second period, getting 6.7 pounds per day, she commenced to scour and fell off in milk flow. This could not be due to a larger amount of oil in the ration, but probably to the influence of the previous month's feeding of cotton seed, modified by the individuality of the cow. A cow that scours, even though it be slight, can not do her best at the pail.

In feeding cotton seed and cotton seed meal, as well as other feed stuffs, one must not rely on tables entirely, but be guided largely by the individuality of the animal with which he is dealing. The amounts of cotton seed meal used in the above experiments are larger than the writers would advise.

THE AMOUNT AND QUALITY OF MANURE COLLECTED FROM COWS ON DIFFERENT RATIONS.

First experiment, 1900. The manure, both liquid and solid, was saved every day, except that dropped when the cows were out of the barn and in bare lots where they spent the time between 8 a. m. and 4 p. m. Hence the manure actually saved consisted only of that dropped during 16 hours of each day, or of that voided during two-thirds of the time.

The liquid manure was saved by the use of sawdust as bedding material. The manure was removed every day to a shed, the roof of which consisted of 12-inch boards without battens, and hence having small cracks every twelve inches. This leak kept the manure moist but seems not to have resulted in any appreciable amount of leaching.

The manuure (including sawdust) collected during the time that the cows stood in the barn was as follows:

	Lbs. in 28 days, 2 cows.	Lbs. daily per cow.
From cotton seed and hay ration, 1st 28 days........	1785	
From do 2nd 28 "	1700	
Total and average..................	3485	31.04
From cotton seed meal and hulls ration, 1st 28 days,	2115	
From do 2nd 28 "	2430	
Total average......................	4545	40.6

These several lots of manure were applied to various farm crops; to ascertain the real or agricultural value of the two kinds of manures we must wait until the crop returns for several years can be reported.

No analyses of the manure was made in the experiment conducted in 1900.

The bedding used was fresh yellow fine sawdust, which in the first experiment was dry enough, but that used in the experiment of 1901 was too moist to be entirely satisfactory. The amounts of sawdust used per period (and included in the figures given above for manure) were with the cotton seed ration 391 and 639 pounds in the respective periods; with the cotton seed meal ration 520 and 644 pounds, respectively.

Second experiment, 1901. The same method as in 1900 was employed in collecting and handling the manure dropped during the 16hours per day that the cows spent in the barn. Only during the second period of this experiment was the manure kept separate and weighed.

The weights given are those obtained by weighing the bulk of manure and soiled bedding at the conclusion of the experiment.

The data follows:

	Lbs. manure from 2 cows, 28 days.	Lbs. manure daily per cow.
From cotton seed and hay ration....	1900	35.7
From cotton s. meal and hulls ration.	3138	56.0

These two lots of manure, each collected during parts of 28 days, were applied to farm crops, and the effects of these two classes of cow manure as compared with each other, with commercial fertilizers, and with no fertilizer, will be recorded in future bulletins of this Station.

The two lots of fertilizers collected as above during the last 28 days of the experiment, were carefully sampled at the end of the experiment and promptly analyzed; and the following table gives the results calculated by us from the analyses made by the chemical department of the Station:

Nitrogen, phosphoric acid, and potash in cow manure, 1901.

	From cow manure.	
	Cotton seed and hay ration.	C. S. meal and hulls ration.
*Camposition.**		
Nitrogen, ...per cent................	0 535	0.830
Phosphoric acid, per cent................	.340	0 350
Potash, ...per cent................	.500	0.485
Moisture, ..per cent................	64.00	66 140
Pounds in 1 ton of manure.		
Nitrogen, ...lbs..............	10 7	16 6
Phosphoric acid,..........lbs	6.8	7 0
Potash, ...lbs	10.0	9 7

The matter that is most worthy of note in the table above is the fact that manure made from a diet consisting largely of cotton seed meal and hulls is 55 per cent. richer in nitrogen than that made from the cotton seed and hay ration; a ton of the former contains 16.6 pounds of nitrogen as compared with 10.7 pounds of nitrogen in the manure from the latter or farm ration. As regards phosphoric acid and potash the two manures are on a practical equality.

* In 1901 the manure dropped during the day when the cows were confined for the *entire 24 hours* was also analyzed, the comparison being almost exactly the same as that of the manure saved during the second period of 28 days (see table above). There was in this fresh manure made from cotton seed, etc., 68 3 per cent. moisture; 0.515 per cent. nitrogen; 0 30 per cent. phosphoric acid; 0 39 per cent. potash. In the manure made from cotton seed meal the percentages were respectively, 68 37; 0.78; 0 325; 0.40. The only notable difference is in the nitrogen, of which the manure from the oil mills ration contained 51 per cent. more than was found in the cotton seed ration.

PROPORTION OF TOTAL EXCREMENT DROPPED IN BARN.

In order to determine what proportion of the manure was dropped in the barn and what percentage in the lots during the eight hours that the cows daily passed in the latter, two cows getting the farm ration and two receiving the purchased foods were kept in the barn for 24 and 48 hours after the close of the experiment, the rations meantime being continued without change.

Solid & liquid excrement per cow in 24 hours.

Cotton seed ration.				Cotton seed meal ration.			
Cows.	Date.	Total excrement and sawdust.	Solid and liquid excrement.	Cows.	Date.	Total excrement and sawdust.	Solid and liquid excrement.
		Lbs	*Lbs.*			*Lbs.*	*Lbs.*
Ada and Queen	Feb. 13 & 14, 1900	55.8	47.8	Ada and Queen	Mar. 23&24, 1900	87.2	72.6
Rozena & Hypatia.	Mar. 23&24, 1900	73.1	56.8	Rozena & Annie.	Feb. 13& 14, 1900	61.5	46.1
Ada and Susan.	Mar 6, 1901 ...	53.8	...	Queen & Hypatia.	Mar. 6, 1901....	103.8	
Average...	per cow	60.9	...	Average ...	per cow	84.2	
Average ...	per 1000 lbs live weight.	72.5	.	Average. ..	per 1000 lbs. live weight.	89.3	

The average amount of solid and liquid droppings and bedding per cow was 60.9 pounds per day with the ration containing cotton seed and 84.2 pounds per day with the ration containing cotton seed meal.

In 1900, with the cotton seed ration, the average amount of solid and liquid excrement dropped per cow in 24 hours (excluding bedding) was 52.3 pounds; the average daily amount of excrement (free from sawdust) collected during the 16-hour stabling period of each day was only 21.9 pounds.

In 1900, with the cotton seed meal ration, the average amount of excrement, free from sawdust, dropped per cow in 24 hours was 59.4 pounds; the average amount collected during the 16 hours of stabling was only 30.2 pounds.

Apparently about one-half the manure was dropped in the barn and about one-half in the lots.

This statement is important because the manure dropped on the lots or pastures usually suffers greater losses, and hence is worth less than that collected while the cows are in the stable. However, the high value of manure from grain fed cows should prompt every dairyman to gather and protect the manure from the lot as well as that from the barn.

In conclusion let us note that the manure from the cotton seed meal ration was greater in amount and much richer in nitrogen than that from the cotton seed ration. Taking the average amounts of manure in all cases where the cows were confined for the whole day and using the analysis of the samples collected in the last periof of 28 days in 1901, we find that the daily excretion of liquid and solid excrement (including bedding) contained plant food as follows:

	Lbs. nitrogen.
60.9 lbs. manure from cotton seed ration..........	.306
84.2 lbs. manure from cotton seed meal ration.....	.700

With the cotton seed meal ration the daily output of nitrogen in the manure was more than twice as great, and the amounts of phosphoric acid and potash considerably larger than with the ration made up largely of cotton seed.

GREEN RYE SUBSTITUTED FOR COTTON SEED HULLS AND FOR SORGHUM HAY.

For 3 weeks beginning March 22, 1900, the four cows which had been used in the experiment comparing a farm-grown with a purchased ration, were fed on green rye as a substitute for the cotton seed hulls and for the sorghum which they had been eating during the second period. The grain ration of the second period was continued in same proportions but in greatly reduced amounts. The rye was in full bloom and rather too old. Excluding the first, or preliminary, week, we find that the result for period III, consisting of 14 days, were as stated below:

Food consumed and milk and butter afforded by 2 cows in 14 days from different rations.

	Lbs. food in 14 days.				Gain or loss in weight	Cotton seed ration.		Cotton seed meal ration.	
	Green rye.	Cotton seed.	Cotton seed meal	Bran and corn mixture. 1:1.		Milk.	Butter.	Milk.	Butter.
					Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Ada	773	....	50 0	36 0	+ 8	.....	....	298.9	12 73
Queen	689	....	73.4	83 9	— 32	......		424.0	13.33
Rozena	783	88 8	......	59 8	— 7	364 8	13 15	......	.....
Hypatia	731	52 8	......	35.2	— 14	272 9	15 27	......	......
Total, 2 cows	.....	...	.....	......	....	**637 7**	**28 42**	**722.9**	**26 06**

Counting green rye at $2.00 per ton and other foodstuffs at prices before mentioned, we find that the cost of food to make one pound of butter was 15.4 cents when cotton seed meal was fed and only 10.5 cents when cotton seed was fed.

This difference in favor of cotton seed over cotton seed meal as an economical producer of butter is apparently too great to be attributed to individual peculiarities of the cows of the two lots, which were chosen with reference to their practical equality.

Direct comparison of green rye as a substitute for either cotton seed hulls or sorghum hay can not be made in this experiment. However the substitution of rye for cotton seed hulls, and also for sorghum hay, reduced the cost of butter, partly perhaps because the large amount of green rye eaten made it practicable to reduce the amount of concentrated food.

Comparing the average daily product during period III with that of the last two weeks of period II, and making no allowances for the fact that the cows while on rye were further removed from time to time of calving than when receiving sorghum or cotton seed hulls, we find:

(1) That the substitution of 52 lbs. of green rye for 14.9 lbs. of hulls (grain also being reduced when rye was fed thus changing the nutritive ratio from 1:4 to 1:3.7), was accompanied by a shrinkage of 19 per cent. in butter and 9 per cent in milk.

(2) That the substitution of 54 lbs. of green rye for 9.1 pounds of sorghum hay (grain also being reduced when rye was fed, changing the nutritive ratio from 1:6.5 to 1:7.3) increased the yield of milk by 18 per cent. and the yield of butter to the extent of 6 per cent.

The results of feeding rye were highly satisfactory for they show that rye was practically able to maintain the normal product (actual yield corrected for advance in location) of butter and to slightly increase that of milk and that its use allowed the daily ration of concentrated food to be decreased to the extent of more than 5 pounds per day, without materially impairing the amount of product. These facts and figures point to an increased use of green crops in late winter and early spring as an effective means of reducing the bill for purchased foodstuffs. An uninterrupted succession of crops for feeding green (soiling) may be had by the use of rye, wheat, common oats, hairy vetch (mixed with small grains), turf oats, and sorghum, etc.

Since the health and working capacity of cows are so greatly improved by soiling crops they should find increased favor.

EFFECT OF GREEN FOOD ON RICHNESS OF MILK.

It is a common belief that milk made from green food contains more water and less fat than that from dry foods. The results of the few experiments made on this point do not bear out the popular belief.

Our results on this point were obtained by making a composite test for butter fat, once a week.

It should be recollected that these determinations of fat were not begun until after the cows had been eating rye for a week. For comparison, we give the percentages of fat found in the milk of the same cows for the weeks beginning March 9 and March 16, 1900, at which time they were receiving only dry food, and a heavier grain ration (though similar in kind) than was given with the rye.

Per cent. of fat in milk; results of composite weekly tests.

NAME.	On dry food, and heavy "grain" ration.			With green rye, and moderate "grain" ration.			
	Date.	Per cent. fat.		Date.	Per cent. fat.		Loss on green food.
							%
Ada........	Mar. 9–15...	3 7	3.85	Mar. 30–A.5.	3.5	3.65	.20
	Mar. 16–22..	4 0		Apr. 6–12...	3.8		
Queen......	Mar. 9–15..	3.2	3.30	Mar 30–A. 5.	3.	2.90	.40
	Mar. 16–22	3.4		Apr. 6–12...	2.8		
Rozena.....	Mar 9–15 ..	4.1	4.15	Mar. 30–A. 5	3.0	3.10	1.05
	Mar. 16–22..	4.2		Apr. 6–12...	3.2		
Hypatia....	Mar. 9–15...	5.0	4.80	Mar. 30–A. 5	4.8	4.80	.00
	Mar. 16–22..	4.6		Apr. 6–12...	4 8		
Average decrease in % fat	....	....		....	....		.41

The uniformity of the figures indicate a decrease in per cent. of fat in the period when rye was fed. It cannot now be said whether it was due to the green food, to temperature conditions, or to a large reduction in the grain ration. The effect of green foods as fed in the South on the percentage of fat in the milk requires further study.

DIGESTIBLE NUTRIENTS IN THE SEVERAL RATIONS FED.

The following table given the amount of digestible nutrients consumed per day in the different periods in comparison with the German or Wolff-Lehmann Standard, which represents the daily requirements of an average cow in full flow of milk:

Digestible nutrients in rations fed.

Ration.	Average weight of cows.	Dry matter.	Digestible nutrients. Protein.	Carbohy-drates.	Ether extract.	Milk per day.	Nutritive ratio.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Wolff–Lehmann Standard.	1000	29	2.5	13	.5	22	1:5.7
"Farm-grown," 1900. .	915	18 75	1 85	9.21	1.81	20.7	1:7.3
"Oil mill," 1900.	957	28.19	3.82	11.98	1.01	29 6	1:3.7
"Farm-grown," 1901.	772	13.07	1.37	5.76	1.42	14.3	1:6.6
"Oil mill," 1901.	752	25 46	3.64	8.36	1.38	19.0	1:3.2
Rye & cotton s., 1900. .	970	20 9	2 2	11.2	1 31	22.7	1:6.5
Rye & c. s. meal, 1900.	960	20.6	3.21	10 71	.90	25.8	1:4.0

Speaking in general terms, protein is that part of the food that goes to make milk, muscle, bone, etc., while carbohydrates (starch, sugar, etc.) and ether extract (fat, etc.) are used as fuel and to give force. Protein is nitrogenous material, and carbohydrates and ether extract are non-nitrogenous. Both classes of compounds must be present in the food to keep the body in its normal working condition.

The average daily ration per cow was as follows:

Cotton seed ration—
- 5.6 lbs. cotton seed.
- 3 7 lbs bran and corn mixture.
- 54 lbs. green rye.

Cotton seed meal ration—
- 4.4 lbs. cotton seed meal.
- 5.0 lbs. bran and corn mixture
- 52 lbs. green rye.

It should be noticed that the cowing eating the cotton seed ration could never be brought up to full feed, or the amount necessary to produce a full flow of milk; in one experiment their ration dropped nearly down to half what the Germans have found to be desirable for a cow to eat.

On the other hand the cows getting cotton seed meal in all cases consumed more protein than necessary.

The nutritive ratio is the number of times that the ratio of the amount of protein (taken as 1) to the total amounts of carbohydrates and fats, the fats having first been multiplied by $2\frac{1}{4}$. The nutritive ratio was narrow (represented by a small number) when cotton seed meal was fed, and wider (or less rich in nitrogen or protein) when cotton seed was fed.

VALUE OF COWPEAS IN CORN FIELDS AS PASTURAGE.

For a period of 19 days, October 7 to 25 inclusive, 1900, three Jersey cows were grazed in a corn field from which the ears had been pulled, the grazing consisting principally of cowpeas, of what remained of the corn blades, and of a little crab and crowfoot grasses.

The corn was planted March 28 in rows five feet apart. Half way between the corn rows was a row of drilled Wonderful cowpeas planted June 4, without fertilizer. The yield of corn was about 25 bushels per acre.

While the cows were grazing in the corn field on cowpeas each received a daily allowance of 3 pounds of cotton seed meal.

From September 23 to October 6 each cow also consumed 3 pounds of cotton seed meal per day. During this earlier period of three weeks, they grazed in a large pasture of bermuda, lespedeza, (Japan clover, carpet grass, etc.) so that the yields made on pea vines can be properly compared with those made on ordinary pasturage. The following table shows the amount of milk and butter afforded daily by each cow:

Average amount of milk and butter produced daily.

Cow.	Milk from		Butter from	
	Mixed pastur'ge.	Cowpeas, etc.	Mixed pastur'ge.	Cowpeas, etc.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
Ida	23.94	25.53	1.03	1.13
Houron	9.72	15.5	.81	.97
Susan	17 64	18.37	1.00	1.01
Average per cow, daily	17.1	19.8	.95	1.04
Per cent. increase	....	15 8	....	9.5

Comparing the product obtained when the cows grazed on cowpeas with that made from ordinary pasturage, we find that the cowpeas gave an average increase of 15.8 per cent in milk and 9.5 per cent in butter. It should be noted that this increase occurred in spite of the fact that the cows were further advanced in the period of lactation when grazing on cowpeas than when on ordinary pasture.

The total amount of product obtained from the three cows during the 19 days while they grazed on cowpeas in a corn field of 3.03 acres was 1129.5 pounds of milk and 59.17 pounds of butter. During this time the three cows consumed a total of 171 pounds of cotton seed meal.

The three cows Ida, Susan, and Houron, during the 19 days while pasturing on cowpeas made gains in live weight of 2687 pounds, subsisted for a period of 85 pounds for the lot. When the field was grazed so close as to threaten to reduce the milk flow, these three cows were removed and three dry Jersey cows were substituted. These three dry cows, with a total initial weight of 2687 pounds, substituted for a period of 9 days on what remained of the grazing on 3.03 acres, meantime receiving no other food whatever and making gains of 12, 16, and 25 pounds, a total of 53 pounds for the lot. Adding this to the 85 pounds gained by the cows giving milk, we have a total gain in live weight of 138 pounds.

The returns from grazing 3.03 acres of cowpeas are brought out by the following:

Financial statement.

By 59 17 lbs. butter, @ 20c		$11.80
By 138 lbs. increase in live weight, @ 2½c		3.45
To 171 cotton seed meal, @ $20	$ 1.71	
Balance (value of 3.03 acres pasturage)	13 54	
Total	$ 15.25	$15 25

Since $13.54 represents the returns from 3.03 acres, the value of the grazing on one acre is $4.47.

The peas were planted for their fertilizing value and the butter removed practically none of this. Hence the cost of growing the peas should be charged in the fertilizer bill of the following crop, and not to the butter produced. However, if it be insisted that this is a proper charge against the cows the expense consists only of the cost of seed, labor of dropping and of covering, the total being somewhat less than a dollar per acre.

If we charge all of this expense of growing the peas to the cows giving milk and entirely neglect the gains made in live weight (the value of which was greater than the cost of growing the peas) the cost of concentrated feed and of pasturage was 8 cents per pound of butter. Balancing gains in live weight against cost of making the pea crop, we have 2.9 cents as the cost of purchased food per pound of butter.

Since there are more farmers interested in beef production than in commercial dairying, we have made an estimate as to the amount of growth of beef cattle that might be expected on an acre, using Thorne's figures as to the relative amounts of food required to make a pound of butter and of beef. By this method we estimate that an acre of grazing of this character made without the aid of any other food, animal products equal to about 80 pounds of increase in live weight. This is confessedly only an estimate but it is in accord with the small amount of data from other sources which is available on this subject.

BULLETIN No. 115. AUGUST, 1901.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

COMMERCIAL FERTILIZERS

JAS. T. ANDERSON,

Acting Chemist.

A. ROEMER,
PRINTER FOR STATE OF ALABAMA,
MONTGOMERY, ALA.
1901.

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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, Alabama.

*To be filled.

AUBURN, ALA., July 24, 1901.

HON. R. R. POOLE,

Commissioner of Agriculture,

Montgomery, Alabama.

DEAR SIR:

I have the honor to submit herewith, in tabulated form, a report of the results of analyses of commercial fertilizers and miscellaneous fertilizing materials for the year ending July 1st.

A large majority of these samples were forwarded to this laboratory through your office, and certificates of analysis were furnished you from time to time as the work was finished. A large number, however, were sent direct to us from dealers and consumers, and in all these cases certificates of analysis were sent direct to the parties.

In addition to the analysis reported in this bulletin, analyses, both quantitative and regulative, of various miscellaneous substances—ores, marls, minerals, waters, dairy products, &c.—have been made for parties from all sections of the State, and have been reported from time to time.

As an introduction to the tables, I respectfully submit a few observations on "Fertilizers—their selection and use," which, it is hoped, will prove of some practical value to the farmers who receive this bulletin.

Very respectfully,

JAS. T. ANDERSON,

Acting State Chemist.

Fertilizers--Their Selection and Use.

Few farmers need be reminded of the necessity of applying fertilizers in some form to their soils in order to maintain their fertility and to increase their crop producing power. The question is not "Shall I fertilize?" but rather "What fertilizers shall I use?" It is proposed in this brief discussion to offer a few suggestions which it is hoped, will be of some value in this connection. These must be taken as suggestions merely, and not as absolute guides in solving the problem. In the present state of knowledge of the science of agriculture, it is impossible to state any general principle of soil fertilization which will be of universal application, so complex are the conditions and requirements to be considered. The character of the soil and the method of its cultivation, the crop to be grown, the season—all these are to be considered in devising any rational system of fertilization.

A soil is fertile when it contains all the materials necessary for plant growth in the required quantity and in the proper form. A soil which is lacking in any of these materials, or which does not have them in the proper form, is in no condition to produce a full crop, and must have the deficient material supplied in the proper amount and form in order to make it productive. As has frequently been stated in these bulletins, there are about a dozen constituents of the soil that are required for plant nutrition. Most of these are found in such quantity in the soil, or are in such little demand by the plant, that the supply of them in the soil is not likely to be exhausted by years of cultivation. Three of the constituents, however, nitrogen, phosphoric acid and potash, are in such demand by the plant that their supply is readily exhausted, and it is necessary to restore these exhausted constituents to the soil in order to make it fertile. For the present, then, soil fertilization consists in restoring to the soil nitrogen, phosphoric acid and potash in such quantities in assimilable form as may be required for the proper nutrition of the growing crop. The rational course, therefore, to pursue with reference to a given soil is first to determine its deficiency in these three constituents and then to supply the deficiency in proper form.

It is not an infrequent occurrence for this department to receive a sample of soil with the request to tell what it needs for its proper fertilization. The correspondent is acting on the hypothesis that a chemical analysis of a soil will determine its fertilizer requirements. Unfortunately it will not do so satisfactorily. The chemist can easily determine what constituents are present in the soil and in what quantities, but he cannot so readily determine whether these constituents are present in assimilable form, and if they are not present in assimilable form, they might as well be absent altogether, as far as the present needs of the growing plant are concerned. Many agricultural chemists, in this and other countries, are seeking to discover methods for determining available or assimilable plant food in soils, but at present there is no such method known which is satisfactory and which admits of universal application.

If chemical analysis fails to answer the question, it may be asked, is there not some way by which the solution may be found? In answer let us quote the language of Dr. Armsby of the Pennsylvania station: "The most satisfactory, and, indeed, usually the only method by which we can at present determine the needs of the soil is to ask the question of the soil itself by growing a crop upon it with different kinds of fertilizers and noting the results. Such soil tests with fertilizers have in many cases given results of much immediate practical value for the locality in which they where undertaken."

On this plan have been conducted for several years the Cooparative fertilizer tests for cotton under the direction of Professor Duggar of the Agricultural Experiment Station of this State, and much valuable information has been accumulated thereby. It would be highly advantageous to the agricultural interests of the State if this work could be greatly extended beyond its present limits. It seems to the writer quite feasible for each intelligent farmer to conduct the experiments for himself and thus secure data that would be highly useful to him. At first glance they may seem complicated and expensive, but in reality they are neither so difficult nor so expensive as they seem. For the benefit of any farmers who may desire to make them the following suggestions are offered:

Select ground that represents fairly as large an area of the farm, and whose soil is as uniform in character as possible. A long strip of land is likely to be more representative in character than a square piece, as it will contain more of the inequalities of the soil, and for this reason is to be preferred for the purpose of these experiments. The land should be as level as possible, and if not level, the plots should be so located that the fertilizers cannot be carried by rain from one plot to another. No part of the strip should be shaded by trees. A convenient size would be 33 feet wide by 416 feet long divided into 6 equal plots each 66 feet long, with a path 4 feet wide between the plots. Each plot, therefore, would be 33x66 feet and measuring exactly one-twentieth of an acre. Each plot should be separated from its neighbor plots, as well as from adjacent cultivated ground, by a 4 ft. path, so that the roots of the plants grown on it can get no fertilizer that is not intended for them. Of course these paths or borders should be kept reasonably free from grass and weeds, which would otherwise feed upon the fertilizers intended for the plants in the plots. Having divided up the plots as indicated and marked them by numbers from 1 to 6 inclusive, prepare the soil thoroughly in the usual way, after applying the fertilizers broadcast as follows:

Plot 1.	No fertilizer.	
Plot 2.	Nitrate of soda	20 lbs.
	Acid phosphate	60 "
Plot 3.	Nitrate of soda	20 "
	Muriate of potash	16 "
Plot 4.	Acid phosphate	60 "
	Muriate of potash	16 "
Plot 5.	Nitrate of soda	20 "
	Acid phosphate	60 "

Muriate of potash.............16 lbs.
Plot 6. No fertilizer.

The acid phosphate in these experiments should contain not less than 8 to 10% of available phosphoric acid. If cotton is to be used in the experiment, use kainit in the place of muriate potash, taking 48 lbs. If legumes, such as clover, peas, beans or vetch, are to be used, cut the amount of nitrate of soda one-half. It is recommended that that crop be used in the experiments which is to be grown in the field the following season, in order that the results of the experiment may be directly applicable. In planting care should be taken to have the plants uniformly distributed over the plots, and as nearly as possible the same number of plants in each plot. The plots should be treated alike in all respects as to the time and manner of cultivation, and in passing from one plot to another, extreme care should be taken not to mingle the soil from one with that of another. This last caution is particularly applicable, when the plow is used in the cultivation. The harvest from each plot should be accurately weighed and the weights recorded. The importance of keeping a full and accurate record for each plot--the kind and amount of fertilizer used, the system of cultivation, and the harvest yield—cannot be too strongly urged. It will be observed that plots 1 and 6 have no fertilizer. These are check plots and are designed to show what the unfertilized soil can do. They will be especially useful in comparatively new soil or in soil that has been previously fertilized, but they should in no case be omitted.

If these experiments have been properly conducted, reasonable inferences may be drawn from a study of the results as to the fertilizer needs of the soil. Too much importance cannot be attached to the conscientious carrying out of every detail. The experiments should be under the personal direction of the farmer himself, and where any part of the labor must be done by another, the most intelligent and reliable laborer should be selected for that purpose.

It is realized that but few farmers are likely to be induced to undertake these experiments, and in the absence of other means of determining the specific needs of the soil, most farmers must assume that all the constituents are needed and must supply them in such amount and in such form as the general considerations of the soil, season and crop may seem to require. So varied are these conditions that it would be impossible to give specific instructions as to methods of fertilization. A few general principles, however, as to the needs of special crops may be stated, which, it is hoped, will serve a useful purpose.

Cotton is a crop that responds promptly and profitably to judicious fertilization, and experience teaches that concentrated complete fertilizers should be used. The profit from manuring with concentrated fertilizers is greatly enhanced by properly preparing the soil in advance. It is profitable to bring the soil into a state of good "tilth" by proper cultivation, and particularly by incorporating into it liberal quantities of organic matter. This may be done by turning under leguminous crops (like the cowpea) or barnyard manure before planting. The complete fertilizer, applied in the drill, should contain a liberal amount of "available phosphoric acid." Any of the soluble salts of potash are good, though kainit is preferred, as it is believed to be useful in preventing "blight." Of nitrogen compounds the organic forms (cotton seed meal, dried blood, tankage, &c.,) are deemed to be best suited for cotton, though nitrate of soda is excellent, especially in soils rich in organic matter. The proper proportions of available phosphoric acid, potash and nitrogen in a complete fertilizer for cotton cannot be said to have been determined with accuracy. As a result of numerous experiments at several of the agricultural experiment stations, 600 to 700 lbs. per acre of a fertilizer running 9% available phosphoric acid, 3% potash and 3% nitrogen is to be recommended.

For cereals and grasses nitrogen has been considered the dominant constituent. This arises from the fact that a top dressing of nitrate of soda at the season when there is a rapid development of stem and leaf, results in a largely increased crop. This occurs, however, only in soils which have a plentiful supply of the mineral constituents, phosphoric acid and potash. It is recommended, therefore, to use at the time of sowing a fertilizer containing a liberal amount of phosphoric acid and potash with a limited supply of nitrogen, and shortly before the maturity of the plant top dress with nitrate of soda.

The Legumes (clovers, peas, beans, vetches, &c.) are crops that do not depend solely on the soil for their nitrogen, but which, under favorable conditions, have the power of drawing at least a part of their nitrogen supply from the atmosphere. To this fact is due their superior excellence as soil renovators, since their growth upon a soil must result in its enrichment in the most costly of the fertilizer constituents, nitrogen. In fertilizing legumes, then, provide a liberal supply of the mineral constituents and a minimum of nitrogen. They seem to require potash in great abundance, Lime, also, is needed to correct a tendency to acidity in the soil which is hurtful to the growth of the bacteria so essential in order that the plant may acquire its nitrogen from the atmosphere. 25 bushels of stone lime per acre, every 4 or 5 years, is recommended for average soils which are used for the frequent growth of legumes.

Root and Tuber Crops require an abundance of all the fertilizing constituents in readily available forms, but they differ widely as to their special needs. In one group may be placed *beets, carrots and mangels*. They require a liberal supply of readily soluble phosphoric acid and nitrogen, and in light, sandy soils the addition of a little potash is advisable. In clay soils they seem to be able to get most of the potash they require from the soil. *Turnips* respond most liberally to applications of available phosphoric acid, while they seem able to extract this constituent from sources not readily accessible to other plants. A liberal supply of nitrogen, also, especially during early growth, is desirable. While the turnip is a voracious feeder on potash compounds, it seems able to obtain this constituent from the natural soil supply, though it should not be required to depend solely on this supply. *Potatoes*, both irish and sweet, require a large amount of potash, which should be in the form of sulphate rather than of muriate. The nitrogen may be mostly in organic forms, though the nitrate of soda or sulphate of ammonia is recommended for the early irish potato. The phosphoric acid in moderate amount should be available.

Fruit Crops differ from the others that we have considered in that they are produced by perennial plants instead of by annuals, and hence they require a different sort of fertilization. As the plants grow slowly, fertilizing materials which give up their constituents slowly are better, perhaps, than those whose constituents are more readily available. Fertilizers of the latter class, however, may supplement those of the former with advantage at such times as there is a rapid devel opment of leaf and fruit. Perhaps the best fertilizer for fruit trees is a mixture of ground bone 3 parts and muriate of potash two parts. An excess of nitrogen must be avoided, as this causes a too rapid growth of both wood and fruit, the latter ripening poorly under such conditions. All fertilizers for fruit crops should be worked well into the soil.

CALCULATION OF COMMERCIAL VALUES OF FERTILIZERS.

The schedule of valuations in force this season is as follows:

Nitrogen........................	14	cents	per	pound.
Water soluble phosphoric acid.....	5	"	"	"
Citrate soluble..................	5	"	"	"
Potash	5	"	"	"

To compute the commercial value of fertilizers according to this scale, the valuation per ton of water soluble and citrate soluble phosphoric acid and potash is obtained by multiplying the per cent of those constituents by $1 00, while the value of the nitrogen per ton is ascertained by multiplying the per cent. of that element by $2.80.

Take for example a fertilizer containing

7.50 per cent. of water soluble phosphoric acid.
2.00 " " " citrate soluble " "
1.25 " " " potash.
2.50 " " " nitrogen.

the commercial value per ton would be:

For the water soluble phosphoric acid	7.50x1.00–$7.50
" " citrate soluble " "	2.00x1.00 $2.00
" " potash	2.00x1.00–$2.00
" " nitrogen	2.50x2.80–$7.00
Total	$17.75

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6200	Alabama Phosphate (So called).....	N. M. Rhodes M. & M. Co.. Shell, Ala..	5.90	5.13	2.42	1.56	1.15	$16.55
6201	Alabama Fertilizer.............	" " " " " "	6.90	2.35	1.80	1.96	2.76	17.50
6208	Dale County Standard Guano......	Ozark C. S. O. M. & F. Co., Ozark, Ala	8.75	3.17	1.08	1.64	3.25	19.76
6209	Ozark H. G. Guano.................	" " " " " " "	9.65	2.53	1.20	1.22	2.95	18.55
6210	Guano No. 3......................	" " " " " " "	9.70	2.39	1.26	1.24	2.52	18.08
6224	B'ham Dis. Bone Am. and Potash...	Birmingham Fert. Co., Birmingham, Ala.	10.00	3.38	.37	.99	1.05	17.20
6225	B'ham H. G. Blood, Bone & Potash.	" " " " "	10.23	3.35	.37	1.87	2.22	21.04
6229	Dale Co. Standard Guano..........	Ozark C. S. O M. & F. Co., Ozark, Ala..	6.35	4.48	.50	2.36	4.11	21.55
6230	No. 2 Ozark Guano................	" " " " " " "	7.45	3.78	.91	1.32	7.84	22.77
6231	Hemes Special Guano No. 1........	Helm Bone Fert. Co., Birmingham, Ala.	0.00	5.49	6.16	1.80	2.29	12.82

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6232	Helm's Special Guano No. 2........	Helm Bone Fert. Co., Birmingham, Ala.	0 00	4.61	5.44	1.65	2.00	$11.23
6238	Farmers' Alliance Guano.	Troy Fertilizer Co., Troy, Ala.........	7.15	3.25	2.65	2.02	2.32	18.38
6239	Big Hit Guano....................	" " " " "	6.50	3 38	3.32	1 38	1.53	15.27
6240	Blood and Bone Guano...........	" " " " "	8.05	3.23	2.42	1.64	2.28	18 17
6241	Hume's Am. Dis. Bone	" " " " "	8.25	2.41	2.52	1.60	2.32	17.46
6242	Meal Mixture.................... ..	" " " " "	7.05	2.73	2.22	1.84	2.18	17.11
6243	Nancy Hanks......................	" " " " "	7.40	2.84	2.36	2.02	2.57	18.47
6244	Old Homestead..	" " " " "	6.55	3.16	3.74	1.16	1.53	14.49
6245	Pike's Pride Guano.	" " " " "	8.00	3 25	2.40	1.66	2.00	17.90
6246	Troy Perfect Guano...............	" " " " "	6.95	2.91	2.04	1.96	2 32	17.67

6247	Soluble Blood and Bone	Troy Fertilizer Co., Troy. Ala	7.10	2.48	3.52	1.26	1.66	14.77
6248	Blood and Bone Guano	" " " " "	8.25	2.85	2.20	1.60	2.00	17.58
6249	Dundee Guano	" " " " "	6.75	2.86	3.34	1.18	1.68	14.59
6254	Fertilizer	Cliff Foy & Bros., Abbeville, Ala	8.55	2.95	.90	2 08	1.66	18.98
6257	Jones Special Formula	Hilton, Bentley & Cosby, Brantley, Ala.	7.35	2.45	3.09	1.10	3.70	16.58
6259	Gray's H. G. Guano	—— Gray, Dadeville, Ala	9.50	2.16	.44	1.50	2.34	18.20
6369	Birmingham Dis. Bone and Potash	B'ham. Fert. Co., Birmingham, Ala	9.90	3.78	.42	.99	1.34	17.79
6270	B'ham H. G. Blood, Bone & Potash	" " " " "	10.35	3.63	.32	1.84	2.52	21.65
6271	Birmingham Soluble Guano	" " " " "	9.80	4.48	.42	1.90	1.31	20.91
6272	Birmingham Standard Grade Fert.	" " " " "	9.75	4.25	.40	1.80	1.18	20.22
6275	Guano	G. W. McKing, Five Points, Ala	5.75	1.68	3.22	1.74	1.97	14.27
6278	Guano	W. L. Patterson, Oswichee, Ala	8.45	2.50	.70	1.98	1.57	18.06
6279	Fertilizer	W. L. Cosby, Walnut Hill, Ala	7.80	2.42	.28	1.40	2.72	16.86
6282	Patapsco Guano	O. J. Belcher, Headland, Ala	8.75	2.93	1.82	.94	1.00	15.31
6291	Grays H. G. Guano	Dadeville Oil Mill, Dadeville, Ala	7.70	2.78	.22	1.56	1.79	16.64
6292	Stone & Johnston's H. G. Guano	" " " " "	7.90	2.79	.26	1.58	1.92	17.03
6293	Home Mixture Guano	" " " " "	7.80	1.91	44	1.50	2.20	16.11
6297	Guano	S. M. Day, Five Points, Ala	6.60	5.00	6.60	1.46	.75	16.44

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

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.			
6298	Goldsmith's Improved Mixture. ..	Prim & Kimbel, Jackson, Ala......	8.60	3.12	2.68	2.00	2.73	20.05
6303	Aurora...........................	Herren & Oliver, Dadeville, "	9.00	3.20	2 25	1.66	1.19	18.04
6304	A. A. P...	" " " "	9.30	4.13	2 32	1.00	1.45	17.68
6305	Coweta H. G. Guano	" " " "	9.20	2.35	2.60	1.80	2.29	18.88
6306	W. O. C....................	" " " "	8.45	3.48	3.32	1 80	2.35	19.32
6313	Blood, Bone and Potash	McGhee, Driver & Co., Lafayette, Ala.	5.65	5.21	4.14	1 60	1 24	16.58
6314	Mastodon	" " " " "	8.70	2.44	1.36	1.44	2.18	17.35
6317	H. G. Potash Guano................	R. A. Russell & Co., Gaylesville, "	6.00	3.92	2.18	1.34	2.07	15.74
6318	Blood and Bone Guano	" " " " "	7.00	4.39	2.06	1.16	1.07	15.71
6325	Capital City Standard Guano.......	Wright, Henderson & Co., Elba, "	6.05	4.07	4.08	1.64	2.32	17.03

2 (97)

6326	Troy Perfect....................	Wright, Henderson & Co., Elba,	"	6.85	2.59	3.06	2.20	2.97	16 57
6327	Georgia State Grange Guano......	" " " "	"	5.05	3.85	2.30	1.38	2.17	14 93
6331	Georgia State Standard	Sanders & Son, Columbia,	"	5.75	3.45	4.00	1.86	2.00	16 41
6334	B'ham H. G. Blood, Bone and Potash.	Lester & Co., Columbiana,	"	8.50	4.06	1.94	1.34	1.53	17 84
6337	Blood and Bone	H. M. Beach & Son, Columbia,	"	5.80	4.02	2.08	1.61	1.87	16 20
6338	Comple Cotton Fertilizer..........	" " " "	"	8.65	1.71	2.24	1.80	2.38	17 78
6339	Jones' Formula....................	" " " "	"	8.85	3.52	1.98	1.04	3.48	18 76
6340	Excelsior	" " " "	"	8 00	2.10	1.30	1.68	1.59	16 39
6341	Farmer's Special	" " " "	"	6.70	5.74	1.46	1.11	4.82	20 37
6342	Helmet	" " " "	"	3.20	5.69	3.36	1.90	2.42	16 63
6345	Ox Cotton Guano	T. C. Masterson, Avoca,	"	8.70	4.39	1.26	1.70	1.55	19 40
6347	Armour's 271	C. A. Steifelmeyer, Hanceville,	"	2.85	7.61	1 34	1.94	1.65	17 54
6348	Meridian Blood and Bone	" " "	"	8.55	3.38	1.92	1.74	1.59	18 39
6350	Early Bird.................. ...	Reynolds Bros., Jemison,	"	8.10	3.75	6.20	1.24	1.64	16 96
6353	Georgia Formula Guano............	Campbell & Wright, Jr., Roanoke,	"	8.85	2.40	2.60	1.72	2.24	18 31
6354	Georgia State Grange Guano	" " " "	"	7.90	2.16	.94	1.65	3.33	18 01
6355	Pon Pon Crop Grower..............	" " " "	"	8.50	2.04	2.56	1.22	2.94	16 90
6356	Randolph Guano...................	" " " "	"	5.50	2.58	1 92	2.54	2.29	17 48

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

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.
6257	Roanoke Guano	Campbell & Wright, Jr., Roanoke, Ala.	7.25	2.45	2.70	1.98	1.41	$16 65
6367	B'ham Blood, Bone and Potash	S. E. Stewart, Hartselle, Ala	7.50	2.80	3.40	1.50	1.76	16 26
6338	Alabama Guano	" " " "	7.30	2.81	2.04	1.98	2.06	17 71
6369	Adair's Am. Dis. Bone	" " " "	7.00	1.64	2.86	1.88	2.38	16 28
6370	Ga. State Grange Fertilizer	" " " "	8.10	1.73	3.02	1.54	2.85	16 99
6371	Ox Cotton Guano	" " " "	8.95	3.84	1.86	1.56	1.74	18 90
6373	Read's H. G. Am. Dis. Bone	" " " "	8.40	3.97	1.48	.72	2.90	17 29
6374	Sample No. 1	C. R. Maxwell, Northport, "	8.75	.90	.40	1.22	2 30	15 37
6375	Sample No. 2	" " " "	19.00	1.44	.36	1.16	2.76	17 45
6377	Helmet Brand Potato Fertilizer	S. F. Alston, Tuscaloosa, Ala	2.30	9.46	2.24	3.72	4.22	26 40

6378	Helmet Brand Blood, Bone & Pot'h.	S. F. Alston, Tuscaloosa, Ala..........	2.25	9.18	1.62	4.18	10.40	33 53
6379	Helmet Brand 271	" " " "	1.85	8.11	1.14	2.14	1.74	17 69
6380	Helmet Brand 386	" " " "	3.30	8 64	2 06	2.50	7.55	26 49
6383	King Cotton Grower.	W. D. Hamilton, Guin, Ala............	6 75	4.19	5.26	.60	1.29	13 91
6385	Scott's Gossypium Phospho.........	C A. Steifelmeyer, Cullman, Ala......	9.90	1.71	1.24	1.88	3.26	20 13
6387	B'ham Blood, Bone and Potash....	" " " "	8.40	3.81	1 64	1.45	2.13	18 40
6389	Bone Compound..................	" " " "	7.25	2.90	6.20	1.60	2.07	16.70
6390	Standard Home Mixture..	" " " "	7.45	3 82	1.08	1.62	2.90	18 71
6391	Helmet Brand 271	" " " "	2.00	7.73	1.52	2.12	2.09	17 76
6394	Ga. State Standard Superphosphate.	Law & Davis, Lincoln, Ala.............	6.25	3.91	2.44	1.68	3.32	18 18
6395	Scott's Gossypium Phospho.........	" " " "	7.40	4.79	.96	1.86	3.20	20.60
6396	Scott's Blood Formula..	" " " "	7.15	4 37	2.08	1.10	2.25	16 85
6399	W. O. C..........................	S. F. Teague, Birmingham, Ala.........	6.30	2.98	3.32	1.58	2.64	17 34
6400	Teague's Beef, Blood and Bone.....	" " " "	6.55	3.53	4.02	1.04	2.07	15 06
6402	Animal Ammoniated	T. H. & A. B. Stephens, Seaborn, Ala...	7.05	2.87	2.68	1.74	1.68	16 47
6403	Blood Formula...	" " " " " ...	9.45	3.13	2.12	1.08	1.86	17 46
6405	B'ham H. G. Fertilizer............	F. Ogden & Son, Sulligent, Ala........	8.35	3.98	.72	1.54	2.78	19 42
6406	Mobile Standard Guano...........	" " " "	5.50	3.97	6.08	1.88	3.42	18 15

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6408	Ox Cotton Guano..................	Porter & Foster, Town Creek, Ala.....	7.85	4 17	1.88	1.72	2.51	$19 35
6410	Blood & Bone....................	J. B. Gray & W. W. Gulledge, Ohatchie	7.10	2.86	3.44	1.19	1.99	15 28
6412	Read's Blood & Bone No. 1.........	T. R. Farish & Bros., Clayton, Ala.....	7.25	3 93	1.42	1.30	2.53	17 35
6415	Aurora Am. Phosphate...........	Jas E. Snead, Snead, Ala.............	5.85	3.32	1.38	1.64	1.90	15 66
6416	Animal Bone Fertilizer...........	" " " "	7.20	4.00	6.10	1.75	1.78	17 88
6419	A. A. P. Bone with Ammonia.......	" " " "	7.35	4.51	1.14	1.35	1.46	17 10
6420	W. O. C. Guano....................	" " " "	8.30	4.47	1.48	2.22	2.62	21 61
6421	Sea Bird Guano..................	" " " "	7.90	2.93	6 82	1 64	2.22	17 64
6422	Coweta H. G. Fertilizer............	" " " "	8.30	5.51	5.44	1.72	1.95	20 58
6424	Sea Gull Compound...............	R. W. Allen & Co., LaFayette, Ala......	8.00	2.75	2.30	1.00	2.34	15 89

6425	Georgia Formula	R. W. Allen & Co., LaFayette, Ala	7.70	3.07	2.18	1.44	2.40	17.20
6428	Am. Dis. Bone	J. R. G. Howell, Dothan, Ala	7.70	5.41	1.54	.98	2.99	18.84
6429	Howell's Fruit Food	.. ..	4.25	3.38	.82	3.16	3.31	19.79
6431	Beef, Blood & Bone Guano	Weathers, Swan & Co, Roanoke, Ala	7.90	3.45	1.80	1.12	1.23	15.72
6432	Solid South Guano	.. ..	7.90	3.30	3.00	1.58	2.24	17.86
6434	Tuskaloosa Guano	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala	8.30	3.54	.26	2.16	2 36	20.25
6436	Goulding's Bone Compound	Hughes Bros., Florala, Ala	6.90	4.08	5.32	1.48	2.05	17.17
6438	Potapsco Guano	R. W. Allen & Co., LaFayette, Ala	8.55	2.89	1.96	1.36	2.32	17.57
6445	Hume's Am. Dis. Bone	Troy Fertilizer Co., Troy, Ala	8.45	3.13	2.42	1.68	2.32	18.60
6447	Troy Perfect Guano	.. ..	7.80	3.32	2.68	1.48	2.11	17.37
6448	Blood and Bone Guano	.. ..	8.05	3.63	2.32	1.62	2.34	18.56
6449	.. .. ..	.. ..	8.55	2.77	2.18	1.64	2.57	18.48
6453	Complete Cotton Fertilizer	P. J. Ham & Son, Elba, Ala	7.85	1.88	3.22	2.00	2.4	17.70
6454	Jones Special Formula	.. ..	8.85	2.65	1.50	1 22	4.02	18.54
6455	Merriman's Cotton Boll Guano	.. ..	9.95	1.38	2.32	1.58	4.07	19.82
6456	.. ..	.. ..	10.05	1.46	1.94	1.34	3.33	18.59
6459	Blood, Bone and Potash	Hilton, Bentley & Cosby, Brantley, Ala.	10.00	2.53	1.72	.94	1.69	16.85
6460	Ga State Grange Fertilizer	.. ..	6.10	2.84	2.56	1.68	2.93	16.57

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6461	Jones Special Formula.	Hilton. Bentley & Cosby. Bentley, Ala.	7.40	3.25	3.10	.95	3.88	17.19
6462	Sample No. 1......................	C. Kimbrough, Alexander City, Ala....	8.20	3.36	1.94	2.06	2.88	20.21
6463	Sample No. 2....	" " " ...	7.05	3.12	1.38	2.43	1.53	18.50
6468	Troy Perfect Guano..............	J. T. Ramage, Brundidge, Ala.	7.55	2.79	3.26	1.94	2.65	18.42
6469	Star Guano.	" " "	6.75	3.53	5.22	2.28	1.55	18.21
6470	Sea Gull Guano..................	" " "	7.00	5.25	4.10	1.84	2.68	20.08
6472	Blood Bone and Potash.	W. F. Kenzie, Greenville, Ala.........	6.00	4.93	5.22	1 98	2.13	18.60
6473	Goulding's Special Compound......	" " "	7.05	3.07	7.08	1.56	2.90	17.39
6476	Alabama Guano....................	J. C. Akin & Son, Notasulga, Ala.......	7.10	3.77	1.28	2.16	2.36	19.28
6478	Ammo. Superposphate	First Bank of Elba, Elba, Ala.........	5.55	3.56	2.80	1.42	2.43	15.41

6479	Hume's Am. Dis. Bone	First Bank of Elba, Elba, Ala	7.85	2.31	4.44	1.24	2.02	15 65
6481	Patapsco Guano	T. K. Brantley & Son, Troy, Ala	8.00	3.14	1.96	.94	2.50	16 27
6482	Sea Gull Guano	" " " "	9.45	1.23	2.12	.98	2.53	15 95
6485	Baltimore Soluble Bone	J. G & John Sanders, Dothan, Ala	8.30	3.89	1.46	.51	1.57	13 76
6493	Georgia Formula	C. H. Butler, Childersburg, Ala	7.55	2.44	2.26	1.41	2.62	16 56
6495	Georgia State Grange	Burks & Coston, Brantley, Ala	7.20	2.47	.98	2.30	2.78	18 89
6497	Ox Cotton Grower	M. F. Patterson, Falkville, Ala	7.30	3.95	2.50	2.16	2.02	19 32
6498	Troy Perfect	Burks & Coston, Brantley, Ala	7.70	2.07	2.28	1.62	2.29	16 60
6499	Blood and Bone	" " " "	4.80	4.22	4.28	1.38	1.83	14 71
6502	Perfection Guano	McMillan & Harrison, Mobile, Ala	7.80	3.06	.74	2.64	3.57	21 82
6503	" "	Jess Jackson, Grand Bay, Ala	10.55	2.56	1.34	1.48	3.34	20 59
6505	Gossypium Phospho	W. S. Crass, Pelham, Ala	9.30	2.37	.78	1.54	2.71	18 69
6508	Big Hit	G. A. Sanders, Luverne, Ala	11.35	1.68	2.02	1.22	1.06	17 51
6509	Hume's Am. Dis. Bone	" " "	7.85	1.58	3.42	1.68	2.34	16 47
6513	Roanoke Guano	A. J. Pittman, Wehodkee, Ala	7.35	2.67	3.08	1.86	2.24	17 47
6514	Randolph Guano	" " "	7.30	3.60	2.80	1.83	2.14	18 16
6516	Beef, Blood and Bone	W. A. Gage & Co., Town Creek, Ala	8.65	4.15	1.30	1.80	2.21	19 05
6517	Helmet 282	" " " " "	2.90	8.92	.98	2.00	3.25	20 62

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6518	Helmet, 271	W. A. Gage & Co., Towne Creek, Ala	2.50	9.10	1.00	2.14	2.42	$20 01
6521	Old Dominion	Phillips Bros, Oxford, Ala	4.05	4.60	2 20	1.92	3.24	17 27
6522	Talladega Am. Dis. Bone	" " " "	6.65	3.00	0.20	2.06	3.38	18 80
6524	Ga. State Standard Guano	Ingram & Co., Anniston, Ala	8.65	2.71	1 44	1.56	2.13	17 96
6527	Eddystone Soluble Guano	J. Markentepe, Cullman, Ala	6.75	4.24	2.66	2.10	1.80	17 67
6528	Fertilizer	Robbins & McGowan, Brewton, Ala	8.95	2.05	2.80	2.18	2.36	19 46
6532	Schuessler & Co's Beef, Blood & Bone	Schuessler & Co., Roanoke, Ala	7.25	3.41	6.24	1.26	1.52	15 71
6533	" " Special Formula	" " " "	7.45	3.34	4.46	1.26	4.25	18 57
6534	" H. G. Fertilizer	" " " "	6.75	3.35	4.90	1.90	2.65	18 07
6538	Ala. Fertilizer	Britt & Johnson, Wetumpka, Ala	8.60	4.99	.56	2.10	2.60	22.07

6541	Hume's Am. Dis. Bone............	McEntyre, Henderson & Adams, Ozark.	7.30	2.95	2.20	1 92	2 80	18.43
6543	Troy Perfect Guano................	" " " "	6 70	2.34	3.66	1.26	3.28	15.85
6544	Goldsmith's Improved Mixture....	" " " "	6.15	3.65	2.10	1.67	1.96	16.44
6545	Swift's Eagle	" " " "	7.10	4.93	1 02	2.02	2.87	20.56
6547	Am. Dis. Bone.....................	B. Bullard, Elba, Ala.................	6.60	5.99	4.96	1.16	1.20	17.04
6548	Crescent Guano	" " "	6.50	9.08	0.62	1.62	1.01	21.13
6550	XXX Blood & Bone Guano.........	George Kroell, Montevallo, Ala.......	8.00	3.66	2.24	1.54	1.60	17.57
5552	Farmers Alliance Guano...........	H. R. & H., Brantley, Ala.............	7.40	2.89	3 26	1.84	2.29	17.73
6553	Nancy Hanks Guano...............	" " " "	7.60	2.17	2.18	1.82	2.51	17.38
6554	Hume's Am. Dis. Bone............	" " " "	7.20	2.39	2.46	2.10	2.81	18.28
6555	Troy Perfect................	" " " "	7.90	2.67	3.08	1.94	2.12	18.12
6556	B. D. Sea Fowl Guano	" " " "	8.40	2.98	2.32	2.04	1.35	18.44
6557	Capital City Guano	" " " "	6 80	3.76	4.44	1.82	2.57	18.23
6461	B'ham Blood, Bone and Potash...	Geo. M. Truss & Co., Springville, Ala..	9.70	3.65	1.30	1.66	2.30	20.30
6563	Fertilizer..........................	J. O. Hodges, Ashville, Ala............	8.10	3.52	1.98	1.68	2.85	19.17
6565	Bear Beef, Blood and Bone........	A. P. Howison, Randolph, Ala.........	7.60	4.58	2.02	2.28	2.47	21.03
6570	Ox Slaughter House Bone	W. W. Carlisle & Bro., Roanoke, Ala....	7.40	4.52	1.18	1.56	2.77	19.06
6573	Blood and Bone Guano.	" " " " " ...	4.60	5.13	1.42	1.70	2.75	17.24

Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6574	Roanoke Guano	W. W. Carlisle & Bro. Roanoke, Ala	5.55	4.44	2.66	2.04	1.79	17.49
6575	Randolph Fertilizer	“ “ “ “ “	6.85	3.91	2.24	2.00	2.03	18.39
6579	Alabama Fertilizer	Sessions & Mizelle, Enterprise, Ala	6.75	5.52	1.38	1.86	1.59	19.07
6582	Helmet 271	T. A. Howle, Oxford, Ala	2.00	8.84	.66	1.98	1.67	18.05
6583	Georgia State Grange Guano	“ “ “	7.45	2.50	1.80	1.70	2.61	17.32
6584	Birmingham Guano	“ “ “	4.85	4.17	1.48	1.14	1.75	13.96
6588	Tip Top	T. J. Land, Cullman, Ala	9.65	2.83	2.32	1.02	1.27	16.61
6590	Stern's Am. Raw Bone	Chapman & Co., Geneva, Ala	4.30	3.60	4.40	1.52	1.66	16.92
6501	Champion Farmers' Choice	“ “ “ “	6.80	3.07	.88	2.14	1.64	17.50
6594	No. 3 Wet Guano	J. S. Collins, Geneva, Ala	7.35	5.24	1.86	1.44	1.70	18.32

6597	Mobile Standard........................	Crutcher & Ward, Cuba, Ala..........	5.40	5.10	6.40	1.65	2.24	17.36
6599	Helmet Brand........................	M. P. White, Attalla, Ala.	1.45	8.97	.58	2.26	1.87	18.62
6601	Scott's Animal Am. Dis. Bone......	W. J. Sibert, Gadsden, Ala............	7.50	2.98	2.82	1.64	1.55	16.62
6603	Mobile Standard Guano	Chas. Ivey, Evergreen, Ala...........	5.65	4.60	6.10	1.72	2.11	17.18
6605	Blood and Bone	Zena Shepherd, Georgiana, Ala.	6.45	3.64	4.16	1.51	2.15	16.47
6608	Alliance Soluble Guano............	J. I. Covington, Bertha, Ala............	6.50	4.27	3.38	1.78	2.01	17.76
6609	Rock City..............................	J. E. F. Westmoreland, Florence, Ala..	6.95	3.48	1.12	1.50	1.75	16.38
6610	Pacific Guano........................	" " " "	7.40	4.23	5.02	1.18	1.84	16.77
6611	Armour's 722.........................	J. A. Kenney, Loop, Ala..............	4.05	9.47	4.28	1.48	2.22	19.88
6616	Corn and Cotton Guano............	J. C. Hartselle & Son, Hartselle, Ala...	5.85	5.41	4.24	1.14	1.68	16.13
6619	King Cotton Grower................	W. A. Shaw, Winfield, Ala..............	5.30	4.43	4.12	1.15	2.03	14.98
6621	Crescent Guano.....................	C. R. Waxwell, Northport, Ala.........	6.30	3.38	4.12	1.68	1.86	16.24
6622	Maxwells' Home Mixture	" " " "	6.55	2.78	0.42	1.96	1.97	16.79
6624	Baltimore Soluble Bone	Bean & McMurray, Heflin, Ala........	8.90	4.89	1.26	.55	......	13.79
6626	Bear, Beef Blood and Bone.........	" " " " "	7.70	5.14	.86	1.38	2.12	18.82
6631	Ox Cotton Guano....................	Franzen & Olsoo, Thorsby, Ala.........	8.00	4.35	2.10	1.78	1.50	18.83
6633	B'ham Dis Bone Am. and Potash...	T. U. Crumpton, Maplesville, Ala	9.05	4.49	.66	.56	1.59	16.17
6634	Star Brand............................	S. N. Rains, Elba, Ala	6.60	4.46	5.34	2.10	1.70	18.64

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Acid Phosphate with Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6635	Blood Formula	W. E Crass, Pelham, Ala	7.45	4.04	4.76	.86	1.95	$15.85
6637	Complete Fertilizer	John Ward, Headland, Ala	2.60	2.21	.84	.82	1.53	8.64
6640	Blood, Bone and Potash	Asa Griffith, Hanceville, Ala	7.95	3.00	2.30	1.54	1.74	17.00
6641	Beef, Blood and Bone	" " " "	7.95	3.98	1.22	1.88	2.06	19.25
6642	" "	" " " "	6.85	6.55	1.85	1.78	2.17	20.55
6643	Tatapsco	" " " "	9.00	3.00	2.25	1.05	1.92	16.86
6647	Meridian Blood and Bone	G. H. Amos, Duck Spring, Ala	7.55	3.10	2.00	2.00	2.30	18.55
6648	" Home Mixture	" " "	8.05	2.90	1.90	1.68	2.25	17.90
6649	Armour's 272	W. T. Andrews, Gold Hill, "	1.35	6.84	6.76	2.16	2.67	16.91
6650	Helmet 272	" " "	2.40	8.55	1.50	2.20	2.78	19.89

6651	Ox Cotton Guano	W. T. Andrews, Gold Hill, Ala.	8.90	3.05	2.05	1.82	1.76	18 81
6653	Blood, Bone and Potash	F. D. Byrum, Byrum, Ala.	8.05	4.00	1.80	.98	1.23	16 02
6654	Georgia State Grange Guano	" " "	7.90	2.50	2.20	1.78	2.70	18 08
6656	A. G. Winkler's Am. Dis. Bone	A. G. Winkler, Greenville, Ala	6.70	2.70	6 25	2.18	2.02	17 52
6658	Am. Dis. Bone	Jno. H. Wilson, Jenifer, "	8.30	2.00	0.40	1.46	2.13	16 52
6664	Mobile Standard	W. W. Burnette, Geneva, "	6.80	7.10	.90	1.84	2.34	21 39
6668	Scott's Gossypium Phospho	Lull & Lacy, Wetumpka, "	9.45	2.65	1.15	1.68	2.41	19 21
6669	" Blood Formula	" " "	8.20	3.26	1.78	1 09	1.95	16 46
6672	" AA	D. D. Hughes, Lebanon, "	7.30	5.35	2.70	1.70	1.45	18 86
6674	" Blood Formula	" " " "	6.90	9.87	1.78	.96	1.25	20 71
6677	No. 271	Cash Supply Co., Mountain Creek, Ala.	3.60	8.56	.74	2.50	2.10	21 26
6678	Alabama Fertilizer	" " " " " "	6.25	4.02	1.78	2.10	2 34	18 49
6679	Georgia Farmer	J. G. Land, Cullman, Ala.	5.05	4.05	3 00	1.56	2.12	15 59
6680	Scott's	Joel W. Ligg. Elkmont, Ala	7.00	2.95	2.80	1.76	1.59	16 47
6686	XXX Am. Dis. Bone	Trawick & Jernigan, Opelika, Ala	5.45	4.62	3.28	1.52	2.31	16 64
6687	XX Blood and Bone	" " " "	5.55	4.73	3.42	1.68	2.06	17 04
6688	Old Time Guano	" " " "	5.50	3.80	4.10	1.64	2.48	16 37
6689	Lee Fertilizer	" " " "	6.45	3.86	1.84	1.64	2 55	17 45

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

ACID PHOSPHATE WITH NITROGEN AND POTASH—Continued.

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Nitrogen.	Potash.	Commercial value.
6633	Alabama Fertilizer.	W. D. Brown, Gravilla, Ala............	7.70	2.50	1.50	2.06	2.04	18 01
6694	Mobile Standard Guano............	" " "	3.85	5.25	6.25	1.92	1.93	16 41
6697	Eddystone Soluble Guano..........	Coley & Sandlin, Alex. City, Ala.......	7.00	5.29	0.70	1.43	1.88	18 06
6698	Magic Cotton Grower..............	" " " " "	7.40	2 65	1.80	1.13	2.38	15.59
6700	Special Blood Mixture..............	" " " " "	5.60	4.20	1 25	.92	1 58	13 96
6703	Goulding's Bone Compound	W. D. Brown, Gravilla, Ala............	8.40	6.25	.90	1.70	.91	20 32
6706	Cahaba Dis Bone Am. & Potash....	White & Spigener, Goodwater, Ala.. .	9.30	4.95	1.30	.78	1.32	17 75
6707	" H. G. Blood, Bone & Potash.	" " " "	7.75	3.80	1.35	1.55	2 04	17 93

6709	Standard Guano..................	White & Spigener, Goodwater, Ala.....	7.00	3.18	0.60	1.38	1.63	15 64
6710	Boss Cotton Grower..............	" " " "	7.10	5.05	2.45	.84	1.93	16 48
6224	B'ham Dis. Bone, Am. & Potash...	Birm'ham Fert Co., Birmingham, Ala..	10.00	3.38	.37	.99	1.05	17 20
6225	B'ham H. G. Fertilizer...........	" " " " "	10.23	3 35	.37	1.87	2.22	21 04
6225	Cahaba H. G. Fertilizer	" " " " "	10.23	3.35	.37	1.87	2.22	21 04
6712	Merriman's Cotton Boll Guano.....	W. C. Perry, Seale, Ala	5.20	6.55	1.55	1.39	1.82	17 46
6714	Troy Perfect	Ben. Jennings, Seale, Ala	6.65	2.65	2.90	1.62	1.86	15 1[illegible]
6717	Eddystone Soluble Guano	W. H. Bynum, Boaz, Ala................	7 30	5.90	2.10	1.44	1.71	18 94
6719	Blood & Bone	J H. Myers, Langstone, Ala	7.25	4.15	5.70	.59	1.91	14 96
6720	Patapsco Guano..........	Bean & McMurry, Heflin, Ala	8.10	3.85	1.75	.82	2.76	17 01
6724	Blood, Bone & Potash............	McEntire, Henderson & Adams, Ozark.	5.30	5.00	5.60	1.96	1.77	17 56
6725	Eddystone Soluble Guano...... ...	Elrod & Gibson, Collinsville, Ala......	6.15	5.59	3.06	1.94	1.53	18 70
6726	No. 1 Guano.......................	W. H. Mizelle, Grimes, Ala...........	6.80	1.69	3.06	1.46	2.06	14 64
6727	No. 3 Guano.......................	" " "	7.15	4.79	1.36	2.12	2.03	19 91
6730	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala. .	6.70	4.55	1.85	2.20	2.13	19 54
6734	Beef, Blood & Bone	R. F. Gilbert, Porterville, Ala.........	6.65	5.43	1.22	.73	1.53	15 65
6735	Magic Cotton Grower	" " "	5.80	6.11	1.44	.90	2.01	16 54
6738	Alabama Guano....................	Gunter & Ealem, Gantt, Ala...........	6.50	3 54	3.16	1.88	1.90	17 20

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

ACID PHOSPHATES WITH POTASH.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID. Warter Soluble.	PHOSPHORIC ACID. Citrate Soluble.	PHOSPHORIC ACID. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6739	Old Homestead	Gunter & Ealem, Gantt, Ala	8.45	3.60	3.10	1.00	2.29	$17 13
6740	Meal Mixture.....................	" " " "	6.10	3.60	2.10	1.98	2.06	17 20
6741	Pike Pride	" " " "	7.60	3.56	1.04	1.54	2.27	17 74
6744	Cow Guano	McEntire Bros., Cullman, Ala..........	5.70	3.03	5.02	1.78	2.20	15 91
6745	Corn and Cotton Guano	" " " "	8.10	.83	5.72	.74	2.25	13 25
6747	Blood and Bone Guano............	S. W. Henry, Springville, "	6.00	4.43	4.32	.86	2.09	14 93
6748	Fertilizer	J. C. Alford & Son, Childersburg, Ala...	6.75	6.57	2.98	1.66	1.77	19 74
6751	Farmer's Special Manure..........	R. Q. Edmonson & Bros., Eufaula, Ala..	7.45	4 90	1.10	.74	2.81	17 23
6753	282..................................	F. L. Johnson & Co., Gadsden, Ala	2 25	7.60	2.35	2.10	2.18	17 91
6754	Complete Fertilizer................	E. J. Neher, Hollywood, Ala	4.60	4.50	4.90	.80	2.13	13 74

6762	S. &. K. Am. Dis. Bone..........	Opelika Chemical Co. Opelika, Ala.....	7.05	4.30	6.30	1.30	1.30	16.29
6768	Blood and Bone Guano.............	" " " " "	7.05	3.85	3.90	2.26	1.66	18.89
6769	Alliance Soluble.................	" " " " "	7.50	3.19	4.76	2.14	2.13	18.81
6770	C C. C. Standard Fertilizer........	" " " " "	7.55	3.84	4.56	2.24	2.01	19.67
6771	Star Brand Guano.................	" " " " "	7.15	3.03	4.82	1.72	1.25	16.25
6772	Pinkard's Home Mixture.	" " " " "	5.45	3.39	1.06	2.40	1.90	17.46
6773	Meal and Phosphate Compound....	" " " " "	7.90	5.00	1.20	2.64	.72	21.01
6774	Good Luck Soluble Guano..........	" " " " "	6.95	4.23	6.62	1.28	1.18	15.94
6775	Diamond Soluble Guano.	" " " " "	7.05	3.30	4.90	2.08	1.27	17 44
6776	Schuessler Bros.' H. G. Guano.....	" " " " "	7.45	2.82	5.08	1.98	1.31	17.12
6777	Schuessler & Co's Beef, Blood & B'ne	" " " " "	7.05	3.73	6.22	1.28	1.45	15.81
6778	" " Special Formula...	" " " " "	6.55	4.10	3.80	1.38	2.14	17.65
6779	" " H. G. Fertilizer...	" " " " "	7.85	3.47	4.78	2.26	2.00	19.65
6809	Sea Gull Soluble Guano............	W. B. Wilhite, Hartselle, Ala..........	6.50	2.88	4.32	1.66	2.19	16.22
6810	Capital City Standard Fertilizer....	" " "	6.20	6.03	1.02	1.60	2.29	19.00
6791	Am. Dis. Bone.....................	Montgomery Fertilizer Co., Montgom'y.	7.00	3.96	5.54	1.24	1.51	15.94
6792	Vandiver's Am. Dis. Bone.........	" " " "	6 50	3.93	7.12	1.29	1.36	15.40
6793	Montg'y Blood and Bone Guano....	" " " "	7.60	3.45	4.80	2.20	2.32	19 53

Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6794	Southern Pacific Guano............	Montgomery Fertilizer Co., Montgom'y.	7.35	3.33	5.32	1.26	1.56	15.77
6795	Plow Brand Soluble Guano.........	" " " "	7.25	4.52	4.28	1.21	1.50	16.66
6796	Tariff Reform Soluble Guano......	" " " "	7.70	2.11	5.84	2.26	2.18	18.32
6797	Early Bird Soluble Guano..........	" " " "	7.75	3.16	5.24	1.28	1.19	15.68
6798	Our Cotton Queen Guano..........	" " " "	6.70	6.82	3.18	1.28	1.80	18.90
6799	Capital City Standard Guano......	" " " "	7.50	3.83	4.92	2.28	2.74	20.45
6800	Willson's Special Compound........	" " " "	8.30	3.74	3.96	1.52	1.67	17.97
6802	Planters Pride Guano..............	West & McMurray, Roanoke, Ala.......	6.95	3.27	2.98	1.55	2.11	16.67
6805	Sea Gull Soluble Guano............	Montgomery Fertilizer Co., Montgom'y.	7.70	3.33	4 62	2.24	2.55	19.85
6806	Crescent Guano....................	" " " "	7.55	3.27	4.68	2.06	1.52	18.09

6807	Clayton Fertilizer	Montgomery Fertilizer Co., Montgom'y.	5.50	3.66	.94	2.40	3.41	19.39
6813	Am. Dis. Bone	C. W. Bell & Son, Lineville, Ala	9.20	.54	3 86	1.92	2.37	17.49
6817	Baltimore Soluble Bone	G. W. Roberts & Co., Collinsville, Ala	7.90	4.11	1.54	1.14	1.85	17.05
6818	H. G. Patapsco Guano	" " " "	9.20	3.06	1.84	1.40	1.78	17.96
6814	Blood, Bone and Potash	C. W. Bell & Son, Lineville, Ala	5.30	6.80	7.30	.08	2.01	14.33
6819	Alabama Fertilizer	W. A. Arnold, Ozark, Ala	8.60	2.40	1.80	1.92	1..7	18.15
6820	Dale County Standard	" " "	8.70	3.91	.74	2.30	1.97	21.12
6822	Solid South Guano	Reeves, Sanders & Co., Heflin, Ala	6.55	3.73	2.92	1.54	1.92	16.71
6823	Am. Dis. Bone	W. F. Vandiver & Co., Montgomery, Ala.	7.15	3.87	5.08	1.43	1.74	16.78
6825	Helmet Brand 271	F. R. King & Co., Leighton, Ala	1.55	10.10	.60	2.04	1.47	18.83
6826	Alliance Soluble Guano	J. C. Pinkston, Shorter, Ala	6.60	3.64	5.06	1.76	2.01	17.02
6829	Goulding's Bone Compound	F. A. Gulledge, Verbena, Ala	6.20	4.22	4.28	1.29	2.85	16.88
6833	Patapsco Am. Dis. Bone	White & Aubry, Roanoke, Ala	7.10	3.44	2.66	1.78	2.02	17.54
6834	Patapsco H. G. Guano	" " " "	8.65	2.91	1.94	1.28	2.08	16.22
6835	Sea Bird Guano	" " " "	7.20	4.57	1.78	1.68	2.34	18.81
6836	Sea Gull Guano	" " " "	8.35	1.53	2.22	1.34	1.89	15.52
6837	W. O. C. Pure Blood Guano	" " " "	6.75	4.37	1.48	1.74	2.13	18.02
6839	Bear Beef, Blood and Bone	A. B. Vandigrift & Son, B'ham, Ala	7.70	4.78	1.62	1.68	2.67	19.85

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6840	Helms Bone, Blood and Potash No. 3	Helm Bone Fertilizer Co., B'ham, Ala.	0.00	6.09	4.36	2.12	2.78	14.81
6841	Helms Bone, Blood and Potash No. 4	" " " " " "	0.00	4.29	5.26	1.92	2.13	11.81
6843	Mobile Standard....................	E. H. & A. S. Murdock, Coffee Springs.	3.15	5.69	5.16	1.96	2.20	16.53
6845	Dismond Guano....................	Cameron Bros, Notasulga, Ala........	5.70	4.66	5.34	1.90	1.33	17.01
6847	Bear Beef, Blood and Bone.........	T. L. Neighbors & Bros, Goodwater, Ala.	7.65	3.12	1.88	2.10	2.42	19.07
6848	Champion Farmers' Choice........	R. S. Pilley, Georgiana, Ala...........	6.70	3.85	3.90	1.86	2.20	17.96
6851	Complete Fertilizer...............	F. E. Oliver, Hyatt, Alabama..........	0.00	3.90	6.28	1 74	2.76	11.53
6854	Sea Foul Guano.................	W. J. Mullins, Clanton, Ala............	7.50	3.83	1.12	1.88	1.72	18.31
6855	Alabama Fertilizer................	" " " "	7.35	2.65	1.70	1.88	1.78	17.04
6857	Magic Cotton Grower.............	West & McMurry, Roanoke, Ala........	6.90	3.58	1.72	0.90	1.28	14.28

6860	No. 3. Eddystone Solublo Guano...	Montgomery Bros., Lincoln, Ala......	6.30	3.94	.96	2.60	1.83	19.35
6862	Bear, Beef, Blood and Bone.........	J. T. Tabor, Keener, Ala......	7.70	4.47	.88	2.04	1.74	19.62
6867	Scott's Gossypium Guano	Haley Bros., Haleyville, Ala...........	9.05	2.60	2.40	1.92	2.84	19.87
6868	Scott's Blood Formula	" " " "	9.50	3.97	1.48	1.02	1.42	17.75
6869	Bear Guano..........................	" " " "	8.45	4.35	2.70	2.00	2.13	20.53
6870	Florence King Cotton Guano......	" " " "	3.90	4.47	5.08	1.44	2.08	14.48
6872	Howle Bros. Bone Compound.....	Howle Bros., Wetumpka, Ala..........	6.80	3.99	6.86	1.74	1.84	17.50
6874	Ozark Guano No. 2................	Ozark C. S. O. M. and Fert. Co., Ozark.	6.75	5.99	1.26	2.30	1.63	20.81
9876	Blood, Bone and Potash Guano....	E. P. Duncan, Alexander City, Ala	5.60	5.64	4.76	1.84	1.20	17.59
6877	Georgia State Grange.............	" " " " "	5.35	3.40	1.80	1.10	3.48	15.31
6879	New Brand No. 721................	J. H. Henderson, Cross Keys, Ala......	4.65	6.49	9.36	1.82	1.04	14.00
6880	Am. Bone	S. J. Baird, Guin, Ala.................	9.85	7.11	5.24	0.11	.43	17.70
6882	King Cotton Grower...............	J. H. Karter Co., Cullman, Ala.........	4.80	5.80	5.50	.84	1.42	14.37
6883	Bear Guano..........................	" " " " "	11.40	5.88	1.22	.04	0.00	17.28
6885	Soluble Guano......................	T. H. McEntyre, Coffee Springs, Ala. ..	2.25	7.95	7.50	1.21	1.20	14.79
6889	Eagle Am. Bone.....................	L. O. Cox, Boaz, Ala..................	6.65	4.25	2.70	1.72	2.32	18.04
6890	Eagle Guano.........................	L. O. Cox, Boaz, Ala..................	8.10	4.15	2.60	1.90	1.97	19.54
6891	Helmet Brant No. 271...............	J. H. Henderson, Cross Keys, Ala......	1.90	8.02	.98	2.02	1.80	17.38

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

Acid Phosphate with Nitrogen and Potash—Concluded.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6892	Helmet Brand No. 272	J. H. Henderson, Cross Keys, Ala	2.70	7.88	1.02	2.38	2.31	$19.55
6893	" " " 285	" " " "	2.00	8.07	2.48	2.00	5.46	21.13
6894	African Cotton Grower 292	" " " "	2.75	11.09	1.36	2.90	2.92	24.88
6896	Eddystone	M. Noble, Avery, Ala	7.30	4.58	1.72	1.82	1.67	18.55
6898	Beef Blood and Bone	Reeves, Landers & Co, Heflin, Ala	7.20	4.27	1.98	.98	1.62	15.83
6901	Old Hickory Guano	T. B. Williams, Cullman, Ala	7.45	2.86	3.34	1.98	1.75	17 60
6902	Am. Dis. Bone Guano	" " "	8.15	4.70	5.50	.44	2.23	16.31
6903	Complete Fertilizer	J. C. Hensley, " "	5.70	3.82	4.28	1.58	2.38	16.32
6909	Coley & Sandlin's Special Guano	Tallapoosa Oil Co., Alexander City, Ala.	6.90	3.50	.50	1.48	2.04	16.58
6910	Cotton Queen Guano	" " " " " "	5.65	2.72	.78	2.10	2 35	16.60

6911	Standard Guano....................	Tallapoosa Oil Co., Alexander City, Ala.	6.60	3.16	.64	1.52	2.20	16.22
6012	Soluble Guano....................	" " " " " "	6.25	3.36	.54	2.10	2.26	17.75
6913	Waters' Special Guano............	" " " " " "	6.40	3.10	1.00	1.52	2.13	15.89
6225	Cahaba H. G. Blood, Bone & Potash	Birmingham Fertilizer Co., B'ham, Ala.	10.23	3.35	.37	1.87	2.22	21.04
6225	Earle, Terrell & Co's. H. G. Fert'r..	" " " " "	10.23	3.35	.37	1.87	2.22	21.04

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Warter Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
6222	B'ham Acid Phos. & Potash Mixture.. ..	B'ham Fertilizer Co., Birmingham, Ala...	8.80	8.35	0.30	2.18	16.33
6223	B'ham Potash Bone....................	.. ..	7.73	4.92	.56	3.59	16.24
6237	Acid Phosphate & Potash...............	Troy Fertilizer Co., Troy, Ala............	7.00	1.97	3.66	3.39	12.33
6250	Dis. Bone & Potash.....................	.. ..	6.85	1.51	3.64	3.90	12.20
6265	B'ham A. P. & Muriate of Pot. Mixt....	B'ham Fertilizer Co., Birmingham, Ala...	10.40	5.03	.22	2.51	17.94
6266	.. .. and Potash Mixture.......	.. ..	7.60	6.30	.40	2.26	16.16
6267	B'ham Bone Ash.........................	.. ..	9.05	4.27	.38	4.30	17.62
6268	B'ham Potash Bone....................	.. ..	9.40	4.62	.38	4.13	18.15
6273	B'ham Acid Phos. and Potash	.. ..	10.20	3.77	.48	1.41	15.38
6280	Acid Phosphate and Potash............	W. Andrews, LaFayette, Ala.............	8.65	3.32	.58	4.41	16.38

6295	.. ..	W. Andrews, LaFayette, Ala	8.20	3.83	.72	4.89	16.92
6299	Coweta Dis. Bone & Potash	Herren & Oliver, Dadeville, Ala.........	12.45	3.43	.62	1.98	17.86
6300	.. ..	.. ..	6.95	4.98	2.12	3.13	15.06
6301	.. H. G. Dis. Bone & Potash	.. ..	11.25	3.09	.56	2.13	16.47
6302	Coweta Standard......................	.. ..	9.00	3.52	.58	4.28	16.80
6310	Acid Phos. & 4% Potash...............	McGhee, Driver & Co., LaFayette, Ala...	.65	9.00	1.50	4.56	14.21
6311	Dis. Bone & Potash....................	.. ..	7.60	5.33	3.12	1.84	14.77
6312	Bone & Potash	.. ..	10.20	5.44	1.36	1.09	16.73
6315	Stono Acid & Potash	R. A. Russell. & Co., Gaylesville, Ala.....	5.15	9.36	1.14	3.49	18.00
6324	Bone & Potash Phosphate	Wright, Henderson & Co., Elba, Ala......	8.75	2.36	1.54	3.39	14.51
6329	Dixie Acid Phos. & Potash.............	Jno. A. Nicholls, Childersburg, Ala.	6.30	6.98	.52	2.41	15.69
6330	Cahaba Acid Phos. & Potash	.. ..	10.25	4.83	.52	1.26	16.34
6333	B'ham Acid Phos. & Potash Mixture....	Lester & Co., Columbiana, Ala	9.45	4.45	1.00	1.01	14.91
6336	8 and 4	H. M. Beach & Son, Columbia, Ala.......	8.55	1.99	.86	4.87	15.41
6344	Bone & Potash	T. C. Masterson, Aorca, Ala	9.50	6.18	3.02	.24	15.92
6349	Marietta Guano Co's H. G. Dis.Bone....	Reynolds Bros., Jemison, Ala.............	8.30	4.01	1.84	2.21	14.52
6351	Bone & Potash Acid....................	Campbell & Wright, Jr., Roanoke, Ala....	9.60	2.01	3.44	2.17	13.78
6352	Potash Acid...........................	.. ..	8.95	2.37	3.68	2.52	13.84

Analyses Reported by the State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
6382	Ashcraft's Formula....................	W. D. Hamilton, Guin, Ala........... ..	5.05	5.47	4.88	2.03	12.55
6398	Teague's Bone and Potash.............	S. F. Teague, Birmingham, Ala..........	6.35	6.52	3.68	2.12	19.99
6411	Read's Alkaline Bone	T. K. Parish & Bro., Clayton, Ala.........	6.15	4.94	1.66	2.40	13.49
6413	Imperial............................	V. B. Atkins & Co., Selma, Ala...........	11.15	3.49	.76	.72	15.36
6417	Coweta H. G. Dis. Bone and Potash....	Jas. E. Snead, Snead, Ala................	9.35	6.84	.66	2.63	18.82
6418	13 and 4 Dis. Bone and Potash.	" " "	8.15	6.76	3.64	4.42	19.33
6423	Patapsco Acid Phosphate..............	R. W. Allen & Co., LaFayette, Ala.......	9.85	5.64	1.26	1.11	16.60
6427	Phosphate with Potash................	J. R. G. Howell, Dothan, Ala.............	7.00	4.15	1.30	3.76	14.91
6444	Acid Phosphate and Potash............	Troy Fertilizer Co., Troy, Ala...........	9.55	3.52	2.48	5.51	18.58
6446	Dis. Bone and Potash..................	" " " " "	9.40	2.85	2.60	5.98	18.23

6452	Ga Bon Compound	P. J. Ham & Son. Elba, Ala.	7.95	3.09	.56	3.75	14.79
6458	Bone and Potash Acid Phosphate	Hilton, Bentley & Cosby, Brantley, Ala.	11.65	1.17	.78	2.83	15.65
6475	Opelika Phosphate and 2% Potash	J. C. Akin & Son, Notasulga, Ala	6.25	4.91	5.14	2.05	13.21
6480	Patapsco Phosphate	T. K. Brantley & Son, Troy, Ala.	10 50	3.12	1.08	1.91	15.53
6483	" " 1% Potash	J. G. & John Sanders, Dothan, Ala	9.90	3.35	2.00	1.97	15.22
6484	Acid Phosphate with 4% Potash	" " " " "	1.80	7.49	1.26	5.86	15.15
6489	Acid Phosphate and Potash	First Bank of Elba, Elba, Ala	7.90	3.28	2.12	3.43	14.61
6490	B'ham Dis. Bone and Potash	C. H. Butler, Childersburg, Ala	9.30	2.76	1.74	1.08	13.14
6491	Acid Phosphate and Potash.	" " " "	10.20	3.31	2.04	1.66	15.17
6492	B'ham Acid Phos. and Potash	" " " "	11.05	2.37	.68	2.32	15.74
6510	"Guano"	W. A. Sims, Elrath, Ala	1.45	8.76	1.94	1 14	11.35
6512	Potash Acid	A. J. Pittman, Wehodkee, Ala	8.00	4.18	1.02	2.51	14.75
6520	Dis. Bone and Potash	Phillips Bros., Oxford, Ala.	8.05	5.84	.86	3.86	17.75
6525	Tenn. Special Wheat Grower	Ingram & Co., Anniston, Ala	1 45	10.20	1.90	6.03	17.68
6531	S. & Co's H. G. Bone and Potash	Scheussler & Co., Roanoke, Ala	5.05	4.79	5.96	1.97	11.81
6535	Sample No. 1	W. W. Hicks & Co., Dadeville, Ala.	7.85	4.99	1.66	1.77	14.[illegible]
6536	Bear Brand Potash Mixture	Britt & Johnson, Wetumpka, Ala	5.80	5.25	5.60	3.49	14.54
6540	Dis. Bone and Potash	McEntyre, Henderson & Adams, Ozark	9 00	3.47	1.68	4.08	16.55

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Acid Phosphate with Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial value.
6542	Dis. Bone and Potash	McEntyre, Henderson & Adams, Ozark	3.60	5.97	2.18	4.11	$13.68
6559	B'ham Acid Phos and Potash Mixture	Geo. M. Truss, Springville, Ala	10.75	6.28	.32	2.64	19.67
6560	B'ham Acid Phos with Potash	" " "	12.00	3.21	.44	2.35	17.56
6571	Bone and Potash Mixture	M. W. Carlisle & Bro., Roanoke, Ala	5.55	6.04	3.56	1.77	13.36
7572	Ox Potash Mixture	" " "	7.30	4.75	6.00	2.22	14.27
6577	Acid Phos with Potash	Sessions & Mizell, Enterprise, Ala	4.35	5.45	4.50	3 75	13.55
6578	Alkaline Bone with 2% Potash	" " "	6.50	4.80	4.36	3.07	14.37
6581	Bone and Potash	T. A. Howle & Co., Oxford, Ala.	8.95	4.43	.72	2.21	15.59
6607	Phosphate 2% Potash	J. I. Covington, Bertha, Ala	5.80	5.82	1.68	2.19	13.81
6613	"Complete Fertilizer"	Burns & Beaver, Lincoln, Ala	7.80	3.97	4.78	2.19	13.96

6617	Tiger Brand Guano	J. C. Hartselle & Son, Hartselle, Ala	4.85	6.12	4.78	2.48	13.45
6625	Bear Bone and Potash	Bean & McMurray, Hefln, Ala	4.45	7.00	6.90	2.12	13.57
6628	Eddystone Bone and Potash	Elsod & Gibson, Collinsville, Ala	10.15	6.32	1.98	1.56	18.03
6665	Scott's H. G. [and Potash]	Lull & Lacey, Wetumpka. Ala	6.95	5.02	.68	2.22	14.19
6667	Pure Dis. Bone and Potash	.. .. ..	9.80	2.80	.90	1.52	14.22
6683	No. 1	Trawick & Jernigan, Opelika, Ala	8.85	4.84	2.96	2 45	14.54
6684	No. 2	.. .. ..	8.30	3.75	3.30	2.88	14.93
6685	No. 3	.. .. ..	8.70	3.96	3.74	3.52	16.18
6695	Marietta H. G. Acid Phos. and Potash	Coley & Sandlin, Alexander City, Ala	6.20	4.70	1.65	2.31	13.21
6696	Water's H. G. Dis. Bone and Potash	.. .. ..	4.00	4.25	.90	2.23	10.48
6699	Cotton Queen	.. .. ..	6.00	4.30	2.00	2.00	12.30
6705	Cahaba Acid Phos. and Potash Mixture	White & Speigner, Goodwater, Ala	12.75	4.20	.70	1.71	18.66
6713	Dis. Bone and Potash	Ben. Jennings, Seale. Ala	7.95	3.45	1.10	3.34	14.74
6716	Eddystone Bone and Potash	W. H. Bynum, Boaz, Ala	4.40	7.40	5 50	2.13	13.93
6723	"Guano",	J. I. Brewer, Tabor, Ala	9.90	3 40	2.20	1.48	14.78
6728	No. 1	J. E. Smith, Stroud, Ala	4.95	7.39	.76	2.21	14.55
6733	Dis. Bone with Potash	R. F. Gilbert, Porterville, Ala	5.75	6.39	.56	1.56	13.70
6737	Dis. Bone and Potash	Gunter & Ealam, Gantt, Ala	6.50	3.94	3.46	2.73	13.17

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphate with Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
6750	Special Potash Mixture	R. Q. Edmonson & Bro., Eufaula, Ala.	5.00	4.92	4.08	4.12	14.04
6752	No. 10—4's	T. L. Johnson & Co., Gadsden, Ala	6.70	5.13	2.42	3.37	15.20
6763	Opelika Acid Phos. & 2% Potash	Opelika Chemical Co., Opelika, Ala.	6.85	6.06	2.28	2.17	15.09
6764	Potash Acid Phosphate	.. ..	7.75	6.95	1.30	2.02	16.72
6765	Schuessler Bro's. H. G. Bone & Potash	.. ..	7.00	5.25	2.50	2.23	14.48
6766	.. .. XXX	.. ..	8.20	6.18	2.42	1.72	16.10
6767	.. & Co's H. G.	.. ..	7.00	4.40	2.80	2.41	14.11
6788	English Acid Phos, with 2% Potash	Montgomery Fertilizer Co., Mont'gy, Ala.	6.95	6.33	2.42	2.34	15.62
6789	Montgomery Acid Phos. and Potash	.. ..	6.50	5.89	2.46	2.37	14.76
6790	Dis. Bone and Potash	.. ..	7.75	6.95	2.39	1.18	15.88

6504	Alkaline Acid Phos. 4% Potash........	Montgomery Fertilizer Co., Mont'gy, Ala.	5.65	3.78	1.92	4.06	13.49
6816	4% Acid Phosphate....................	G. W. Roberts & Co., Collinsville, Ala...	.90	5.75	.80	4.25	10.90
6831	Potash Acid.....	White & Aubrey, Roanoke, Ala...........	11.90	2.70	1.30	1.64	16.24
6832	Patapsco Bone & Potash......	.. ..	7.00	4.20	1.50	2.67	14.87
6858	B'ham Potash Mixture.................	W. J. Mullins, Clanton, Ala............	8.15	4.86	.64	2.02	16.03
6859	No. 1 Eddystone Bone & Potash........	Montgomery Bros., Lincoln, Ala..........	6.45	5.95	4.70	1.86	14.26
6863	Adair's Formula	Jno. T. Tabor, Keener, Ala...............	6.85	6.31	1.84	2.22	15.38
6878	Howle Bros' Phos. & Potash...........	Howle Bros., Wetumpka, Ala.............	10.05	5.18	2.12	1.16	16.31
6888	Eagle Dis. Bone & Potash	L. O. Cox, Boaz, Ala	5.75	6.50	3.20	1.00	13.25
6900	H. G. Bone & Potash..................	T. B. Williams, Cullman, Ala	8.50	4.66	7.14	1.59	12.75
6906	Tallapoosa Dis Bone and Potash........	Tallapoosa Oil Co., Alex. City, Ala......	7.75	4.85	.70	2.00	14.60
6907	Our Best Fertilizer Bone and Potash....	.. ..	7.60	4.75	0.40	1.68	14.03
6908	Coley & Sandlin's Special Bone & Potash	.. ..	7.85	4.94	.66	1.63	14.42
6222	Cahaba Acid Phos. & Potash Mixture...	B'ham Fertilizer Co., Birmingham, Ala...	8.80	5.35	.30	2.18	16.33
6437	Bone & Potash	R. W. Allen & Co., LaFayette, Ala........	8.55	3.67	2.08	2.80	15.02

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

ACID PHOSPHATE.

Station Number.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	Citrate. Soluble.	Acid Soluble.	Commercial Value.
6206	High Grade Acid........................	Ozark Cotton S. O. M. and Fert. Co. Ozark, Ala.	11.95	3.12	.96	15.07
6220	B'ham High Grade Acid Phosphate....	Birmingham Fertilizer Co., Birmingham, Ala...	12.73	3.79	.20	16.52
6221	Birmingham Standard Grade Phosphate.	" " " " "	11.33	3.62	.23	14.95
6227	H. G. Acid Phospate (Light)	Ozark Cotton S. O. M. and Fert. Co., Ozark, Ala.	12.00	2.79	.44	14.79
6228	H. G. Acid Phosphate (Dark)...........	.. ..	12.30	4.24	1.76	16.54
6233	English Dis. Bone Phosphate...........	Troy Fertilizer Co., Troy, Ala..................	9.70	3.71	5.42	13.41
6234	Troy Acid Phosphate..................	.. ..	9.20	3.44	5.04	12.64
6235	H. G. Acid Phospnate....................	.. ..	9.40	3.26	4.94	12.66
6236	English Acid Phosphate................	.. ..	9.45	2.56	5.24	12.01
6252	Acid Phosphate......	P. R. Tunstall, Mobile, Ala..	11.60	6.10	1.20	12.20

6253	Acid Phosphate	T. Y Connor, Tuskegee	11.30	5.90	1.00	17.20
6262	B'ham H. G. Acid Phosphate	Birmingham Fertilizer Co., Birmingham, Ala.	13.20	4.61	.34	17.81
6263	.. ..	.. ..	12.55	4.07	.48	16.62
6264	.. ..	.. ..	12.05	2.80	.10	14.85
6274	Acid	G. W. McKiny, Five Points, Ala	6.00	5.57	1.68	11.57
6276	Acid Phosphate	W. W. Mizell, Grimes, Ala	13.00	3.13	.22	16.13
6277	Phosphate	W. L. Patterson, Oswichee, Ala	5.25	3.77	1.78	10.02
6285	Acid Phosphate	W. J. Hulto, Abbeville, Ala	8.15	5.15	.90	13.30
6290	Oil Mill Phosphate	Dadeville Oil Mill, Dadeville, Ala	11.35	3.67	.48	15.02
6294	H. G. Acid Phoshpate	Troy Fertilizer Co., Troy, Ala	10.15	3.58	.52	13.73
6296	Acid	S. M. Day, Five Points, Ala	11.20	4.98	.42	16.18
6307	H. G. Acid Phosphate	V. M. Harris, Kent, Ala	10.15	7.46	1.64	17.61
6316	Stono Dis. Bone	R. A. Rsssell & Co, Gaylesville, Ala	4.25	10.00	1.00	14.25
6319	Wando	.. ..	10.70	4.18	.72	14.88
6320	Acid Phosphate	D. H. Lewis, Gordon, Ala	1.00	8.95	2.20	9.95
6321	Diamond	O. & C. P. Dumas, Arlington, Ala	12.30	3.22	.08	15.52
6322	Georgia State Grange Acid Phosphate	Wright, Henderson & Co., Elba, Ala	10.00	3.06	1.44	13.06
6323	Troy H. G. Acid	.. ..	11.20	1.96	4.74	13.16

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Acid Phosphates—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6328	Montgomery Phosphate	Jno. A. Nicholls, Childersburg, Ala	11.50	4.32	.88	15.82
6332	P. & H. Royal Acid Phosphate	Sanders & Son, Columbia, Ala	11.50	3.35	1.10	14.85
6335	Acid Phosphate	H. M. Beach & Son, Columbia, Ala	13.00	2.53	.52	15.53
6343	Ox H. G. Dis. Bone	T. C. Masterson, Aorca, Ala	11.50	4.26	1.94	15.76
6346	Scott's H. G. Acid	C. A. Steifelmeyer, Hanceville, Ala	10.80	3.77	1.18	14.57
6358	Dis. Bone	Graves & Burdin, Deposit, Ala	8.20	2.82	7.38	11.02
6366	B'ham H. G. Phosphate	S. A. Stewart, Hartselle, Ala	11.50	2.79	.66	14.29
6372	Read's Matchless Acid		9.25	5.10	2.00	14.35
6376	Cahaba H. G. Phosphate	S. F. Alston, Tuscaloosa, Ala	11.40	4.75	1.60	16.15
6381	Acid Phosphate	W. D. Hamilton, Guin, Ala	8.00	5.09	5.56	13.09

6384	Scott's H. G. Acid Phosphate	C. A. Steifelmeyer, Cullman, Ala	14.00	2.34	.36	16.34
6386	B'ham Acid Phosphate	" " " "	9.90	3.74	.76	13.64
6388	Atlas Acid Phosphate	" " " "	14.40	2 98	1.22	17.38
6392	Ga. State Standard Acid Phosphate	Law & Davis, Lincoln, Ala	3.55	9.79	2.26	13.54
6393	Scott's H. G. Phosphate	" " " "	9.10	6.24	2.16	15.34
6397	Teague's Acid Phosphate	S. F. Teague, Birmingham, Ala	9.30	6.14	3.16	15.44
6401	Scott's H. G. Acid	T. H. & A. B. Stephens, Seaborn, Ala	10.35	5.94	1.66	16.29
6404	B'ham H. G. Acid Phosphate	F. Ogden & Son, Sulligent, Ala	10.15	4.15	.70	14.30
6407	Ox H. G. Dis. Bone	Porter & Foster, Town Creek, Ala	13.65	3.82	1.48	17.47
6409	Ala. Acid Phosphate	J. B. Gray & W. W. Gulledge, Ohatchie, Ala	7.95	4.85	5.00	12.80
6426	H. G. Acid Phosphate	J. R. G. Howell, Dothan, Ala	5.05	8.89	1.76	13.94
6430	Dis. Bone Acid	Weathers, Swann & Co., Roanoke, Ala	8.10	5.29	.56	13.39
6433	Tuscaloosa Acid Phosphate	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala	13.95	3.98	.62	17.88
6435	H. G. Acid Phosphate	Hughes Bros., Florala, Ala	12.75	5.56	1.44	18.31
6440	Troy Acid Phosphate	Troy Fertilizer Co., Troy, Ala	9.85	4.50	2.50	14.35
6441	H. G. Acid Phosphate	" " " "	9.25	4.48	1.72	13.73
6442	English Acid Phosphate	" " " "	9.90	3.71	3.60	13.61
6443	English Dis. Bone Phosphate	" " " "	9.60	3.93	2.72	13.53

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Acid Phosphates—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6450	Excelsior Acid Phosphate	P. J. Ham & Son, Elba, Ala	13.40	3.47	.38	16.87
6451	Pomona " "	" " " " "	1.75	3.47	.18	16.22
6457	Ga. State Grange Acid Phosphate	Hilton, Bently & Cosby, Brantley, Ala	10.10	4.05	1.30	14.15
6465	H. G. Acid Phosphate	J. T. Ramage, Brundidge, Ala	13.55	3.16	2.54	16.71
6466	" " "	" " " "	11.95	6.08	1.98	18.03
6467	" " "	" " " "	9.54	7.17	1.88	16 62
6471	Goulding's H G. Acid Phosphate	W. F. McKenzie, Greenville, Ala	14.85	3.42	.88	18.27
6474	J. C. Akin & Son's No. Acid Phosphate	J. C. Akin & Son, Notasulga, Ala	10.35	4.41	4.04	14.76
6477	H. G. Acid Phosphate	First Bank of Elba, Elba, Ala	12.50	2.67	3.58	15.17
6486	" " "	W. E. Townsend, Elrath, Ala	.95	9.82	1.48	10.77

6494	H. G. Acid Phosphate	Burks & Coston, Brantley, Ala	8.55	4.51	4.84	13.06
6496	H. G. Dis. Bone	M. F. Patterson, Falkville, Ala	12.50	3.50	3.60	16.00
6501	Acid Phosphate	McMillan & Harrison, Mobile, Ala	14.20	3.65	0.20	17.85
6504	H. G. Acid Phosphate	W. S. Crass, Pelham, Ala	11.53	3.21	1.56	14.76
6506	″ ″ ″	Troy Fertilizer Co., Troy, Ala	15.30	1.76	1.94	17.06
6507	″ ″ ″	G. A. Sanders, Luverne, Ala	15.25	2.34	3.26	17.59
6511	″ English Acid Phosphate	A. J. Pittman, Wehodkee, Ala	10.45	5.29	4.76	15.74
6515	H. G. Dis. Bone	W. A. Gage & Co., Town Creek, Ala	12.25	4.42	2.08	16.67
6519	Dis. Bone	Phillips Bros., Oxford, Ala	6.95	8.30	1.00	15.25
6523	Scott's H. G. Acid Phosphate	Ingram & Co., Anniston, Ala	12.10	4 61	1.04	16.17
6526	Eddystone Dis. Bone	J. Markentepe, Cullman, Ala	10.75	5.89	3.66	16.64
6529	H. G. Acid Phosphate	S. N. Power, Elba, Ala	13.00	4.07	1.58	17.07
6530	S. & Co's H. G. English Acid Phosphate	Schuessler & Co., Roanoke, Ala	9.45	4.91	5.74	14.36
6537	Pure H. G. Acid Phosphate	Britt & Johnson, Wetumpka, Ala	11.80	3.62	.58	15.42
6539	H. G. Acid Phosphate	McEntyre, Henderson & Adams, Ozark, Ala	13.00	3.81	3.84	16.81
6546	″ ″ ″	B. Bullard, Elba, Ala	9.35	7.27	.48	16.62
6549	Imperial Dis. Bone	George Kroell, Montevallo, Ala	11.35	3.88	.82	15.23
6551	H. G. Acid Phosphate	H. R. & H., Brantley, Ala	13.35	5.23	3.32	18.58

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

Acid Phosphates—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial value.
6558	B'ham H. G. Acid Phosphate	Geo. M. Truss & Co.. Springville, Ala	13.95	5.10	.20	$19 05
6562	Acid Phosphate	J. O. Hodges, Ashville, Ala	9.70	6.00	2.50	15.70
6564	Bear Dis. Bone	A. P. Howison, Randolph, Ala	13.00	5.76	2.84	18.76
6569	H. G. English Acid	M. W. Carlyle & Bro., Roanoke, Ala	6 90	6.15	6.80	13 05
6576	Matchless Acid Phosphate	Sessions & Mizell, Enterprise, Ala	7.90	4.19	3.76	12.09
6580	Birmingham Acid	T. A. Howle & Co., Oxford, Ala	6.75	7.08	.92	13.83
6585	Acid Phosphate	F. T. & J. C. Butler, Paint Rock, Ala	7.95	5.16	5.84	13.11
6589	Imperial Acid	T. G. Land, Cullman, Ala	12.20	3.00	1.30	15.20
6589	Stern's H. G. Acid Phosphate	Chapman & Co., Geneva, Ala	12.70	6.10	1.70	18.80
6592	No. 1 Wet Phosphate	J. S. Collins, Geneva, Ala	3.50	6.99	4.56	10.49

6593	No. 2 Wet Phosphate	J. S. Collins, Geneva, Ala	12.15	6.80	.90	18.95
6595	Crescent City Acid Phosphate	Crutcher & Ward, Cuba, Ala	12 60	4.09	2.76	16.60
6596	I. X. L. Acid Phosphate	.. .. ..	12.80	5.51	2.04	18.31
6298	Read Phosphate	M. P. White, Attalla, Ala	9.00	5.68	.92	14.68
6600	Scott's H. G. Acid Phosphate	W. J. Silbert, Gadsden, Ala	12.35	3.82	.98	16.17
6602	I. X. L. Phosphate	Chas. Ivey, Evergreen, Ala	10.40	4.46	5.24	14.86
6604	H. G. Acid Phosphate	Zena Sheperd, Georgiana, Ala	11.10	5.22	2.28	16.32
6606	.. .. ..	J. I. Covington, Bertha, Ala	8.70	5.82	.98	14.52
6612	Acid Phosphate	J. W. Grace. Elkmont, Ala	8.50	4.54	5.86	13.04
6614	Tenn. Valley Acid Phosphate	J. C. Hartselle & Son, Hartselle, Ala	6.65	4.26	6.44	10.91
6615	Florence Acid	.. .. ..	8.35	5.45	6.40	13.80
6618	.. .. Phosphate,	W. A. Shaw, Winfield, Ala	8.45	4.93	4.02	13.38
6620	Tuscaloosa Acid Phosphate	C. R. Maxwell, Northport, Ala	13.65	4.58	1.62	18.23
6623	Bear H. G. Dis. Bone	Bean & Murray, Heflin, Ala	6.95	8.13	1.42	15.18
6627	Sunny South Acid Phosphate	Elrod & Gibson, Collinsville, Ala	10.10	5.42	3.08	15.52
6629	Ox Acid Phosphate	Eranzen & Olson, Thorsby, Ala	9.60	6.49	2.86	16.00
6630	Ox H. G. Dis Bone	.. .. ..	9.45	5.33	2.12	14.78
6632	Cahaba Acid Phosphate	T. U. Crumpton, Maplesville, Ala	9.80	3.01	.54	13.71

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ACID PHOSPHATES.

Station Number.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Commercial Value.
6638	Acid	Asa Griffith, Hanceville, Ala	12.20	4.30	3.20	16.50
6639	Birmingham Acid	.. ..	10.30	3.30	1.05	13.60
6644	XXX Dis. Bone	G. W. Wise, Madison, Ala	7.35	5.65	3.25	13.00
6645	Sunny South	.. ..	9.25	5.35	3.55	14.60
6646	Meridian Southern Acid	G. H. Amos, Duck Spring, Ala	11.65	4.15	2 30	15.80
6652	Georgia State Grange Acid	F. D. Bynum, Bynum, Ala	3.75	9.70	1.45	13.45
6655	A. G. Winkler's H. G. Acid Phosphate	A. G. Winkler, Greenville, Ala	17.20	1.75	.25	18.95
6657	Talladega Acid Phosphate	John H. Wilson, Jenifer, Ala	13.30	3.20	.70	16.50
6660	Ox H. G. Dis. Bone	Hertzell & Anderson, Madison, Ala	11.10	7.90	.40	19.00
6661	Cahaba Acid Phosphate	John H. Wilson, Jenifer, Ala	13.20	3.85	.40	17.00

6663	English Acid Phosphate	W. W. Burnett, Geneva, Ala	12.00	4.45	2.00	16 45
6666	Port Royal Dis Bone	Lull & Lacey, Wetumpka, Ala	12.35	2.15	.70	14.50
6670	Acid Phosphate	Stewart & Hazelwood, Eden, Ala	5.40	5.77	.48	11.17
6671	Dis Bone	.. ..	8.35	3.34	.36	11.79
6673	Georgia State Standard	D. D. Hughes, Lebanon, Ala	2 30	10.73	2.02	13.03
6675	Prolific Acid Phosphate	D. D. EcGowen, Cuba, Ala	14.50	4.40	.80	18.90
6476	Acid Phosphate	Cash Supply Co., Mountafn Creek, Ala	11.60	2.07	.08	13 67
6681	No. 1. Dis. Bone	Trawick & Jernigan, Opelika, Ala	9.50	4.86	3.34	14.36
6682	No. 2 Dis. Bone	.. ..	10.00	4.25	3.40	14.75
6690	I. X. L. Phosphate	W. D. Brown, Graville, Ala	11.85	4.05	2.50	15.90
6691	Goulding's H. G. Phosphate	.. ..	12.50	3.60	1.45	16.10
6692	Alabama Pure H. G. Phosphate	.. ..	11.10	4.65	1.95	15.75
6701	Alabama Phosphate	Green & Mullins, Active, Ala	10.55	5.20	2.55	15.75
6704	Tallapoosa Dis. Bone	White & Spigner, Goodwater, Ala	10.40	1.15	4.55	11.55
6711	Phosphate Excelsior Bone Compound	W. C. Perry, Seale, Ala	6.60	6.40	.70	13.00
6716	Eddystone Dis. Bone	W. H. Bynum, Boaz, Ala	8 25	7.85	2.25	16.10
6718	Alabama Acid Phosphate	J. H. Myers, Langston, Ala	14.05	2.80	.40	16.85
6721	No. 1 Acid Phosphate	J. C. Alford, Childersburg, Ala	9.55	8.20	1.05	17.75

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

ACID PHOSPHATES—Concluded.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Commercial value.
6722	No. 2 Acid Phosphate	J. C. Alford, Childersburg, Ala	12.15	6.15	.95	$18.30
6729	Magnet Acid	Davis, Marshall & Co., Mobile, Ala	9.55	6.92	2 98	16.47
6732	Piedmont Acid Phosphate	R. F. Gilbert, Porterville, Ala	7.85	5.71	.54	13.66
6736	H. G. Acid Phosphate	Gunter & Elem, Gantt, Ala	13.45	3.65	2.80	17.10
6742	Cow Acid	McEntire Bros., Cullman, Ala	5.90	8.08	4.62	13.98
6743	Bull Acid	.. ..	7.10	4.87	7.88	11.97
6746	Acid Phosphate	S. W. Henry, Springville, Ala	8.15	5.42	3.98	13.57
6749	XXX Dis. Bone	R. Q. Edmonson & Bros., Eufaula, Ala	6.85	7.12	2.28	13.97
6755	Acid Phosphate	T. L. Johnson & Co., Gadsden, Ala	9.65	5.48	1.32	15.13
6756	J. C. Adkin & Son's No. 1 Acid Phosphate	Opelika Chemical Co., Opelika, Ala	10.80	5.61	2.54	16.41

6757	Griel Bros. English Acid Phosphate	Opelika Chemical Co., Opelika, Ala...........	10.70	6.59	1.86	17.29
6758	Standard Acid Phosphate	.. ..	11.30	6.00	2.00	17.30
6759	H. G. English Acid Phosphate	.. ..	10.90	6.48	2.02	17.38
6760	S. & Co's H. G. English Acid	.. ..	10.75	6.39	2.46	17.14
6761	H. & T. H. G. Acid Phosphate........	.. ..	10.65	6.63	2.52	17.28
6780	H. G. Acid Phosphate	Montgomery Fertilizer Co., Montgomery, Ala..	11.05	5.69	2.26	16.74
6781	Vandiver's XX Acid Phosphate	.. ..	10.25	6.13	2.82	16.38
6782	S. & O. H. G. Acid Phosphate..........	.. ..	11.05	5.95	2.80	17.00
6783	Thompson's English Acid Phosphate	.. ..	10.95	6.26	1.84	17.21
6784	Star Brand Acid Phosphate.............	.. ..	10.85	5.76	2.54	16.61
6785	Early Bird H. G. Acid Phosphate......	.. ..	10.40	7.25	1.80	17.65
6786	S. & K. English Acid Phosphate........	.. ..	11.05	6.81	1.84	17.86
6787	W. L. & Co's H. G. Acid Phosphate......	.. ..	11.20	6.18	2.12	17.38
6803	H. G. English Acid Phosphate	.. ..	11.65	4.73	2.42	16.38
6808	H. G. Acid Phosphate	W. B. Willhite, Hartselle, Ala...............	8.80	6.28	2.52	15.08
6811	Dixie Acid Phosphate	C. W. Bell & Son, Lineville, Ala...............	10.90	4.87	4.58	15.77
6812	H. G. Dis. Bone	.. ..	5.70	7.45	5.80	13.15
6815	H. G. Acid Phosphate..................	G. W. Roberts & Co., Collinsville, Ala.........	4.80	7.49	1.86	12.29

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphate.

Station Number.	Name of Sample.	By Whom Sent	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6821	Marietta H. G. Acid	Reeves, Sanders & Co, Heflin, Ala	11.70	5.14	.26	16.84
6824	Sunny South Acid Phosphate...........	W. B. Vaughn, Elkmomit, Ala	9.00	6.09	6 56	15.09
6827	H. G. Acid Phosphate................	F. A. Gulledge, Verbena, Ala..................	13.95	5.13	0.42	19.08
6828	Ox Dis. Bone...........................	.. ..	10.75	5.17	2.68	15 92
6830	Coweta H. G. Acid	White & Aubrey, Roanoke, Ala...............	6.90	4.69	3.26	11.59
6838	Sunny South Phosphate	A. B. Vandigraft & Son, Birmingham, Ala....	10.50	5.12	2.98	15.62
6842	English Acid Phosphate...............	E. H. & A. S. Murdock, Coffee Springs, Ala....	10.70	6.32	1.38	17.02
6444	Standard Acid Phosphate....	Cameron Bros., Notasulga, Ala................	9.25	5.79	3.46	15.04
6846	Bear H. G. Dis. Bone	T. L. Neighbors & Bros, Goodwater, Ala........	10.50	4.78	3.02	15.28
6852	Birmingham H. G. Acid Phosphate.....	W. J. Mullins, Clanton, Ala..................	11.40	4.35	.75	15.75

6856	Marietta H. G. Dis. Bone Acid	West & McMurry, Roanoke, Ala	6.65	4.77	.78	11.42
6858	Eddystone Dis. Bone	Montgomery Bros., Lincoln, Ala	10.45	4.79	2.86	15.24
6861	Adair's H. G Dis. Bone	John T. Tabor, Keener, Ala	10.25	2.10	3.80	12.35
6864	Scott's Acid	Haley Bros., Haleyville, Ala	12.35	4.04	1.06	16.39
6865	Florence Acid	.. ..	8.85	5.60	4.80	14.45
6866	Bear Acid	.. ..	10.15	5.74	3.16	15.89
6871	Howle Bros. Acid Phosphate	Howle Bros., Wetumpka, Ala	11.35	6.48	.52	17.83
6873	Phosphate No. 3	Ozark C. S Oil Mill and Fert. Co., Ozark, Ala.	8.20	7.15	1.40	15.35
6875	Black Diamond Acid	E. P. Duncan, Alexander City, Ala	7.30	7.06	2.54	14.36
6881	Tiger Acid	The J, H. Karter Co., Cullman, Ala	7.90	6.10	6.20	14.00
6884	English Acid Phosphate	T. H. NcEntyre, Coffee Springs, Ala	9.00	5.77	3.08	14.77
6886	Eagle Acid Phosphate	L. O. Cox, Boaz, Ala	5.45	8.01	3.84	13.46
6887	Eagle Dis. Bones.	.. ..	6.00	8.14	2.16	14.14
6895	Sunny South Acid	M. Noble, Avery, Ala	9 35	4.54	3.46	13.89
6397	Phosphate	Rintz Turner, Thomasville, Ala	9.65	4.03	1.22	13.68
6899	Acid Phosphate	T. B. Williams, Cullman, Ala	9.70	5.62	3.48	15.32
6904	Eagle Acid Phosphate	S. J. Baird, Guin, Ala	10 55	5.94	5.06	16.49
6905	Tallapoosa H. G. Acid Phosphate	Tallapoosa Oil Co, Alexander City, Ala	9.90	5.35	.70	15.25

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphate.

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6220	Cahaba H. G. Acid Phosphate	Birmingham Fertilizer Co., Birmingham, Ala.	12.73	3.79	.20	16.52
6220	Earle Terrell & Co's. H. G. Acid Phos.	.. ..	12.73	3.79	.20	16.52
6221	Cahaba Standard Grade Phosphate	.. ..	11 33	3.62	.23	14.95
6220	Prolific Acid Phosphate..	.. ..	12.73	3.79	.20	16.52

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Miscellaneous Fertilizers and Fertilizing Materials.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Nitrogen.	Potash.
6214	Cotton Seed Meal	Tucker & Willingham, LaFayette, Ala	....	....	2.79	7.14	2.06
6215	.. .. .. Off	.. ..	....	....	2.77	6.18	1.62
6216	.. .. ..	Mutual Cotton Oil Co., Columbus, Ga	....	....	......	7.20	....
6217	.. .. ..	Dothan .. .. .. Dothan, Ala	....	....	2.80	7.32	1.89
6218	.. .. .. Off	.. ..	....	....	2.88	6.42	1.87
6219	.. .. ..	LaFayette Cotton Oil Co., LaFayette, Ala.	....	....	2.86	6.42	2.01
6255	.. .. .. No. 1	Dadeville Oil Mill, Dadeville, Ala	....	....	2.67	7.11	1.95
6256	.. .. .. No. 2 Off	.. ..	....	....	2.61	6.86	1.99
6260	.. .. ..	Walter Andrews, LaFayette, ..	....	....	2.65	6.84	2.04
6261	.. .. .. Off	.. ..	....	....	2.90	6.96	1.94

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

MISCELLANEOUS FERTILIZERS AND FERTILIZING MATERIALS.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.
			Citrate Soluble.	Acid Soluble.	Total.		
6283	Cotton Seed Meal No. 2	Greenville Cotton Oil Mill, Greenville, Ala	......	.....	2.93	6.96	2.08
6284	" " " " 3 Off..........	" " " " " "	......	....	3.10	6 42	1.90
6286	" " " "A"	D. E. Huger & Co., Mobile, Ala..........	....	....	3.64	6.54	1.92
6287	" " " "Z"	" " " "	....	.....	3.48	6.54	1.79
6308	" " "	J. T. Scott, Buffalo, Ala	....	....	3.10	6.54	1.81
6359	" " "	Jefferson Cotton Oil Mill, B'ham, Ala. ..	......	.....	2.42	7.32	1.88
6360	" " "	Sylacauga Oil Mill, Sylacauga, "	......	....	2.87	7.08	1.72
6361	" " "	Richmond Cotton Oil Mill, Sheffield, Ala.	......	......	2 67	6.66	1.72
6362	" " "	B. Schmidt & Son, Lincoln, Ala..........	....	.....	2 97	7.08	1.58
6363	" " "	T. G. Connor, Tuskegee, "	......	.....	3.02	6.90	1.62

6364	Cotton Seed Meal	C. C. Woodard, Fruitdale, Ala	......	......	3.75	7.08	1.76
6365	" " "	Evergreen M'f'g Co., Evergreen, Ala	......	......	2.90	6.84	1.64
6414	" " "	Jackson & Chapman, Grand Bay, "	......	......	3.56	6.84	2.15
6488	" " " Off	C. C. Woodard, Fruitdale, "	......	......	3.82	7.02	2.32
6489	" " " Bright	" " "	......	......	3.25	6.96	1.91
6662	" " "	Leder Oil Mills, Demopolis, "	......	......	3.18	6.84	1.84
7048	" " "	" " " " "	......	......	3.80	6.96	1.60
6202	Bat Manure & Cave Earth	L. H. Scruggs, Huntsville, "	......	......	9.35	2.84	1.51
6203	Coarse Horse Manure	J. F. Duggar, Auburn, "	......	......	.52	1.27	1.80
6203	Fine Horse Manure	" " "	......	......	.67	.87	1.00
6205	Fertilizer No. 7	Helm Milling Co., Birmingham, "	......	......	......	....	2.62
6207	Muriate of Potash	Ozark C. S. Oil Mill & Fert. Co., Ozark	......	......	......	......	56.15
6213	Tankage	B'ham Hide & Tallow Co., B'ham, Ala	......	......	10.13	6.04	......
6226	Fertilizer No. 1748	Mississippi Station, Starksville, Ala	......	......	......	......	2.75
6251	German Kainit	Troy Fertilizer Co., Troy, Ala	......	......	......	......	13.40
6258	Kainit	Trawick & Jernigan, Opelika, Ala	......	......	......	......	14.12
6281	Ashes	C. C. Woodard, Fruitdale, "	......	......	1.85	......	1.28
6288	Soil	F. Y. Anderson, Birmingham, "	......	......	.20	.07	.05

Analyses Reported by the State Chemist from July 1, 1900 to July 1, 1901.

Miscellaneous Fertilizers and Fertilizing Materials—Concluded.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.
			Citrate Soluble.	Acid Soluble.	Total.		
6289	Soil	Prattville Mercantile Co., Prattville, Ala.	......	......	.26	.03	.06
6309	Muriate	C. C. Woodard, Fruitdale, Ala.	......	......	......	......	51 90
6439	Phosphate Rock	J. C. Adams, Montgomery, Ala.	......	......	.45	......	......
6464	Cotton Seed Meal Ash	Huntsville Nursery Co., Huntsville, Ala.	15.68	.60	16.28	......	1.20
6500	German Kainit	McMillan & Harrison, Mobile, Ala.	......	......	......	......	12.64
6566	No. 1 Phos- Rock	J. A. Alexander, Prattville, Ala.	......	......	1.45	......	......
6567	No. 2 " "	" " " "	......	......	.40	......	......
6568	No. 3 " "	" " " "	......	......	.45	......	......
6586	Kainit	F. T. & J. C. Butler, Paint Rock, Ala.	......	......	......	......	10.74
6636	Marl	J. F. Jones, Evergreen, Ala.	......	......	.23	......	......

6659	Kainit	J. H. Wilson, Jenifer, Ala.					13.14
6731	German Kainit	Davis, Marshall & Co., Mobile, Ala.					14.14
6849	Phosphate Rock	H. S. Houghton, Blount Springs, Ala.			.32		
6850	.. ..	Prim & Kimbel, Jackson, Ala.			.22		
7049	.. ..	C. F. Austin, Auburn, Ala.			.72		
7050	.. ..	A. U. Grouby, Abbeville, Ala.			.34		
6211	Pure Tobacco Stems	Helm Milling Co., Birmingham, Ala.					9.13
6212	Mixture Tobacco Stems and Filler	.. ..					2.48

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

MISCELLANEOUS SAMPLES FROM THE COMMISSIONER.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Nitrogen.	Potash.	Commercial value.
6914	No. 806.	Commissioner of Agriculture, Montgomery, Ala.	12.70	3.79	.76	.....	2.40	$18.89
6915	" 807	" " " " "	7.40	3.22	3.78	.....	2.59	13.21
6916	" 808	" " " " "	11.95	5.59	.66	.....	.....	17.54
6917	" 809	" " " " "	7.95	5.78	4.32	1.28	2.29	18.60
6918	" 810	" " " " "	11.95	3.10	1.06	.....	2.69	17.83
6919	" 811	" " " " "	6.35	3.15	2.50	1.60	2.59	16.57
6920	" 812	" " " " "	11.85	5.07	.88	.....	2.58	19.50
6921	" 813	" " " " "	11.55	5.10	.80	.....	2.40	19.05
6922	" 814	" " " " "	7.35	2.66	3.54	1.60	2.10	16.55
6923	" 815	" " " " "	11.20	6.20	.30	.....	2.05	19.45

6924	No. 816	..	..	..	..	..	7.30	3.78	.12	1.94	2.20	18.71
6925	.. 817	..	..	..	..	..	6.60	3.67	4.08	1.82	2.29	17.66
6926	.. 818	..	..	..	..	..	6.40	4.20	7.70	1.98	2.13	18.27
6027	.. 819	..	..	..	..	..	13.05	3.39	.96	......	....	16.44
6928	.. 820	..	..	..	..	..	6.50	4.54	2.46	1.00	2.45	16.29
6929	.. 821	..	..	..	..	..	7.70	6.21	5.34	......	......	13 91
6930	.. 822	..	..	..	..	..	7.60	3.53	2.62	1.82	1.80	18.03
6931	.. 823	..	..	..	..	..	7.70	5.60	1.90	1.64	1.60	18.49
6932	.. 824	..	..	..	..	..	9.35	3.55	6.20	......	1.41	14.31
6933	.. 825	..	..	..	..	..	6.35	3.04	5.96	2.14	1.67	17.05
6934	.. 826	..	..	..	..	..	7.75	2.94	1.26	......	2.40	13.09
6935	.. 827	..	..	..	..	..	10.75	2.59	3.36	1.42	2.49	19.81
6936	.. 828	..	..	..	..	..	8.70	2.56	.94	1.96	2.31	19.06
6937	.. 829	..	..	..	..	..	8.70	2.23	1.52	1.30	2.67	17.24
6938	.. 830	..	..	..	..	..	8.35	5.44	.96	......	......	13.79
6939	.. 831	..	..	..	..	..	10.25	4.08	.72	.28	2.38	19.49
6940	.. 832	..	..	..	..	..	7.00	3.34	3.26	I.72	2.40	17.56
6941	.. 833	..	..	..	..	..	8.40	4.23	1.42	1.72	2.05	19.50

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Miscellaneous Samples from the Commissioner—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6942	No. 834	Commissioner of Agriculture, Montgomery, Ala	8.70	6.68	2.12	.18	2.57	$18.45
6943	.. 835	.. ..	9.55	3.19	1.66	1.88	2.56	20.56
6944	.. 836	.. ..	6.95	5.32	8.53	.50	1.32	14.99
6945	.. 837	.. ..	7.95	6 81	7.84	.....	......	14.76
6946	.. 838	.. ..	7.95	5.50	2.10	1.72	1.43	19.70
6947	.. 839	.. ..	11.30	6.05	2.20	......	......	17.35
6948	.. 840	.. ..	8.40	4.58	3.82	.98	1.66	17.38
6949	.. 841	.. ..	4.55	4.40	1.00	.....	......	13.95
6950	.. 842	.. ..	8.60	3.48	2.12	1.88	2.10	19.44
6951	.. 843	.. ..	......	.....	......	.....	13.60	13.60

6952	.. 844	..	..	..	..	9.15	3.61	2.34	1.06	2.24	17.97
6953	.. 845	..	..	..	..	12.60	3.50	2.40	......	......	16.10
6954	.. 846	..	..	..	..	6.85	4.15	3.50	1.96	1.54	18.03
6955	.. 847	..	..	..	..	11.70	2.93	1.72	....	......	14.63
6956	.. 848	..	..	..	..	9.00	1.81	1.34	1.76	1.39	17.13
6957	.. 849	..	..	..	..	7.85	3.43	.82	.12	2.22	13.84
6958	.. 850	..	..	..	..	7.20	4.49	4.06	1.88	2.41	19.36
6959	.. 851	..	..	..	..	7.45	3.80	6.65	1.36	1.80	16.86
6960	.. 852	..	..	..	..	6.70	2.98	6.32	1.88	1.49	16.43
6961	.. 853	..	..	..	..	11.65	5.56	1.84	......	.....	17.21
6962	.. 854	..	..	..	..	6.25	4.57	2.28	1.92	2.59	18.79
6963	.. 855	..	..	..	..	7.20	3.92	.78	2.38	2.44	20.22
6964	.. 856	..	..	..	..	5.45	6.62	2.28	......	......	12.07
6965	.. 857	..	..	..	..	10.40	4.44	3.66	......	......	14.84
6966	.. 858	..	..	..	..	7.50	4.40	5.40	2.18	1.43	19.43
6967	.. 859	..	..	..	..	6.65	3.12	2.68	1.70	2.39	16.92
6968	.. 860	..	..	..	..	5.05	10.42	1.68	......	......	15.47
6969	.. 861	..	..	..	..	5.50	4.89	6.66	1.88	2.63	18 28

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Miscellaneous Samples from the Commissioner.

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6970	No. 862	Commissioner of Agriculture, Montgomery, Ala.	9.80	7.37	4.38	....	......	17.17
6971	·· 863	·· ·· ·· ·· ··	11.20	5.06	.84	.....	..	16.26
6972	·· 864	·· ·· ·· ·· ··	8.65	4.65	2.30	2.04	3.83	20.84
6973	·· 865	·· ·· ·· ·· ··	......	......	......	......	12.28	12.28
6974	·· 866	·· ·· ·· ·· ··	12.40	6.54	2.26	......	....	18.94
6975	·· 867	·· ·· ·· ·· ··	4.90	6.06	6.94	1.86	2.31	18.48
6976	·· 868	·· ·· ·· ·· ··	12.65	3.93	.92	....	.52	17.10
6977	·· 869	·· ·· ·· ·· ··	13.15	3.87	1.08	......	....	17.02
6978	·· 870	·· ·· ·· ·· ··	13.00	5.20	1.00	.....	......	18.20
6979	·· 871	·· ·· ·· ·· ··	8.10	4.85	3.20	.82	2.28	17.53

6980	No. 872	..	..	..	..	..	1.65	12.79	2.06	.....	......	14.44
6981	.. 873	..	..	..	..	..	7.45	8.02	1.38	....	......	15.47
6982	.. 874	..	..	..	..	..	6.80	3.25	2.40	1.72	2.75	17.62
6983	.. 875	..	..	..	..	..	7.25	3.96	2.94	2.30	2.14	19.79
6984	.. 876	..	..	..	..	..	6.10	3.49	2.66	1.84	1.91	16.65
6985	.. 877	..	..	..	..	..	5.44	12.34	.62	......	..	17.78
6986	.. 878	..	..	..	..	..	7.75	3.47	5.38	1.72	1.64	17.7[illegible]
6987	.. 879	..	..	..	..	..	8.45	5.11	4.84	1.04	1.31	17.7[illegible]
6988	.. 880	..	..	..	..	..	9.10	5.59	3.56	.68	1.67	18.25
6989	.. 881	..	..	..	..	..	5.12	10.19	.54	.02	1.42	16.79
6990	.. 882	..	..	..	..	..	10.85	3.28	.52	.04	1.19	15.43
6991	.. 883	..	..	..	..	..	5.25	3.71	.44	1.20	3.00	15.32
6992	.. 884	..	..	..	..	..	6.90	2.90	.95	......	2.13	11.93
6993	.. 885	..	..	..	..	..	10.90	4.69	1.54	.....	......	15.59
6994	.. 886	..	..	..	..	..	7.05	6.35	2.10	.16	2.41	16.26
6995	.. 887	..	..	..	..	..	8.85	2.95	2.20	......	......	12.80
6996	.. 888	..	..	..	..	..	8.05	2.09	1.36	......	.....	[illegible].14
6997	.. 889	..	..	..	..	..	9.70	.35	6.70	2.02	1.69	17.40

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Miscellaneous Samples from the Commissioner—Continued.

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Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6998	No. 890	Commissioner of Agriculture, Montgomery, Ala	7.10	5.00	4.00	1.78	1.34	$18.42
6999	.. 891	.. ..	5.80	4.88	1.22	2.32	2.27	19.45
7000	.. 892	.. ..	6 00	6.54	1.96	1.24	1.54	17.55
7001	.. 893	.. ..	7.35	3.04	3.26	1.66	2.29	17.33
7002	.. 894	.. ..	4.55	9.37	.98	3.54	2.41	25.24
7003	.. 895	.. ..	2.65	8.14	.86	1.92	2.56	18.73
7004	.. 896	.. ..	2.20	9.38	.62	2.04	1.91	19.20
7005	.. 897	.. ..	2.30	9.66	1.84	2.40	2.64	21.32
7006	.. 898	.. ..	8.55	3.69	3.26	1.24	2.28	17.99
7007	.. 899	.. ..	9.95	1.35	9.90	......	......	11.30

7008	.. 900	..	..	..	..	8.95	2.65	2.80	1.28	1.04	16.23
7009	.. 901	..	..	..	..	8.20	3.39	1.96	.....	2.24	13.83
7010	.. 902	..	..	..	..	11.60	5.11	1.54	.12	.13	17.18
7011	.. 903	..	..	..	..	11.25	6.01	3.04	08	.10	17.58
7012	.. 904	..	..	..	..	5.00	4.97	1.98	......	2.77	12.74
7013	.. 905	..	..	..	..	7.90	4.87	6.48	.10	2.91	15.86
7014	.. 906	..	..	..	..	6.80	3.51	1.04	2.08	1 51	17 64
7015	.. 907	..	..	..	..	7.70	3.52	.88	1.96	2.51	19.22
7016	.. 908	..	..	..	..	5.10	3.81	2.04	1.98	2.72	17.17
7017	.. 909	..	..	..	..	12 70	3.28	4.82	.....	......	15.98
7018	.. 910	..	..	..	..	7.40	2.06	3.64	2 04	2.09	17.26
7019	.. 911	..	..	..	..	7.75	5.49	1.36	1.02	1.28	17.18
7020	.. 912	..	..	..	..	8.30	7.43	2.92	..	2.00	17.73
7021	.. 913	..	..	..	..	6.85	5.67	4 28	.	......	12.52
7022	.. 914	..	..	..	..	8.00	2.12	3.98	1.38	2.18	16.16
7023	.. 915	..	..	..	..	7.95	4 21	2.64	1.34	1.22	17.13
7024	.. 916	..	..	..	..	9.25	5.63	2.92	......	......	14.88
7025	.. 917	..	..	..	..	9.00	3.44	1.96	1.56	1.57	18.38

Analses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Miscellaneous Samples from the Commissioner—Concluded.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value
7026	No. 918	Commissioner of Agriculture, Montgomery, Ala.	9.15	.50	1.90	1.48	2.73	16.52
7027	.. 919	.. .. ..	7.60	3.11	2.74	2.02	2.00	18.37
7028	.. 920	.. .. ..	8.06	3.74	.66	......	3.22	15.56
7029	.. 921	.. .. ..	9.20	1.54	1 36	1.70	2.77	18.27
7030	.. 922	.. .. ..	9.25	4.02	1.58	1.62	1.36	19.17
7031	.. 923	.. .. ..	10.35	5 64	5.86	......	......	15.99
7032	.. 924	.. .. ..	7.20	8.07	2.08		1.80	17.07
7033	.. 925	.. .. ..	6.40	3.72	2.78	1.60	1.56	16.55
7034	.. 926	.. .. ..	6.35	2.15	2.60	1.34	2.24	14.49
7035	.. 927	.. ..	7.90	5.17	1.68	.96	.87	16.63

7036	.. 928	..	..	..	9.35	2.70	1.80	1.64	2.06	18.70
7037	.. 929	..	..	..	13.50	2.18	1.72	......	......	15.68
7038	.. 930	..	..	..	6.25	6.33	1.32	......	......	12.58
7039	.. 931	..	..	..	6.85	5.96	6.04	......	2.28	15.09
7040	.. 932	..	..	..	6.00	6.09	7.46	1.40	1.49	17.50
7041	.. 933	..	..	..	5.85	3.81	4.54	1.60	2.32	16.46
7042	.. 934	..	..	..	6.45	4.46	4.04	1.58	1.49	16.82
7043	.. 935	..	..	..	8.15	2.64	1.76	2.02	1.87	18.32
7044	.. 936	..	..	..	8.15	3.89	2.76	1.46	1.76	17.89
7045	.. 937	..	..	..	13.40	5.34	1.06	.....	......	18.74
7046	.. 938	..	..	..	8.50	5.34	2.66	1.10	1.12	18.04
7047	.. 939	..	..	..	7.60	2.90	3.20	2.20	2.11	18.77

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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Mobile Acid Phosphate & Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–4	2–3	1–2	$ 11 16
..	Mobile Dissolved Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–4	2–3	2–3	12 17
..	Mobile Alkali Bone Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	6–8	2–4	2–3	4–5	12 17
..	Mobile Ammoniated Fertilizer, manufactured by Mobile Phosphate Company, Mobile, Ala	200	2.06–3	7–9	2–4	15–2	1–2	15 77–23 40
..	Genuine German Kainit, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	....	.....	.....	12–13	12 13
..	Mobile 446 Special Truck, manufactured by Mobile Phosphate Company, Mobile, Ala	200	3.30–4.50	3–4	1–2	1–2	4–8	19 24–26 60
..	Mobile H. G. Truck Fertilizer, manufactured by Mobile Phosphate Company, Mobile, Ala	200	6.60–8	4–5	2–3	1–2	4–6	28 48–36 40
..	I. X. L. Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	10–12	2–3	2–3	.....	12 14
..	English Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	12–13	2–3	2–3	.....	14 16
..	Mobile Standard Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.05	6–7	2–3	1.50–2	2–3	14 62–20 00

Oct. 1	KKK Ammoniated Soluble Bone, manufactured by Mobile Phosphate Company, Mobile, Ala	200	85–1.25	8–10	2–3	1.50–2	1–2	13 38–18 50
..	Eclipse Soluble Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.05	7–8	2–3	1.50–2	1–2	14 62–20 00
..	Mobile Soluble Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–3	2–3	3–4	13 00–17 00
..	Mobile Double Eagle Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.50	7.50–8.50	2.50–3 50	1.50–2	2–3	15 62–21 00
..	Rhodes Blood and Bone, manufactured by Mobile, Phosphate Company, Mobile, Ala	200	1.65–2.50	6–7	2–3	1.50–2	2–3	14 62–20 00
..	Mobile Blood Bone and Potash Compound, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.50	6–7	2–3	1.50–2	2–3	14 60–20 00
..	Patapsco Guano Co's XX Acid Phos and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	8	2	2	4	14 00
..	Acid Phos and 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	5	3	2	4	12 00
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	8	2	2	2	12 00
..	Acid Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	10	2	2	1	13 00
..	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	11	2	2	.....	13 00
..	Mastodon Ammo. Soluble Phos., manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	7	3	2	2	16 62
..	Georgia Formula, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	7	1	1	2	14 62
..	Mascot Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga	200	.82	8	2	2	1	13 30
..	XX Acid Phosphate with Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	8	2	2	4	14 00
..	Acid Phosphate with 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	5	3	2	4	12 00
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	8	2	2	2	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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Citrate Soluble.	Acid Soluble	Potash.	Relative Commercial Value.
1900 Oct. 1	Acid Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	10	2	2	1	$13 00
..	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	11	2	2	....	13 00
..	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	.....	.....	.....	48	48 00
..	Genuine German Kainit, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	..	....	...	12	12 00
..	Patapsco Guano Company's Patapsco Guano, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	3	2	2	16 62
..	Ammoniated Dissolved Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	1	1	2	14 62
..	Baltimore Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.82	8	2	2	1	13 30
..	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	....	.....	.. ..	48	48 00
..	Genuine German Kainit, manufactured by Georgia Chemical Works, Augusta, Ga.	290	....	.....	......	.. .	12	12 00
..	Pon Pon Crop Grower—Patapsco Guano Co's, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.00	7	3	1	2	14 80

..	Sea Gull Guano, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.00	7	3	1	2	14 80
..	Md. Am. Diss. Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	6	3	1	1	14 62
..	12% Dissolved Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	10	2	1.50	.....	12 00
..	High Grade Blood and Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	7	....	3	3	.....	22 60
..	Special, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	7.50	.....	2 50	2.50	.....	23 50
..	Fine Ground Beef Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2.50	.....	12.50	12.50	.....	19 50
..	Pure Raw Bone Meal, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	4	.....	6	7	.....	17 20
..	Acidulated Animal Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2	......	12 50	4.50	3	22 60
..	Ammoniated Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2.50	3	4	3	1	15 00
..	Blood, Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	4	6	3	2	7	27 20
..	Fertilizer No. 583, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	4	5	3	2.50	3	22 20
..	Fertilizer No. 386, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	2.50	5	3	2	6	21 00
..	Fertilizer No. 285, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5.50	2.50	1.50	5	17 62
..	Fertilizer No. 282, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5.50	2.50	1.50	2	14 62
..	Fertilizer No. 281, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5.50	2.50	1.50	1	13 62
..	Fertilizer No. 272, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5	2	1.50	2	13 62
..	Fertilizer No. 271, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5	2	1.50	1	12 62

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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analyses					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	African Cotton Grower, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	2.50	5	4	1	3	$ 19 00
..	Potato Fertilizer, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	3.50	3.50	2.50	1	4	19 40
..	Fertilizer No. 721, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	1	12 20
..	Fertilizer No. 722, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	2	13 20
..	Fertilizer No. 821, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	1	13.20
..	Fertilizer No. 822, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	5	3	1.50	2	14 20
..	Ammo D. B. and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	6.50	3.50	2	2	16 20
..	Acid and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	......	7	3	1.50	2	12 00
..	Acid and Potash manufactured by Armour Firtilizer Works, Kansas City, Kansas	467	.....	6	2	1	4	12 00
..	Acid Phosphate, manufactured by Armour Fertilizer Works, Kansas City, Kansas	200	....	8	4	2	......	12 00

..	Old Plantation Guano, manufactured by Union Fertilizer Co., Atlanta, Ga	167	1.64.7	6	2	2	2	14 61
..	Union Cotton Grower, manufactured by Union Fertilizer Co., Atlanta, Ga	200	1.64.7	6	2	2	2	14 61
..	Dixie Guano, manufactured by Union Fertilizer Company, Atlanta, Ga.	200	1 64.7	6	2	2	2	14 61
..	Animal Bone and Peruvian Compound, manufactured by Union Fertilizer Co., Atlanta. Ga	200	82.4	7	3	2	1	13 31
..	Merrimac Guano, manufactured by Union Fertilizer Co., Atlanta, Ga	200	1.61.7	6	2	2	2	14 61
..	Blood, Bone and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	3	2	1	13 31
..	Free Silver 16 to 1 Compound, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	3	2	1	13 31
..	U. C. Dis. Bone, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	3	2	2	12 00
..	Union Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	3	2	2	12 00
..	Dixie Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	3	2	2	12 00
..	Merrimac Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	3	2	2	12 00
..	Union Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	9	3	2	......	12 00
..	Dixie Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	9	3	2	......	12 00
..	Merrimac Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	9	3	2	......	12 00
..	Bone and Potash Mixture, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	6	2	2	4	12 00

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Union High Grade Acid Phosphate and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	6	2	2	2	$10 00
..	Taylor's Anti-Sharp-Shooter, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	3	2	1	13 31
..	Star Brand, manufactured by Union Fertilizer Company, Atlanta, Ga	200	82.4	7	3	2	1	13 31
..	U. C. Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	6	2	2	4	12 00
..	Read's Soil Food, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	2–3	14 61
..	Farmer's Special Manure, manufactured by Read Phosphate Co., Nashville, Tenn	200	82–1.64	8–10	2–3	1–2	3–4	15 30
..	Read's Cotton Flower, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	3–4	1–2	3–4	16 60
..	Wynn's Pacific Guano, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 60
..	Read's Blood and Bone, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 60
..	Read's Matchless Cotton Grower, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 61

..	Read's Farmers' Friend Fertilizer, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	1.647-2.47	6-8	3-4	1-2	1-2	14 61
..	Read's Blood, Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	.82-1.647	6-8	2-3	1-2	1-2	13 30
..	Read's Blood and Bone and No. 1, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	1.647-2.47	6-8	2-3	1-2	2-3	14 61
..	Read's Blood and Bone Special, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	.82-1.647	7-10	3-4	1-2	1-2	13 30
..	Read's Alkaline Bone, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	8-10	2-3	1-2	2-3	12 00
..	Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	8-10	2-3	1-2	2-3	12 00
..	Read's Special Potash Mixture, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	8-10	2-3	1-2	4-6	14 00
..	Read's Acid Phosphate and Pot., manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	.....	6-8	2-3	1-2	4-6	12 00
..	Read's Matchless Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	10-12	2-3	2-3	...	12 00
..	Read's XXX Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	10-12	3-4	2-3	....	13 00
..	Read's High Grade Acid Phosphate, manufactured by Read Phosphate Co , Nashville, Tenn..................................	200	....	10-12	4-5	2-3	.....	14 00
..	Read's H. G. Amo. Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	1.647-2.47	8-10	2-3	1-2	2-3	16 61
..	Satin Staple Guano. manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	2.05-3.07	6-8	4-6	2-3	2-3	17 75
..	Missing Link Guano, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	1.02-1.53	6-8	4-6	2-3	2-3	14 85
..	Up to Date Guano, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	.823-1.23	6-8	4-6	2-3	1-2	13 30
..	Peterkin's Improved Formula, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	8-10	4-6	2-3	2-3	14 00
..	Dissolved Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn..................................	200	....	6-7	4-5	2-3	2-3	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 Manufactured, and Where Manufactured.	Weight of Package.	Guarantee Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1960 Oct. 1	Available Bone Acid Phosphate, manufactured by Read Phosphate Co,, Nashville, Tenn.	200	....	9-10	5-6	2-3	......	$ 14 00
..	Electric Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	8-9	4-5	2-3	......	12 00
..	Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville. Tenn	200	....	8-10	2-3	10-12	2-3	12 00
..	Adair's Acid Phosphate, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7-9	3-4	2-4	......	10 00-13 00
..	Acid Phosphate and Pot., manufactured by A. D. Adair and McCarty Bros.. Atlanta, Ga	200	....	7-9	3-4	2-4	1-2	11 00-14 00
..	Ammoniated Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	1.75-2.50	5-8	3-4	2-4	2-3	14 90-17 00
..	Adair's Soluble Pacific Guano, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	1.75-2.50	7-8	3-4	2-4	2-3	16 60-19 00
..	Planters' Soluble Fertilizer, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	300	1.75-2.50	5-8	3-4	2-4	2-3	14.90-17 00
..	McCarty's Soluble Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	83-1.25	7-8	3-4	2-4	1-2	13 38-16 00
..	Adair's Special Potash Mixture, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	5-8	3-4	2-4	4-6	12 00-15 00

..	Adair's Formula, manufactured by A. D. Adair and McCarty Bros,, Atlanta, Ga	200	......	7-9	3-4	2-4	2-3	12-00 15 00
..	McCarty's Potash Formula, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7-9	3-4	2-4	2-3	12 00- 15 00
..	Special Bone and Potash Compound, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7-8	3-4	2-4	4-6	14 00- 17 00
..	Adair's Soluble Bone and Potash, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7-8	3-4	2-4	2-3	12 00- 15 00
..	Adair's H. G. Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	9-12	3-4	2-4	......	12 00- 15 00
..	Furman Acid Phosphate, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	....	7-9	3-4	2-4	......	10 00- 13 00
..	Furman Acid Phosphate and Potash, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	....	7-9	3-4	2-4	1-2	11 00- 14 00
..	Furman High Grade Fertilizer, manufactured by Furman Farm Improvement Co , Atlanta, Ga	200	1 75- 2.50	7-8	3-4	2-4	2-3	16 90- 19 00
..	Buffalo Bone Fertilizer, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	1.75- 2.50	5-8	3-4	2-4	2-3	14 90- 17 00
..	Furman Soluble Bone, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	88-1.25	7-8	3-4	2-4	1-2	13 38- 16 00
..	Farish Furman Formula, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	....	7-9	3-4	2-4	2-3	12 00- 15 00
..	Furman's H. G. Dissolved Bone, manufactured by Furman Farm Improvement Co., Atlanta Ga	200	....	9-12	3-4	2-4	......	12 00- 15 00
..	Swift's Special G. Guano, manufactured bySwift's Fertilizer W'ks, Atlanta, Ga	200	4.12	7-9	2-4	1-3	3	24.03
..	Swift's Monarch H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	3.29	6-8	2-4	1-3	4	21.21
..	Swift's Cotton King H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	2.47	7-9	2-4	1-3	2	17 92
..	Swift's Eagle H. G, Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.65	7-9	2-4	1-3	2	16 62
..	Swift's Golden Harvest S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.65	6-8	2-4	1-3	2	14 62

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

When Received.	Name of Fertilize. or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Swift's Pioneer S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.24	7–9	2–4	1–3	1	$ 14 47
..	Swift's Cotton Plant S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta Ga	200	1.65	7–9	2–4	1–3	1	14 62
..	Swift's Plow Boy S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.82	7–9	2–4	1–3	1	13 30
..	Swift's Homestead H. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	4	14 00
..	Swift's Plantation S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	4	14 00
..	Swift's Wheat Grower S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	2	12 00
..	Swift's Atlanta L. G. P. & P., manufactured by Swift's Fertilizer Works. Atlanta, Ga	200	....	8–10	2–4	1–3	1	11 00
..	Swift's Capital H. G. A. Phos., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	10–12	2–4	1–3	......	14 00
..	Swift's Chattahoochie S. G. A. Phos., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	10–12	2–4	1–3	......	12 00

1900 Oct. 1	Swift's Empire Std. Guano, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	1.65	6-8	2-4	1-3	2	14 62
..	Swift's Dixie Std. Phos. and Pot., manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	....	8-10	2-4	1-3	2	12-00
..	Swift's German Kainit, manufactured by Swift's Fertilizer Co., Atlanta, Ga	100	......	......	......	......	12	11 00
..	Swift's Ground Bone and Blood, manufactured by Swift's Fertilizer Co., Atlanta Ga.	200	13.18	16%	Amo.	......	......	36 00
..	Swift's Muriate Potash, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	......	......	......	......	50	50 00
..	Swift's Ground Tankage, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	7.31	Amo.	......	9%	......	22 46
..	Swift's Nitrate of Soda, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	15.65	Amo.	......	19%	......	43 83
..	Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	....	6	4	1	2	12 00
..	Eagle Ammoniated Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	1 65	6	2	1	2	14 62
..	Eagle Beef, Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	.82	7	3	1	1	13 29
..	Teague's Beef Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	.82	7	3	1	1	13 29
..	Teague's Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	....	7	3	1	2	12 00
..	Teague's Acid Phos., manufactured by Louisville Fertilizr Co., Louisville, Ky	200	....	8	4	1	...	12 00
..	Eagle Guano, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	1.65	7	3	1	2	16 62
..	Eagle Dissolved Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	....	10	4	1	......	14 00
..	Eagle Acid Phos., manufactured by Louisville Fertilizer Co., Louisville, Ky	200	....	8	4	1	......	12 00
..	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	7	3	1	4	14 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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Ox Potash Special, manufactured by Tennesee Chemical Co., Nashville, Tenn	200	....	6	2	1	4	$ 12 00
..	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	8	2	1	4	14 00
..	Ox H. G. Amoniated Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1.65	6	4	1	2	16 62
..	Ox Cotton Grower, Manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1 65	6	4	1	1	15 62
..	Ox Special Wheat and Corn Guano, manufactured by Tennesee Chemical Co., Nashville, Tenn	200	.85	9	3	1	1	15 38
..	Ox Bone with Ammonia and Potash, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	.85	6	4	1	1	13 38
..	Ox Slaughter House Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1.65	6	2	1	2	14 62
..	Ox H. G. Diss Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	......	8	6	1	.....	14 00
..	Ox Alkaline Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	9	3	1	2	14 00
..	Ox Bone and Potash, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	7	5	1	1	13 00

Ox Potash Mixture, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	....	8	2	1	2	12 00
Ox Acid Phosphate, manufactured by Tennessee Chemical Co., Nashville Tenn.	200	....	7	5	1	.....	12 00
Ox Potash Acid, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	....	8	2	1	1	11 00
Ox Special Truck Guano, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	3.30	8	2	1	4	23 24
Complete Fertilizer, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1.70	7	2	2	2	15 76
Truck Farmer's Friend, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1.70	7	2	2	4	17 76
Acid Phosphate, manufactcred by Scholze Bros., Chattanooga, Tenn.	200	....	12	2	1	......	14 00
Marietta H. G. Acid Phosphate, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	12–14	2–3	2–3		16 10
Marietta H. G. Acid Phosphate with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8–10	2–3	2–3	1.25–2.25	13 13
Piedmont Acid Phosphate, manufactured by Marietta Guano Co., Atlanta Ga.	200	......	10–12	2–3	2–3	......	13 80
Magic Cotton Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8–10	2–3	2–3	1–2	16 00
Beef Blood and Bone Compound, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8–9	2–3	1–3	1.25–2 25	16 65
Disolved Bone with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	7–9	2–3	2–3	2–4	12 95
Same for Wheat, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	7–9	2–3	2–3	2–4	12 95
Wheat and Clover Grower, manufactured by Marietta Guano, Co., Atlanta, Ga	200	....	10–12	2–3	2–3	2–4	16 40
Golden Grain Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	6–8	2–3	2–3	4–6	14 40
M. Y. C. H. G. Dis. Bone, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8–10	2–3	2–3	2–4	14 10

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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Planters Pride Guano, manufactured by Marietta Guano Co., Atlanta, Ga.	200	1.75	7	2	1–3	1.25–2.25	17 50
..	Solid South Guano. manufactured by Marietta Guano Co., Atlanta, Ga.	200	1.75	7	2	1–3	1.25–2.25	17 58
..	Lee Fertilizer, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.75	8	1	2	2.00	15 90
..	XX Blood and Bone, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.00	8	1	2	1.00	12 80
..	High Grade Guano, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.50	7	2	2	1.75	14 95
..	Old Time Guano, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.25	7	1	2	1.00	12 50
..	XXX Ammoniated Dissolved Bone, manufacturedby Trawick & Jernigan, Opelika, Ala	200	.82	8	1	2	1.00	12 29
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	12	1	2	......	13 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	10	2	2	1	13 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	10	2	1	1	12 00

..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	9	2	2	2	13 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	9	1	2	2	12 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	9	1	2	3	13 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	8	1	2	3	12 00
..	H.G. English Acid, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	12	2	2	2	14 00
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	11	1	2	......	12 00
..	Dale County Standard Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.20	7	2	1	2	16 80
..	Ozark High Grade Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.20	7	2	1	2	16 80
..	Complete Cotton Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.65	6	1.70	1	2	14 62
..	Ozark High Grade Phosphate, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	....	3	11	2	......	14 00
..	English Acid Phosphate, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	....	11	3	......	......	14 00
..	Blood and Bone, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	1.65	7	2	....	2	15 62
..	English Dissolved Bone, Buford & Co., imported by Troy Fertilizer Co., Troy, Ala.	200	....	11	3	......	......	14 00
..	Dissolved Bone and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	....	7	2	......	3	12 00
..	Acid Phosphate and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	....	7	2	......	3	12 00
..	German Kainit, manufactured by The Troy Fertilizer Co. Troy, Ala.	200	....	......	......	......	12	12 00
..	The Troy Acid Phosphate, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	......	10.50	2.50	......	......	18 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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	H. G. Acid Phosphate, manufactured by the The Troy Fertilizer Co., Troy, Ala	200	....	11	3	......	....	$ 14 00
..	Pelican R. B Guano, manufactured by Standard G & C. Mfg. Co., New Orleans, La	100–200	1.65–2.50	4–5	4–5	.	1.50–3	
..	Miss. Home Guano, manufactured by G. & G. Mfg. Co., New Orleans, La	100–200	1.65–3.29	4–6.50	5–6.50	..	24.25	
..	Blood, Bone and Meat Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La	100–200	1.70–2.67	4–8	4.25–6.25	......	24.25	
..	Stern's Am. R. B. Sup. Phos., manufactured by Standard G, & C. Mfg. Co., New Orleans, La	100–200	1.65–2.50	4–5	5.00–5.50	......	1.50–3	
..	Standard Am. Sol. Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La	100–200	1.65–3.50	4–5	4–5	.....	1.50–3	
..	Champion Farmers' Choice, manufactured by Standard G. & C, Mfg. Co., New Orleans, La	100–200	1.65–2.50	4–5	4–5	......	1.50–3	
..	Ground Bone, manufactured by Standard G. & C. Mfg Co., New Orleans, La	100–200	2.50–3.25	.....	.	18 50–21.00	......	
..	Dissolved Bone, manufactured by Standard G. & C. Mfg. Co., New Orleans, La	100–200	....	13–14	2–5	......	......	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.	100–200	....	10–12	2–4	......	......	

Kainit, Manufactured by Standard G. & C. Manufacturing Co., New Orleans, La.	100–200	....	......	......	.....	12–14	
Farmers Alliance, manufoctured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	.....	2	15 62
Blood and Bone, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	6.50	1.50	......	2	14 62
Dundee Guano, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	......	1	13.30
Old Homestead, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	.....	1	13 30
Big Hit Guano, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	.....	1	13 30
Troy Perfect, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	......	2	15 62
Nancy Hanks, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	......	2	15 62
Meal Mixture, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	.....	2	15 62
Hume's Am. Dissolved Bone, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	.....	2	15 62
Pike's Pride, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	.....	2	15 62
Soluble Blood and Bone Guano, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	......	1	13 30
Soluble Pacific Guano, manufactured by the Pacific Guano Co., Boston, Mass., and Charleston, S. C.	200	1.75	6.50	2.00	2.00	1.00	14 40
Meridian Home Mixture, manufactured by Meridian Fertilizer Factory, Meridian Miss.	200	1.65	7.50	1.50	.75	2.00	15 12
Meridian Blood and Bone, manufactured by Meridian Fertilizer Factory, Meridian, Miss.	200	1.65	7.50	1.50	.75	2.00	15 12
Meridian Farmers' Friend, manufactured by Meridian Fertilizer Factory, Meridian, Miss.	200	1.25	7.50	1.50	.75	1.00	13.12
Meridian Southern Phosphate, manufactured by Meridian Fertilizer Factory, Meridian, Miss.	200	....	12.00	2.00	1.00	....	14 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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble		
1900 Oct. 1	Meridian English Phos. manufactured by Meridian Fertilizer Factory, Meridian, Mississippi	200	....	8.00	2.00	1.00	.....	$12 00
..	Bowker Cotton Fertilizer, manufactured by Bowker Fertilizer, Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Naston Guano. manufactured by Bowker Fertilizer Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Crown Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Sure Crop Fertilizer, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Dis. Bone Phos., manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	10	2	2	......	12 00
..	Bowker Dis. Bone with Potash, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	8	2	2	2	12 00
..	Kainit, manufactured by Bowker Fertilizer Company, Elizabeth, N. J	....	....	......	......	......	12	12 00
..	Ashepoo Fert., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	1.75	6 25	2.25	2.00	1.00	14 40
..	Eutaw Fertilizer, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	1.75	6.25	2.25	2 00	1.00	14 40

Oct. 1	Ashepoo Guano, manufacturad by Ashepoo Fertz. Co., Charleston, S. C	200	2.10	6.00	2.00	1.00	1.00	14 88
..	Eutaw Blood and Bone Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11 38
..	Ashepoo Blood and Bone Guano, manufactured by Ashepoo Fertz Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11.38
..	Ashepoo Dis. Bone with Am. and Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11 38
..	Eutaw Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	1.75	6.25	2.25	2.00	2.00	15 40
..	Enon Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	2.00	2.00	12 50
..	Pioneer Acid Phos,, manufactured by Ashepoo Fert.. Co., Charleston, S. C	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Bone Ash, manufactured by Ashpoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	1.00	11.50
..	Ashepoo XX Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Eutaw XX Acid Phos., manufactured by Ashepoo Fertz Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Bronwood Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Eutaw Acid with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2 00	2.00	1.00	11 50
..	German Kainit, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	....	....	......	11.00	11 00
..	Carolina Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Coomassie A. P. with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	9.50	2.50	1.00	2 00	14 00
..	Ashepoo Acid Phos. with Potash, manufactured by Ashepoo Fertz Co., Charleston, S. C.	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Acid Poash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	......	10 50

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Eutaw Acid Phosphate, manufactured by Ashepoo Fertilizer Co., Charleston, S. C	200	......	8.50	2 00	1.00	.....	10 50
..	Coomassie Acid Phosphate, manufactured by Ashepoo Fertilizer Co., Charleston, S. C	200	......	9.50	2.50	2.00	.....	12 00
..	Blood and Bone and Potash, manufactured by New Orleans Acid and Chemical Co., New Orleans, La	200	.823	7.00	3	2	1	13 30
..	Acid Phosphate with 4% Potash, manufactured by Potapsco Guano Co., Baltimore, Md.	200	......	5.00	3	2	4	12 00
..	Ammoniated Dissolved Bone and Potash, manufactured by Dothan Guano Co., Dothan, Ala	200	.823	8.00	2	2	2	14 30
..	Standard Grade Corn and Cotton Compo., manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	7.00	2	1	2	15 62
..	Standard Grade Grange Mixture, manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	5.50	2	1	3	15 12
..	Peterman's Leader, manufactured by Dothan Guano Co., Dothan, Ala	200	.82	8 00	2	1	1	13 30
..	Grange Mixture, manufactured by Dothan Guano Company, Dothan, Ala	200	1.65	5.50	1 25	1	3	14 37
..	Corn and Cotton Compound, manufactured by Dothan Guano Co., Dothan, Ala.	200	1.65	7.00	1.00	1	2	14 62

Howell's Fruit Food, manufactured by Dothan Guano Company, Dothan, Ala	200	1.50	5.50	2.00	1	3 1-2	15 20
Phosphate with 3% Potash, manufactured by Dothan Guano Co., Dothan, Ala	200	....	8.00	1.50	1	3	12 50
High Grade Acid Phosphate, manufactured by Dothan Guano Co., Dothan, Ala	200	......	11.00	2.00	1	.....	13 00
Blood and Bone Fertilizer, manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	7.00	2.00	1	2	15 62
Ammoniated Dissolved Bone, manufactured by Dothan Guano Co., Dothan, Ala	200	.82	8.00	2.00	1	1	13 30
Genuine German Kainit, manufactured by Dothan Guano Co., Dothan, Ala	200	......	......	......	......	12%	12 00
B. D. Seafowl Guano, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.85	6.50	2.50	2.00	1.00	15 18
Bradley's Patent Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.85	6.50	2.50	2.00	1.00	15 18
Ammoniated Dissolved Bone, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.65	6.00	2.00	2.00	1.00	13 62
Eagle Am. Bone Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.65	6.00	2.00	2.00	1.00	13 62
Bradley's Palmetto Acid Phosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	....	9.00	3 00	2 00	.....	12 00
Cow Phosphate Acid, manufactured by Cullman Cotton Company, Cullman, Ala	200	......	12-13	1-2	2-3	......	13 00
Bull Phosphate Acid, manufactured by Cullman Cotton Company, Cullman, Ala	200	....	12-14	2-4	1-2	......	11 00
Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82-100-1	......	......	10-11	1.1-15	13 30
Cow Guano, manufactured by Cullman Cotton Company, Cullman, Ala	200	1.65-2	......	......	10-12	1.1-15	15 62
Guano No. 8—P., manufactured by Cullman Cotton Company, Cullman, Ala	200	....	8	2	.....	4	14 00
Guano No. 3—S., manufactured by Cullman Cotton Company, Cullman, Ala	200	1.65	6	2	......	2	14 62

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

When Received.	Name of Fertilize. or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Best Made, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1.17	2	$16 62
..	Cow Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8.21	1.79	1.32	1	15 62
..	Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	7.35	2.65	1.83	1	13 80
..	Cow Acid Phosphate, manufactured by Cullman Cotton Co, Cullman, Ala	200	....	12%	1%	2%	......	15 00
..	Bull Acid Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala	200	....	12%	2%	1%	......	14 00
..	No. 5 B Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	7	2	....	2	15 62
..	No. 6 A., manufactured by Cullman Cotton Co., Cullman, Ala	200	1.50	7	2	......	2	15 20
..	No. 9 C., manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	......	1	15 62
..	Guano 16. P., manufactured by Cullman Cotton Co., Cullman, Ala	200	....	12	......	......	4	16 00
..	Mountain City Lint, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	6	4	1	4	16 30

Oct. 1	Mountain City Lint, No. 2, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	6	4	1	4	18 60
..	Corn and Cotton Lint No. 2, manufactured by Cullman Cotton Co., Cullman, Ala	200	1 65	10	2	......	2	16 60
..	No. 1024, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	4	18 60
..	No. 735, manufactured by Cullman Cotton Co., Cullman, Ala	200	2.50	6	1	1	5	19 00
..	No. 1034, manufactured by Cullman Cotton Co., Cullman. Ala	200	2.50	8	2	1	4	21 00
..	No. 1023, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	3	17 62
..	No. 823, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	6	2	1	3	15 62
..	No. 822, manufactured by Cullman Cotton Co., Cullman, Ala	200	1 65	6	2	1	2	14 62
..	No. 1022, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	2	19 62
..	No. 922, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	7	1.50	1	2	15 12
..	No. 1021, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	1	15 62
..	No. 1014, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	8	2	1	4	16.30
..	Acid and Potash No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	....	8	2	2	2	12 00
..	Acid and Potash No. 12-2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	....	8	4	2	2	14 00
..	Acid and Potash No. 4, manufactured by Home Mixture Guano Co., Columbus, Ga	200	....	6	2	2	4	12 00
..	Home Mixture No 1, manufactured by Home Mixture Guano Co., Columbus, Ga	200	1.65	7	2	2	1	14 62
..	Home Mixture No. 2, manufactured by Home Mixture Guano Co.. Columbus, Ga	200	1.65	6	2	2	2	14 62

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 Manufactured, and Where Manufactured.	Weight of Package	Guaranteed Analyses: Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Home Mixture No 3, manufactured by Home Mixture Guano Co., Columbus, Ga	200	1.65	8	2	2	2	$ 16 62
..	Home Mixture No 4, manufactured by Home Mixture Guano Co, Columbus, Ga	200	1.65	6	2	2	4	16 62
..	Acid Phosphate No. 1, manufactured by Home Mixture Guano Co., Columbus, Ga	200	......	10	2	2	......	12 00
..	Acid Phosphate No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	......	12	2	2	......	14 00
..	Potatoe Mixture, manufactured by Home Mixture Guano Co., Columbus, Ga	200	1.65	4	2	1	6	16 62
..	Kainit, manufactured by Home Mixture Guano Co., Columbus, Ga	200	....	.....	....	.....	12	12 00
..	Goldsmith Imported Mixture, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	1.65	7.00	2.00	2.00	1.00	14 62
..	Gold Dust, manufactured by New Orleans Acid and Fertilizer Co., Greta, La	200	1.65	7.00	2.00	2.00	1.00	14 62
..	Blood, Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	1.65	7.00	2.00	2.00	1.00	14 62
..	Good Luck, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	1.65	7.00	2.00	2.00	1.00	14 62

..	Dixie Soluble Bone and Potash with Ammonia, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.............	200	1.65	6.00	1.00	2.00	1.00	12 62
..	Diss. Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La....................................	200	.....	8.00	2.00	2.00	2 00	12 00
..	Acid and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	......	8.00	2.00	2.00	4.00	14 00
..	Black Diamond Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	.....	10.00	2.00	2.00	....	12 00
..	Crescent City Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La........................	200	.....	10.00	2.00	2.00	.....	12 00
..	W. O. C. A. Pure Blood Guano, manufactured by Coweta Fertilizer Co., Newnan and Columbus, Ga........................	167	1.65	8	2	1	2	16 62
..	Coweta H. G. Fertilizer, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga... ..	200	1.65	8	2	1	2	16 62
..	Coweta Animal Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga..........	200	1.65	6	2	1	2	14 62
..	Sea Bird Guano manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co. Newnan, Ga..................	200	1.65	6	2	1	2	14 62
..	Aurora Amo. Phosphate, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.......	200	1.65	7	2	1	1	14 62
..	Coweta Stand. Dis. Bone and Potash, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	......	8	2	1	2	12 00
..	Coweta Wheat and Grass Grower, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	....	8	2	1	2	12 00
..	Coweta H. G. Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga..........	200	......	12	2	1	......	14 00
..	Coweta Standard Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga......	200	......	10	2	1	.....	12 00
..	Coweta Diss. Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga..........	200	......	10	2	1	......	12 00
..	I. A. P. Bone with Amonia and Potash, manufactured by Coweta Chemical Co., Branch Virginia-Car Chemical Co., Newnan, Ga.	200	.83	8	2	1	1	13 31
..	13 & 14 Diss. Bone and Potash. manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga...........	200	.....	11	2	1	4	17 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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Nalue.
				Phospporic Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	10 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.......	200	....	8	2	1	4	$ 14 00
..	8 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	6	2	1	4	12 00
..	Coweta Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	....	10	2	1	2	14 00
..	German Kainit, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga..............	200	....	......	....	.....	12	12 00
..	Muriate of Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga...............	....	...	.....	......	....	48	48 00
..	Old Dominion Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga	200	1.65	6	2	2	1.50	14 12
..	Southern Amd. Dissolved Bone Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga	200	1 65	6	2	2	1	13 62
..	Patent Pacific Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga.........	200	1.65	6	2	2	1	13 62
..	Etowah Guano, manufactured by Old Dominion Guano Co, Atlanta, Ga..	200	.85	6	3	2	1	12 38
..	Blood and Bone Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga..	200	.85	6	3	2	1	12 38

..	Old Dominion Dissolved Bone, manufactured by Old Dominion Guano Co, Atlanta, Ga	200	....	10	2	2	......	12 00
..	Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion, Guano Co., Atlanta, Ga	200	....	8	2	2	2	12 00
..	Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co., Atlanta Ga	200	....	6	2	2	4	12 00
..	Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co , Atlanta, Ga	200	....	8	2	2	4	14 00
..	Bear H. G. Dissolved Bone, manufactured by Continental Fertilizer Co,, Nashville, Tenn	200	....	8	6	1	......	14 00
..	Bear H. G. Beef Blood and Bone, manufactured by Continental Fertilizer Co . Nashville, Tenn	200	1.65	8	2	1	2	16 62
..	Bear Special Wheat and Corn Grower, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	8	3	1	2	13 00
..	Bear Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	......	9	3	1	1	13 00
..	Bear Potash mixture, manufactured by Continental Fertilizer Co , Nashville, Tenn	200	....	8	2	1	2	12 00
..	Eddystone Soluble Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	1.65	7	2	1	1	14 62
...	Eddystone Dissolved Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	10	3	1	.....	13 00
..	Eddystone Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	7	5	1	1	13 00
..	Eddystone Potash Mixture, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	7	3	1	2	12 00
..	Sunny South Acid Phosphate, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	10	3	1	......	13 00
..	Bear Phosphate and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	8	2	1	1	11 00
...	Eddystone Cotton Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	.85	6	4	1	1	13 38
..	Etiwan H. G. Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C	200	....	11–13	2–3	2	......	13 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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Etiwan Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	......	10–12	2	2	.....	12 00
..	Plow Brand Raw Bone Superphosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	6–8	2–3	2	2–3	14 60
..	Diamond Soluble Bone, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	....	11–13	2–3	2	.....	13 00
..	Plow Brand Soluble Fertilizer, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	7–9	2–3	2	1–2	14 60
..	American Ammoniated Bone Superphosphate, manufactured by Williams & Clark Fertilizer Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
..	Cumberland Bone Superphosphate of Lime, manufactured by Cumberland Bone Phosphate Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
..	Goulding's Vegetable Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	3.30	5	2	1	4	20 24
..	Goulding's H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co. Limited, Pensacola, Fla.	200	....	12	3	1	.....	15 00
..	Goulding's Atlas Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	209	....	10	3	1	....	13 00
..	Goulding's Mixture, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	10	2	1	.....	14 00

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..	Genuine German Kainit, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	....	....	.....	12	12 00
..	Goulding's H. G. Phosphate and Potash, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	......	10	2	1	1	13 00
..	Goulding's Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Goulding's Special Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Goulding's Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Goulding's English Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Goulding's St. George Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.85	7	2	1	1.50	12 38
..	Winkler H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	12	3	1	....	15 00
..	A. G. Winkler's Ammoniated Dissolved Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Gem Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	5	3	1	2	14 62
..	English Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola Fla.	200	....	9	3	1	1.50	12 00
..	Samson Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	1.50	15 12
..	Samson Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	10	3	1	....	13 00
..	Goulding's 3% Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	...	6	2	1	3	11 00
..	Goulding's 4% Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	6	2	1	4	12 00
..	Goulding's XXX Potash Acid, manufactured by The Goulding Fertilizer Co., Limited. Pensacola, Fla.	200	....	12	2	1	2	16 00
..	Tucker, Willinghanm & Co's Special H. G. Potash Guano, manufactured byThe Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.85	7	3	1	3	15 38

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 Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS. Nitrogen.	PHOSPHORIC ACID. Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Earle Terrell & Co. H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Earle Terrell & Co. H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	11-13	2-3	2	......	13 00
..	Earle Terrell & Co. Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	8-10	2-3	2	2-3	12 00
..	Cadeville Oil Mill H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	...	12 00
..	Cahaba Acid Phos. and Pot Mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	8-10	2-3	2	2-3	12 00
..	Cahaba Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	8-10	2-3	2	4-5	14 00
..	Cahaba Bone Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	6-8	2-3	2	4-5	12 00
..	Cahaba Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala..	200	....	6-8	2-3	2	1-2	11 30
..	Cahaba Dis. Bone Am. and Potash. manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	8-10	2-3	2	1-2	13 30
..	Cahaba H. G. Blood, Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60

..	Cahaba H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Cahaba Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 30
..	Cahaba Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 60
..	Birmingham H. G. Blood, Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Birmingham H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Birmingham Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 60
..	Birmingham Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingam, Ala.	200	1.64-2 46	6-8	2-3	2	2-3	14 60
..	Birmingham Dis. Bone A. M. and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.82-100	8-10	2-3	2	1-2	13 30
..	Jefferson County Standard Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Cahaba Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	....	12 00
..	Cahaba H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	11-13	2-3	2	...	13 00
..	Cahaba Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	....	12 00
..	Cahaba H. G. Diss. Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	11-13	2-3	2	...	13 00
..	Cahaba Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	8-10	2-3	2	1-2	11 00
..	Birmingham Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	....	12 00
..	Birmingham H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	11-13	2-3	2	...	13 00
..	Birmingham Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	....	12 00

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Birmingham H. G. Dissolved Bone, manufactured by Birmingham, Fertilizer Co., Birmingham, Ala.	200	......	11–13	2–3	2	.....	$ 13 00
..	Birmingham Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	8–10	2–3	2	1–2	11 00
..	Birmingham Acid Phosphate and Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	......	8–10	2–3	2	2–3	12 00
..	Birmingham Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	8–10	2–3	2	4–5	14 00
..	Birminghham Bone and Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	6–8	2–3	2	4–5	12 00
..	Birmingham D Bone and Muriate Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	10–12	2–3	2	2–3	14 00
..	Birmingham Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	82–100	6–8	2–3	2	1–2	11 30
..	Navassa Cotton Fertilizer, manufactured by Navassa Guano Co, Wilminghton, N. C	200	1.65	6.00	2.00	2 00	2.00	14 62
..	Navassa Bone and Ash, manufactured by Navassa Guano Co, Wilmington, N. C	200	......	7.00	3.00	2.00	2.00	12 00
..	Dissolved Bone with Am. and Potash, manufactured by Navassa Guano Co,, Wilmington, N. C.	2 00	.82	7.00	3.00	2.00	1.00	13 30

..	Navassa Acid Phosphate, manufactured by Navassa Guano Co., Wilmington, N. C	200	....	9.00	3.00	2.00	...	12 00
..	Acid Phosphate with Potash, manufactured by Navassa Guano Co., Wilmington, N C........	200	....	7.00	3.00	2.00	1.00	11 00
..	Navassa Complete Fertilizer, manufactured by Navassa Guano Co., Wilmington, N C	200	1.65	6.00	3.00	2.00	1.00	14 62
..	Navassa Wheat Mixture, manufactured by Navassa Guano Co., Wilmington, N. C	200	....	7.00	3.00	2.00	4.00	14 00
..	Navassa Grain Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C........	200	1.65	6.00	2.00	2.00	2.00	14 62
..	Genuine German Kainit, manufactured by Navassa Guano Co., Wilmington, N. C........	200	....	....	.....	....	12.00	12 00
..	Giant Guano, manufactured by Rasin Monumental Co., Richmond, Va	200	1.65	6	2	2	2	14 62
..	Soluble Sea Island, manufactured by Rasin Monumental Co., Charleston, S. C........	200	1.65	6	3	2	1	14 62
..	Rasin's Empire Guano, manufactured by Rasin Monumental Co., Atlanta, Ga	200	1.65	6	3	2	1	14 62
..	Rasin's Dixie Guano, manufactured by Rasin Monumental Co., Atlanta, Ga........	200	1.65	6	2	2	2	14 62
..	Kainit, manufactured by Rasin Monumental Company, Atlanta, Ga.	200	....	......	......	......	12	12 00
..	Acid Phosphate, manufactured by Rasin Monumental Company, Atlanta, Ga	200	....	10	4	2	......	14 00
..	Bone and Potash, manufactured by Rasin Monumental Co, Atlanta, Ga........	200	....	7	3	2	2	12 00
..	Dissolved Bone, manufactured by Rasin Monumental Company, Atlanta, Ga........	200	1.65	7	3	2	....	14 62
..	Columbia Guano, manufactured by Columbia Fertilizer Co., Columbia, Ala........	200	1.65	6	1	1	2	16 12
..	Farmer's Friend, manufactured by Columbia Fertilizer Company, Columbia, Ala........	200	1 00	6	1	1	3	15 00
..	Columbia H. G Acid Phos, m'f'd by Col. Fert. Co., Columbia, Ala.	200	....	10	2	1	.....	13 00
..	Dis. Bone and Potash, m'f'd by Col. Fert. Co., Columbia, Ala.....	200	...	6	2	1	3	13 00

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

When Receivek.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	German Kainit, manufactured by Columbia Fertilizer Co., Columbia, Ala.	200	......	......	......	......	12	$ 12 00
..	Sipsey H. G. Acid Phosphate, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	......	11	2	1	......	13 00
..	Sipsey H. G. Acid Phos. and Potash, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	......	9	1	1	2	12 00
..	Graham's Best Guano, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	2	7	2	1	2	16 60
..	Etowah Fertilizer, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	13 80
..	King Cotton, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	13 80
..	Our Best Fert. Am. D. B. & Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.80	6.50	2.50	.50	2.00	13 24
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.06	6.50	2.00	.50	1.00	15 05
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.00	6.00	1.50	.50	2.00	15 10
..	Waters Special Guano, manufactured by Tallapoosa Oil Co , Alexander City, Ala.	200	1.50	7.50	2.80	.50	1.00	15 00

..	Walters Special Dis. Bone and Potash, manufactured by Tallapoosa Oil Co, Alexander City, Ala.	200	....	10.00	2.00	1.00	1.00	13 00
..	Coley's & Sandlin's Spe. D. B. and P., manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	....	10 00	2.00	1.00	1.00	13 00
..	Tallapoosa H. G. Acid, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	....	11.00	2.50	2 00	.....	13 50
..	Tallapoosa Dis. Bone and Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	......	10.00	2.00	2.00	1.00	13 00
..	Our Best Fertilizer D. B. and P., manufactured by Tallapoosa Oil Co, Alexander City, Ala.	200	....	11.00	2.00	1.00	1.00	14 00
..	Standard Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15 00
..	Soluble Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	2.00	6.50	2.00	.50	1.00	15 10
..	Coley & Sandlin's Special Guano. manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15 00
..	Ober's Sol. Am. Sup. Phos. of Lime, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	....	6.50	1.50	2	2	15 04
..	Farmers Standard Am. Phos., manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.70	6.50	1.50	1.50	2	14 76
..	Ober's Special Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	1.65	6	3	3	2	15 62
..	Ober's Dis. Bone with Am. and Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	1.00	7	2	1.50	2	13 80
..	Ober's Farmers Mixture, manufactured by G. Ober & Sons Co., Baltimore, Md.	200	.75	7	2	1.50	2	13 10
..	Ober's Dis. Bone Phos. and Potash. manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	....	8	2	2	2	12 00
..	Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	....	6	2	2	4	12 00
..	Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	....	8	2	2	4	14 00
..	Ober's Standard Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.80	6	2	2	2	15 04

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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble		
1900 Oct. 1	Ober's Dis. Bone Phosphate, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	......	11	3	2	......	$14 00
..	Randolph Fertilizer, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	2 00	6.75	1.25	1.25	1.50	15 00
..	Roanoke Guano, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1.75	6 75	1.25	1.25	1.00	13 90
..	Pride of Alabama, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1 65	6.75	1.25	1.25	2.00	14 62
..	Jones' Best, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1.65	6.75	1.25	1.25	1.00	13 62
..	H. G. Cotton Grower, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	.82	8.50	1.50	1.50	1 00	13 30
..	H. G. English Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	......	10.	2.00	2.00	....	12 00
..	Potash Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	......	8.50	1.50	1.50	2.00	12 00
..	Ashcraft's Formula, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	......	8.75	1.25	2.76	......	12 00
..	King Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	......	2.15	1.00	13 35

Oct. 1	Florence Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	9.67	3.33	1.98	.....	13.00
..	Tiger Guano, mannfactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	8.75	1.25	2.76	2.00	12 00
..	Corn and Cotton, manufactured by Tennessee Valley Fert Co. Florence, Ala	200	1.65	10.00	....	.....	1.00	15.62
..	Tiger Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	11.38	1.62	2.27	.....	13 00
..	Tiger Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	......	......	1 00	13 30
..	C. S. Meal and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	1.65	10.00	......	.....	2.00	14 62
..	Blood and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	...	......	1.00	13 30
..	H. G. Dis. Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	12.00	....	.....	.....	12 00
..	S. and K. Am Diss. Bone, manufactured by Montgomery Fertz Co., Montgomery, Ala	200	.83	8	2	1	1	13 32
..	Kainit, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	......	....	......	....	12	12 00
..	Montgomery Acid Phos. with Potash, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	8	2	1	2	12 00
..	Meal and Phos. Compound, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	1.65	7	2	1	.....	13 62
..	High Grade Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	.....	13 00
..	H. G. English Acid Phos., manufrctured by Montgomery Fert. Co., Montgomery, Ala	200	....	12.	2	1	....	14 00
..	Star Brand Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	.....	13 00
..	Early Bird H. G. Acid Phos , manufactured by Montgomery Fert. Co., Montgomery, Ala	200	......	11.	2	1	....	13 00
..	S. and K. English Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	......	13 00

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis: Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	S. & O. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Vandiver's XX Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13 00
..	Griel's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	....	11	2	1	..	13.00
..	Thompson's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Pinckard's Home Mixture, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Alliance Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	6	2	1	2	14.62
..	Crescent Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	1.65	7	2	1	1	14.62
..	Star Brand Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	1	14.62
..	Plow Brand Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	.83	8	2	1	1	13.32
..	H. & F. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co, Montgomery, Ala.	200	....	11	2	1	..	13.00

..	W. L. & Co's H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Dissolved Bone and Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	9	2	1	1	12.00
..	Alkaline Acid Phosphate 4% Potash, manufactured by Montgomery Fe tilizer Co , Montgomery, Ala	200	....	6	2	1	4	12.00
..	English Acid Phosphate with 2% Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	10	2	1	2	14.00
..	S a Gull Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala..	200	1.65	7	2	1	2	15.62
..	Capital City Standard Fertilizer, manufactured by Montgomery Fertilizer Co , Montgomery, Ala....	200	1.65	7	2	1	2	15.62
..	Montgomery Blood and Bone Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala..	200	1.65	7	2	1	2	15 62
..	Tariff Reform Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Clayton Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	1.65	7	2	1	2	15.62
..	Southern Pacific Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Our Cotton Queen Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	.83	8	2	1	1	13.32
..	Early Bird Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Vandiver's Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	.83	8	2	1	1	13.32
..	Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Wilson's Special Compound, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Schuessler & Co., manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	..	..	..	..	....
..	Schuessler H. G. Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	6	2	1	2	14.62

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 Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analyses					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Schuessler & Co. Special Formula, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	3	$ 15 32
..	Schuessler & Co. Beef Blood and Bone, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	1	13 32
..	Schuessler & Co H. G. Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala	200	....	8	2	1	2	12 00
..	Schuessler & Co. H. G. English Acid Phos., manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	10	2	1	.....	12 00
..	Schuessler Bros. H. G. Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62
..	Schuessler Bros. H. G. Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	8	2	1	2	12 00
..	Schuessler Bros. XXX Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	9	2	1	1	12 00
..	Kainit, manufactured by Opelika Chemical Company, Opelika, Ala	200	....	....	....	.....	12	12 00
..	C. C. C. Standard Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala	200	1.65	6	2	1	2	14 62
..	Diamond Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62

..	Good Luck Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala	200	.83	8	2	1	1	13 32
..	Standard Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala	200	....	11	2	1	......	13 00
..	Opelika Acid Phos. with 2% Potash, manufactured by Opelika Chemical Co., Opelika, Ala	200	....	8	2	1	2	12 00
..	Blood and Bone Guano, manufactured by Opelika Chemical Co., Opelika, Ala	200	1.65	7	2	1	1	14 62
..	J. C. Adkin & Son, No. 1 Acid Phos., manufactured by Opelika Chemical Co., Opelika, Ala	200	....	11	2	1	.....	13 00
..	H. G. English Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala	200	......	10	2	1	....	12 00
..	Potash Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala	200	....	8	2	1	2	12 00
..	W. C. Bradley & Co's. Standard Guano, manufactured by Virginia-Carolina Chemical Co., Charleston, S. C	200	1.65	6	2	2	2	14 62
..	W. C. Bradley & Co's. Soluble Guano, manufactured by Virg'a-Car. Chemical Co., Richmond, Va	200	1.65	7	3	2	2	14 62
..	W. C. Bradley & Co's H. G. Potash Acid, manufactured by Virginia-Carolina Chemical Co, Richmond, Va	200	....	9	3	2	2	14 00
..	W. C. Bradley & Co's. H G. Acid Phosphate, manufactured by Virginia-Carolina Chemical Co., Richmond, Va	200	....	10	4	2	.....	14 00
..	W. C. Bradley & Co's. Standard Pot Acid, manufactured by Virginia-Carolina Chemical Co., Richmond, Va	200	....	7	3	2	2	12 00
..	T.W. & Co's Eng. H. G. Acid with Mur. Potash, manufactured by Virginia-Carolina Chemical Co, Richmond. Va	200	....	9	3	1	1	13 00
..	T. W. & Co's. Bone and Muriate of Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va	200	....	7	3	2	2	12 00
..	T. W. & Co's. Special H. G. Potash Guano, manufactured by Virginia-Carolina Chemical Co., Richmond, Va	200	.82	7	3	2	3	15 30
..	T. W. & Co's Muriate of Potash Mixture, manufactured by Virginia-Carolina Chemical Co., Richmond, Va	200	....	9	3	1	2	14 00

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Blanchard H. G. Acid Phos., manufactured by Virginia-Carolina Chemical Co., Atlanta, Ga.	200	....	10	4	2	.....	$14 00
..	Rome Soluble Guano, manufactured by Rome Guano Co., Rome, Ga.	200	1.65	6	2	1	2	14 62
..	Blood and Bone with Potash, manufactured by Rome Guano Co., Rome, Ga	200	.85	8	2	1	1	13.38
..	Royal Guano, manufactured by Rome Guano Co., Rome, Ga.	200	1.65	8	2	1	......	14 62
..	High Bone and Potash, manufactured by Rome Guano Co., Rome, Go.	200	....	8	2	1	2	12 00
..	Standard Acid Phos., manufactured by Rome Guano Co. Rome, Ga.	200	....	10	2	1	......	12 00
..	National Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	.82	6	4	.....	2	13 29
..	Blood and Bone Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	.82	6	4	.....	2	13 29
..	Rock City Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	1.64	5	3	.....	2	14 59
..	Tennessee Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	1.64	5	3	......	3	14 59

Oct. 1	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	.....	......	12 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	3	.....	......	13 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	......	......	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	......	......	14 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	300	....	11	4	......	......	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	......	......	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	11	4	......	......	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	12	4	......	......	16 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	6	4	......	1	11 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	......	8	4	......	2	14 00
..	Sadler's Formula, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	2	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	......	12 00
..	Tennessee H. G Diss. Bone and Potash, manufactured by National Fertz. Co	200	....	6	4	......	2	12 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	6	4	....	1	11 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	2	14 00
..	Tennessee Century Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	4	16 00
..	Tennessee H. G. Acid Phos., manufactured by National Fertz. Co., Nashville, Tenn	200	....	11	4	......	......	15 00

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

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Valve.
			Nitrogen.	Phosphoric Acid. Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1909 Oct. 1	Old Hickory Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	1.64	5	3	.....	2	$14 59
..	Old Hickory Guano, manufactured by National Fertz Co., Nashville, Tenn	200	1.64	6	4	.....	3	16 59
..	Ammoniated Diss. Bone, manufactured by Nalional Fertz. Co., Nashville, Tenn	200	.82	6	4	.....	1	13 29
..	Alabama Fertilizer, manufactured by Alabama Fertz Co., Montgomery, Ala	200	1.80	7	1.50	.....	1.50	15 04
..	Acid Phosphate, manufactured by Alabama Fertz. Co., Montgomery, Ala	200	....	11	2	.....	.....	13 00
..	Kainit, manufactured by Alabama Fertz. Co., Montgomery, Ala	200	....	.....	....	....	12.	12 00
..	Muriate of Potash, manufactured by Alabama Fertz. Co., Montgomery, Ala	200	....	....	....	....	52.	52 00
..	Concentrated Tankage, manufactured by Hiller, Hirsh & Co., New York	200	13.	.....	.....	.....	.....	36 40
..	Ground Blood, manufactured by Swift & Co., Chicago	200	14.	.....	.....	..	.....	42 00

LICENSES.

The following is a list of the Licenses issued this season to July 1st, 1901, with the date when issued, number of license, and post office of the local dealers.

Date of Issue.		Name.	P. O. Address.	No. of License.
1900.				
Oct.	3	Adair & McCarty Bros	Atlanta, Ga	4
"	15	Armour Fertilizer Works	Kansas City, Mo	29
"	50	Alabama Fertilizer Co	Montgomery	37
Nov.	19	Adamson & Edwards	Ophelia	53
Dec.	14	Acree, O. A. C	Newton	68
"	27	Adamson, Edwards & Co	Ophelia	86
"	29	Allridge & Shelton	Brooksville	87
"	31	Allen, C. B	Ashland	95
1901.				
Jan.	7	Andrews, W. T	Gold Hill	133
"	11	Andrews & Co	Camp Hill	172
"	12	Alston, S. F	Tuscaloosa	174
"	12	Akin, J. C	Notasulga	178
"	15	Alston & Farrow	Wetumpka	184
"	15	Adkinson, D. I B	Florala	189
"	15	Atkins, V. B. & Co	Selma	193
"	15	Akin, J. C	Camp Hill	206
"	15	Agee, R. H. & W. C	Selma	252
"	15	Ashepoo Fertilizer Co	Charlston, S. C	265
"	17	Atkinson & Atkinson	Jemison	319
"	17	Atkin & Allgood	Thornton	341
"	21	Albritton, E. S	Warrior	400
"	21	Ashhurst, J. V	Tallassee	416
"	22	Arnold, W. A	Ozark	424
"	23	Allen & Co., R. W	Lafayette	441
"	23	Atkins, L. C. & Co	Langston	445
"	25	Atkins, Jos. M	Brompton	467
Feb.	1	Adams, J. E	Welden	512
"	4	Arant, J. M. & Sons	Waverly	533
"	5	Abecrombie, A. J	Leeds	545
"	7	Atkins, B. C	Reform	561
"	8	Amos, G. H	Duck Springs	573
"	13	Agee, W. P	Perdue Hill	594
"	19	Allen, L. M. & Co	Phil Campbell	625
"	19	Abecrombie, J. H	Leeds	636
"	19	Anthony, W. L	Hurtsboro	637
"	20	Ash & Crandall	Birmingham	652
"	20	Alderhold, J. L	Piedmont	656
Mch.	16	Appling Mercantile Co	Oakman	750
"	19	Adams, J. G	Anniston	757

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
Mch.	26	Awbry, J. J	Mason, Ga	771
Apl.	4	Atkins & Owens	Heflin	785
"	22	Alford, J. C. & Son	Childersburg	803
1900				
Oct.	3	Bailey, W. E	Aster	11
"	11	Birmingham Fertilizer Co	Birmingham	26
Dec.	10	Brantley, T. K. & Ivie	Troy	58
"	10	Butler, Cole & Co	New Hope	61
"	13	Buford & Co	Hartford	67
"	22	Bank of Enterprise	Enterprise	81
1901				
Jan.	2	Benson Henderson & Co	Andalusia	101
"	4	Beeland, J. T. & Bro	Greenville	114
"	7	Brice, J. A	Oneonta	130
"	7	Brown. J. A	Kellyton	136
"	8	Bates, J. T	Plevna	138
"	8	Butler, F. T. & J. C	Paint Rock	146
"	14	Brannon & Henderson	Troy	199
"	15	Brown, W. S	Birmingham	234
"	15	Bradley Fertilizer Co	Charleston, S. C	249
"	15	Bean & McMurry	Heflin	254
"	15	Beach, H. M. & Son	Columbia	258
"	16	Brown, J. W	Sylacauga	278
"	16	Brown, W. D	Gravella	292
"	17	Beale Bros	Luverne	314
"	17	Barnes, Jasper E	Dothan	317
"	17	Beason, J. L. & Co	Whitney	320
"	17	Boon, Alonzo	Camp Hill	334
"	17	Bullard, Bartow	Elba	342
"	17	Barfield Bros	Barfield	343
"	17	Bell, C. W. & Sons	Lineville	344
"	18	Blackburn, J. W. & McConnel	Fayette	349
"	18	Butler, C. H	Childersburg	351
"	18	Bullock, J. A	Shorter	364
"	19	Bellinger, W. C	Gadsden	375
"	19	Bodiford, W. H	Abbeville	380
"	21	Britt & Johnson	Wetumpka	388
"	21	Bryan, T. L. & Co	Ozark	395
"	21	Bains Bros	Cleveland	397
"	21	Burns & Beavers	Lincoln	398
"	21	Brake, J. L	Warrior	399
"	21	Barnett, W. W	Geneva	401
"	23	Beyer, F. & Son	Cullman	444
"	25	Brantzy, T. M	Kennedy	465
"	25	Baird, S. J	Guin	468
"	25	Bynum, W. H	Boaz	469
"	29	Blackwood, D. R	Cleveland	488
"	30	Butler, J. E	New Hope	497
"	30	Brodbeck & Zundel Bros	Point Clear	498
"	31	Boyett Bros & Rodgers	Andalusia	507

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1901.				
Jan.	28	Bear, Lewis & Co	Pensacola, Fla	481
..	28	Brawner & Brawner	Castlebury, Ala	482
..	28	Burt, R. A	Collinsville	483
Feb.	1	Bell J. J	Florala	515
	2	Banks, T. C	Attalla	522
..	2	Burks & Coston	Brantley	526
..	4	Brundridge Banking Co	Brundridge	529
..	4	Bynum, T. D	Bynums	532
..	7	Bowdon, C. P	Gordon	555
..	7	Boreland, J. B. & Co	Pinckard	564
..	11	Burgess, J. L	Scottsboro	587
..	13	Blansitt Bros	Sulphur Springs	596
..	13	Brown & York	Boaz	606
..	13	Bell, W. R	Goddard	614
..	16	Barton, W. M	Lynn	623
..	16	Baits, G. J. & J. W	Toney	629
..	19	Black, Jas. A	Luverne	647
..	20	Bryant & Williams	Notasulga	653
..	25	Baccus, W. B. & Son	Baccus	670
M^ch^.	5	Baker, D. W	Goodwater	683
..	5	Boazman, Tom	Marcoot	686
..	7	Byers, Mrs. Ada V	Ashville	697
..	11	Babcock, H. T	Troy	714
..	12	Blackburn, N. W. & Co	Leesburg	733
..	16	Braswell, M. L	Pleasant Gap	740
..	21	Brittain, J. C	Summit	761
..	14	Butler & Collier	Gurley	796
..	26	Banks & Owen	Hurtsboro	806
May	4	Banks, R. D	Jackson's Gap	809
1900.				
Oct.	3	Continental Fertilizer Co	Nashville, Tenn	7
..	31	Campbell & Wright, Jr	Roanoke, Ala	39
Nov.	20	Cowart, J. H. & Co	Goshen	55
Dec.	10	Cameron, Jas. A	Columbiana	63
..	12	Covington, J. I	Bertha	66
..	15	Cassels Bros	Gadsden	70
..	21	Cross, W. S	Pelham	78
..	29	Coley & Sandlin	Alexander City	92
1901.				
Jan.	5	Carlisle, M. W. & Bro	Roanoke	125
..	5	Crew, C. M	Goodwater	126
..	7	Cox, L. O	Boaz	127
..	9	Cullman Cotton Co	Cullman	149
..	11	Clark & Parker Bros	Searight	166
..	12	Crump, J. C. & Son	Sand Mountain	177
..	14	Copeland, J. S	Troy	200
..	15	Crumpton, W. E	Maplesville	216
..	15	Cawthon, W. C. W	Andalusia	224
..	15	Carter Co., The J. H	Cullman	225
..	15	Cleveland, M. L. & Co	Randolph	245
..	15	Cameron Bros	Notasulga	237

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1901.				
Jan.	15	Carney, W. M. & Co	Atmore	239
..	15	Cantelou, Lamar & Son	Wetumpka	262
..	16	Cross, Fred	Portersville	271
..	17	Crew, B. F	Goodwater	322
..	17	Carter, Jno. S	Haleyville	333
..	17	Cole, G. P	Loachapoka	339
..	17	Cornelius, H. M	Walnut Grove	347
..	19	Carroll, J. S	Troy	371
..	19	Chapman & Co	Geneva	379
..	21	Crew, J. W	Elamville	389
..	21	Campbell & Wright	Tuskegee	391
..	21	Capps, D. W	Capps	405
..	21	Carroll & Watson	Watford	406
..	23	Cobb, H. C	Millbrook	431
..	23	Columbia Fertilizer Co	Columbia	432
..	23	Colquitt Bros	Luverne	434
..	23	Chadwick & Brice	Snead	435
..	23	Curry, W. W	Albertville	438
..	23	Carr, J. A	Carrville	446
..	28	Collins, N. S	Collinsville	476
..	28	Collins, J. R	Bankston	480
Feb.	1	Chapman & Warren	Georgiana	509
..	1	Cosper, R. E	Sterrett	517
..	4	Collins, H. D	Fayette	541
..	8	Coxwell, Jno. M	Perdue Hill	571
..	9	Carleton & Co	Dudleysville	582
..	13	Clarke & Harwell	LaGrange, Ga	589
..	16	Cope, A. M	Union Springs, Ala	627
..	20	Crutchen & Ward	Cuba	654
..	23	Cox, W. H	Springville	667
Mch.	5	Collins, The Co	Warrior	677
..	5	Costin, J. W. & Co	Luverne	692
..	9	Cartwright, R. N	Cartwright	704
..	11	Crew, R. A. & Son	Goodwater	717
..	12	Cooper, J. F	Fax	729
..	16	Clem, R. M	Fairmount	738
..	16	Coleman & McAlpin	York	744
..	16	Clements, N. B	Oregonia	747
..	30	Crump, H. C	Sedden	779
April	6	Cothran, T. E	Alexis	791
..	22	Crow Bros	Jacksonville	804
1900.				
Oct.	22	Davenport, N. S	Valley Head	32
Nov.	12	Dothan Guano Co	Dothan	48
1901.				
Jan.	4	Dawkins, W. T	Abbeville	109
..	8	Dean, J. J	Charlton	140
..	10	Davie, B	Clayton	161
..	10	Donaldson & Shaw	Haleyville	163

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1901				
Jan.	14	Dyer, W. C	Stanton	197
"	15	Dennis, J. A. & Co	Ansley	209
"	15	Dent, Geo. H	Eufaula	243
"	15	Dan, J. P	Milport	246
"	16	Dumas, O. & C. P	Arlington	294
"	16	Davis, W. C. & Co	Sand Mountain	298
"	16	Draper & Co	Oxford	303
"	17	Dailey, M. W	Avoca	338
"	18	Dorman, Jas. F	Carrville	350
Nov.	21	Davis, E. R	Rock Run Station	402
"	21	Darrow, E. J	Coats Bend	404
"	23	Duncan, E. P	Alexander City	440
"	24	Downey, J. W. & T. B. Chattin	Section	450
Feb.	4	Dyar, C. M. & L F	Reedbrake	536
"	5	Deramus, D. I	Verbena	546
"	6	Downs, J. B	Clanton	551
"	11	Dunn, A. M	Elamville	588
"	13	Doughty, J	Fayette	610
"	19	Decatur Warehouse & Milling Co	Decatur	643
"	25	Davenport, E. T. & Co	Valley Head	671
Mch.	5	Dunlap, W. R	Wolf Creek	678
"	5	Davis, Marshall & Co	Mobile	695
"	12	Duncan, R. A	Dickson	727
"	16	Davis, Chas. S	Hurtsboro	743
Apl.	9	Dean, J. I	Red Level	789
1900				
Oct.	12	Elrod & Gibson	Collinsville	28
Dec.	28	Earle, Terrell & Co	Birmingham	88
1901				
Jan.	15	Emmett, L. S., Son & Co	Albertville	253
"	16	Edmonson, R. Q. & Bro	Eufaula	281
"	18	Espy, Jno. R	Gordon	355
"	22	Ellis, J. M. & Son	Union Springs	430
"	26	Evens Bro's	Heflin	473
Feb.	1	Echols & Hargrove	Hartselle	519
"	5	Ellison, W L	Walnut Grove	543
"	7	Edwards, J. B	Talladega	554
"	19	Eubanks & Cheney	Piedmont	642
"	20	Edwards, R. D	Sylacauga	650
Mch.	16	Elliott, J. A & Son	Moundville	746
"	16	Evens, D. H	Hillion's Store	749
May	17	Elington, S. M	Munford	815
1900				
Oct.	3	Furman Farm Improvement Co	Atlanta &E't Pt.,Ga	5
Nov.	15	Farmers & Merchants Bank	Troy	50
Dec.	14	Foy, Cliff & Bro's	Abbeville	69
"	20	First Bank of Elba	Elba	76
1901				
Jan.	4	Folmar, W. B	Troy	111
"	4	Frazen & Olson	Thorsby	112

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1901				
Jan.	4	Flynt, H. L	Guntersville	117
..	5	Folmer, Walden & Byrd	Enterprise	121
..	10	Farley, Jno. C.	Opelika	162
..	14	Farmers Alliance Co-operative Co.	Opelika	191
..	14	Farrow, T. L	Guntersville	203
..	15	Fuller, Foshee Mercantile Co	Brewton	222
..	15	Fuller, J. H. & Sons	Alexander City	255
..	19	Farnham, J. H	Evergreen	369
..	22	Fleming, W. L. & Son	Brundidge	425
..	23	Forrester, R. B	Cowarts	439
..	30	Fountain, H. B	Albertsville	502
Feb.	4	French, J. E.	Brundidge	528
..	19	Flippo & Phillips	Bear Creek	646
..	23	Farrell, J. D	China Grove	669
Mch.	5	Fort Gaines Oil and Guano Co	Fort Gaines, Ga	675
..	12	Foust, V	Rosa	726
..	13	Feagin, T. K	Feagin.	734
..	16	Fruitdale Lumber Co	Fruitdale	748
..	19	Frames, J. H	Slate	756
..	26	Farrin, A. J	Ohatchee	754
..	28	Fielder, J. B	Loachapoka	772
..	28	Fields, A. S	Fern Bank	774
1900				
Oct.	3	Goulding Fertilizer Co	Pensacola, Fla	8
..	6	Georgia Chemical Works	Augusta, Ga	22
..	8	Grisham, J. M	Whitehead.	24
Dec.	10	Gadsden Installment House	Gadsden	59
..	19	Gadsden Cotton Seed Oil Co	Gadsden	74
1901				
Jan.	3	Gulledge, F. A	Verbena	104
..	3	Goldthwaite, Robt	Montgomery	108
..	14	Guthrie Bros	Sulligent	179
..	15	Gary, Kennedy & Co	Selma	228
..	15	Griel Bro's & Co	Montgomery	241
..	15	Guin Bro's	Kennedy	245
..	16	Gilbert, R. F	Portersville	278
..	16	Grady, J. W	Stroud	282
..	16	Guntersville Dry Goods Co., The	Guntersville	304
..	16	Grant Bro's	Louisville	307
..	17	Gilliland, C. H. & Sons	Goodwater	325
..	17	Gray, J. B. & W. W. Gulledge	Ohatchie	336
..	19	Gunter, G. W	Brockton	382
..	21	Gunter & Ealum	Gantt	409
..	24	Green, Jas. F	Arthur	451
..	28	Green, Alex	Thomasville	486
..	39	Green & Mullins	Active	496
Feb.	2	Gallant, J. A	Gallant	525
..	4	Glenn Bro's	Branchville	534
..	7	Golden, B. F	Thaddeus	558
..	13	Graham, J. R	Boliver	590

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1901.				
Feb.	13	Gage. W. A. & Co	Town Creek	592
"	13	Graves & Burdine	Deposit	598
"	13	Grace, J. W	Elkmont	611
"	14	Gilbert, J. J. & Sons	Gold Mine	615
"	16	Gilbert, John R	Pinckneyville	630
"	22	Gilliland, M. E	Hill	659
"	22	Griffith, Asa	Hanceville	660
Mch.	5	Griffis & Son	Sedden	676
"	5	Gray, Wm	Dadeville	685
"	9	Griffith, G. F	Hokes Bluff	705
"	12	Guin, P. C	Covin	731
"	12	Gable & Clapp	Gum Springs	732
"	19	Gilbert, P. N	Coalville	758
"	30	Gammill, J. W	Camp Hill	775
Apl.	23	Gooday Bros	Daphne	799
May	4	Goldson Harper & Son	Brocton	808
"	4	Gray, W. C. & Co	Oxford	811
1900.				
Oct.	3	Home Mixture Guano Co	Columbus, Ga	9
"	11	Helm Bone Fertilizer Co	Birmingham	25
"	33	Howe & Co	Stevenson	34
"	31	Holman, H. C	Ozark	40
Nov.	15	Henderson, Fox	Troy	51
Dec.	10	Ham, P. J. & Sons	Elba	60
"	19	Henderson, Rainer & Hill	Brantley	75
"	21	Howell, J. R. G	Dothan	77
"	22	Henderson, Holloway & Co	Enterprise	82
	31	Hester, R. B. & Son	Roanoke	93
"	31	Holly & Lindsay	Abbeville	94
1901.				
Jan.	1	Henderson, J. D. & Co	Searight	99
"	2	Hill, Jones & Co	Roanoke	102
"	3	Hill & Shaffey	Dadeville	106
"	4	Hilton, Bentley & Cosby	Brantley	113
"	4	Hatton, D. J. & Son	Wait	115
"	4	Howard, J. M	Albertville	168
"	4	Howle, T. A. & Co	Oxford	173
"	14	Herring, T. J	Midland City	194
"	16	Hilliard, W. L	Troy	198
"	14	Henderson, J. Robt	Fullerton	205
"	15	Henderson & Waters Bros	Brundridge	218
"	15	Howle Bros	Wetumpka	230
"	15	Hertzler & Anderson	Madison	231
"	15	Howison, Allen P	Randolph	286
"	16	Henderson, Chas	Troy	269
	16	Henry, S. W	Springville	272
"	16	Harrison, W. D. & Co	Ashford	295
"	16	Henderson, J. H	Cross Keys	300
"	16	Hartsell, J. C, & Son	Hartselle	310
"	17	Hooper, C. W. & Co	Selma	323

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1901.				
Jan.	17	Hughes & Bros	Flolala	329
	18	Harwell, W. O	Opelika	354
	19	Hixon, S. D. & D. A	Perote	387
	21	Head, T. L	China Grove	403
	21	Hughes, D. D	Labanon	414
	21	Hooper, A. B	Alexander City	415
	22	Haralson, J. B	Langston	416
..	22	Haynes, D. P. & Bro	Oxford	428
	23	Hartsell, J. P	Hartselle	442
	23	Hoffman & Graves	Waverly	443
	23	Hixon Bros	Hixon	447
	24	Haynes, Parker & Co	Lineville	448
	24	Haight, J. H. & Son	Fruitdale	453
	24	Hicks, W. W. & Co	Dadeville	455
..	25	Harrell, W. F	Bangor	460
..	29	Hodo, J. B	Millport	489
..	30	Hammond, M. W	Marl	493
..	30	Hood, J. M. & Son	Albertsville	501
..	31	Heard & Lee	Camp Hill	506
Feb.	1	Hamilton, M. D. & Co	Guin	514
..	1	Herrin & Oliver	Dadeville	531
..	4	Head & Warren	Gum Springs	547
..	6	Hicks & Heard	Camp Hill	548
..	6	Hodges, J. A	Ashville	570
..	6	Hightower, C. B	York Station	578
..	6	Haley Bros	Hayleyville	579
..	6	Hamilton, N. O	Ragland	581
..	6	Hood, Yielding & Co	Birmingham	584
..	6	Hood, Robt	Kymulga	602
..	6	Henderson & Black	Troy	604
..	6	Henderson, Alex. & Co	Troy	605
..	6	Hamilton, B. F	Coal City	617
..	6	Herston & Barnes	Garland	673
..	6	Hitchcock, J. G. & Son	James	690
..	6	Hearn & Wood	York	700
Mch.	8	Harris & Sherrod	Courtland	703
..	8	Harkins, Max & Clyde	Fayette	718
..	11	Hudson, F. N	Blountsville	741
..	16	Hargrove, J. H	Hartselle	760
..	21	Hendrix, S. T	Peterman	762
..	30	Hodges Mercantile Co	Ashville	780
Apl.	5	Hollinsworth & Co	Millin	787
..	10	Haynie, A. C	Hurtsboro	792
..	22	Hines & Son	Standing Rock	800
..	25	Hall, J. A	Pea Ridge	805
Dec.	6	Ingram & Co	Anniston	64
Jan.	15	Ivey, J. W	Rutledge	211
Feb.	4	Ingram & Trawick	Opelika	537
..	19	Ivey, Chas	Evergreen	638

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Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1900			
Oct. 23	Jones, J. B	Fayette	35
Dec. 29	Johnston, Geo. A	Clayton	91
1901			
Jan. 15	Jones, V. D	Troy	238
" 15	Johnson, W. A	Rutledge	256
" 18	Johnston, Thos. L. & Co	Gadsden	359
" 21	Jennings, B	Tuskegee	390
" 21	Jordan, H R. & Son	Collinsville	392
" 22	Jackson, Jess H	Grand Bay	420
Feb. 1	Jemison, S. E	Sunny Side	511
" 2	Johnson, L. M	Alexander City	523
" 8	Johnson, J. J	Geneva	577
" 13	Jackson, Geo. W	Mount Hope	591
Mch. 5	Johnson, J. E	Chattanooga, Tenn	694
Apl. 5	Jones, A. F	Talladega	786
1900			
Oct. 18	Killian, H. H	Branden	30
1901			
Jan. 11	King, H. S	Searight	167
" 11	Kelly & Segrist	Midland City	169
" 16	Kyser, Geo. W	Ripton	277
" 16	Kroell, Geo	Montevallo	279
" 16	King, F R. & Co	Leighton	312
" 19	King, Claude	Leighton	386
" 21	Klaus, J & Co	Huntsville	413
" 22	Kitchens, J. W. & Bro	Heflin	421
" 24	Kelly, D. E. & J. O	Jeff	457
" 28	Kelly, Walter	Normal	497
" 28	Killen Dry Goods Co., The	Fort Payne	484
Feb. 6	Kennedy, J. A	Loop	552
Mch. 9	Kinney, P. H. & Co	Navvoo	705
Apl. 5	Keener, D. P	Keener	784
1900			
Oct. 3	Louisville Fertilizer Co	Louisville, Ky	14
Dec. 11	Long Bro's	Jasper	65
" 21	Long-Richardson Mercantile Co	Jasper	80
1901			
Jan. 2	Law, Edmons & Byrd	Enterprise	97
" 5	Lester & Co	Columbiana	123
" 7	Leach, R. R	Liberty	135
" 8	Land, J. G	Cullman	145
" 9	Loeb, J. & Bro	Montgomery	147
" 12	Lauderdale, A. R	Goodwater	175
" 14	Lull & Lacy	Wetumpka	202
" 15	Lazinby, Reynolds & Co	Forest Home	212
" 15	Langston, J. N	Jemison	217
" 15	Little, Chas. E	Auburn	247
" 15	Law & Davis	Lincoln	261
" 16	Lidden, F. B. & Co	Gordon	284
" 16	Lane Bro's	Sylacauga	291

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1901				
Jan.	18	Leath, Scott	Cullman	357
"	18	Leeman, E. D	Athens	365
"	19	Landers Bro's	Heflin	383
"	23	Long, T	Greenville	433
"	28	Latham, S. A. & Co	Montevallo	478
"	29	Livingston, Y. C	Notasulga	487
"	30	Long, C. W	Granger	495
Feb.	7	Lowery, W. W. & Co	Atmore	563
"	7	Long, W R	Lynn	565
"	13	Legg, Joel W	Elkmont	595
"	13	Lagney, H. W	Eden	607
"	13	Linn, W. W	Falkville	612
"	13	Logan, W. J. P	Benson	613
"	16	Laxon & McCord	New Market	621
"	19	Landham, J. R. & Co	Anniston	632
"	22	Lewis & Estes	Athens	661
Mch.	9	Lile, J. L	Trinity	707
"	18	Lumpkins, J. B. H	Jacksonville	755
"	30	Lowe, A. S	Hazel Green	781
Apl.	10	Lyon, R. L	Riley	794
"	10	Lee, W. A	Glen Allen	795
"	26	Lefils, W. F. & Son	Easonville	807
May	28	Lloyd, Ellison & Co	Creek Stand	812
1900				
Oct.	3	Marietta Guano Co	Atlanta, Ga	2
"	3	Mobile Phosphate Co	Mobile	10
"	3	Meridian Fertilizer Factory	Meridian	13
"	3	Montgomery Fertilizer Co	Montgomery	19
"	30	Marks & Gayle	Montgomery	36
Nov.	12	Malone & Sons	Dothan	47
Dec.	19	Meadows, Smith T. & Co	Opelika	73
"	31	Mullins, W. I	Clanton	96
1901				
Jan.	3	Manley, Hornsbey & Handley	Roanoke	107
"	7	Mills, J. B	Abbeville	129
"	7	Milner, Henry	Columbiana	131
"	8	Moon & Harris	Lineville	139
"	14	Macon, W. H	Wetumpka	183
"	14	Masterson, T. C	Arcola	204
"	15	Moody, J. W. & Son	Brompton	233
"	15	Middlebrook, J. Z	Elamville	250
"	16	Maxwell, C. R	Northport	287
"	16	Metcalf, P. M	Hartford	296
"	16	Miller, Lovelace & Co	Dadeville	306
"	17	Mizell & Bro	Ozark	316
"	17	Mayo, A. B	Talladega	329
"	17	Milligan, W. G	Heflin	345
"	17	Mahan, W. H. & Son	Randolph	348
"	19	Murphree, Joel D	Troy	370
"	19	Murphree, J. D Jr., Cashier	Troy	379

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1901			
Jan. 21	Myers, H. J	Langston	396
" 30	Moog & Weil	Battles	500
Feb'y. 4	Murdock, E. H. & A. S	Coffee Springs	542
" 7	Moore, Chancey & Pepper	Phil Campbell	559
" 16	Mays & Winter	Waverly	625
" 23	Merritt & Adams	Geneva	666
Mch. 5	Melton & Co	Pine Apple	682
" 5	Mills, W. R. & Sons	Pine Apple	688
" 7	Maroney, C. L. & Co	Montevallo	696
" 9	Miller & Sons	Oxford	708
" 11	Mathews, J. E	Flint	715
" 16	Moore, S.	Courtland	753
Feb. 7	Mayberry, W. C & Sons	Waverly	562
" 8	Moore, W. S	Perdue Hill	572
" 8	Montgomery Bros	Lincoln	575
" 8	Miller & Barnett	Berry	576
" 13	Mapes, M. A.	Phil Campbell	600
Jan. 4	McClung, F. M	Coats Bend	120
" 8	McEntine & Millard	Hanceville	144
" 9	McNaro & Pitman	Albertville	148
" 14	McKenzie, W. F	Greenville	193
" 15	McGehee, Driver & Co	LaFayette	227
" 15	McEntyre, Henderson & Adams	Ozark	240
" 16	McGowen, W. E	Cuba	302
" 16	McDonald, T. C	Luverne	305
" 17	McClusky & Co. and Boaz Gin Mill Co	Boaz	346
" 22	McMillan & Harrison	Mobile	413
" 25	McEntire Bros	Cullman	466
Feb'y. 4	McCallet, James E	Deposit	535
" 4	McCluney & Miller	Coats Bend	538
" 7	Mackentepe, J. W. & Son	Cullmaan	569
" 16	McWorter, A. J	Stricklin	624
" 20	McIntyre & Sellers	Ashford	655
Mch. 5	McEntyre, T. H. & Co	Coffee Springs	679
" 7	McCrackin & Baker	Berry Station	698
" 28	McQueen, J. S. & Co	Greenville	773
1900			
Oct. 3	N. O. Acid and Fertilizer Company	New Orleans, La	16
Nov. 3	Navassa Guano Co	Wilmington, N. C.	43
Dec 24	National Fertilizer Co.	Nashville, Tenn	84
1901			
Jan. 3	Newman, Robert	Abbeville	103
May 15	Neighbors, J. A. & Co	Goodwater	264
" 9	Neighbors, T. L. & Bros	Goodwater	152
" 15	Newton, W. F	Dothan	221
" 16	Nichols, J. A	Childersburg	286
" 21	Nation & Pate	Liberty	407
Jan. 21	Noble, M	Avery	408
" 29	Northcutt, J. A	Winfield	491
Feb'y. 1	Newton, W. M	Bellville	513

LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of Licenses.
1901			
Feb'y. 7	Nolan Bros	Alexander City	556
" 16	Nelson, Mrs. A. B	Walnut Grove	622
" 16	Nixon, W. D	Merrellton	626
" 20	Neher. E. J	Holleywood	648
Mch. 12	Nettles, T. A	Kempville	725
" 15	Nicholson. L. S	Collinsville	736
" 25	Norwood & Co	Ft. Deposit	765
" 30	Nix, Thomas	Travis	778
1900			
Oct. 3	Old Dominion Guano Co	Atlanta, Ga	15
" 3	Opelika Chemical Co	Opelika	20
" 30	Ozark C. S. Oil Mill Fert. Co	Ozark	38
1901			
Jan. 14	Ober. G. & Sons Co	Baltimore, Md	185
" 16	Oakley, W. F	Columbia	290
" 17	Ogletree, T. W	Eastaboga	337
" 18	Overton, E. A	Huntsville	363
" 19	Ogden, F. & Sons	Sulligent	381
Jan. 2	Oldfield, John M	Hazel Green	410
Feb. 14	Oliver, J. M	Dadeville	618
Mch 11	Overstreet, W. W	Greensboro	719
1900			
Nov. 2	Patrick, P. A	Florence	41
Dec. 29	Perryman, Bros	Heflin	90
1901			
May 2	Presswood, J. A	Andalusia	100
" 4	Pilcher, Geo. W	Dothan	110
" 5	Pinkard, E. M	Clanton	124
" 9	Pittman, A. J	Wehadkee	150
" 9	Pilcher, W. C	Dothan	154
" 10	Patton & Archibald	Foster	158
" 11	Phillips, J. R. & Co	Bear Creek	170
" 14	Pridley, W. G	Sulligent	180
" 14	Pinkston, J. C	Shorter	195
" 15	Planters and Merchants Bank	Ozark	220
" 15	Platt and Long	Kennedy	244
" 15	Phillips Bros	Oxford	260
" 15	Pacific Guano Co	Charleston, S. C	266
" 15	Patapsco Guano Co	Baltimore, Md	267
Jan. 16	Parish, T. R. & Bros	Clayton	275
" 16	Pope, J. F. & Co	Vincent	289
" 16	Parker, James M	Equality	297
" 16	Pearce, J. P, Son & Co	Carbon Hill	309
" 16	Pearson, H. W	Alexander City	311
" 17	Planters Warehouse and Commission Co	Eutaw	326
" 18	Patterson, M. F. & Son	Falkville	356
" 18	Pope, G. W. & Co	Luverne	367
" 19	Perkins, Jr., W. W. Estale	Springville	378
" 21	Phillips & Goddard	Clarence	393
" 21	Porter & Foster	Town Creek	412

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901				
Jan.	25	Porter, C. J. & Co	Jacksonville	464
..	26	Perry, W. C	Seale	471
..	26	Pearce, Jim & Co	Guin	475
..	30	Pierce, W. S. & Co	Louisville	503
..	31	Pope, J. F	Wilsonville	504
..	31	Pearce, J. M	Pearce's Mill	508
Feb.	1	Prattville Mercantile Co	Prattville	521
..	8	Pride, W. G. & Bro	Madison	568
..	9	Pope, M. F	Fayetteville	580
..	3	Payne, J. M	New Market	597
..	3	Probst Bros	Fayette	608
..	16	Patterson, J. B	Mid	628
..	16	Pressly & Co	Springville	631
..	26	Peacock, S. D	Garland	672
Mch.	5	Pilley, R. L	Georgiana	681
..	5	Patterson Bros	Pine Apple	687
..	5	Porter & Stewart	Munford	689
..	8	Pridgen, J. M	Key	702
..	9	Pruett & Pruett	Goodwater	711
..	12	Pully, C. H. & Co	Huntsville	723
..	16	Pitts, W. M	Union Springs	742
	26	Phillips, J. P. & Co	Ashville	766
Apl.	17	Penny, M. F	Hoke's Bluff	797
May	5	Parker, C. C. & Co	Albertville	810
..	18	Pepper, W. J	Phil Campbell	814
1900				
Oct.	22	Read Phosphate Co	Nashville, Tenn	33
Nov.	3	Rasin-Monumental Co	Baltimore, Md	44
Dec.	3	Rome Guano Co	Rome, Ga	57
1901				
Jan.	2	Rainer Bros	Troy	98
..	4	Rogers, J. W	Burleson	116
..	7	Rhodes & Bro	Georgiana	128
..	7	Riddle, A. J. & Son	Arab	134
..	7	Rouse, L. D	Wetumpka	137
..	9	Reynolds, H. C. & W. B	Centreville	151
..	9	Robertson & Floyd	Opelika	153
..	10	Rice & Russell	Arab	164
..	14	Riddle, D. H	Goodwater	181
..	15	Riddle, S. W. & Co	Gadsden	215
..	16	Rhodes Mill & Mercantile Co., The N. M.	Shell	299
..	17	Ramage, Jas. T	Brundidge	335
..	18	Reynolds Bros	Jemison	361
..	19	Russell, R. A. & Co	Gaylesville	373
..	19	Reaves, Launders & Co	Heflin	384
..	21	Russell Bros	Attalla	394
..	22	Rainer, S. P	Union Springs	429
..	24	Roe, S. N	Elba	452
..	24	Reynolds, E. H	Notasulga	458
..	25	Riley, F. M	Riley	463

LICENSES—Continued.

Date of Issue.		NAME.	P. O. ADDRESS.	No. of License.
1901				
Jan.	26	Read & Co	Edwardsville	472
..	29	Reynolds, J. F	Nottingham	490
..	30	Rigsby & Camp	Phil Campbell	494
..	30	Randall & Son	Daphne	499
Feb.	1	Robertson, Robt. C	Fayette	510
..	1	Ryan & Co	McGuinn	518
..	13	Rentz & Turner	Thomasville	593
..	19	Robertson, Jas. R. & Son	Cropwell	633
..	19	Roberts, G. W	Collinsville	645
..	20	Russell, W. W	Fort Payne	649
..	23	Ranschenburg, C. F	Spruce Pine	664
Mch.	8	Rodgers, T S,	Morris	701
..	9	Rice, C. E	North Port	713
..	11	Reynolds, H. C & W. B	Blocton	716
..	11	Reynolds. Walker	Rendalia	724
..	12	Roberts, J. E	Pleasant Gap	739
..	16	Rosser & Johnson	Dadeville	745
..	21	Roberts, W. I	Fayette	759
..	22	Roy, J. D	Deatsville	763
..	26	Robbins & McGowan Co	Brewton	767
1900				
Oct.	3	Stumpe, J. M	Florence	1
..	3	Swift Fertilizer Works	Atlanta, Ga	12
..	3	Standard Guano & Chemical Mfg.Co	New Orleans, La	17
Dec.	10	Smith, R. H	Collinsville	62
..	15	Stewart, W. A	Dawson	71
..	17	Savannah Guano Co.	Savannah, Ga	72
..	21	Sanders, J. G. & John	Dothan	79
..	22	Stokes, R. E	Abbeville	83
..	28	Snead, J. H	Boaz	89
1901				
Jan.	3	Snead, Jas. E	Snead	105
..	4	Sellers & Orum	Montgomery	119
..	7	Schuessler & Co	Roanoke	132
..	8	Stiefelmeyer, C. A	Cullman	142
..	10	Snead, C. E. & Bro	Boaz	160
..	14	Smitherman, H. M	Goodwater	182
..	14	Smith Bros. & Co	Warrenten	186
..	14	Stiefelmeyer, C. A	Hanceville	187
..	14	Stewart, S. E	Hartselle	188
..	15	Stephens, S. B	Petrey	208
..	15	Schloss & Kahn	Montgomery	210
..	15	Sellers, W. R	Troy	223
..	15	Savage, Chas. B	Evergreeen	226
..	15	Sturkie & Duke	Gadsden	229
..	15	Shepherd, Z	Georgiana	242
..	15	Sanders, G. A. & Son	Luverne	257
..	16	Stewart, T. F	Spring Garden	288
..	16	Schiffman, S. & Co	Huntsville	301
..	16	Sibert, W. J	Gadsden	308

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901				
Jan.	16	Scholze & Bro	Chattanooga, Tenn	312
..	17	Simms & Bro	Blountsville, Ala	315
..	17	Spraggins, J. R	Hackleburg	318
..	17	Shorter, E. S. & Co	Eufaula	324
..	17	Shipp & Co	Albertville	328
..	17	Stanley Bros	Jasper	331
..	17	Scarborough, W. A. & Co	White Plains	332
..	17	Shellmet N. S	Welsh	340
..	18	Storey, The A. G. Mercantile Co	Talladega	353
..	18	Snodgrass, J. D	Scottsboro	360
..	18	Sanders & Son	Columbia	362
..	19	Smith, J. W	Cooper	377
..	19	Smith, M. S	Selma	385
..	22	Smith & Davis	Fort Payne	426
..	23	Schuessler Bros	LaFayette	436
..	23	Selman & Co	Albertville	437
..	24	Self, E	Selfville	454
..	24	Smith, G. H	Ealums	456
..	25	Sellers, C. W. & Sons	Inverness	459
..	26	Stark, W. E	Seale	470
..	28	Stokes, Sessions & Co	Ozark	485
Feb.	1	Sessions & Mizell	Enterprise	516
..	4	Strock, W. H	Verbena	527
..	5	Stephens, T. H. & H. B	Seaborn	544
..	6	Stonacher, F. W	Luttrell	549
..	7	Schwab Jonas Co	Birmingham	550
..	6	Smith, E S	Argo	552
..	7	Stringfellow, E. M	Reform	560
..	8	Shreve Bros	Andalusia	567
..	13	Smith, Fred	Steels Depot	601
..	19	Smith, M. L	Dadeville	634
..	19	Shaw, W. A	Winfield	641
..	19	Sellman, A. J	Albertville	644
..	22	Stewart, Formby & Co	Piedmont	657
..	22	Sampy, W. L	Gadsden	658
..	22	Sims, J F	Brompton	662
..	22	Stewart & Hazlewood	Eden	663
..	24	Stanford & Collins	Crews Depot	665
Mch.	12	Sellers, R. D. & Son	Omega	728
..	12	Smith, H. B	Yancey	730
..	14	Searight Mercantile Co	Searight	735
..	30	Smith Bros	Sylacauga	776
..	30	Stewart, T. O	Munford	777
Apr.	2	Scott, G. G	Mt. Pleasant	782
..	5	Stewart, B. M. & J. E	Spring Garden	788
..	6	Stone, J. A	Alexis	790
Feb.	17	Skelton, R. S	Scottsboro	798
May	8	Snow, P. H. & J. T. Mosely	Boaz	813
1900				
Oct.	5	Tennessee Chemical Co	Nashville, Tenn	6

LICENSES—Continued.

Date of Issue.	AME.	P. O. ADDRESS.	No of License.
1900			
Oct. 5	Troy Fertilizer Co	Troy	21
" 18	Tallapoosa Oil Co	Alexander City	31
" 8	Thompson & Kelley	Normal	23
Nov. 2	Tennessee Valley Fertilizer Co	Florence	42
" 5	Trawick & Jernigan	Opelika	45
" 14	Talladega Fertilizer Co.	Talladega	49
Dec. 24	Tuscaloosa Cotton Seed Oil Co	Tuscaloosa	85
1901			
Jan. 10	Thomas Bros	Alexander City	157
" 11	Tucker, Willingham & Co	Lafayette	171
" 14	Talley, J. T	Roanoke	190
" 14	Thornton, E. L., Manager	Mountain Creek	196
" 15	Thornton, B. E	Gordo	214
" 15	Turnipseed, W. O	Oxford	259
" 16	Truss, Geo. M. & Co	Springville	273
" 18	Thomas, W. C. & Co	Gold Hill	357
" 19	Teague, S. F	Birmingham	376
" 25	Thomasville Mercantile Co	Thomasville	461
" 26	Thompson, W. C	Hartselle	474
Feb. 1	Thompson, W. C. & Co	Prattville	520
" 4	Talley, Dyer N	Trussville	539
" 7	Towers, W. W	Maple Grove	557
" 8	Thompson, C. W	Tuskegee	566
" 13	Tisdale, W. R	Andalusia	599
" 14	Tabor, Jno. T. & Co	Keener	619
" 19	Teague Bros	Ashville	640
" 20	Thomas & Barwick	Oneonta	651
Mch. 5	Terry, A. T. & Son	Forney	691
" 11	Taylor, G. W	Huckabee	722
" 26	Toney, Harris	Swancott	768
" 26	Trammell & Co	Roanoke	770
1900			
Nov. 26	Union Fertilizer Co	Atlanta, Ga	56
1901			
Feb. 13	Usry, O. E	Hebron, Ala	603
1900			
Oct. 3	Virginia and Carolina Chemical Co	Atlanta, Ga	3
" 11	Virginia and Carolina Chemical Co	Newnan, Ga.	27
Nov. 5	Vandiver & Co., W. F	Montgomery	46
1901			
Jan. 15	Vandegrift. A. B. & Son	Birmingham	251
" 16	Virginia and Carolina Chemical Co	Charleston, S. C	274
" 16	Vaughn, W. B	Elkmont	280
" 16	Vinson Banking Co	Georgiana	293
1900			
Oct. 3	Winston, J H	Jenifer	18
Nov. 16	Winkler, A. G	Greenville	52
" 19	West & McMurry	Roanoke	54
1901			
Jan. 4	Wright, Henderson & Co	Elba	118

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
.n.	5	White & Awbrey	Roanoke	122
"	8	Wood, N. W	Collinsville	141
"	8	Wood, W. J	Abbeville	143
"	9	Williams, T. B	Cullman	155
"	10	Wilhite, W. B	Hartselle	156
"	10	Webb, Jno. C	Demopolis	159
"	11	Walker, Rushton & Co	Rutledge	165
"	21	Walker, J. E	Alexander City	176
"	14	Weathers, Swann & Co	Roanoke,	207
"	15	Warten, Henry	Athens	213
"	15	White & Edmonson	Troy	219
"	15	Woodward, J. B	Talladega	232
"	15	Wilder, R. M	Brantley	248
"	15	Ward, W. L & Son	Selma	263
"	16	Windham, W. C	Troy	268
"	16	Warnock & Sons	Oxford	276
"	16	Whaley, Monroe	Blountsville	283
"	16	Woolf, John P	Piedmont	285
"	17	Wright, A. R	Farill	321
"	17	White, J. B. & Co	Talladega	330
"	18	White & Spigener	Goodwater	352
"	18	Weil, M. H. & Co	Huntsville	366
"	19	Walker & Ashcraft	Kennedy	374
"	21	Willis, J. J. S	Mt. Andrew	411
"	22	Webb & Morgan	Langston	417
"	22	Whitehead, J. B	Winfield	422
"	22	Watkins, F	Opelika	423
"	22	White, M. A	Attalla	427
"	28	Westmoreland, J. E. F	Florence	479
"	29	Walker, J. H	Wolf Creek	492
"	31	Williams, P	Lebannon	505
b.	2	Welden, R. G. & Co	Wilsonville	524
"	4	Wilder, A. C. & Co	Vincent	530
"	4	Welch & Co., Wm	Alexander City	540
"	8	Winn & Son	Clayton	574
"	9	Waite & Maddox	Easonville	583
"	9	Wood, R. R	Childersburg	585
"	9	Wise, G. W	Madison	586
"	13	Wilson & Co	Russelville	609
"	14	Walker, F. M	Dadeville	616
"	14	Williamson, F. F. & Son	Opelika	620
"	19	Walls, H. D	Grant	639
"	23	Woodall, A. W	Springville	668
"	28	Wood & Hattemer	Fort Deposit	674
h.	5	Ward, H. B	Cuba	680
"	5	Windham & Ennis	Hillsboro	693
"	7	Wallace, S. H	Klein	699
"	9	Williams, Pinkney	Lebanon	706
"	9	Walkley, D. W	Wetumpka	712

LICENSES—Continued.

Date of Issue.	Name.	P. O. Address.	No. of [illegible]
1901.			
Mch. 11	Wilson, W. M. & Bro	Clanton	72[illegible]
" 11	Walker, J. T. & J. B	Plevna	73[illegible]
" 11	Wilson, J. C. & Son	Lincoln	75[illegible]
" 11	Williams, J. S	Pansey	75[illegible]
" 11	Winter, Loeb & Co	Montgomery	76[illegible]
" 11	Waldrip, J. R	Hanover	76[illegible]
" 11	White, J. W. Bros	Clayton	78[illegible]
" 11	Windham & Co	Moulton	79[illegible]
" 11	Wedgeworth, Walter E	Akron	80[illegible]
" 11	Wedgeworth, Will M	Greenwood	80[illegible]

FERTILIZER LAWS.

PROVISIONS REGULATING THE SALE OF FERTILIZERS.

378 (139). *Sale or exchange of commercial fertilizers; license required.*—Commercial fertilizers must not be sold or exchanged without a license from the commissioner authorizing the person making the sale or exchange to deal therein. All sales or exchanges made without such license are void.

See citations to section 386 (141).

379 (140). *License; fee; duration.*—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.

380. *Evidence.*—The printed report of a commissioner or a certified copy of the record in his office showing the issuance of a license to sell or exchange commercial fertilizers, and to whom and when issued, is presumptive evidence of the fact that such license was issued to such person at such date. But this provision does not preclude the introduction of the license in evidence.

336 (141). *Dealer must attach tags, else sales or exchange void.*—Before selling or exchanging, or offering to sell or exchange fertilizers, the licensees must attach one of such tags to each bag, barrel or package containing two hundred pounds or any less number of pounds; two tags to each bag, barrel or package containing more than two hundred pounds and not more than four hundred pounds, and one additional tag for each additional two hundred pounds or fractional part thereof, contained in such bag, barrel or package; and a sale or exchange of fertilizers not so tagged is void.

A sale of commercial fertilizers, made in violation of statutory requirements, is void, and no recovery can be had for the price.—Campbell v. Segers, 81 Ala. 59; Steiner v. Ray, 84 Ala. 93; Clark's Cove Guano Co., v. Dowling, 85 Ala. 142; Merriam v. Knox, 99 Ala. 93; Brown v. Adair, 104 Ala. 652; Kirby v. Huntsville Fertilizer & Milling Co., 105 Ala. 529.

When contract of sale made in this State.—Johnson v. Hanover Nat. Bank, 88 Ala. 271; Hanover Nat. Bank v. Johnson, 90 Ala. 549; Brown v. Adair, 104 Ala. 652.

Residence of sellers and place of manufacture of goods are immaterial when delivery made in this State.—Merriman v. Knox, 99 Ala. 93; Brown v. Adair, 104 Ala. 652.

Tags must be attached at the time of the sale; if previously attached, and lost before the sale. others must be supplied, else the sale is void. Clark's Cove Guano Co. v. Dowling, 85 Ala., 142; Kirby v. Huntsville F. & M. Co., 105 Ala., 529.

Action on commercial paper given for the price of fertilizers sold without compliance with statutory requirements cannot be maintained, even by a bona fide purchaser before maturity.—Hanover Nat. Bank v. Johnson, 90 Ala. 549.

When want of license pleaded, burden of proof on plaintiff.—Edisto Phosphate Co. v. Sanford, 112 Ala. 493.

387. *Including tag tax in price of fertilizer vitiates sale.*—Whenever any manufacturer, merchant or other person selling fertilizers shall, directly or indirectly, include such tag tax in the price of the fertilizer sold, such sale is void.

388. *Contracts for sale of fertilizers at fictitious prices; only real market value recoverable.*—In contracts for the sale of fertilizers in which an excessive or fictitious price is put upon such fertilizers with the stipulation that if such fertilizers are paid for on or before a certain date they may be paid for in a smaller sum than such excessive or fictitious price, or in cotton or other produce at an excessive or fictitious price, the difference between the excessive or fictitious price charged for the fertilizers and their real market value shall be held a penalty; and in all suits to enforce such contracts only the real market value of such fertilizers, with the interest thereon, shall be recovered.

38. *Parol evidence competent.*—Parol evidence is competent to show such market price, the situation of the parties and the consideration of such contracts, as in cases of usury, notwithstanding any writing in the premises.

390. (42). *Fertilizers to be submitted to commission.*—Before offering a fertilizer for sale or exchange, the person proposing to sell or exchange must submit to a 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 fertilizers 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.

See citation to section 386 (141).

391 (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 fertilizers or chemicals, 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 value of the principal ingredients as set forth in the preceding section as priced by the commissioner of agriculture at the beginning of each season, and in every case the brand must specifically set forth the percentage contained in the fertilizer section, in the terms of that section.

392 (144). *Fertilizers; what not included in term.*—The term "fertilizer," or "commercial fertilizer," used in this chapter, does not include common lime, land plaster, cotton seed meal, ashes, or common salt not in combination.

393 (145). *Chemist of department.*—The professor of chemistry of the Agricultural and Mechanical College is the official chemist of the department. On the application of the commissioner he must analyze and certify the analysis of all fertilizers, samples of which are furnished him; and, at the request of the commissioner, if he can without conflict with his duties as professor, must attend conventions of agricultural chemists, make reports of such matters as he may deem of interest to the department, and render such other services in the line of his profession as the commissioner may require.

394 (146). *Compensation of Chemist.*—The chemist is entitled to

his necessary travelling expenses while on duty assigned to him by the commissioner, payable from the funds of the department as provided in the next article.

395 (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 admissable as evidence in any of the courts of the State. on the trial of any issue involving the merits of such fertilizer or chemical.

BULLETIN No. 116. SEPTEMBER, 1901.

ALABAMA.

Agricultural Experiment Station

OF THE

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AUBURN.

Texas or Acclimation Fever.

By C. A CARY.

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NOTICE.

Bulletin No. 115 treats of the chemical analysis of commercial fertilizers made by the Chemist for the State Department of Agriculture. Since the bulletin is issued by the Department in large number and generally distributed among the farmers of Alabama, the Experiment Station has printed a limited edition for its own use, and copies will only be sent to the Station Libraries and the Directors of the Stations and a few other parties who are keeping files of the Bulletins for binding. But Bulletin 115 will be sent to any person applying for it until the issue is exhausted.

P. H. MELL, *Director.*

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TEXAS OR ACCLIMATION FEVER,

By C. A. Cary.

INTRODUCTION.

The cattle breeding industry of the South has been held in check by the fact that Northern-bred and imported cattle could not be brought into the South without running great and unprofitable risks. In fact, the danger of losing such cattle was so great as to prevent or prohibit bringing fresh and imported strains of breeding animals into the infected regions of the South. As a result of this natural barrier, few beef-bred cattle came to improve the scrub stock or to improve the animals that had a tinge of Jersey blood in them. Possibly Jersey blood is more widely scattered among the native scrub cattle of the South than that of any other breed. Consequently, with a well-bred Jersey bull to head a herd, one could soon develop a respectable and profitable herd of grade Jerseys by using such a bull upon selected native Southern-bred cows. But none of the native Southern cattle have beef tendencies. Most of them do not mature until six or seven years old, and when mature they are too small for profitable beef animals—especially for shipping to distant markets. Beef animals must mature before they are three years old or they are not profitable.

The necessity for animal industry, especially cattle raising—is fast dawning upon the farmer of the South. It leads to diversified farming; it decreases the demand for commercial fertilizers by supplying larger quantities of manurial fertilizers that can be made upon the farm and are far better than commercial fertilizers, because they are cheaper, and more permanently improve soil, both in mechanical condition and in available plant food. Feeding animals upon the farm and saving the liquid and solid manures gives the farmer a double use of the feed stuffs produced on the farm; because the manurial products contain from 60 to 90 per cent. of all the fertilizing materials that were found in the feeds that were fed the animals. For example: Cotton seed hulls and cotton seed meal lose but very little of their value as fertilizers by feeding them to cattle, providing the the liquid and solid manures coming from the animal are properly saved and utilized. The cattle industry does not mean that we shall not raise cotton, but that we can raise as much or more cotton than we do now upon less acreage and with less work and less expense for fertilizers.

During the past three years more beef-bred animals have been brought into the State of Alabama than during any previous time in its history. Unfortunately, some of them have been lost by acclimation or Texas fever; but the larger number of them have been saved by careful handling. Methods of acclimating or immunizing Northern-bred or foreign-bred cattle have been developed so that the dangers of acclimation have been reduced to the minimum—so that it is no longer unprofitable to bring into the South highly-bred breeding animals.

The chief object of this bulletin is to describe the methods of immunizing susceptible cattle to Texas fever, and give the records that have been made at this station and others by using the improved methods of immunizing Northern and foreign-bred cattle.

WHAT IS TEXAS FEVER ?

In various parts of the country this disease is known by different names; it has been called Texas fever, acclimating fever, Southern fever, tick fever, Spanish fever, red water, hæmaturia, black water, murrain, dry murrain, yellow murrain, bloody murrain, hollow-horn and hollow-tail.

Texas fever is caused by a very small animal parasite (*Pyrosoma bigeminum,* Smith) which was discovered by Theobald Smith in 1889. Its chief place of living is in the red blood cells of cattle. In some condition it lives in the cattle tick and is carried from immune cattle or cattle sick with Texas fever, to non-immune or susceptible cattle by the tick. In this transmission of the microparasite from the diseased to the healthy animals, it passes through two generations of ticks. The female tick abstracts blood from its host; falls to the ground, deposits a large number of eggs that hatch in 14 to 45 days, and the young seed ticks get upon susceptible cattle and inoculate them. In many cases the fever appears in the cattle about the time the young ticks molt the second time; then the young ticks are about one-eighth of an inch long, and the careless observer may declare there are no ticks on the animal sick with Texas fever. It may be here stated that this micro-parasite has two hosts (cattle and ticks of two generations) and possibly can not live anywhere outside these two hosts. At least its existence in other hosts or places have not been discovered. In some respects it resembles the malerial parasite of man, but its stages of development, are not as well known as those of the malerial miscro-parasite. Yet some things are known of its form and life history in the red blood cells of cattle, and in the plasma of the blood. In mild cases of

Texas fever the micro-parasite appears as a single round body in the red cell near the preriphery or the outer border. Sometimes there may be two of these round bodies in a single red cell of the blood. Occasionally the small round bodies may appear singly or in pairs in the plasma of the blood. In severe cases that usually occur in hot weather and when the temperature of the animal is high, there may be two spindle or pear-shaped bodies in one red cell of the blood. According to Smith, 5 to 50 per cent. of the red cells of the blood may contain these micro-parasites—the number of red cells infected will vary with the type (mild or acute) of the fever. The number of red cells infected will also vary with the different organs from which the boold is taken for microscopic examination. Blood from the capillaries of the liver, heart-muscle, and kidneys, contain from 20 to 90 per cent. of infected red blood cells; while the blood from the capillaries of skeletal or voluntary muscles and the skin may contain very few (10 per cent. or less) infected red blood cells.

Fresh or dried smears of blood may be examined under the microscope. For fresh smears collect a small amount of blood with platinum loop; place it in the center of a clean cover glass; drop the cover glass, blood side down, upon a clean slide and surround the cover glass with vaseline or paraffine; the mount is now ready for examination under the microscope. In making dried smears, take two clean square cover glasses; place a small drop of blood (picked up with the platinum loop) on one of the clean squares a little to one side of the center, and with another clean square spread the droplet of blood over the lower cover glass by attempting to scrape off the droplet with one edge of the upper cover glass, holding the upper one in the right hand inclined at an angle of about 20 degrees, with the lower one that is held between the thumb and finger of the left hand. Dry the smears immediately after making them, and place them in the hot air oven, keeping them there for one and one-half to two hours, at a temperature 110 to 120 degrees C. Stain the smears with Lœffler's alkaline methyl blue from one to one and one-half minutes; wash in water and dip for an instant into a one-third per cent. acetic acid solution to remove excess of diffuse stain in the red blood cells; wash in water and mount in water or dry and mount in xyol balsam. Examine with a high power objective. (Smith's method.)

The **CHANGES** that **OCCUR IN THE BLOOD** are very characteristic in a case of Texas fever. Red blood cells in great numbers are destroyed by the micro-parasite. This is determined by actual count of the red blood cells in a definite quantity of blood; the test being made before, during and after or following the fever. In healthy old cattle the average number of red blood cells in a cubic millimeter is about 6,000,000. In healthy young calves the average number of red cells per cmm. may be as high as 8,000,000. In healthy mature or middle-aged cattle the average number may be about 7,000,-000 per cmm. In acute cases of Texas fever the number of red cells in the blood may be reduced 2,000,000 or less per cmm. In mild cases of Texas fever the number of red cells will vary between 3,000,000 and 5,000,000 per cmm.

As associated with, or as a result of the great loss of red blood cells (anæmia) the red cells will vary in size and shape; some are very much larger than normal red blood cells and when stained with Lœffler's alkaline methyl-blue, become diffusely stained, and some of them contain very small granules. These large red cells are found in some forms of anæmia in man, and are called megalocytes.

The **UNITED STATES GOVERNMENT** has **ESTABLISHED** a **QUARANTINE LINE** which is fixed for the regulation of inter-state trade in cattle, so that Southern tick-infested cattle cannot be taken into non-tick-infested States (excep for immediate slaughter) during the warm seasons when pastures and susceptible cattle may become infected with ticks, and the latter inoculated with the micro-parasite of Texas fever. All the States, or parts of States, south of this line are in the tick-infested region, and all north of it are in the tick-free region. This line starts at the Atlantic Ocean, near the southern boundary of Virginia, runs westward, leaving nearly all of North Carolina, all of Georgia, Alabama, Mississippi, Louisiana, and Texas, part of Tennessee, Arkansas, Indian Territory, New Mexico, Arizona, and the southern part of California south of the Governmental quarantine line, in the tick-infested part of the United States.

This quarantine line and the fact that all Northern-bred cattle shipped into the South have Texas fever, have led many people to believe that Texas fever occurs only in Northern-bred cattle, and never in the native cattle of the South. But it has been proven in some cases, beyond doubt, that calves are not born immune to Texas fever even though their dams are immune. In truth, it is very probable that all cattle are born susceptible to Texas fever, and only acquire immunity after birth, by having one or more attacks of the fever. The micro-parasite in the blood of the dam can not pass into the fœtus in the uterus because the blood in the circulation of the mother does not pass directly into the circulation of the fœtus. The serum of the blood of the mother passes through membranes into the circulation of the fœtus and it is very probable that the micro-parasite does not pass through these membranes. Moreover, blood serum contains very few of the micro-parasites.

The calves that are born of immune cows and live in tick-infested lots or pastures, acquire immunity while young, by having such a mild attack of the fever that it is not observed. Possibly complete immunity is only acquired by two or more mild attacks that appear as the succeeding broods of ticks inoculate them.

Some of the calves born of immune cows escape tick infestation, and consequently escape inoculation. When full grown, or several years old, they may be taken into a tick-infested pasture or the ticks may be brought to them by introducing new cattle into the herd; then they may die of Texas fever. Many farms in Alabama are tick-free; many town lots are tick-free; parts of many farms and pastures are tick-free; consequently cattle that are bred and raised in such tick-free places are susceptible to Texas fever. Tick-free lots, pastures and farms are so made by keeping all cattle off them for one or more years, by rotation of crops and pastures, by burning the grass, by killing all the ticks on the home cattle, by stock law all the year round, and by introducing no new cattle without first completely ridding them of ticks. Ticks do not travel any great distance (a few feet only), except when upon their host; by themselves, ticks will rarely, if ever, cross a road 60 feet wide. Hence a tick-infested and tick-free farm may be very near each other and remain in that condition, providing cattle and horses are not permitted to go from one farm to the other, except when these farm animals are free of ticks. Records of losses in Alabama of native, Southern-bred cattle, from Texas fever have been reported to me every year for several years, and I have records of Texas fever occurring in Alabama-bred cattle in every season of the year. Of course the severe and fatal cases occur mostly in hot portions of the year, while most cases that occur in winter are mild. One or two illustrations may bring out some of the above-mentioned conditions. A certain dairyman had kept his cattle and farm free of ticks for several years. He bought some new cattle, which were infested with ticks, and placed them in his herd. In due time his home-raised cows began to die with what he called "red water," which was Texas fever. Another man sold his entire herd of cattle that had been kept free of ticks; these cattle were moved just a few miles, and in a short time many of them died of Texas fever. Parties who buy calves or feeders from various farms in a neighborhood, beat or county, nearly always lose several some time after the calves or feeders have been brought together in the new feeding pens or pastures.

It might be well to state here that Hunt of Australia claims that some cattle ticks do not possess the micro-parasite of Texas fever—especially in a virulent form. This might explain some of the outbreaks of Texas fever among Southern-bred cattle in herds that are collected from many different farms or pastures. But so far as I know, all ticks of this species in the United States that have been tested, have been able to transmit the micro-parasite; and no positive facts have been discovered that show that the micro-parasite will vary in its virulency. Hence we must regard all ticks of this species as carriers of the Texas fever micro-parasite.

THE SOUTHERN CATTLE TICK (*Boophilus bovis*, Riley), is said to be a native of Northern Africa, and reached the Southern States by way of Spain, South America, Central America and Mexico. The life history of this tick, as discovered by Cooper Curtice, is described as follows:

The large female tick (the one so easily observed on cattle) drops to the ground when filled with blood from its host; hides in some secluded place; lays or deposits from 1,500 to 3,000 eggs, and then dies. The incubation period, or time required for the eggs to hatch, will vary from 14 to 45 days; the length of time depends upon varying conditions of temperature and moisture. Warm weather and a little moisture shortens the period of incubation; cool weather or heavy rains prevent or retard hatching of the tick's eggs and destroy many young ticks. The small ticks fresh from the eggs are six-legged, and very lively, collecting in bunches, not unlike in appearance a mass of chicken mites. They are called "seed ticks" because they look like a small seed or because they are said to be the seed of the tick. They crawl or climb upon grass, weeds or any object near the place of hatching. Cattle passing through the grass or weeds will become infested with "seed ticks," which soon attach themselves by their mouth parts to the skin of their host. In 12 to 15 days the "seed tick" molts ("sheds its skin") and then possesses eight legs (4 pair) instead of six. A second molting occurs in from four to six days after the first, and following this second molting, the female tick very soon becomes larger than the male; the male possesses pointed shoulders, and never gets much larger after the second molting. The female engorges itself with blood from its host, and thus develops into the large, plump, fat tick that can be so easily observed upon infested cattle, and when mature drops to the ground and dies laying eggs. Thus the round of life is completed.

COULD ALABAMA OR THE ENTIRE SOUTH EXTERMINATE THIS SPECIES OF TICKS?

According to some authorities tick extermination is possible. One farm, one beat, one county can be made tick-free. Why not an entire State? If every cattle owner in Alabama would voluntarily (or by compulsion) fight for the extermination of the tick it might be accomplished in two years. But extermination would now be next to impossible in the free-range counties of Alabama. It could be much more easily accomplished in stock law counties where the cattle are not permitted to run at large during the entire year. Every cattle owner being required to keep his cattle confined to his own pastures or definite limits could, by use of dips or washes, destroy the ticks on his cattle, horses and mules. He could also change his pasture from one part of his farm to another, at least once a year, or as often as he applies some dip or wash to the cattle to kill the ticks. The best time to get rid of the ticks on the cattle is in the winter when there are very few ticks. Once getting the cattle entirely free of ticks, they could then be put in a pasture where no cattle had been for one year or more. Following this the cattle must be inspected closely once every week, and if ticks should appear again kill them with dips and washes. Three applications of a tick-destroying dip or wash should be made; the second application should be given about ten days after the first, and the third about ten days after the second. The cattle are then ready to go into the tick-free pasture. If the herd is large it would be best to construct a dipping tank large enough to immerse one animal at a time. The tank might be wholly or partly sunk into the ground, having a pen and approaching chute, and a draining platform near the exit chute. The Bureau of Animal Industry at Washington, and Dr. Francis of College Station, Texas, have used large dipping tanks, and by applying to either of them by letter, plans and methods of constructing such tanks might be secured. Beaumont oil floating on warm water in the tank could be used to destroy ticks. It is cheap, and could be applied full strength. Cotton seed oil or kerosene oil emulsion can be used, but they are more expensive than Beaumont oil. Where a farmer has only a few cattle the Beaumont oil could be applied with cotton lint or rags by putting each animal in a brake or chute and going over the animal thoroughly with the oil.

All new animals entering the herd must be made tick-free before being turned into the pasture with the herd.

What would be gained by having Alabama or the entire South free of ticks?

The most important advantage would be free and unrestricted cattle trade with the North, and all of Europe at all seasons of the year. You could then bring into the South cattle from the North at any season of the year without danger of loss from Texas fever. If Alabama or any Southern State were to produce "feeders" or "stockers" they could be shipped directly to the corn belt States at any season, and not be hampered by a quarantine extending from March or April until November or December. In short, the entire train of troubles coming from Texas or Southern cattle fever would be wiped out. All of this would be most desirable if all the tick-infested States would line up and completely exterminate the tick. But if one county or beat should exterminate the ticks within its borders (unless it be adjacent to the Government quarantine line), it would be in a great deal of trouble by its isolation. Unless adjacent to the quarantine line it could not ship its cattle out only at such times as could the tick-infested counties. Moreover, breeders in the tick-infested counties could not buy cattle in the tick-free county because such cattle are as susceptible to Texas fever as the Northern-bred cattle. Cattle from tick-infested counties could not be taken into a tick-free county without keeping them in quarantine until they are made tick-free by dipping, etc.

The question of extermination of the tick resolves itself into this: It is a good thing for counties of townships contiguous to the Government quarantine line to make a fight to exterminate the tick and have the quarantine line moved South of them. But to commence in the center of a tick-infested State would only lead to trouble by increasing the number of outbreaks of Texas fever or by completely shutting off tick-free places from cattle trade with surrounding territory. I would not advise local tick extermination in Alabama except to get small pastures or places for acclimation purposes, and such places are not absolutely necessary for the new methods of acclimating Northern or foreign-bred cattle. Now this does not mean that any cattle owner should permit his cattle to become literally covered with ticks, but instead every cattle owner can keep off the excessive number of ticks and yet have a sufficient number of ticks to keep his cattle immune and to permit the calves to acquire immunity. No doubt excessive tick infestation retards the growth and development of beef cattle, and also the milk-producing capacity of the milch cow.

HOW TO RECOGNIZE AND DISTINGUISH TEXAS FEVER IN THE LIVING ANIMAL.

1. Learn the history of the diseased cattle. Were they bred and raised in a tick-infested or a tick-free region? Were new ticky cattle brought into the herd, or were the sick cattle put into a new pasture where ticks are present, either upon cattle or in the pasture? Look carefully for the small ticks upon the sick cattle. It takes an inexperienced person some time to find the small, young ticks. In some cases the ticks may have

been entirely or partially removed by use of oils or drugs or dips, but not until after the ticks had inoculated the animal.

2. The temperature of a tick-inoculated animal may rise before any other symptoms are observed. In mild cases the temperature will range between 103 and 105; in severe cases it may vary from 105 to 108 degrees Fah. The temperature may remain above normal a few days then drop to normal (102) for a few days. In chronic cases there may be variable or regular periods of alternate rising and falling of the sick animal's temperature. (See Admiral's temperature record in Table No. II.)

3. In mild cases the appetite is capricious or changeable. The sick animal may refuse feed at one time, and at another eat quite or nearly a normal or full feed. In acute or severe cases the appetite is entirely or almost completely lost; the sick animal may nibble at this or that feed, but will eat very little. Rumination is suspended (does not chew the cud) in all severe cases, during the high fever period, and some times until convalescence begins; this would lead some persons to claim that the animal was sick from "loss of cud."

4. At first or during the high fever period, the bowels are inactive. Loss of appetite, ceasing to ruminate and inactivity of the bowels indicate that digestion is suspended. The inactivity of the bowels may be indirectly a result of loss of red blood cells, a result of the high fever, or it may be due to congestion and sometimes inflammation of smaller or larger areas of mucous membrane lining the fourth or true stomach and of the intestines. Sometimes upon post mortem examination the mucous membrane of the fourth stomach and of intestines are found eroded or ulcerated—the membrane in small spots or patches has sloughed off. No doubt that the bowels are paralyzed, and no amount of heavy

purgatives will move them in that condition. Very probably many cases are killed by frequent doses of heavy purgatives, when small oleaginous (raw linseed oil) laxatives should be given to soothe the inflamed areas. Fermentation may be kept down by giving dram doses of creolin in one-half pint of water three or four times per day. When the animal's condition changes for the better, or begins to improve, the bowels may then become freely active; but in no case should the active bowels be checked; this will be corrected as the animal improves.

5. The respirations may be slightly accelerated, but in acute cases they are very rapid, running as high as 30 to 60 per minute. The rapid respirations are short or shallow, and in some cases are accompanied by a cough, and sometimes by groaning or grunting sounds.

6. The pulse in acute cases is rapid and as the number of red blood cells decrease, the pulse grows weaker. The weakness of heart and blood vessels and general muscular weakness cause the patient to lie down much of the time. When it attempts to walk the gait is wabbling, staggering, unsteady equilibrium. Sometimes the sick animal stands with depressed head and arched back.

7. The kidneys are usually quite active. Large quantities of urine are passed. In mild cases the urine is darker than usual and in severe cases the urine may be blood red (port wine color). This excess of color is the coloring matter from the broken-down red cells of the blood, and it is excreted from the body largely by the kidneys. The red colored urine does not contain blood, yet it leads many to call the disease "bloody murrain" or "red water." Remember that all acute cases or fatal cases do not pass red urine, but out of a number of sick animals in a herd some of the severe cases will pass red urine.

8. In some cases the eyelids become swollen so much that the animal can hardly open the lids sufficiently wide to see. Many cases are accompanied by a more or less prominent swelling under throat or root of the tongue, between the branches of the lower jaw.

As a rule the sick animal becomes separated from the rest of the herd; if weather is warm it seeks the shade, stands with arched back and shrunken abdomen, or lies down from weakness. In cool weather, or during the winter season, many cases perish largely from exposure to cold nights and cold rains.

EXAMINATION AFTER DEATH may help one in making an accurate decision in regard to the disease causing the death of the animal. Post mortem conditions are sometimes quite characteristic and constant; yet in some instances some of the common characteristics may be absent or not sufficiently marked as to be recognized. The condition of the carcass as to flesh will vary with the length of time the animal was sick, and the type or severity of the disease. As a rule a few days of high fever that suspends all digestive action will lead to rapid emaciation. In cutting through the skin notice that there is very little blood in it or the tissue just under the skin, and the small amount of blood in the skin is pale, and does not readily coagulate. After opening the abdominal cavity, examine the liver, the spleen, the kidneys, the bladder, the stomachs, and the intestines. If the animal died in one to three days after becoming sick the liver may be very large—engorged with blood and bile, giving it a rather dark brown color; but if the animal lived a number of days after becoming sick the liver will be engorged with bile and will have a deep yellowish tinge; this yellow color is very prominent upon a cut surface of the liver. The gall bladder is usually excessively distended with thick flaky bile. The bile is said to be thicker and more flaky in cases that were sick several days before dying than it is in cases that die in a short time after becoming affected.

The spleen or "melt" is generally much larger than it is in the healthy animal; it may be three or four times as large as a normal, healthy one. It is darker than a normal one, and when cut open its bluish-black contents slowly flow out. There are some genuine cases of Texas fever in which the spleen is not very much enlarged or changed in color and structure.

The mucous membrane lining the fourth stomach and intestines may be inflamed or eroded in spots or patches; cut them open and wash away the contents so that the red, inflamed or ulcerated condition may be distinctly observed. In some cases the contents of the fourth stomach and of the intestines in places may be tinged with blood; if the intestinal contents are hard and firm they may be surrounded by a gelatinous material or exudate that is in places tinged with blood.

In severe cases when the animal dies early in the course of the disease, the kidneys may be enlarged and they may have a uniform brownish red color throughout their entire structure. Cover glass smears made with blood taken from the kidneys will show that a very large per cent. of the red blood cells contain the microparasite. The bladder will usually contain more or less dark brown or red colored urine. The color is produced by the hæmoglobin that is held in solution in the urine and comes from the disintegrated red cells of the blood. The urine also contains albumen.

The white membranes or tissues of the body—such as the serous and mucous membranes, the connective tissue under the skin, etc.—may become tinged with yellow very like the jaundice yellow in man. This is most prominent or marked in chronic cases or cases of long duration.

The heart, according to Smith, has the right ventricle "distended with blood, fluid or clotted, according to the time elapsing between death and the examination. The left ventricle is usually firmly contracted and may contain a small quantity of fluid or clotted blood." The small extravasations of blood under the epicardium and endocardium are quite constant; they are most numerous on the outside and inside of the left ventricle.

WHAT IS IMMUNITY TO TEXAS FEVER?

IMMUNITY means that an animal is not susceptible to Texas fever. It is now believed that an animal can acquire immunity only by having the disease—one or more attacks. One severe attack of the fever or two or more mild attacks usually insure a safe immunity.

Immunity will last as long as the life of the animal, if said animal becomes infested with ticks one or more times each year of its life. But my observation of the disease, as it occurs in native Alabama-bred cattle, leads me to believe that immunity can be lost in two or three years by keeping the animal free of all ticks. I am confident that loss of immunity in this way explains the occasional outbreak of Texas fever in herds that have been kept free of ticks for two or more years, and then letting the cattle become infested with ticks.

METHODS OF PRODUCING IMMUNITY TO TEXAS FEVER.

The natural method is the one in which the ticks do the inoculating. Four different forms of tick inoculations have been tried. In many instances Northern-bred cattle were brought into the South, turned out with the herd; permitted or forced to "rough it," and survive or perish with slight or excessive tick inoculation and poor care. Fifty to ninety per cent. of Northern-bred and imported cattle so treated died—a mortality too great to be profitable. A modified form of this careless way has been employed by many with much more favorable results. The susceptible animals are kept by themselves in barns, pastures and lots separated from native Southern cattle; at the same time a few ticks are allowed to get on the cattle, but excessive tick infestation is prevented. In a majority of such animals tick-inoculation occurs gradually. One summer in the South under such conditions has usually produced immunity. However, losses by this means are too great to recommend it when better means can be obtained.

Dr. Connoway of the Missouri Experiment Station, and Dr. Francis of the Texas Experiment Station, have tried to control tick inoculation by placing a definite number of young seed ticks upon the suscpetible animals at different times. Collect full grown female ticks from Southern cattle and put them in a fruit jar or some vessel having a little moist earth at the bottom; this jar is then placed in an incubator or in the kitchen near a warm chimney or stove; in 15 to 20 days the female ticks will have deposited their eggs and the eggs will have hatched into a mass of lively seed ticks. About 25 of these seed ticks are placed upon each susceptible animal (best time in late fall or in winter) and they will inoculate each animal so that in the course of 10 to 30 days the fever will appear. When the animals recover from the mild attack of the fever (say in 40 to 50 days) a larger number (about 100) of incubator seed ticks are put upon each animal; this should produce a second attack of fever. When the cattle recover from it they are immune and ready for the pasture. At no time in this treatment should the cattle want for good feed and protection from cold nights and rains. Some losses occur by this method, and it is a little more inconvenient and uncertain than either of the two methods that will be mentioned following this.

The fourth modified form of tick inoculation is the **one where sucking calves, 2 to 4 months old, are brought into the South in the fall or winter or early spring,** and allowed to take milk from a Southern-bred cow or are fed fresh sweet milk from a Southern cow. While young and during the time before it is weaned, put a few seed ticks upon the calf or permit them to get upon it in small numbers. Natural tick inoculation will then occur when the calf is best able to resist severe fever and to recover from it. It is possible that the milk of a Southern-bred immune cow may have some immunizing power, but I doubt it. I think the milk of a non-immune cow would be as effective because it keeps the calf in the best of condition to resist, and to recover from, the fever or attack of the micro-parasites upon the red blood cells. It is a well-known fact that young calves or cattle do not have Texas fever in as severe a form as do older or mature cattle. All competent observers or investigators of Texas fever have noted that fact. According to Hunt of Australia, (who produced by inoculation the fever in calves born of immune cows), immunity is not inherited. It is very probable that all Southern-bred calves do not inherit immunity, but acquire it after birth by tick inoculation. No doubt that the vast majority of Southern-bred calves have the fever in such a mild form that it is not appreciable. This partial immunity of calves to the fever may be explained by the fact that young animals have a greater number of red blood cells per cubic millimeter than do older animals, and can carry on the functions of the blood better in case of loss of red blood cells. Also, the power of reproducing red blood cells is greater in the young than in the older animals. This may be due to the fact that there is a relatively greater quantity of red marrow in the young animals, and this red marrow tends to reproduce red blood cells nearly as fast as they are destroyed by the micro-parasite. The general vigor of a young animal may add to its resisting and recuperating power. Moreover, it is well-known that young animals exhibit greater power of repairing wounds and recovering from almost any disease than older ones. Broken bones unite quicker and better in young animals than in mature ones. As Dr. Francis remarks, this method of immunizing sucking calves is a good and safe way for farmers who buy a few animals; but where many animals are wanted for a large ranch it is cheapest to use the defibrinated blood method. One drawback to immunizing calves is that the owner must wait one or two years before the calves develop into breeding animals; it means loss of time, but is a safe method.

The Defebrinated Blood Method of producing immunity to Texas fever in cattle was originated or discovered in Australia. It has been most extensively employed i nthis country by Dr. Connoway of the Missouri Experiment Station, and Dr. Francis of the Texas Experiment Station. It has been tested by the Bureau of Animal Industry at Washington, D. C., and by the Louisiana, the Mississippi and the Alabama Experiment Stations.

Brefly speaking, it consists in inoculating a susceptible or non-immune animal with blood that is freshly drawn from an immune animal and defebrinated. The animal from which the blood is derived should be at least two years old, and Southern-bred, and known to have had ticks upon it some time during the second summer of its life. A Northern-bred animal, that has acquired immunity by having had an attack of Texas fever within one year, may also be used as a source of blood for inoculation. After securing the animal the following instruments and articles should be prepared for the inoculation:

A sterilized hypodermic syringe, one or two sterilized scalpels or sharp knives, one or two sterilized aspirating needles with an inside diameter of 1 to 2 millimeters; a clean sterilized beaker or wide-mouth bottle, containing a small glass rod, and the bottle or beaker should be plugged with aseptic absorbent cotton; one pair of scissors, a 2 per cent. solution of creolin, and sterilized cotton or sponge, and sterilized distilled water. The water may be sterilized by boiling one hour.

Any or all of the above named articles, except the creolin solution and water, may be sterilized by placing them in a vessel of cold water, and then heating the water until it boils for one hour.

The animal from which the blood is to be drawn may be secured by using a cattle nose-leader or by casting it with ropes, hobbles, etc. Clip the hair very close over a space 3 to 6 inches long and 2 inches wide along the jugular forrow on either side of the neck (just over the jugular vein). Wash the clipped skin with soap and water; then with the creolin solution and then with distilled water. Now cord the neck of the animal as the neck of a horse is corded just before it is to be bled. When the neck is corded the jugular vein stands out prominently. Now the aspirating needle, with its point inclined toward the head, is pushed into the jugular vein and the blood that escapes through the hollow needle is caught in the sterilized breaker or wide-mouth bottle, and stirred slowly with the glass rod, being careful to hold the cotton plug over the mouth of the breaker or bottle while stirring. As the fibrin collects in clots on the glass rod, it may be lifted out, and by a quick jerk of the rod the clot is dislodged from the rod and the rod is then returned to the breaker or bottle, and the blood is stirred until no more fibrin collects on the glass rod. In the breaker or bottle will remain nearly all of the red blood cells floating in the blood serum and some of these red blood cells will contain the micro-parasites that cause Texas fever. This deferinated blood should be kept warm (above 90 degrees Fah.) and when the susceptible animals are ready for inoculation, the defebrinated blood may be drawn into the warm hypodermic syringe and 1 cc injected under the skin of each susceptible animal. Remember that it is essential that the defibrinated blood should be kept warm and that the inoculations should be made as soon as possible after the defirinated blood is prepared, because it may become cool, or contaminated with septic or pus germs. It is best to have the cattle that are to be inoculated confined by halter or chains or stanchions in stalls. I should not advise the use of defibrinated blood that is over an hour old.

In about six to ten days after the inoculation the temperature of the inoculated animals will rise, ranging between 103 and 106 degrees Fah. The fever may continue from 3 to 15 or more days; then fall to normal (102); a secondary fever usually begins about the thirtieth day after the inoculation and may continue for several days. According to Pound, Francis and Connoway the primary inoculation fever appears in 6 to 10 days, and the secondary inoculation fever appears about the thirtieth day after the inoculation. The primary inoculation fever, as a rule, is more regular or will occur with greater regularity than the secondary inoculation fever. In many cases the primary inoculation fever will be constant and regular, thereafter the temperature may rise and fall irregularly. In rare instances there may be a low continuous fever covering 20 to 40 days. Again there may occur but one fever period and that occur 20 to 30 days after the inoculation. As a rule, it requires from 40 to 50 days to pass through the inoculation fever periods. After recovery from the first inoculation, a second one is given to each animal. In case the first inoculation does not produce a fever running up to 105, it is always best to give a second inoculation and increase the dose of defibrinated blood; if 1 cc was employed in the first inoculation, use 2 cc of defibrinated blood in the second inoculation. As a rule, the second inoculation produces fever periods as in the first inoculation, but the fever is milder than it was following the first inoculation.

Inoculations to produce immunity to Texas fever should be made in the South sometime between Nov. 1st and the following March 1st, and never during hot weather. During the early spring or during the winter, immediately after the cattle have recovered from the inoculation fever, permit a few ticks to get on them. And when the hot weather of June, July, August and September comes, keep off the excess of ticks by applying once per week over places where ticks are most frequently found on the animals, crude Beaumont oil, or a 20 per cent. kerosene oil emulsion.

Immune animals are injured to some extent by supporting an excessive number of ticks.

In looking for accurate results from a large number of inoculations I wrote Dr. Francis of the Texas Experiment Station, and he kindly gave me the valuable facts which you may see in his letter published below.

Notice that out of 1,500 animals inoculated by him $3\frac{1}{2}$ per cent. were lost by inoculation fever and less than 7 per cent. by exposure to tick inoculation after recovery from defibrinated blood inoculation. Remember that the vast majority of the cattle inoculated by him were placed in large pastures on ranches where little or no attempt was made to keep off ticks; and that in many previous instances Northern-bred cattle under like conditions had a mortality as high as 50 to 90 per cent.

College Station, August 5, 1901.

Dr. C. A. Cary, Auburn, Ala.

Dear Doctor—I have your letter of the 2nd in regard to our experiments with Texas fever. I am preparing a bulletin on the subject now and hope to have it off within six weeks. I have inoculated about 1,500 calves. These run all the way from a few months old to two years of age. I cannot tell you without several hours' work just how many of each age. I may say, however, that the best age is about one year old. The best time of the year is any time from November to March.

We consider one cubic centimeter as a standard dose. We use all the way from one-half of one cc to two cc, but one cc is a standard dose. We take the blood direct from the jugular vein of any Texas-raised animal that is in good health. We usually take something that is two or three years old, so as to avoid the transmission of tuberculosis.

As a general rule, we make two inoculations. I think, however, that one is enough, but we use two merely to be sure of an infection. If the time between inoculation and exposure to ticks is several months, I favor two inoculations.

I think that all our calves born in Texas are susceptible to fever, but pass through it while they are still young. I have seen some of our calves with the acute fever and passing red urine that were born and raised here. If they be raised in a pen, say in town, the death rate is pretty high among them, but those that are raised out in pastures the death rate is very low, and the attacks escapes ordinary observation.

The mortality from inoculation fever is about $3\frac{1}{2}$ per cent. Dr. Conoway has written me the exact number that he has done, and the mortality. It is essentially the same as ours, but I hardly feel at liberty to give you his data. He will certainly supply you with it if you write him. I am yours very truly,

M. FRANCIS.

P. S.—To make a general statement will say that we now save about 90 per cent. of all Northern cattle brought into this country. M. F.

TABLE I—Temperature Records of Registered Northern-Bred Cattle, Inoculated with Defibrinated Blood.

DATE.	Admiral.		Baroness.		Champion.		Gazelle.		Clemantina.		Charley.	
1899.—1900.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
Dec. 26	....	100.6	....	102.6	....	103.0	....	102.6	....	101.6	....	102.6
Dec. 27	102.0	101.4	102.2	100.8	100.0	102.2	100.4	102.0	102.0	101.6	100.4	100.4
Dec. 28	104.4	101.8	100.4	101.6	100.8	102.0	100.2	101.6	100.0	101.6	100.6	102.4
Dec. 39	101.6	102.2	101.2	102.2	101.4	102.8	101.6	102.6	101.4	101.2	100.8	102.8
Dec. 30	101.8	101.4	101.4	102.6	101.8	102.2	101.8	102.2	101.4	101.8	101.6	102.2
Dec. 31	101.8	101.8	101.8	101.2	101.2	102.2	101.8	101.8	101.4	101.4	102.0	102.2
Jan. 1	101.8	102.0	101.8	102.8	102.2	102.4	101.8	102.2	101.4	101.4	103.2	101.6
Jan. 2	102.0	101.6	101.8	103.0	101.8	102.6	101.2	102.6	101.0	102.0	102.2	102.4
Jan. 3	102.4	102.0	102.4	102.6	102.8	102.6	101.4	102.4	101.0	101.6	102.4	102.2
Jan. 4	101.4	102.0	103.4	103.0	101.4	102.8	101.6	102.4	101.4	101.4	100.8	102.4
Jan. 5	102.2	102.0	104.2	103.6	102.2	103.6	101.4	102.4	100.4	101.4	102.0	102.2
Jan. 6	101.4	101.4	104.8	104.6	102.0	102.4	101.6	103.0	101.2	102.0	101.8	102.0
Jan. 7	101.4	102.0	104.2	104.2	102.0	103.8	103.8	104.6	100.8	101.0	101.8	102.0
Jan. 8	102.0	101.8	103.0	104.8	102.6	102.2	103.2	103.4	101.4	101.8	101.8	102.0
Jan. 9	101.6	102.8	103.6	104.8	102.6	103.0	101.4	103.2	101.2	101.6	102.0	102.2
Jan. 10	101.8	101.6	103.8	105.0	102.5	103.2	104.0	104.2	101.2	102.4	101.8	102.5
Jan. 11	102.2	102.4	104.8	104.0	104.2	104.0	104.4	104.2	102.0	102.2	102.2	102.8
Jan. 12	101.3	101.6	102.4	103.2	101.8	101.8	103.4	104.8	101.8	102.2	101.0	101.4
Jan. 13	101.6	101.8	103.0	104.0	101.6	102.6	104.0	105.4	102.0	101.8	102.0	102.0
Jan. 14	101.6	101.8	103.2	104.6	102.0	102.1	104.6	104.3	101.2	102.0	100.8	101.6
Jan. 15	101.4	101.8	103.6	104.4	102.0	103.4	103.4	103.0	101.6	101.8	101.8	102.3
Jan. 16	101.6	102.8	104.1	105.2	102.0	103.4	102.2	102.6	101.4	101.8	101.4	101.8
Jan. 17	101.4	101.2	103.6	104.8	102.8	103.2	102.4	102.4	102.0	101.6	101.2	102.6
Jan. 18	102.8	103.4	104.6	105.4	102.3	103.0	102.8	103.2	101.0	101.4	102.2	102.2
Jan. 19	102.0	102.0	103.6	103.6	103.0	103.8	102.2	103.6	101.0	101.6	101.5	103.0
Jan. 20	102.0	102.4	103.8	105.0	101.8	101.4	103.0	104.4	101.4	101.6	102.2	101.8
Jan. 21	101.2	102.0	103.0	104.2	102.2	103.2	104.0	104.2	100.2	101.0	101.6	102.2
Jan. 22	101.6	103.1	105.2	105.4	102.2	102.9	103.6	104.2	101.2	101.4	102.2	103.2
Jan. 23	102.0	102.0	102.2	103.4	101.8	103.2	103.4	103.8	101.0	102.4	103.0	103.8

Jan. 24	101.6	103.2	102.6	104.0	102.0	102.4	102.8	103.2	101.0	102.2	102.6	103.4
Jan. 25	103.4	103.2	102.8	103.4	102.8	104.2	102.6	102.2	101.0	102.6	102.8	103.0
Jan. 26	102.2	103.2	102.6	103.0	103.0	104.2	102.0	102.2	101.4	102.0	103.6	103.6
Jan. 27	104.0	104.4	102.2	102.8	103.0	106.0	101.8	101.4	102.0	101.8	103.0	103.8
Jan. 28	102.0	104.0	102.2	103.2	104.4	106.0	101.4	101.6	101.6	102.0	103.0	103.0
Jan. 29	103.4	104.8	103.2	103.4	103.6	106.0	101.6	102.2	102.2	102.2	102.2	102.8
Jan. 30	103.0	103.6	103.6	103.6	104.2	105.2	101.4	102.6	101.6	102.8	102.6	103.2
Jan. 31	103.0	103.4	102.8	102.4	105.0	105.6	102.4	102.6	101.2	102.8	102.6	103.0
Feb. 1	104.0	104.6	103.0	103.6	105.6	105.6	103.4	103.0	102.8	104.2	102.0	102.0
Feb. 2	102.6	103.6	102.8	103.6	105.2	105.8	103.0	103.4	102.6	105.0	102.0	102.0
Feb. 3	102.8	103.8	103.0	103.0	103.4	105.8	102.0	101.4	102.0	105.6	101.6	101.8
Feb. 4	102.6	102.6	102.8	103.0	105.0	105.2	101.8	102.2	101.6	104.4	101.4	102.2
Feb. 5	101.2	102.0	103.2	103.4	104.6	104.6	102.0	102.0	102.6	105.0	101.2	101.0
Feb. 6	102.8	102.0	102.6	103.0	105.6	105.8	101.6	102.0	101.4	103.0	102.2	102.0
Feb. 7	102.2	102.0	103.0	102.2	104.4	103.0	102.4	103.0	102.6	103.4	102.4	101.6
Feb. 8	102.0	102.0	103.0	102.6	102.4	102.0	102.2	102.6	102.4	103.2	102.0	101.8
Feb. 9	101.2	101.0	102.6	102.6	101.0	102.2	102.0	102.4	102.0	102.0	100.6	101.4
Feb. 10	101.4	101.8	103.0	102.6	102.4	101.8	102.4	102.6	102.0	102.2	102.0	101.6
Feb. 11	102.0	101.4	103.2	102.8	102.0	102.8	102.4	102.4	102.2	102.0	102.0	101.8
Feb. 12	102.0	101.6	103.4	103.4	104.0	101.8	102.0	102.2	101.6	102.4	102.4	101.4
Feb. 13	102.0	101.8	102.6	102.4	102.4	103.0	101.8	102.4	101.6	102.0	101.4	101.6
Feb. 14	101.0	102.0	102.0	102.0	101.8	103.4	102.6	102.0	101.4	101.6	102.2	102.6
Feb. 15	101.6	101.6	102.4	102.4	102.0	103.0	101.8	102.4	102.0	102.0	102.2	101.8
Feb. 16	101.2	102.0	102.4	102.8	101.8	102.4	102.0	102.4	101.2	102.0	101.8	102.8
Feb. 17	101.8	101.4	103.0	103.2	101.8	101.4	101.8	102.4	101.6	102.0	102.6	101.0
Feb. 18	100.8	101.4	103.4	103.6	101.4	102.4	102.4	102.6	101.8	102.4	102.0	102.4
Feb. 19	101.2	101.6	103.4	103.6	101.4	103.0	102.6	102.6	100.4	101.4	101.4	101.8
Feb. 20	101.8	101.4	102.8	103.4	102.4	102.4	101.4	101.4	100.8	102.0	102.0	102.0
Feb. 21	102.0	101.6	102.2	102.4	102.2	102.6	102.2	102.0	102.0	102.0	102.2	101.8
Feb. 22	101.2	101.6	102.2	102.2	101.8	101.8	101.4	100.6	100.8	101.4	101.2	102.2
Feb. 23	101.2	101.6	101.8	102.6	102.2	103.0	101.4	101.8	101.0	101.4	101.0	102.0
Feb. 24	101.4	101.8	101.8	103.0	102.0	101.8	102.0	102.2	101.4	101.8	101.8	102.0
Feb. 25	101.4	101.6	101.6	102.6	102.0	102.6	101.8	101.4	102.0	101.2	101.2	102.4

TABLE I.—Continued.

DATE.	Admiral		Baroness.		Champion.		Gazelle.		Clemantina		Charley	
1899.—1900.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M	P. M.
Feb. 26	100.8	104.0	102.0	102.0	102.0	102.4	100.4	102.4	100.8	101.6	101.6	101.6
Feb. 27	101.4	103.4	102.0	105.2	101.4	102.8	101.8	101.6	102.0	102.4	101.8	101.6
Feb. 28	101.0	101.4	102.0	102.0	102.2	102.6	101.2	101.2	101.0	101.0	101.4	101.0
March 1	101.4	102.6	102.2	102.8	101.6	102.2	101.4	101.0	101.2	102.4	101.8	101.6
March 2	101.0	102.0	104.4	103.8	102.8	103.2	101.2	101.4	100.8	101.0	101.4	102.0
March 3	102.0	103.6	103.6	105.4	101.2	104.6	101.2	102.0	101.8	101.4	101.6	102.4
March 4	102.0	102.0	101.0	102.0	101.2	102.4	102.0	102.0	102.0	101.8	101.0	102.0
March 5	101.0	102.0	102.0	102.2	102.4	102.2	101.6	102.0	100.8	101.4	102.0	102.0
March 6	101.0	101.2	101.6	102.0	103.0	102.6	101.4	102.2	101.2	102.0	101.6	102.0
March 7	101.4	101.4	101.8	102.0	102.0	102.0	101.4	101.6	101.4	101.6	101.6	101.0
March 8	101.4	101.0	102.4	101.6	102.4	101.8	101.8	101.2	101.6	101.4	101.4	101.0
March 9	102.0	102.4	102.4	103.6	101.6	103.4	102.0	102.0	102.0	101.6	101.6	102.2
March 10	101.0	102.0	102.8	102.8	102.0	102.8	101.2	102.0	101.0	101.8	102.0	101.4
March 11	101.0	102.0	102.2	102.6	101.6	105.0	101.6	102.8	101.4	102.0	101.8	103.8
March 12	101.0	102.6	102.0	103.2	102.0	104.4	102.2	101.8	101.4	101.6	101.8	103.0
March 13	101.0	102.0	104.0	104.4	101.8	103.6	101.8	102.0	101.6	102.0	101.4	102.4
March 14	101.2	101.8	102.4	103.0	103.0	103.4	102.2	101.6	101.4	101.2	101.6	102.4
March 15	101.4	101.0	102.0	102.0	103.0	102.4	101.2	101.4	101.4	101.4	102.4	101.4
March 16	101.0	101.8	102.4	102.4	102.2	103.0	101.4	102.0	101.4	102.0	101.2	102.0
March 17	102.0	102.0	101.8	102.4	102.2	102.2	100.8	101.8	101.4	102.0	100.8	101.8
March 18	100.4	101.8	101.4	102.6	101.6	102.0	101.0	102.0	100.8	101.4	100.6	101.8
March 19	101.0	101.6	102.2	102.2	101.0	102.8	101.2	102.0	101.2	101.2	100.6	101.8
March 20	101.2	102.2	102.8	104.0	101.6	102.2	101.2	102.4	101.6	101.6	101.0	102.0
March 21	101.0	102.0	102.8	102.0	101.8	101.6	102.0	102.0	101.2	101.6	102.0	102.0
March 22	103.0	101.6	102.4	103.0	101.4	102.2	101.2	102.0	101.2	102.2	102.0	102.0
March 23	101.0	101.0	102.4	103.0	101.0	102.2	101.0	101.2	101.4	101.8	101.4	100.6
March 24	101.0	101.6	102.6	102.6	101.0	102.0	101.8	102.0	102.0	102.4	101.0	102.0
March 25	101.2	101.2	102.8	102.2	102.6	102.0	102.0	101.4	101.6	101.6	102.0	102.4
March 26	101.4	101.8	102.0	102.2	102.0	102.6	101.6	102.2	101.6	102.0	102.0	101.6

March 27.............	100.6	101.5	101.8	103.2	102.0	102.2	101.6	102.0	101.4	103.0	101.8	102.5
March 28.............	100.8	101.4	101.4	102.6	102.2	102.4	102.0	102.2	101.8	102.0	101.8	102.0
March 29.............	101.0	101.6	101.6	102.4	102.0	102.4	101.4	102.4	101.2	102.6	101.8	101.8
March 30.............	101.4	101.8	101.2	102.4	101.6	102.8	101.4	102.2	102.0	102.6	102.0	102.2
March 31.............	101.6	101.6	101.0	102.8	102.0	102.8	101.8	102.0	101.2	103.0	101.8	102.4
April 1	....	....	....	....	....	....	....	....	103.2	103.2	....	.....
April 2	....	....	....	....	....	....	....	....	102.2	102.8	....	....
April 3	....	....	....	....	....	....	....	....	....	102.2	....	.....
April 4	....	....	....	....	....	....	....	....	....	....	....	.....
April 5	....	....	....	....	....	....	....	....	....	....	....	.....

TABLE II.

Temperature Records of Registered Bulls which had Texas Fever as a result of Tick Inoculation the first Summer following Defibrinated blood Inoculation.

DATE.	Admiral.		Charley.		Champion.	
1900.	A. M.	P. M.	A. M.	P. M.		
August 10	....	107.0	....	107.0	....	....
August 11	105.8	106.2	106.2	106.0	....	....
August 12	106.4	106.4	105.4	104.8	....	....
August 13	106.0	104.8	103.0	101.8	....	....
August 14	105.0	106.6	101.0	102.8	....	....
August 15	101.8	100.8	101.0	102.0	....	....
August 16	100.0	101.0	101.2	103.0	....	....
August 18	....	105.4	....	105.8	....	....
August 19	107.0	107.4	105.0	105.4	....	....
August 20	106.0	105.6	104.8	106.3	....	107.4
August 21	105.0	105.4	....	104.8	....	....
August 22	103.6	105.0	105.0	102.8	106.0	105.0
August 23	103.0	105.0	101.8	102.4	102.4	102.4
August 24	100.6	104.8	102.0	103.4	101.0	102.4
August 25	104.0	104.8	102.0	102.4	103.0	104.0
August 26	104.0	104.9	101.8	104.0	102.0	104.6
August 27	104.0	104.2	101.8	102.4	101.2	101.8
August 28	103.0	105.0	101.8	104.4	102.0	100.4
August 29	103.0	105.0	101.8	105.0	106.0	105.0
August 30	103.0	104.2	102.4	104.4	102.8	105.4
August 31	103.0	104.2	....	103.6	....	105.2
September 1	103.4	104.2	....	102.0	....	102.2
September 2	103.2	103.8	....	....	....	....
September 3	103.0	103.9	....	....	....	....
September 4	103.0	104.4	....	....	....	....
September 5	103.6	104.4	....	....	....	....
September 6	103.0	104.2	....	....	....	....
September 7	103.0	104.2	....	....	....	....
September 8	104.0	103.8	....	....	....	....
September 9	103.0	104.8	....	....	....	....
September 10	103.0	104.3	....	....	....	....
September 11	103.0	104.6	....	....	....	....
September 12	103.4	104.8	....	....	....	....
September 13	102.8	103.0	....	....	....	....
September 14	103.0	103.8	....	....	....	....
September 15	102.8	104.6	....	....	....	....
September 16	102.8	104.8	....	....	....	....
September 17	102.6	103.8	....	....	....	....
September 18	102.0	102.8	....	....	....	....
September 19	101.6	104.8	....	....	....	....
September 20	101.6	104.4	....	....	....	....
September 21	101.4	104.4	....	....	....	....
September 22	102.4	104.2	....	....	....	....
September 23	101.8	104.6	....	....	....	....
September 24	101.6	104.8	....	....	....	....
September 25	102.8	105.0	....	....	....	....
September 26	102.2	103.8	....	....	....	....
September 27	102.2	105.0	....	....	....	....

TABLE II.—Continued.

DATE.	Admiral		Charley.		Champion	
1900	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
September 28	103.0	105.6	....	....	....	....
September 29	102.2	105.6	....	....	....	....
September 30	101.0	104.6	....	....	....	....
October 1	101.8	103.8	....	....	....	....
October 4	104.0	104.6	....	....	....	....
October 6	103.2	104.4	....	....	....	....
October 7	103.2	104.6	....	....	....	....
October 8	....	103.6	....	....	....	....
October 9	....	102.8	....	....	....	....
October 10	....	103.6	....	....	....	....
October 11	....	102.8	....	....	....	....
October 12	....	102.8	....	....	....	....
October 14	....	102.8	....	....	....	....
October 19	....	103.2	....	....	....	....
October 20	....	104.0	....	....	....	....
October 21	....	102.8	....	....	....	....

CLINICAL RECORDS OF THE ANIMALS INOCULATED WITH DEFIBRINATED BLOOD.

All of the cattle that were inoculated at Auburn were stabled at night, carefully handled during the entire period of inoculation. The ticks were kept off by weekly applications of kerosene oil emulsion. Neither cotton seed nor any of its products were fed them during the inoculation periods. Unless otherwise mentioned, the blood used in the inoculations was derived from a two-year-old Southern-bred Jersey heifer, which had been infested with ticks during its second summer, and had been tested for tuberculosis.

1. Admiral (see Table I), a red poll bull, bred in Illinois, arrived in Alabama Nov. 11, 1899, at the age of ten months, weighing 742 lbs. December 26, 1899, was inoculated with 1 cc of defibrinated blood. Very little, if any, primary inoculation fever occurred; but a fairly good secondary inoculation fever began January 25, 1900 (30 days after the inoculation), and continued until February 4. He was inoculated a second time February 21, 1900, with 1½ cc of defibrinated blood. A very slight rise of temperature appeared on February 26 and 27, March 3 and 4, and March 22. The inoculation fever periods in this animal were all more or less irregular, very slight or absent, excepting the secondary inoculation fever following the first inoculation. During the entire inoculation periods he exhibited no signs of ill health. Ticks first appeared upon him June 16. July 21 he was very much depressed or dumpish. August 10 he began to breathe rapid and shallow; morning temperature 107, and at noon 108 degrees Fah., remaining at about 106 for the next four days; then it dropped to normal for two days, rising to 107.4 on August 19. His

temperature ranged between 103 and 105 until September 15, remaining above normal nearly all of the time from August 19 to October 1. Thereafter there were occasional or irregular rises in his temperature (see his temperature record in Table II). When the high fever began his urine became highly colored (port wine color), and was excreted in large quantities; this condition continued for more than a week. The urine contained a large quantity of albumen.

August 11, about the beginning of the fever, his bowels became inactive; he was first given Epsom salts, and then raw linseed oil with rectal injections of warm water,—the last being given three times per day. But the moderate doses of purgatives and large enemas failed to produce a normal action of the bowels for 14 days. His bowels began to act August 26, and the feces were very soft, dark in color and many times were covered with gelatinous mucus. His appetite was almost entirely lost; he nibbled at bran, sorghum, hay and grass; but did not ruminate until he began to recover. Digestion was almost entirely suspended. During the suspension of digestion, fermentation and bloating were controlled by giving internally dram doses of creolin and by using the trocar and canula (tapping the rumen or pounch to let out the gas). His weakness caused him to lie down much of the time. About August 26 he began to improve, his appetite became a little better; rumination and digestion were resumed, and his bowels began to act freely; yet recovery was slow and in fact he has not yet completely recovered. Periods of improvement and periods of depression have appeared irregularly for twelve months. August 8, 1899, two days before the fever began, he weighed 1027 lbs., and September 24, 805 lbs.; March 30, 1901, 775 lbs.; October 5, 1901, 905 lbs. His appetite, digestion and assimilation have been deficient; have been below normal, and consequently very little improvement has been made.

August 13, 1900, there were 4,175,000 red cells in 1 ccm. of his blood.

August 20, 1900, there were 4,550,000 red cells in 1 ccm. of his blood.

August 23, 1900, there were 4,400,000 red cells in 1 ccm. of his blood.

August 17, 1901, there were 6,400,000 red cells in 1 ccm. of his blood.

September 26, 1901, there were 7,090,000 red cells in 1 ccm. of his blood.

The treatment of Admiral during the fever was directed toward keeping the bowels active by using rectal injections of warm water, and by giving, per mouth, small doses of raw linseed oil,—creolin and tapping being used to control bloating. Quinine in 30 to 120 grains doses were given every six hours to destroy the micro-parasite which causes the disease. To keep up heart action and tide over periods of great depression and weakness, tincture of digitalis was given in 2 to 4 fluid dram doses; also tinct. of nux vomica was used to stimulate the heart. Gention was given as a stomachic to improve the appetite and digestion after the acute stage had passed; also tincture chloride of iron and Fowler's solution of arsenic were tried, with the idea that they would increase the hæmoglobin and number of red blood corpuscles. But no appreciable results followed the use of the last two named drugs.

Clemintina (see Table I), a registered red poll heifer, bred in Illinois, was 1 year old when shipped to Auburn, Ala., arriving November 8, 1899, and then weighed 770 lbs. December 26 she was inoculated with 1 cc of defibrinated blood. She had no primary inoculation fever, and a very slight secondary fever appeared February 1 to 8, about 36 days after inoculation. February 21 she received a secondary inoculation of 1½ cc of defibrinated blood. A very slight elevation of temperature occurred about 40 days after the second inoculation. Of all the six full blood cattle inoculated at the same time she reacted the least. During the shipment she accidentally got with calf and aborted July 26. Preceding and following the abortion she had some fever and it is very probable that the abortion was caused by the fever. According to the Australian authorities Texas fever produced by defibrinated blood inoculation is often attended by abortion in pregnant cows. This heifer has kept in the best condition, and has made an almost continuous growth from the time of her arrival in Alabama to the end of her second summer. November, following her first summer she weighed 1020 lbs. at 2 years old, and on August 10, 1901, she weighed 1190 lbs. She dropped a bull calf about September 20, 1901.

Champion of Alabama, (see Tables I and II), a shorthorn bull, bred in Missouri, arrived at Auburn, Ala., November 8, 1899, at the age of 7 months, weighing 472 lbs. In shipping he caught cold and had an attack of bronchitis the first week after his arrival in Alabama. December 26 he was inoculated with 1 cc of defibrinated blood. If primary fever appeared it lasted only one day, on January 11. A well marked secondary inoculation fever occurred from January 28 to February 7, beginning 31 days after the inoculation, and continuing 12 days. February 21, 1900, he received a second inoculation of 1½ cc of defibrinated blood. The fever periods following the second inoculation were indistinct and irregular. During the secondary fever period of the first inoculation he became very sluggish, lost his appetite and decreased about 20 lbs. in weight. This calf was weak and unthrifty when inoculated, and had days of dumpishness and loss of appetite during the entire winter. While the reaction to the inoculation was well marked for only one period, yet he seemed to be affected more by the fever than any of the other five animals that were inoculated at the same time. During the summer of 1900 and of 1901 he became infested with ticks at different times, and for a short time in August had a period of high fever, going as high as 107 one evening (see Table II). Thereafter he made rapid gains, and on August 10, 1901, he weighed 1200 lbs. His growth during the second summer has been very good.

Sixth Gazelle of Maple Hill (See Table I), a shorthorn heifer, bred in Missouri, arrived in Alabama November 8, 1899, at the age of 11 months, weighing 692 lbs. Was first inoculated December 26 with 1 cc of defibrinated blood. The primary inoculation fever began January 7, (12 days after inoculation), and continued until January 26 (19 days). The secondary inoculation fever appeared about January 31; it was very mild and not distinctly marked. On February 21, this heifer received a second inoculation of $1\frac{1}{2}$ cc of defibrinated blood, but no distinct fever reaction followed this inoculation. She lost her appetite one or two days, and had one day of short and rapid respirations during the primary fever of the first inoculation. February 16 and 22 a very few ticks were found on her. June 16 several ticks were found on her, having been in tick-infested pasture since April. July 16 she appeared dull and stupid, and July 24 her temperature rose a little above the normal; no doubt she had, at this time, a very mild attack of fever. She passed through the first summer making good gains and growing. At the beginning of the inoculation period she weighed 685 lbs. at the close (April 4, 1900), 805. After this she passed her first and second summers and second winter, much of the time in tick-infested pastures. August 10, 1901, she weighed 1060 lbs., and August 11 dropped a fine 77-lb. heifer calf.

Baroness of Alabama, (see Table I), a full blood Angus heifer, bred in Illinois; arrived in Auburn, Ala., November 8, 1899, at the age of 8 months, weighing 520 lbs. December 26 she was inoculated with 1 cc of defibrinated blood. The primary inoculation fever began about January 2 to 4, and continued until about January 22. The secondary inoculation fever appeared about the last day of January and first of February. Following the primary fever occasional irregular rises of temperature appeared. February 21, 1900, she received her second inoculation of 1½ cc of defibrinated blood; the 9th and 10th days following the inoculation she had fever, and on the 20th day she had a temperature of 104 morning and evening. The primary inoculation fever following her first inoculation was good and continued longer than usual, and the heifer then became sluggish and off her feed. At time of first inoculation she weighed 555 lbs.; near the close of the primary fever 540 lbs.; at the close of the inoculation periods (April 4), 570 lbs.; September 1, 1900, 700 lbs.; March 30, 1901, 810 lbs.

Charley Gardner, (see Tables I and II), an Angus bull, bred in Illinois, arrived at Auburn, Ala., November 8, 1899, at the age of 8 months, weighing 605 lbs. December 26, 1899, he was inoculated with 1 cc of defibrinated blood. An almost imperceptible primary fever appeared about January 1. The secondary inoculation fever began January 22 (27 days after the inoculation) and lasted abuot 10 days. At no time did his fever reach 104. On February 21, 1900, he received a second inoculation of $1\frac{1}{2}$ cc of defibrinated blood. No fever followed this inoculation. After being infested with ticks some time in June or July, he had a rather severe attack of fever, beginning about August 10, when his temperature ran up to 107. This period of fever lasted three days; his temperature went up to 104-106 for four days. The fever checked his appetite and made him lose some in weight, but rumination, digestion and action of bowels were at no time completely suspended, as in Admiral's case.

August 8, 1900, just before the fever, he weighed 1015 pounds.

September 1, 1900, just after the fever, he weighed 930 pounds.

August 10, 1901, near close of his second summer, he weighed 1450 pounds, when about 30 months old.

REMARKS ON INOCULATION OF THE SIX CATTLE IN TABLE I.

One positive mistake that we made with the three full blood bulls which were inoculated at the same time as the three full blood heifers, was that they were not permitted to get ticks on them early in the spring immediately following recovery from the inoculation fever. The heifers were turned out with the herd cows and became infested with ticks early in the spring, while the bulls were kept by themselves in small pasture lot, and did not, in fact, get but few ticks on them until July, when the weather was hot, a dangerous time for fever. Another mistake was made in the second inoculation of all those that did not react well to the first inoculation. The second inoculation dose (coming from same source as first) should have been $2\frac{1}{2}$ cc instead of $1\frac{1}{2}$ cc. The fever must be produced by the inoculation at least once and if possible twice before the animal is safely immune. The temperature should run up to, at lowest, 104 to 105.

TABLE III.

Temperature Records of Northern-Bred Grades that were Inoculated with Defibrinated Blood.

DATE.	S. H. GRADE		A GRADE I		A. GRADE II		A GRADE III	
1899–1900.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Nov. 24	102.0	102.0	104.0	103.0	102.0	102.6	102.6	105.0
Nov. 25	102.0	102.0	102.0	102.0	102.0	102.6	101.6	103.0
Nov. 26	102.0	102.0	102.0	102.6	102.0	102.0	102.2	102.6
Nov. 27	102.0	101.0	102.0	102.0	102.0	102.6	102.2	103.0
Nov. 28	102.4	103.0	102.6	102.0	102.0	103.0	102.0	102.0
Nov. 29	102.2	103.0	102.0	102.0	102.0	102.6	101.0	103.0
Nov 30	102.4	103.0	102.0	102.6	102.2	102.4	101.4	103.0
Dec. 1	104.0	104.0	102.0	102.6	103.6	104.0	102.6	103.6
Dec. 2	102.4	103.6	102.0	103.0	102.2	103.0	101.4	104.0
Dec. 3	102.4	102.4	102.0	101.6	102.0	102.2	103.0	102.2
Dec. 4	103.0	103.0	102.2	102.6	102.4	102.0	103.0	103.4
Dec. 5	103.2	102.8	102.0	102.4	102.0	102.2	103.4	102.6
Dec. 6	100.0	102.0	102.0	103.0	102.0	102.0	102.6	104.0
Dec. 7	101.6	102.0	102.0	103.0	102.0	103.2	101.6	103.0
Dec. 8	101.0	102.0	102.0	102.6	102.4	103.0	101.6	103.0
Dec. 9	102.6	102.6	103.0	103.6	102.0	102.2	101.0	102.0
Dec. 10	102.0	103.0	102.6	103.6	102.6	103.0	102.6	103.2
Dec. 11	104.0	103.0	103.0	103.2	103.0	103.4	102.6	103.4
Dec. 12	100.[illegible]	103.0	102.0	103.4	102.8	102.0	102.0	103.6
Dec. 13	100.6	102.6	102.0	102.4	101.8	103.0	100.8	104.0
Dec. 14	102.0	103.4	102.4	103.0	102.0	103.2	102.6	103.4
Dec. 15	100.0	102.0	102.0	103.0	102.0	102.4	101.4	102.6
Dec. 16	100.2	102.6	102.4	103.0	102.0	103.0	102.2	103.4
Dec. 17	101.2	102.6	102.6	103.0	102.0	102.6	102.4	103.2
Dec. 18	102.0	102.6	103.0	103.0	100.0	102.0	102.0	103.0
Dec. 19	102.2	103.6	102.6	104.0	102.4	103.6	100.0	103.0
Dec. 20	102.2	103.2	102.0	103.0	102.2	103.0	102.0	103.4
Dec. 21	102.6	102.6	102.6	102.8	102.0	103.0	102.4	102.4
Dec. 22	102.0	102.2	102.6	102.6	102.4	103.0	102.6	102.8
Dec. 23	101.0	102.0	102.6	103.0	102.0	103.0	101.0	103.0
Dec. 24	102.2	102.4	102.6	102.6	102.4	103.0	102.0	102.6
Dec. 25	101.0	102.0	102.4	103.0	102.0	102.4	102.2	102.4
Dec. 26	100.8	102.0	102.0	102.6	102.4	103.0	102.2	102.4
Dec. 27	100.0	102.0	102.4	103.0	102.2	102.6	102.2	102.6
Dec. 28	102.6	102.6	102.6	102.6	102.4	102.6	102.0	102.6
Dec. 29	102.0	102.0	102.6	103.0	102.4	102.0	102.0	103.0
Dec. 30	102.2	102.4	102.6	103.0	102.4	102.6	102.0	102.6
Dec. 31	102.0	102.4	102.6	103.2	102.0	102.4	102.4	102.6
Jan. 1	101.0	102.0	102.4	103.2	102.0	102.6	102.2	102.4
Jan. 2	102.0	102.2	102.0	102.2	101.6	102.0	102.4	102.6
Jan. 3	102.0	102.4	101.4	102.6	101.0	102.0	102.2	103.0
Jan. 4	102.2	102.6	102.0	102.2	102.0	102.2	102.0	105.0
Jan. 5	102.0	102.2	102.6	102.6	102.0	102.2	101.2	102.0
Jan. 6	101.[illegible]	102.0	102.2	102.6	102.4	102.6	102.0	102.0
Jan. 7	102.0	102.2	102.6	103.0	102.6	102.6	102.4	102.6
Jan. 8	102.0	102.4	102.0	102.4	102.2	102.6	102.0	102.2
Jan. 9	102.2	102.6	102.4	102.6	102.6	103.0	102.6	103.0
Jan. 10	101.6	103.0	102.6	103.0	102.6	102.6	102.0	102.6

TABLE III.—Continued.

DATE	S. H. GRADE		A. GRADE I		A. GRADE II		A. GRADE III	
1899—1900.	A M	P. M.	A M	P.M	A.M.	P.M	A. M	P. M.
Jan. 11	103.0	103.0	102.6	103.0	103.0	103.2	103.4	103.0
Jan. 12	102.2	101.6	102.0	102.0	102.6	102.4	103.0	102.6
Jan. 13	102.2	102.0	102.0	102.4	102.6	102.6	102.6	103.0
Jan. 14	101.6	102.0	102.6	102.6	102.6	103.0	102.0	102.6
Jan. 15	102.4	102.6	102.6	102.6	103.0	102.6	102.6	102.4
Jan. 16	102.6	102.0	102.6	102.4	103.0	102.6	102.6	102.6
Jan. 17	102.2	102.4	102.6	102.0	103.0	102.6	102.0	102.0
Jan. 18	103.0	102.6	103.2	102.4	103.4	103.0	103.0	102.2
Jan. 19	103.0	102.4	103.0	102.4	103.6	103.0	102.6	102.2
Jan. 20	102.2	102.4	102.2	102.6	103.6	103.0	102.0	102.6
Jan. 21	102.4	102.6	102.0	102.6	102.6	103.0	102.0	102.6
Jan. 22	102.0	102.4	103.0	102.0	102.6	102.2	102.0	102.2
Jan. 23	102.0	102.2	102.0	102.4	102.6	102.6	102.2	102.6
Jan. 24	.....	102.4	.....	102.2	.....	102.6	.....	102.0
Jan. 25	102.0	102.6	102.0	102.6	103.0	102.6	103.0	102.2
Jan. 26	102.0	102.4	102.0	102.6	102.6	102.4	102.4	102.6
Jan. 27	102.0	102.4	102.0	102.6	102.6	103.0	102.0	102.4
Jan. 28	102.0	102.2	102.0	102.6	102.2	102.4	102.0	102.2
Jan. 29	102.0	102.2	102.0	102.6	102.6	103.0	102.0	102.2
Jan. 30	101.4	102.0	102.0	102.0	102.0	102.2	101.6	102.0
Jan. 31	102.4	102.6	102.4	102.6	102.6	103.0	102.4	102.6
Feb. 1	102.2	102.0	102.0	102.4	102.6	102.0	101.0	102.0
Feb. 2	102.4	102.0	102.6	103.0	103.0	103.0	103.0	103.2
Feb. 3	102.0	102.0	102.0	102.2	102.6	102.2	102.0	103.0
Feb. 4	102.4	102.0	102.6	102.6	102.6	102.4	102.6	102.6
Feb. 5	102.0	102.0	102.4	102.0	102.6	102.4	102.4	102.0
Feb. 6	103.0	102.6	103.0	102.6	102.6	102.4	102.6	102.4
Feb. 7	103.2	102.6	103.0	102.0	103.0	102.2	102.6	102.0
Feb. 8	104.0	103.0	103.2	102.6	103.2	103.0	103.0	102.6
Feb. 9	102.6	102.0	103.0	102.6	102.6	102.6	102.0	102.0
Feb. 10	103.0	102.6	103.0	102.6	102.6	102.4	102.2	102.2
Feb. 11	102.0	102.0	102.6	102.0	102.6	102.0	102.0	101.6
Feb. 12	103.4	103.0	102.6	102.0	103.0	102.6	103.0	102.6
Feb. 13	102.6	102.4	102.0	102.4	103.0	102.6	102.0	102.0
Feb. 14	102.6	102.0	102.0	103.0	102.0	102.0	102.6	102.0
Feb. 15	102.0	102.2	102.0	102.6	102.6	102.6	103.0	103.0
Feb. 16	102.6	103.0	102.0	102.6	102.4	102.2	102.4	102.0
Feb. 17	102.6	102.6	102.0	102.4	102.2	102.4	102.2	102.0
Feb. 18	102.6	102.4	102.0	102.0	102.4	102.0	102.0	102.0
Feb. 19	102.6	102.0	101.2	102.6	102.0	102.2	102.0	102.0
Feb. 20	101.6	102.0	102.0	102.4	102.4	102.6	103.0	102.6
Feb. 21	102.2	102.6	102.0	102.2	102.4	102.6	102.4	102.6
Feb. 22	102.0	102.2	102.0	102.1	102.6	102.2	102.6	102.4
Feb. 23	101.2	.....	102.0	.....	102.6	.....	102.6	.....

The four Northern-bred grades that were brought to Auburn, Ala., November 8, 1899, with the six full bloods, were inoculated one month before the full bloods, and were differently handled and fed. They were all inoculated the first time November 24, 1899, with 1 cc of defibrinated blood, derived from the same two-year-old Southern-bred Jersey heifer; and on January 24, 1900, they all received a second inoculation of $1\frac{1}{2}$ of defibrinated blood. During the inoculation periods they were fed small rations of bran and very poor hay; housed at night and bad days, and allowed the run of a dry lot on good days. (See temperature records in Table III).

Shorthorn Grade Heifer, bred in Missouri, about 8 months old at time of arrival in Alabama, and weighed 320 lbs. The primary fever began about November 28 or December 1, and continued until about December 5th. and rose slightly again December 9, 10 and 11. Her temperature came up again December 18, and irregular slight elevations of temperature occurred until the second inoculation on January 24. During this first period a low fever prevailed, and the heifer exhibited weakness and an unthrifty condition. The low fever following the second inoculation was a little higher and more unbroken or continuous than the fever following the first inoculation. This heifer was not in good condition at the beginning of the inoculation periods, and was not fed a sufficient quantity of good feed during the fever. A liberal supply of good feed is always essential during inoculation fever. She was turned into a tick-infested pasture about March 1, and became so badly infested with ticks in April that it was necessary to get her up and treat her with kerosene oil emulsion in order to remove them. This heifer did make some growth during her first summer, but did not begin to improve in a normal, healthy manner until the spring of 1901. September 1, 1901, she weighed about 800 lbs.

Angus Grade Heifer No. I; bred in Illinois, about 8 months old at time of arrival in Auburn, Ala. About December 8 the primary reaction began. Slight irregular rises of temperature occurred every few days until second inoculation on January 24, 1900. Primary reaction began about February 6, and lasted about 4 days. February 23 she was turned into tick-infested pasture with the herd, and became infested with ticks early in the spring. She made good gains in flesh during the summer, and on November 10, 1900, weighed 725 lbs. During the second summer she developed without any checks, and now weighs about 900 lbs.

Angus Grade Heifer No. II, bred in Illinois, at time of arrival in Auburn, Ala., 8 months old, and weighed 415 lbs. Primary inoculation fever appeared about December 1. Secondary inoculation fever not very difinitely located, but probably began about January 9. Temperature rises were irregular and very mild, following both first and second inoculations. She never showed symptoms of ill health and at the end of the inoculation periods she weighed 490 lbs. She was turned into a tick-infested pasture and became infested with ticks early in the spring, and never showed any signs of sickness, weighing at the end of the first summer 670 lbs. At the end of the second summer she weighed about 800 lbs.

Angus Grade Heifer No. III; bred in Illinois, about 8 months old at time of arrival in Auburn, Ala., and weighed 420 lbs. About December 1 the primary reaction began. The secondary inoculation fever not very distinctly located unless January 7 to 13 or January 18 to 24 be so regarded. The primary reaction following the second inoculation began about February 3, and the secondary reaction appearing about February 20. No reaction is high or very distinctly located. This heifer was very wild and mean to handle, and was not fed during the first and second summers and the second winter, as were Nos. 1 and 2. At the end of the first summer she weighed 610 lbs., and in September, 1901, she weighs about 800 lbs. She became infested with ticks the first summer and several times since, but has never exhibited any signs of ill health.

TABLE IV.

Temperature Records of four Registered Angus Calves. Inoculated with Defibrinated Blood.

DATE	Barnes, H. I		Barnes, H. II		Barnes, B.		Little B.	
1900.	A. M.	P. M.	A. M.	P M	A. M.	P.M.	A. M.	P. M.
February 13	103.0	102.6	103.0	102.6	102.0	102.2	......	......
February 14	102.0	103.6	102.6	102.6	102.0	103.6	......	......
February 15	102.6	103.0	102.6	103.0	101.6	102.0	......	......
February 16	102.6	103.2	102.6	103.0	102.0	103.0	......	......
February 17	102.6	103.2	102.6	103.2	102.0	103.0	......	......
February 18	102.6	102.0	102.6	102.0	102.0	102.2	......	......
February 19	102.0	103.2	102.0	104.0	101.0	103.0	......	......
February 20	103.0	103.2	103.4	103.6	101.6	103.0	......	......
February 21	103.4	103.6	103.6	105.0	102.0	105.0	......	103.0
February 22	102.0	103.6	102.6	103.6	102.0	102.0	102.0	102.0
February 23	102.6	103.0	103.0	104.0	102.0	102.6	102.0	102.0
February 24	102.6	102.6	103.0	102.6	102.0	102.0	103.0	102.0
February 25	102.6	103.0	102.6	102.6	102.0	102.2	102.6	102.0
February 26	104.6	103.0	103.2	103.0	101.2	102.0	102.0	102.0
February 27	103.6	103.0	103.0	103.2	101.6	102.0	102.0	102.0
February 28	102.6	102.2	102.0	102.0	102.0	102.0	102.0	102.0
March 1	102.6	102.4	102.0	102.0	102.2	102.0	102.2	102.0
March 2	102.6	103.0	103.0	104.0	102.0	103.0	103.0	104.0
March 3	102.0	102.6	102.0	102.6	103.0	102.6	104.0	105.0
March 4	103.0	103.6	102.6	103.0	102.0	103.0	104.0	104.0
March 5	102.6	103.0	102.0	102.6	102.0	102.6	105.0	106.0
March 6	102.6	103.0	102.6	103.0	102.0	102.6	106.0	106.0
March 7	102.0	102.6	102.6	102.6	102.0	102.0	106.0	105.2
March 8	102.0	102.0	102.0	102.0	101.2	102.0	104.2	103.4
March 9	102.0	102.6	102.0	102.6	102.0	104.0	102.6	103.0
March 10	103.0	103.0	103.0	103.0	103.0	102.6	103.0	103.0
March 11	103.0	103.6	103.0	102.6	103.0	103.0	102.6	102.0
March 12	102.6	102.6	102.6	102.6	103.0	102.6	102.0	102.0
March 13	102.4	102.6	102.4	102.6	103.0	103.0	102.0	103.0
March 14	103.0	103.0	103.0	103.0	102.0	103.0	104.4	105.0
March 15	102.6	102.4	103.0	102.6	104.0	103.0	104.0	103.2
March 16	102.6	103.4	102.0	103.4	101.6	103.0	103.0	102.0
March 17	102.2	102.0	102.0	102.6	102.0	102.6	102.0	102.0
March 18	102.4	103.0	102.0	102.6	102.0	102.6	102.0	102.0
March 19	102.6	103.0	102.6	103.4	103.6	103.0	102.6	101.4
March 20	103.0	102.6	103.0	102.6	103.2	103.0	102.6	102.0
March 21	102.0	103.0	102.4	103.2	103.0	103.6	102.6	102.2
March 22	103.0	103.2	102.0	102.6	102.6	102.6	102.0	102.0
March 23	103.0	103.2	102.6	103.2	103.4	104.0	102.4	102.6
March 24	102.0	102.0	103.0	102.6	103.0	103.0	103.0	102.0
March 25	102.6	102.4	102.6	103.0	103.0	103.4	102.6	102.0
March 26	102.2	103.0	102.4	103.0	102.4	103.0	102.0	102.2
March 27	102.0	103.0	102.0	102.6	102.6	103.2	102.2	......
March 28	102.0	102.6	101.6	102.6	102.6	103.0	......	......
March 29	102.0	102.2	102.0	102.0	102.0	102.6	......	......
March 30	102.6	102.6	102.0	102.2	102.6	103.0	......	......
March 31	102.0	102.4	102.0	102.6	102.2	103.0	......	......
April 1	102.6	103.2	102.0	102.0	102.6	102.6	......	......
April 2	102.6	102.2	102.4	103.0	102.2	103.0	......	......
April 3	102.6	102.4	102.0	102.0	103.0	102.6	......	......
April 4	102.6	102.4	102.2	102.0	103.0	103.0	......	......
April 5	102.0	.....	102.0	.....	102.2	.....	......	......

In Table No. 3, "Barnes, H., I," "Barnes H., II," and "Barnes, B.," represent two heifers and one bull. They are full blooded Angus calves about 6 months old at time of their arrival in Alabama, and were bred in Illinois. February 11 they arrived in Auburn, Ala., and February 13 they were each inoculated with 1 cc of defebrinated blood derived from the same two-year-old Alabama-bred Jersey heifer. The inoculation fever periods are fairly well marked (see Table No. IV), but are somewhat irregular. These calves were fed shorts, corn meal, and received daily from 3 to 4 gallons of milk from two Alabama-bred Jersey cows. The milk very probably had no immunizing power, but it kept these calves in excellent condition to withstand the inoculation fever. They all grew and gained in weight during the inoculation period. April 5, 1900, they were taken to the home of their owner, Hon. R. B. Barnes, Opelika, Ala., where they have spent two summers without showing any symptoms of Texas fever. The heifers were turned into tick-infested pastures and the bull was kept by himself in a small pasture where he did not get many ticks on him the first summer. Consequently in November following the first summer the bull was given a second inoculation of 1½ cc of defibrinated blood. The cattle have suffered no inconvenience from the inoculation, and the exposure to tick inoculation during the second summer.

The "Little B." in Table No. IV. represents an Angus bull calf, bred in Missouri. He arrived at Auburn, Ala., February 20, 1900, and was then about 10 months old. This calf was small and thin at time of arrival, but on February 21 he was inoculated with 1 cc of defibrinated blood from the same Alabama-bred Jersey heifer. Notice by the table that his reactions or inoculation fever periods were better marked than were those of the

Barnes calves. This is partly due to the fact that he was older and was not fed milk to keep him stronger and better able to resist the micro-parasites. He was fed shorts, wheat bran and corn meal, and maintained a growing appetite and made good gains in weight during the entire 35 days he was in Auburn. When shipped to his owner, Mr. W. G. Little, Livingston, Ala., he could not be forced into the small crate in which he came to Auburn from Missouri. This animal has now passed two summers in Alabama, and has never exhibited any signs of Texas fever.

TABLE V.—SUMMARY OF CATTLE INOCULATED WITH DEFIBRINATED BLOOD IN ALABAMA.

No.	OWNER.	BREED.	AGE.	Native State.	Time of Arrival in Ala.	First Inocu-lation.	Dose.	Second Inocu-lation.	Dose.	Deaths from Inocu-lation.	REMARKS.
3	Expt. Station,	Angus grades	8 mo's.	Ill......	Nov. 8	Nov. 24	1cc	Jan. 24	1.5cc	.....	
1	" "	S. Horn grade	8 "	Mo....	"	"	1cc	"	1.5cc	....	
1	" "	S Horn Bull .	8 "	Mo.....	"	Dec. 26	1cc	Feb. 24	1.5cc	...	
1	" "	S.Horn Heifer	1 year.	Mo.....	"	"	1cc	"	1.5cc	....	
1	" "	R. Poll Bull	1 "	Ill.	"	"	1cc	"	1 5cc	......	Had severe fever following
1	" "	R. Poll Heifer	1 "	Ill. ...	"	"	1cc	"	1.5cc	....	Summer.
1	" "	Angus Bull ..	8 mo's.	Ill.	"	"	1cc	"	1 5cc	....	
1	" "	Angus Heifer.	8 mo's.	Ill......	"	"	1cc	"	1.5cc	....	
1	Barnes,......	Angus Bull.	6 mo's,	Ill......	"	Feb. 12	1cc	Nov.	1.5cc	....	Given Jersey milk during Inoc.
2	"	Angus Heifers	6 mo's.	Ill.	Feb. 9	"	1cc	....	.....	....	" " " " "
1	Little.......	Angus Bull .	10 mo's	Mo....	"	Feb. 21	1cc	....	.....	....	
1	Dumas......	S. Horn Bull..	9 mo's.	Tenn. ..	Feb. 20	Nov	1cc	....	....	....	Passed first sum'r without fever
2	"	S. Horn H. .	9 mo's.	"	Nov.	"	1cc	....	....	....	" " " " "
1	Mr. G.......	Herefords....	2 years	Mo....	"	Mch 13.	2cc	....	....	....	
1	T. and P.....	Jersey H....	2 years.	Ky ...	Winter.	Mch 14.	2cc	....	....	1	The last nine were inoculated
1	Sadler.	Jersey H.....	2 years.	Ky....	"	"	2cc	....	.....	1	by Fred G. Matthews, of South
1	Proctor	Jersey H.....	18 mo's.	Ky....	"	"	2cc	....	.....	....	Florence, Ala.
1	Thurman....	Jersey B.	2 years.	Ky....	"	"	2cc	....	....	....	
1	Cohens.	Jersey H.....	2 years.	Ky.....	"	"	2cc	....	....	....	
1	Nathan,.....	Jersey Cow ..	4 years.	Ky.....	"	"	2cc	....	....	....	
1	"	Jersey Calf...	6 mo's.	Ky.....	"	"	2cc	....	...	....	

The total number of cattle inoculated was 27, and out of this number two died of inoculation fever and one was seriously injured by severe attack of Texas fever as a result of tick inoculation the first summer. At least four others had the fever some time during the first summer but were not injured by it. Of the 18 inoculated by myself none were lost; one was seriously injured by tick inoculation the first summer, and four others had the fever in more or less mild form the first summer.

Clinical Notes on Dumas Short-Horns.

The two Shorthorn calves, owned by Dumas, of Arlington, Ala., were inoculated only once. (see Table V). This was done in November. The following August Mr. Joel Dumas writes me stating that about ten days after the calves were inoculated the primary inoculation fever appeared and continued about two weeks, the temperature ranging from 103 to 106. The heifer's temperature was invariably higher than that of the bull calf. During the high fever the bowels were kept active by drenching the calves with raw linseed oil, and when they would not eat they were drenched with milk. After recovery they were turned into a pasture with other cattle, and "have had ticks on them all along." He says: "My Shorthorn calves have done very well, and I think now they are perfectly immune." Nov. 1., these calves were safe.

Notes on the last nine cases in Table No. V:

F. G. Matthews, of Florence, Ala., inoculated these animals, and under date of April 8, 1901, writes me as follows:

"I first measured the dose in a small two drachm graduated, allowing something over a half drachm for a dose (2 cc). Nine head of cattle were inoculated. Seven of them were Jerseys (one 6 months old, one 18 months old, four were 2 years old, and one was 4 years old); they came from Kentucky; the other two were 2 year old Herefords, and came from the St. Louis market. All of these cattle were brought to Alabama during the past winter.

"The vessels used were sterilized by placing them in cold water and bringing it up to boiling.

"On the 13th of March I drew the blood from a native scrub bull, 18 months old, defibrinated it, and immediately inoculated the Herefords.

"On the 14th of March I drew 2 ounces of blood, prepared it, and immediately inoculated T. and P.'s 2-year-old Jersey cow; a few minutes later, Sadler's 2-year-old Jersey cow; about 15 minutes later Proctor's 18-month-old Jersey heifer; about 30 minutes later Thurman's 2-year-old Jersey bull; about an hour later Cohen's 2-year-old cow (she was in wood's pasture, and had to be hunted), and about an hour later we secured Nathan's 4-year-old cow and 6-month-old calf and inoculated both of them. (Numbered in the order named). Cows Nos. 1 and 2 died March 25. On that day the temperature of No. 3 was 104; No. 4, 103; No. 5, 105. March 26, No. 3, 107; No. 4, 103; No. 5, 105; Nos. 6 and 7, 104. No. 3 was too weak to stand up long at a time. March 27, No. 3, 105.5; No. 4, 102.5; No. 5, 102.5; Nos. 6 and 7, 105. These temperatures remained this way for several days and then subsided. The animals suffered loss of appetite one or two days. The bull's temperature went up again in a few days to 104, and No. 3 developed a swelling under the throat and weeping at the eyes—these conditions passed off in a few days.

"I can not understand why Nos. 1 and 2 should have died and No. 3 became so violently affected when all others took the regular or normal course. Possibly the severity of the fever in these three cases was due to the freshness of the blood at the time they were inoculated, the blood being somewhat old at the time the others were inoculated."

"Very respectfully,

"FRED G. MATTHEWS."

The time of year when these 9 head of cattle were inoculated was not altogether suitable—the weather was a little too warm. The best time of year for inoculation is from November 1st to March 1st. Moreover, some of these cattle were too old to be inoculated with safety, and the dose of defibrinated blood was too large for a single or first inoculation. The strength of the blood of an immune animal is never known until it is tested by inoculation; hence it is always safest to use the minimum dose in the beginning or the first time the blood is used. All of these animals should have been collected at one place so that there would have been no delay in the inoculations following the drawing of the blood and the defibrinating it. The vessels were not sufficiently sterilized. They should have been boiled at least for thirty minutes, and for safety one hour.

TABLE VI—Summary of Northern-Bred Cattle shipped into Alabama in the last 3 years and acclimation attempted by natural tick inoculation.

No.	Age when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama.	Died of Texas Fever	Living and acclimated.	Remarks.
1	1 year.	bull		Polled Durham		Wilcox		1	
1	8 mo's.	heifer		Red Poll	Lambert	"		1	Kept away from Southern cattle.
1	18 mo's.	"		" "	"	"		1	Separated from herd cattle.
2	14 mo's.	bulls		" "	"	"	2		Allowed to run with herd
2	18 mo's.	"		" "	"	"		2	Well cared for and isolated.
2	3–5 yrs.	cows		" "	"	"	1	1	
1	4 yrs.	bull	Tenn	" "		"	1		
1	1 yr.	"		R. P.& S. H. Cross		"		1	Kept isolated.
1	1 yr.	"		Shorthorn		"		1	" "
1	18 mo's.	"		"		"		1	
1	2 years,	"		Red Poll		"		1	
1	45 days.	"		Devon		"	1		
1	45 days.	"		"		"		1	
2	18 mo's.	heifers		Red Poll		"		2	
1	9 mo's.	bull	Ill	Angus	Kernachan	Colbert		1	Well cared for.
1	"	heifer	"	"	"	"		1	" " "
1	1 year.	"	Tenn.	"	"	"		1	" " "
1	"	bull	Mo.	Hereford	Swope	Lawrence		1	Isolated and stabled.
5	2 yr's.	heifers	"	"	"	"		5	" " "
1	9 mo's	bull	Ill.	Angus	Hare	Monroe		1	
3	10-18mo	bulls	Penn.	Devons		Chambers	1	2	
15	"	heifer	"	"		"	4	11	
1	3 yrs.	bull	"	"	McGehee	"		1	Isolated and stabled.
1	8 mo's.	"		Shorthorn	Davis	"		1	
1	"	heifer		"	"	"		1	

TABLE VI—Continued.

1	4 yrs	bull	Tenn.	Red Poll grade	Jones	Lee	.....	1	Taken to Florida before summer.
1	4 yrs.	cow	"	" "	"	"	1	.....	Died of Texas Fever in July.
1	3 yrs	cow	"	S. P. & R. P. Cross	"	"	1	.....	
1	5 yrs.	cow	"	" "	"	"	.....	1	
1	18 mo's.	heifer	"	Shorthorn, grade	"	"	1	.....	
1	7 mo's.	heifer	"	Red Poll, grade	"	"	.....	1	
9	1 year	.....	Neb	Shorthorn	McLatchy	Washington	2	7	Two of the 7 sick at time of report
1	15 mo's.	bull	Ohio	"	Talson	Etowah	.....	1	Kept isolated.
1	16 mo'f.	heifer	"	"	"	"	.....	1	" "
1	.....	bull	.....	Red Poll grade	Hamilton	"	.....	1	
1	1 yr	bdll	Mo	Hereford	Rodgers	Sumter	.....	1	
2	1 yr	heifer	Mo	"	"	"	2	.....	
1	1 yr	bull	Ohio	Red Poll, grade	McCain	"	1	.....	
1	1 yr	bull	Tenn.	" "	McCain & Cobb.	"	.....	1	
1	1 yr	bull	"	" "	Horn	"	.....	1	
1	1 yr	bull	"	" "	Scarborough.	"	.....	1	
1	1 yr	bull	"	Angus	Thornton	"	.....	1	
1	6 mo's.	bull	Ill	"	Ennis	"	.....	1	
2	6 mo's.	heifer	Ill.	"	"	"	.....	1	
1	6 mo's.	heifer	Tenn,	Shorthorn	Paul Gee	"	.....	1	Had Texas Fever and recovered.
1	6 mo's.	bull	"	"	" "	"	.....	2	" " " " "
1	6 mo's.	heifer	"	Red Poll	" "	"	.....	1	" " " " "
2	6 mo's.	heifers	"	Shorthorn	R. H. Seal	"	.....	1	" " " " "
2	9 mo's.	heifers	"	"	Seymour	"	.....	2	
1	9 mo's.	bull	"	"	"	"	.....	2	

TABLE VI.—Cont'd.

Summary of Northern-Bred Cattle shipped into Alabama in the last three years, and acclimation attempted by natural tick inoculation.

No.	Age when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama	Died of Texas Fever.	Living and acclimated	REMARKS.
10	6-12 mos	3 b, 7 h	Tenn. ..	Shorthorn.	F. I. Derby. ..	Sumter	2	8	
2	6-22mos	1 b, 1 h	“ ..	“	J. Sims.......	“ ...	1	1	
1	6 mo's.	heifer..	“ ..	“	Wallace	“ ...	1	......	Died second year.
1	1 yr....	bull	....	“	Comer........	Bullock	......	1	
1	3 yrs ..	bull....	......	“	“	“	......	1	
4	4 yrs ..	cows...	....	“	“	“	1	3	
1	4 yrs ..	cow....	....	Jersey	Haughton	“	....	1	
1	1 yr....	bull...	... ...	Shorthorn	Foster........	“	1	.....	
3	1 yr....	heifers.	....	“	“	“	3	.....	
1	2 yrs...	heifer..	....	“	“	“	...	1	
1	2 yrs ..	heifer..	....	Jersey	“	“	...	1	
5	1 yr ...	1 b, 4 h.	Miss (?)	Herefords.	Rainer	“	3	2	Ship'd Mch from Columbus, Miss.
1	7 mo's.	bull....	Tenn.	Shorthorns......	Culver........	“	.....	1	Shipped in October to Ala.
2	7 mo's.	heifers.	“	“	“	“	.....	2	“ “ “ “ “
1	8 mo's.	bull	....	Angus	Goldthwaite..	Montgom'y	.....	1	Weight 1400 lbs, at about 30 mo's.
1	5 mo's.	bull ..	....	Short horns	Marks	“	.....	1	Shipped Nov. 1899. to Ala.
2	8 mo's	1 b, 1 h	....	“	Gunter.......	“	.....	2	
2	8 mo's.	1 b, 1 h.	....	“	P. Tyson.....	“	....	2	
4	6 mo's.	1 b, 3 h.	....	“	McLemore ...	“	1	3	
3	8 mo's.	1 b, 2 h.	....	“	T. W. Oliver.	“	.....	3	
1	....	cow....	....	“	Smith........	“	.....	1	
2	....	1 b, 1,c.	......	Red Poll........	“	“	.....	2	
1	......	bull....	......	Polled Durham ..	“	“	......	1	
2	....	......	....	Short horns.....	Torbert	Lee...		2	

The total number of Northern-bred cattle on this list is 139. This, however, does not include all the Northern-bred animals shipped into Alabama during the past three years. There were many others brought into Alabama during the same period but we were unable to get authentic reports about them.

Of the total number reported (139), there were 31 fatal cases of fever; or 22.3 per cent. of the entire number died of Texas fever from inoculation, At the same time it should be noted that some of these cattle are still susceptible to Texas fever because they have been kept entirely free from ticks. Comparing the results (22.3 per cent. loss) with about 10 per cent. of deaths of Dr. Francis, where 1500 cattle were inoculated with defibrinated blood to produce immunity, gives a decided favorable balance for the new inoculation method. Or, compare the 22.3 per cent. loss with the 8 per cent. of deaths as shown in the summary of defibrinated blood inoculations made in Alabama.

In order to aid Alabama farmers who may desire to embark in the stock business by buying Northern-bred cattle, the veterinarian of the college and station will inoculate such animals with defibrinated blood, providing his expenses are paid to and from the place where cattle are to be inoculated. Parties desiring such inoculations will please notify the veterinarian in advance so that a date may be fixed to suit his convenience.

All farmers who have bought Northern-bred or foreign-bred cattle into Alabama at any time during the past three years will do us a great favor by reporting the results of their respective attempts at acclimating their cattle. Please give the age of each animal at time of arrival in Alabama; sex, breed, State from whence they came, how long said cattle have been in Alabama, how many are safely acclimated, with method of acclimating, and how many died with Texas or acclimating fever. If a number of animals were acclimated, the report may be tabulated as in Table VI.

We also solicit reports of all contagious or infectious diseases occurring among farm animals in Alabama. In case of serious or alarming outbreaks report directly to the veterinarian, and if possible, and best, he will at once visit the locality to determine the cause, and suggest ways of preventing and treatment.

I wish to take this opportunity to thank all those who so kindly sent in reports, and hope this bulletin will in part repay them for their trouble. I am especially thankful to Mr. R. W. Clark, who has charge of the stock at the Experiment Station, and who so carefully and faithfully looked after ten of the inoculated cattle that were directly in his care.

REMEMBER.

1.—That an animal sick with Texas fever can not infest or transmit the disease to healthy cattle.

2.—That the only known means by which the microparasite that causes Texas fever can be transmitted from diseased cattle to healthy ones is through two generations of the Southern cattle tick.

3.—That tick-free cattle never have Texas fever as long as they are tick-free.

4.—That cattle with Texas fever have or have had ticks upon them.

5.—That all cattle must acquire immunity after birth by having one or more attacks of Texas fever.

6.—That immunity to Texas fever is not inherited.

7.—That Southern-bred cattle have Texas fever when very young (sucking calves), and are usually but slightly affected by it.

8.—That the older the animal the more severe the fever; the older the animal the greater the mortality.

9.—That all cattle north of the government quarantine line are susceptible to Texas fever.

10.—That all Southern-bred cattle raised on tick-free farms and tick-free town lots are susceptible to Texas fever.

11.—That immune cattle will lose their immunity if kept free of ticks for two or more years.

12.—That in hot weather Texas fever is usually more acute and fatal than in cool seasons.

13.—That the best time to bring Northern-bred or foreign-bred cattle into Alabama is between November 1st and March 1st.

1.—That it is safer to bring young sucking calves into Alabama for acclimation than cattle over one year old.

15.—That sucking calves (2 to 4 months old,) can be shipped into the South by express; fed milk from a Southern-bred and immune cow, and be made immune by natural tick innoculation with a great degree of safety or little danger of loss.

. 16.—That one or two inoculations with defibrnated blood derived from an immune animal will produce a relatively safe immunity to Texas fever.

17.—That the best age for inoculating with defibrinated blood is one year or less.

18.—That the best time for the inoculation is from November 1st to March 1st.

19.—That inoculations should not be attempted in hot weather.

20.—That pregnant cows are liable to abort when they have inoculation or Texas fever.

21.—That inoculated animals should receive the best of feed and care during and after the inoculation fever.

22.—That from 50 to 90 per cent. of Northern-bred or susceptible cattle die with Texas fever when they are turned into tick-infested pastures, and allowed to rustle for themselves.

23.—That less than 10 per cent. of susceptible cattle are lost when they are made immune by the defibrinated blood inoculation method; about 3 per cent. die with the inoculation fever, and about 7 per cent. die with Texas fever as a result of tick inoculation during the first summer.

24.—That it is best to keep all cattle from becoming literally covered with ticks.

25.—That if you are adjacent to the government quarantine line it is best to exterminate all the ticks on your farm and farm animals.

NOTICE—Parties who are interested, and who may desire a Farmers' Institute held in their town or city, will please write the veterinarian of the college and station, stating when they desire the institute, and about how many farmers they can get to attend said meeting. Our funds for this work are limited, but we aim to visit as many counties as possible with our means during the year. We can visit one or two places each month while college is in session, and a number of counties during the summer vacation. Dr. C. A. Cary is Official Director of Farmers' Institute for the station and college.

BULLETIN No. 117. DECEMBER, 1901.

ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

ORCHARD NOTES.

By C. F AUSTIN.

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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, Alabama.

ORCHARD NOTES.

The season of 1901 was in many respects a favorable one for Alabama fruit-growers. The very mild preceeding winter had left the trees in excellent condition. Some of the earlier blooming plums escaped the frost and bore a good crop. The crop of fruit in the Experiment Station orchard was not as large as that of the preceding year; but it must be stated that the crop secured during 1900 was unusually large. The spring of 1901 was very late, wet and cold, and, therefore, prevented in many varieties a normal setting of fruit. As a result of the late spring the earlier varieties fruited from one to two weeks later than usual.

The young apple orchard planted in the years 1897 and 1900 continues to be very promising. Nearly every variety made a strong, vigorous growth during the past season. The method of treatment was the same as outlined in Bulletin 112, and has proven satisfactory. Some of the varieties planted in 1897 bore their first fruit this season.

Observations as to the prevalence of apple leaf rust (*Roestelia*) showed that the following varieties were affected:

Aikin, slightly.
Babbitt, slightly.
Battyani, slightly.
Buncomb, slightly.
Bledsoe, slightly.
Bradford, slightly.

Benoni, slightly.
Cillagos, slightly.
Cannon Pearmain, slightly.
Carolina Greening, very badly.
Cooper's Red, slightly.
Carter's Blue, very baldy.
Chattahooche, very badly.
Dam, slightly.
Early Harvest, slightly.
Elgin Pippin, slightly.
Equinettelee, badly.
Family, very badly.
Grime's Golden, slightly.
Hands, slightly.
Homing, slightly.
Haygood, very badly.
Jeffries' Everbearing, slightly.
Jonathan, very badly.
Julian, badly.
Keeskemet, slightly.
Moultries, badly.
Mangum, badly.
Marvina, badly.
Nickajack, very badly.
Mavarack Sweet, slightly.
Oszi-vaj, slightly.
Pear (or Palmer), slightly.
Red Limbertwig, slightly.
Rawls Janeton, slightly.
Red June, badly.
Rome Beauty, very badly.
Red Beitigheimer, slightly.
Rodes Orange, very badly.
Sekula, slightly.
Summer Wafer, slightly.

Shockley, very badly.
Senator, very badly.
Santa, badly.
Sweet Bough, slightly.
Thornton's Seedling, slightly.
Taunton, slightly.
Texas Red, slightly.
Walalyfi, badly.
Yellow English, slightly.
Yopp's Favorite, very badly.
Yellow Horse, slightly.
York Imperial, slightly.

The following varieties were free from rust this season:

Apple of Commerce.
Arkansas Black.
Buda Summer.
Black Ben Davis.
Champion.
Cooper's Early.
Epir.
Fanny.
Fall Pippin.
Garvenstein.
Hyari Piros.
Hershall Cox.
Hew's Crab.
Jennings.
Kennard's Choice.
Maggar.
Metell.
Mammoth Black Twig.
Maiden Blush.
Noble Savor.

Pasman.
Ponjik.
Red Astrachan.
Early Red Margaret.
Sabadka.
Summer Queen.
Saxon Priest.
Selymes.
Summer Cheese.
Shackleford.
Tuscaloosa Seedling.
Winesap.
Yakor.
Yates.

Early Red Margaret, Sabadka, Winesap, and Yakor which showed rust last year, escaped this, and, in addition to those affected last year, there are thirty-four more varieties affected this season. A greater number of the Hungarian varieties were affected this year than last year. Resistant varieties have for the past few seasons been giving a good deal of promise, but this season so many more varieties were affected than usual, that it is probable we have no varieties in our orchard that are perfectly resistant to the disease.

Spraying to Prevent Rust.—To determine if very thorough spraying with Bordeaux mixture would have any effect upon the rust, one tree of each variety was selected and kept very carefully sprayed from early spring until late in the fall. The Bordeaux mixture was used at the rate of six pounds of copper sulphate and six pounds fresh lime to fifty gallons of water.

The varieties selected for this spraying experiment were affected during the season of 1900 as follows:

Carter's Blue, slightly.
Cooper's Red, moderately.

Dam, slightly.
Early Red Marguerite, badly.
Family, very badly.
Hames, slightly.
Horse, moderately.
Jonathon, very badly.
Red June, slightly.
Santa, badly.
Senator, badly.
Shockley, badly.
Thornton's Seedling, slightly.
Winesap, slightly.
Yakor, slightly.

The trees were very carefully sprayed on the following dates during the season: March 24th, before growth started; April 25th, May 4th and 22nd, June 5th and 20th, July 23rd, August 9th and 28th.

On October 10th the trees were examined and the following notes taken showing the relative amount of rust on the sprayed trees. The trees at this time were heavily covered with the Bordeaux mixture:

Carter's Blue, badly.
Cooper's Red, badly.
Dam, slightly.
Early Red Marguerite, very badly.
Hames, slightly.
Horse, moderately.
Red June, slightly.
Jonathon, very badly.
Santa, very badly.
Senator, very badly.
Shockley, very badly.
Thornton's Seedling, slightly.
Winesap, slightly.
Yakor, slightly.

This seems to indicate that spraying with Bordeaux mixture has no effect upon the disease. Some of the varieties were even more affected this season than last. In reviewing the work of the past few seasons, it may be said that the rust is gradually increasing throughout the orchard. At present there are but few varieties that have not been at least slightly affected with the rust. While many of the varieties have not been affected so as to show reduced growth, many others have received a very serious setback from this cause.

The Green Aphis of Apples.—This insect has been very troublesome this season, and spread upon many varieties not attacked before.

The following varieties have been more or less affected:

Aikin, badly.
Apple of Commerce, very badly.
Battyani, badly.
Black Ben Davis, very badly.
Bledsoe, slightly.
Benoni, slightly.
Carolina Green, badly.
Cooper's Red, badly.
Cooper's Early, badly.
Early Harvest, slightly.
Elgin Pippin, badly.
Epir, very badly.
Family, badly.
Garvenstein, slightly.
Horse, very badly.
Jeffries' Everbearing, very badly.
Jennings, slightly.
Mammoth Black Twig, very badly.

Moultries, very badly.
Mangum, very badly.
Mamma, slightly.
Noble Savor, badly.
Nickajack, slightly.
Mavarack Sweet, slightly.
Os-zi-vaj, badly.
Pear (or Palmer), badly.
Red Limbertwig, badly.
Rawls Janeton, very badly.
Red Beitigheimer, very badly.
Red Margaret, slightly.
Summer Queen, very badly.
Saxon Priest, badly.
Shockley, slightly.
Senator, very badly.
Summer Cheese, slightly.
Sweet Bough, badly.
Shackleford, badly.
Texas Red, slightly.
Tuscaloosa Seedling, slightly.
Winesap, badly.
Wealthy, slightly.
Yellow English, badly.
Yakor, slightly.

This agrees to some extent with last year's report. There were sixteen varieties attacked this season that were not last, and thirteen varieties that were attacked last year that are free this. As in the case of the rust, the varieties that are resistant to the attack of the insects are becoming fewer every year. The indications are that there are no varieties that we can say are perfectly resistant to the attacks of this insect.

List of Hardy Varieties.—The following have been free from rust, aphis, and leaf spot for the past three seasons: Hyari Piros, Magyur, Maiden Blush, Metell, and Ponyike. There were eight hardy varieties last year and only five this. Three of the American varieties —Aikin, Babbitt and York Imperial—were slightly attacked with rust. Of the varieties that are not in the above list, but that have made a satisfactory growth, and are in good condition this fall are the following:

Aikin.	Jennings.
Arkansas Black.	Keeskemet.
Babbitt.	Kinnard's Choice.
Battyan.	Limbertwig.
Buncomb.	Mavarack Sweet.
Bradford.	Red Astrachan.
Bledsoe.	Summer Wafer.
Carter's Blue.	Selymes.
Champion.	Yakor.
Epir.	York Imperial.
Elgin Pippin.	Wilalyfi.
Gravenstein.	

The following varieties fruited for the first time this season: Bledsoe, Champion, Red Limbertwig, Thornton's Seedling, and Whalye.

The work with the bearing orchard has been along the line of spraying with Bordeaux mixture as a preventative against summer rot* and other diseases that cause the decay of fruit before maturity. As the first test along the line it was decided to keep the orchard very thoroughly sprayed from early spring until the fruit was ripe. The orchard was sprayed nine times

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*We use the term summer rot to denote all the kinds of rot as a class. The one rot very noticeable this season was what is known as black rot (Sphæropsis malorum).

during the summer at the following dates: March 27th, before growth started; April 8th and 25th, May 22nd, June 5th and 22nd, August 9th and 28th. Paris green was used, after the blossoms had fallen, at the rate of eight ounces to fifty gallons of the mixture, which was the same as that used in spraying for apple rust. Care was taken to cover the whole tree very thoroughly, and especially the fruit.

Notes on Varieties.—The varieties that were practically free from rot are: Early Harvest, Hames, Hews' Virginia, Hiley's Eureka, Hubersham Late, Prior's Red, Red June, Summer Red, Thornton's Seedling, Shockley, Stephens' Winter, Winesap.

Varieties only slightly affected by the rot: Ben Davis, Golden Pippin, Horn, Kellageskee, Limbertwig, Red Astrachan, Rome Beauty, Rawls' Janeton, Shannon Pippin, Terry's Winter, Yopp's Favorite.

Varieties which rotted badly: American Golden Russett, Cannon Pearmain, Elgin Pippin, Red Limbertwig, Yellow English.

The growing of apples is a very difficult problem so far South, and without spraying a greater per cent. of the apples are more or less rotten before they are ripe. The orchard was an old one, and has had very little treatment. It was full of all kinds of diseases and insects that had flourished at will.

The work of the fruit season seems to point to the conclusion that by careful selection of varieties, good cultivation, and thorough spraying, good clean apples can be grown here from June until early winter. The old trees this season have made a good, strong, healthy growth.

CHERRIES.

In the spring of 1898 eleven of the leading varieties of cherries were planted. All of the trees of three of the varieties have died. Several more are making a struggle for existence. Four of the varieties have made a good strong growth and seem to be fairly hardy in this climate. They are: Deyhouse, Governor Wood, Ostheimer, and Suda. These varieties all bloomed full and gave promise of a heavy fruitage this season, but when the fruit was about half grown the bulk of it dropped off. Whether this peculiarity is due to the climatic conditions or to the trees not being old enough can not at present be determined.

Although cherries can not be recommended for general planting they should be in the list of the home garden for the northern half of the State.

Varieties.	No. of trees set 1898.	No. of trees alive 1901.	General condition in the fall 1901.
Abbasse........	2	1	Fairly strong and vigorous.
Black Tartarian	2	1	Weak and growth poor.
Dyehouse	1	1	Vigorous and strong with a good growth.
Early Richmond	1	0	
English Morello	1	0	
Governor Wood.	2	1	Vigorous, good healthy growth.
Mont. O. King.	2	2	Fairly vigorous, growth small.
Napolean.......	1	0	
Ostheimer......	2	2	Strong and vigorous with a good growth.
Suda...........	2	2	Strong and vigorous with a good growth.
Wragg.........	2	2	Vigorous, fair growth.

JAPAN WALNUTS.

Trees were set in 1896. They fruited for the first time this season. The nuts are of medium size, borne in large clusters, from six to twelve; shell is a little thicker than that of the English walnut, which they resemble to some extent. The meat is sweet and of good quality, the tree bears early and is a very rapid grower. It makes a handsome tree, having leaves of immense size. It should be included in the list for home planting throughout the State.

PEACHES.

The peach orchard has done well this season, for while the crop has not been large, nearly all varieties have borne some fruit. A coöperative experimental orchard was planted in 1898, at the request of a committee of the Association of Agricultural Colleges and Experiment Stations, for the testing of the geographical limits of the successful cultivation of the different races of peaches. The test consisted of three varieties of three trees each, of the five races of peaches. The orchard bore a good crop this season, and it is now possible to form some idea of their value.

Alexander.—An old standard sort. Medium, greenish, white, covered with red; flesh white, firm, juicy, sweet; clingstone. Season first to the middle of June; tree vigorous and productive. A leading early market sort.

Mt. Rose.—Medium to large, white, with red cheek; flesh quite firm, juicy, rich, sweet; freestone; a leading market variety; ripens from the first to the middle of July. Tree vigorous and usually quite productive.

Old Mixon.—This is another old variety. Medium to large, yellowish white, with red cheek; flesh white, very rich and juicy; freestone; a good shipper, and well known upon the market. Season from the middle to the last of July.

PEENTO RACE.

Varities—**PEENTO**, **WALDROW**, and **ANGEL**. The varietieth of this race bloom so early that the blossoms are all killed by the frost. See table of blooming period.

NORTH CHINA RACE.

Chinese Cling.—Large, globular, pale yellow; flesh very firm, sweet, rich; a close clingstone; a fine sort for pickling; season first to the middle of July. Tree vigorous and quite productive.

Elberta.—Large to very large, round oval, pale yellow unless fully ripe; flesh pale yellow, firm, rich, juicy, slightly acid; freestone; ripens last of July to first of August. Tree strong, vigorous and very productive. The leading market variety for the South.

Mammie Ross.—Large, round, white, with red cheek, and small red specks over the surface; flesh white, streaked with red under the skin; tender, juicy, sweet; clingstone; season first to the middle of July. Tree vigorous and productive. A promising new variety.

SOUTH CHINA RACE.

Pallas.—Medium, roundish, greenish yellow, with some red over the surface; flesh very white, sweet, rich; freestone; a promising variety for home use and local market; season middle of July. Tree vigorous and very productive. The best variety of the race.

Tabor.—Medium, roundish oblong, pointed, covered with red; flesh white, sweet, juicy; clingstone. Tree vigorous and fairly productive; ripens the last of July.

Honey.—Small, yellowish white, oval, slightly flattened, terminating in a prominent point; flesh very white, sweet, tender, juicy; freestone; season first of July. Trees are fairly vigorous and quite productive.

SPANISH RACE.

Imperial.—Medium to large, roundish oblong, greenish yellow, covered with reddish spots over the surface; flesh white, tender, juicy, sweet; freestone; season last of July. Tree vigorous and quite productive.

Onderkonk.—Small to medium, pale yellow, flesh yellowish, tender, juicy, good; freestone; ripens about the first of August. Tree vigorous and productive.

Cable's Indian.—Small, roundish, dull grayish red; flesh firm, reddish; clingstone; season first of August. Tree vigorous and productive.

Notes on the Blooming of the Races of Peaches for 1901.

Varieties.	Jan. 22.	Feb. 20.	Feb. 24.	March 4.	March 15.	March 26.	April 1.	April 6.
				PERSIAN RACE.				
Alexander. ..	....	....	....	....	....	buds showing pink	full bloom..	blossoms falling.
Mount'in Rose	....	....	....	buds swollen..	first blooms.	full bloom..	....	....
Old Mixon....	....	....	....	buds swollen..	first blooms.	full bloom..	....	....
				PEENTO RACE.				
Peento.	buds showing pink.	blooms fallen..	....	....	Blossoms	all killed by	the frost.	....
Waldrow.....	....	buds showing pink..	blooming...	....	Blossoms	all killed by	the frost.	....
Angel.......	....	....	buds showing pink .	full bloom..	Blossoms	all killed by	the frost.	....
				NORTH CHINA RACE.		all killed by	the frost.	
Chinese Cling.	....	....	....	....	buds pink..	full bloom..	blossoms falling.	....

Notes on the Blooming of the Races of Peaches for 1901,

Varieties.	Jan. 22.	Feb. 20.	Feb. 24.	March 4.	March 15.	March 26.	April 1.	April 6.
Elberta	....	....	....	....	buds opening.	full bloom..	blossoms fallen.	....
Mammie Ross.	....	....	....	....	buds pink.	full bloom..	blossoms falling.	....
				SOUTH CHINA RACE.				
Pallas........	....	....	....	....	buds pink..	full bloom..	blossoms fallen.	....
Tabor..	....	....	....	....	buds pink..	blooming...	blossoms falling.	....
Honey	....	....	buds pink..	buds opening..	full bloom..	blossoms falling.	....	....
				SPANISH RACE.				
Imperial.	....	....	....	buds pink..	full bloom..	blossoms fallen.	....	....
Onderkonk. ..	....	....	buds swollen....	buds pink..	full bloom..	blossoms fallen.	....	....
Cable's Indian	....	....	....	buds swollen.	blooming...	full bloom..	....	....

The varieties of the Peento race bloom so early that they have no value outside the orange belt. The trees of the South China and Spanish races are strong, vigorous growers, and very productive. Many varieties of these races are suitable for the southern half of the State and coast region for home use and local market. As yet neither race contains any varieties that will compete with the leading market sorts of the Persian or North China races. A variety of peaches containing the vigor and productiveness of the trees of the South China and Spanish races, with the size, color, appearance and general market qualities of the Persian and North China races would be a valuable addition to Southern peach growing.

NOTES ON OTHER VARIETIES OF PEACHES.

Carmen —Large, nearly round, white with red cheek; flesh firm, white, rich, juicy, slightly acid; nearly free; season first to middle of July. Tree vigorous and productive. A promising variety for general planting.

Early Crawford.—An old standard variety; large, oblong oval, rich yellow with a red cheek; flesh yellow, firm, rich, slightly acid; season middle to last of July. Tree vigorous and usually productive. Under favorable conditions this is one of the leading commercial varieties. It wants a rich heavy soil to do its best, for upon poor land it is a shy bearer.

Grey.—Medium to large, rather long and flattened, with a prominent point at the end; skin very smooth, pale yellow, slightly sprinkled with red; flesh thick, firm, rich, sweet; freestone. Tree vigorous and quite productive. It seems to be a promising variety.

Hale's Early.—Medium to large, roundish, greenish white, nearly covered with red; flesh firm, good; clingstone; season middle of July. Tree vigorous and very productive. This is an old market sort, its greatest drawback is its tendency to rot at harvest time.

Matthew's Beauty.—Large, roundish, yellow; flesh thick, firm, rich, sweet; freestone; season middle to last of August. Tree vigorous and fairly productive. This variety follows Elberta and is a promising late sort.

McKinney.—Medium to large, yellowish with red cheek; flesh white, firm, juicy, sweet; clingstone; season middle to last of June. Tree a strong grower and fairly productive; a promising new variety.

Stump.—Medium to large, round with red cheek; flesh thick, firm, sweet, juicy; freestone; season first of August; tree strong, vigorous and productive. An old sort, but still one of the best white varieties in its season; a good keeper and shipper.

Ovido.—Small to medium, roundish oblong with prominent point at the end, greenish yellow with red cheek; flesh greenish white, tender, juicy and sweet; freestone. Tree a strong grower and very productive.

Sneed.—Medium, roundish oval, white with red cheek; flesh greenish white, juicy; clingstone; season last of May. Tree strong, vigorous and productive. The earliest peach yet produced.

Triumph.—Medium, yellow, nearly covered with red; flesh yellowish, tender, juicy, good; nearly free; season first to middle of June. Tree vigorous and productive; an excellent early peach and a good shipper.

Victoria.—Small to medium, nearly round, pale yellow; flesh pale yellow, sweet, juicy; freestone; season first of August. Tree a good grower and quite productive.

LIST OF VARIETIES FOR GENERAL PLANTING IN THE STATE.

As a short list including some of the best market sorts, we would suggest the following, given in the order of ripening: Sneed, Triumph, Carmen, Mammie Ross, Mountain Rose, Chinese Cling, Elberta, Stump, Matthew's Beauty. For a longer list for home use and local market take the above list and add to it Alexander, McKinney, Hale's Early, Early Crawford, Grey, Pallas, Tabor, Imperial. The last four varieties are suitable only for the southern half of the State and coast region.

Notes on the Blooming of Peaches.

Varieties.	March 4.	March 15	March 26.	April 1.	April 6.
Carmen..........	buds swelling.	buds opening.	full bloom.	blossoms falling.	....
Early Crawford ..	....	first blooms.	full bloom.	blossoms falling.	....
Grey	buds swelling.	first blooms.	full bloom.	blossoms falling.	....
Hale's Early.	....	buds pink.	first blooms.	....	full bloom.
Marks.......	....	buds pink.	full bloom.	....	....
Matthew's Beauty	....	first blooms.	full bloom.	blossoms falling.	....
McKinney.	....	buds pink.	first blooms.	full bloom.	blossoms falling.
Stump...........	....	first blooms.	full bloom.	blossoms falling.	....
Ovido	buds opening.	full bloom.	blossoms fall en.	....	....
Reeves...........	buds swelling.	first bloom.	full bloom.	blossoms falling.	....
Sneed...........	buds swollen	buds opening.	full bloom.	blossoms fallen.	....
Triumph.....	....	buds swollen.	blooming	full bloom.	blossoms fallen.
Victoria.........	....	blooming	blossoms fallen.	....	....

PLUMS.

The season has not been a very favorable one for plums. The varieties have fruited very unevenly. This is probably due to the excessive crop of 1900, which left the trees in poor condition. The hailstorm of May 13th did a considerable damage by the hailstones marking the surface of the fruit so as to give it a poor appearance. On account of the freedom from late frost this spring, we were able to get some fruit from the very early blossoming sorts. We give a table of notes on the blossoming period, and general condition of crop, and another tabulation showing the number of trees of each variety, that were set in 1896, the number of trees that have died from 1896 to the fall of 1901, and the number of trees alive at present, with a note as to their general condition.

During the present season a large number of trees have died from some unaccountable cause. For one to have a sucessful plum orchard, a setting of trees must be made every year. So that as fast as one orchard gives out another will be coming on to take its place. (For description of plums and varieties for planting see Bulletin No. 112.)

Notes on the Blooming of Plums 1901.

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Abundance, Berger, Botan and Yellow Fleshed Botan.	....	buds showing white.	buds opening.	full bloom.	....	....	About one-half crop.
Burbank..........	buds showing white.	buds opening.	full bloom..	fallen.	....	....	Very light.
Blood No. 4	buds opening.	nearly full bloom.	blossoms falling.	....	....	....	Good.
Berckman's	....	buds opening.	full bloom..	falling......	....	....	Light.
Chabot, Babcock, Bailey's Japan, Hattankio, Munson, or Yellow Japan.........	....	buds opening.	full bloom..	fallen.	....	....	Light.
Chas. Downing...	....	....	buds swelling.	buds opening.	nearly full bloom.	blossoms falling.	Full.
Emerson.........	buds opening.	full bloom..	falling......	....	....	....	Full.

Notes on the Blooming of Plums 1901.—Cont'd.

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Excelsior		buds opening.	full bloom	fallen.			Very good.
Earliest of All			buds swelling.	buds opening.	full bloom.		Failure.
Golden Beauty			buds swelling	buds opening.	blooming.	blossoms falling.	Very full.
Gold		buds opening.	blooming	fallen.			Fair.
Hale		buds opening.	blooming	fallen.			Failure.
Hawkeye					buds swelling.	blooming.	Good.
Kelsey	buds opening.	blooming	falling.				Light.
Kurr		buds white.	buds opening.	falling			Very good.
Lone Star		buds white.	full bloom	fallen.			Failure.

Notes on the Blooming of Plums in 1901.—Cont'd.

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Long Fruited				buds opening.	full bloom	falling.	Failure.
Maru				buds swelling.	buds opening	full bloom	Failure.
Normand		buds opening.	blooming	falling			Very full.
Milton			buds opening.	blooming	full bloom		Fair.
Orient		buds opening.	blooming	falling			Tree died before ripening crop.
Pres. Wilder			buds opening.	blooming.	full bloom		Light.
Red Nagate			buds opening.	blooming	blossoms falling.		Full.
Rockford					buds opening.	blooming.	Failure.
Satsuma	buds opening.	blooming	blossoms falling.				Good.

Notes on the Blooming of Plums in 1901.—Cont'd.

Varieties	March 4.	March 9.	March 15.	March 26.	April 6	April 11.	Condition of crop in 1901.
Transparent......	....	buds opening.	blooming ..	blossoms falling.	....	....	Very full.
Willard..........	....	....	....	buds opening.	blooming ..	blossoms falling.	Failure.
Wickson..........	buds opening.	blooming.	blossoms falling.	....	....	....	Light
Whitaker.........	....	....	....	buds opening.	blooming...	blossoms fallen.	Good.
Wayland	....	....	buds opening	blooming.	full bloom..	blossoms fallen.	Failure.
Wooten	....	....	buds opening.	blooming ..	full bloom..	blossoms falling.	Full.
Wild Goose.......	....	....	buds white.	buds opening	blooming ...	blossoms fallen.	Full.
Yosebe...........	....	....	buds white.	buds opening.	blooming ...	blossoms falling.	Light.

Notes on the General Condition of the Orchard.

Varieties. JAPANESE TYPE.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Abundance, Berger, Botan, Yellow Fleshed Botan..........	8	7	1	Strong, vigorous, good growth.
Berckmans.	2	1	2	In good growing condition.
Burbank.........	4	2	2	Poor growth, trees dying.
Blood No. 3......	2	0	2	
Blood No. 4.....	2	2	0	Making a good growth.
Chabot, Babcock, Baily, Hattankio, Munson, Yellow Japan..........	11	4	7	The few trees left are in good condition.
Hale............	3	3	0	Very strong and vigorous.
Kelsey..........	2	1	1	Tree in fair condition.
Kerr............	3	2	1	Quite strong and vigorous.
Long Fruited.....	2	0	2	
Maru............	2	0	2	

Notes on the General Condition of the Orchard.—Cont'd.

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Normand.........	2	2	0	Trees in good condition.
Orient............	2	0	2	
Red June, Red Nagate	5	3	2	Strong and healthy trees.
Satsuma..........	2	1	1	Last tree slowly dying.
Willard	2	0	2	
Yosebe...........	1	1	0	In very good condition.
Totals.. ...	55	29	26	
AMERICAN TYPE.				
Hawkeye	2	0	2	
Rockford.... ...	2	1	1	Making a struggle to live.
Weaver..........	2	0	2	
Wyant.	2	0	2	
Totals......	8	1	7	
WILD GOOSE TYPE.				
Charles Downing.	2	1	1	Making good growth.

Notes on the General Condition of the Orchard.—Cont'd.

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Milton..........	2	2	0	In good condition.
Miner............	2	0	2	
President Wilder.	2	1	1	Making good, strong growth.
Whitaker........	2	1	1	Making fair growth.
Wild Goose.......	2	1	1	Growth very poor.
Wooten.....	2	2	0	Small growth.
Totals..	14	8	6	
WAYLAND TYPE.				
Golden Beauty...	2	2	0	Very strong and vigorous.
Wayland.........	2	1	1	Last tree nearly dead.
Totals..	4	3	1	
CHICASAW TYPE.				
Emerson..........	2	2	0	Making a steady growth.
Lone Star........	2	2	0	Only a fair growth.
Transparent.....	1	1	0	Vigorous growth.

Notes on the General Condition of the Orchard.—Cont'd.

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Totals......	5	5	0	
HYBRID PLUMS				
Gold....	2	2	0	Making good, strong growth.
Excelsior..... ...	2	2	0	Vigorous and strong.
Wickson	2	1	1	Making very poor growth.

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Agricultural Experiment Station.

AUBURN.

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ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

COWPEA CULTURE.

By J. F. DUGGAR.

BROWN PRINTING CO., PRINTERS & BINDERS.
MONTGOMERY, ALA
1902.

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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, Alabama.

COWPEA CULTURE.

By J. F. Duggar.

Summary.

Cowpeas may be planted in May, June or July. For the production of seed, planting in June has been most satisfactory.

By planting New Era cowpeas April 26, two crops were matured before frost.

Early planting lengthens the period of growth and increases the tendency for the plants to form runners.

Weevil in cowpea seed should be destroyed by the use of carbon bi-sulphide.

Subsoiling and liming failed to increase the yield.

In one test broadcast sowing afforded a larger yield of hay than did drilling and cultivation, but the latter method is more certain to afford a fair crop of peas in an unfavorable season.

A large number of varieties have been tested, both as to yield of seed and of hay. Those averaging the largest production of grain are New Era, Black and Red Ripper. The varieties making the largest average yields of hay for three years are Wonderful and Clay. Wonderful, or Unknown, is a standard general purpose cowpea for the central and southern parts of the State.

The number of seed in a bushel varied from 94,634 with the Taylor variety, to more than 236,000 with New Era and Small Black.

The number of pounds of dry unhulled peas required to shell a bushel of 60 pounds varied between 78 pounds

with Brown-eye Crowder and 90 pounds with Wonderful.

Fertilizer experiments at Auburn on soil repeatedly fertilized showed very slight gains from any fertilizer, but on poor sandy or loamy soils an application of acid phosphate, with or without potash, is recommended. In three tests acid phosphate proved superior to crude or raw phosphate.

In composition cowpea hay resembles wheat bran, and the seed are much richer in nitrogen, or muscle-forming material, than either wheat bran or corn. By the use of a good quality of peavine hay the usual corn ration of working teams can be greatly reduced.

As compared with the velvet bean as a forage plant, cowpeas have the advantage in convenience of curing and in palatability, but are at a disadvantage on certain soils by reason of the susceptibility of cowpeas to the attacks of the nematode worm and of several fungous diseases. Velvet beans and beggar weed were found to be exempt from injury from nematodes.

At Auburn the yield of forage has averaged higher from cowpeas than from velvet beans, soy beans or beggar weed.

There is great need for a suitable grass to grow with cowpeas to aid in retaining the cowpea leaves during curing and to hasten the curing process. A volunteer growth of crab grass often serves this purpose. German millet has been found fairly satisfactory for sowing with the early varieties, but it matures too early for use with medium and late varieties.

Sorghum sown with cowpeas increased the yield of hay, but did not make curing easier.

The most profitable method of disposing of the growth of cowpeas consists in cutting the vines for hay and using the roots as fertilizer for the next crop.

Where haying is not practicable and picking too expensive except for seed, the vines should be grazed while the leaves are still retained.

Cows pastured on corn stalks and drilled cowpeas between the corn rows afforded butter and increased live weight worth in 1900 $4.47 per acre grazed over; the next year the returns in butter alone from cowpeas drilled between the corn rows was $5.28 per acre.

As an economical method of harvesting the grain of cowpeas the use of a scythe or reaper is practicable for the bunch varieties, the entire mass being thoroughly cured.

In curing peavine hay no rule as to the number of hours of exposure in swath, in window, or in cocks can be blindly followed, as the method must vary with the luxuriance and succulence of the vines and the condition of the weather. The aim should be to retain all the leaves, which requires that the exposure of the unraked hay be as short as practicable and that part of the curing be effected while the partially cured material is in windrows or cocks.

Hay caps make haying with cowpeas less risky, and when they are repeatedly used in curing hay from a succession of plantings, they soon repay their first cost.

With different varieties from 51 to 75 per cent. of the weight of the entire plant was obtained in the hay, the remainder being in roots, stubble, and fallen leaves.

The leaves averaged 30 per cent. of the weight of the hay.

Analyses made of leaves, pods and blooms, fine stems, coarse stems, fallen leaves, roots and stubble, showed that the leaves were at least twice as rich in protein (or muscle-forming material) as the other portions of the plant.

Introduction.

This bulletin gives the results of experiments made at Auburn during the past six years. The experiments have been planned and directed by the writer and all the weighings and supervision of labor have been in charge of Mr. T. U. Culver.

Our work with cowpeas is divisible into two parts, that which relates to their cultivation and use as forage plants and that which takes note of their value as fertilizers or soil improving plants. This bulletin treats only of the first division of the subject. Our next bulletin will record results showing the fertilizing value of cowpeas and the best methods of disposing of this plant when the improvement of the soil is the principal aim.

The cowpea is highly appreciated by the best farmers in every southern state, yet several times as many acres as at present might be devoted to it with advantage.

An enormous increase in the acreage of cowpeas would do more, we think, than any other immediately practicable reform to cure the ills of southern farming, to enrich the soil, to raise the acreage yield of all other crops, to build up the live stock industries, and to promote diversified farming.

Time for Planting Cowpeas.

The cowpea is very tender as regards cold. It is strictly a hot weather plant and the seed should not be planted until the soil is quite warm. It can be planted as early as the beginning of the cotton planting season. But such early planting is unwise in itself as well as in conflict with other work that is imperative in April.

Usually nothing is gained by planting before the first of May, and our largest yields of seed have been obtained by planting after the first of June. It should be noted that in the variety test of 1901, where most of the plots afforded more than 20 bushels of seed per acre, planting did not occur until June 28.

Rather late planting tends to promote seed production and to reduce the growth of vine. Early planting promotes a luxuriant growth of vines, with consequent increased tendency for the vines to run and tangle, and often results in a decreased yield of seed.

Whippoorwill peas planted in drills, April 19, 1898, and cultivated, did not ripen seed until the latter part of summer, and a period of 160 days elapsed between the dates of planting and picking, though properly the harvesting should have taken place several weeks earlier. This was in a year when the rainfall was deficient up to July, and abundant after the first week in July.

Compare this with the Whippoorwill variety planted July 1, 1896, in drills in the special phosphate test. Here all the pods were ripe 87 days after planting.

Notice also that, in 1900, in the fertilizer experiment, only 99 days elapsed between the planting and picking of the Whipporwill cowpeas.

Likewise Whipporwill peas planted June 28, 1901, were picked almost clean 102 days after the date of planting.

These and other examples which we might cite indicate that by planting cowpeas rather late we greatly shorten the period of growth.

Even when it is desired to grow two crops of cowpeas the same year it is not necessary to plant many days before May 1. In 1901 we grew two crops of New Era cowpeas to full maturity, the second crop being from pods ripening in midsumer.

The seed planted April 26 matured a crop which was picked July 22 and planted July 26.

This planting in turn afforded a crop (of mature pods) before frost, about 90 per cent. of the pods being ripe on November 1.

The New Era is the only one among the varieties tested here, from which we have endeavored to obtain two crops in one year. Such a course is probably advisable only where cowpeas for planting are scarce and costly.

The middle of July is probably the latest date of planting with the expectation of getting a large yield, and with most varieties planting in June seems preferable at Auburn.

To destroy the weevil that becomes so destructive in stored cowpeas on the approach of warm weather, we use carbon bisulphate, which is also needed as a means of destroying the weevil in corn. The cost is 10 to 20 cents per pound, and one pound will treat a number of bushels of shelled cowpeas. About an ounce of the liquid is poured into an open can and placed upon the upper surface of the peas in a box or barrel and a cloth spread over all. The treatment may be repeated after a few days. The liquid evaporates rapidly, and the vapor of carbon bi-sulphide destroys insect life. The vapor is highly inflammable and no flames or lighted pipe should be allowed near until the odor has disappeared.

Preparation and Planting.

The place in the rotation usually assigned to cowpeas is that of a partial crop planted between the corn rows at the last or next to last cultivation, or else that of a second crop on the land where oats, wheat, or rye has been harvested.

It is not putting the matter too strongly to say that 80 per cent. of the acreage of corn in this State should have cowpeas between the rows and that at least 80 per cent. of the area from which small grain is cut in May and June should be planted in cowpeas.

On sandy upland where the corn rows are five feet apart we prefer to plant the cowpeas in a single drill half way between the lines of corn and to plant at the next to the last cultivation, so that the last cultivation serves also to give the cowpeas a start. On good bottom land, well supplied with moisture, we prefer to cow cowpeas broadcast in corn, and this, of course, can be done only at the time of the last cultivation.

On rich land care should be taken that the sowing of cowpeas, especially of the running varieties, does not take place so early that the corn will be overrun by the vines. Avoidance of this trouble lies either in late planting or in the use of the bunch varieties.

In drilling cowpeas between the corn rows we obtain a more uniform start by employing the planter than by dropping the seed by hand in the first or center scrape furrow and covering with the two siding furrows of the scrape run next to the corn.

We have employed numerous methods of planting cowpeas after small grain. Since work is pressing at this season and the soil sufficiently moist for plowing only for relatively brief periods, our usual policy is to plant the seed without waiting to make thorough preparation.

There is room for considerable ingenuity in determining the best method of completing the preparation and giving the first cultivation. One of the most important aims to be kept in view in this is to keep the land nearly level so that the plants may better resist drought and so that a mower may be conveniently used. After the first cultivation, when this serves also as a partial breaking, only the heel scrape or other shallow-working implement should be used.

Though drilled cowpeas on the Experiment Station farm when growing alone are usually hoed once, yet we are inclined to think this is often an avoidable and unprofitable operation.

With cowpeas intended for hay, pasturage or fertilizer, it is, of course, even less necessary than where the prime object is the production of seed.

Possibly the weeder, which we have successfully used on other crops, and which others have run over cowpeas without injury, may prove a partial substitute for the hoe. It should be employed when grass and weeds are extremely small.

We have made no test to ascertain the best amount of seed, which will doubtless vary somewhat with different varieties. The usual amount is one to one and one-half bushel when sown broadcast and about half a bushel per acre when planting is in drills far enough apart to permit cultivation.

The grain drill, with all tubes open or with part of them stopped, is sometimes used in planting cowpeas.

SUBSOILING.

Two tests of the effect of subsoiling for cowpeas have been made on reddish loam soil, in the same field as that used for similar experiments with corn and cotton. In both cases the variety Wonderful was employed. The peas were in drills and were cultivated several times.

In 1897 cowpeas were planted on a plot that had been imperfectly subsoiled in February, 1896, by using a scooter run to a depth of four inches in the bottom of the furrow made by a one-horse turn plow. This operation was not repeated in 1897.

On both the plot thus treated and on that which had never been subsoiled the crop was exceedingly poor. The plot once subsoiled yielded at the rate of 6.7 bushels per acre and that not subsoiled 5.6 bushels.

In May, 1898, cowpeas were planted on a plot which had been subsoiled as above in the preceding February. The yield of hay was 5,120 pounds on the subsoiled plot and only 40 pounds less on the plot never subsoiled. A different result might have resulted from thorough work with a subsoil plow.

Drilling Versus Sowing Broadcast.

May 12, 1898, Wonderful cowpeas were sown broadcast at the rate of 60 pounds per acre and plowed in with one-horse turn plows. On the same date an equal quantity of seed was planted in drills, which was done by dropping the seed by hand in every third turn plow furrow, the nex t furrow-slice serving as a covering.

On all plots the fertilizer, phosphate and muriate of potash, was applied broadcast on the plowed surface and harrowed in.

The vines were cut September 13. After curing for a week, most of this time in cocks, the weights of hay were found to be as follows:

Pounds of cowpea hay per acre from drilling versus broadcast sowing.

Plot No.		Hay per acre. Lbs.
4	Broadcast	6,400
7	Broadcast	6,400
5	Drilled	5,600

In this test broadcast sowing afforded 800 pounds of hay per acre more than drilling. The large yields indicate that the season was favorable and the rainfall records show that a large amount of rain fell in July and August.

The drilled peas were cultivated twice with scrapes, the total number of furrows per row being three.

In addition to experimental plots we plant every year considerable areas of cowpeas, both broadcast and in drills. In deciding on the best method of planting in this "general crop" we are governed by the price and available supply of seed and labor. We use four to six pecks of seed sown broadcast and two or three pecks in drills. In sowing broadcast we seldom plow in the seed, as in the above-described experment, but sow them on the plowed land and cover seed and fertilizer with disc harrow or with one-horse cultivator.

In planting in drills we open the drills in plowed or unplowed ground, and are careful either to apply the fertilizer in the covering furrow or else to mix it with the soil before the seed are dropped.

Where the ground has been plowed, the combined grain drill and fertilizer distributor would doubtless be satisfactory, stopping most of the tubes if it is desired to drill the seed in rows wide enough for cultivation.

Our observations lead to the belief that in unfavorable seasons drilling and cultivation gives the largest yield of hay (and always of seed) and that in seasons of abundance of rainfall broadcast planting affords the greater amount of hay, but not of seed.

VARIETIES.

During each of the past six years one or more tests of varieties of cowpeas have been undertaken. Some of these tests have been vitiated by agencies that need not be stated here, and only those are here reported which have been free from inequalities and errors.

Varieties of cowpeas have been tested both with reference to the yield of seed and to the yield of hay. The variety Whippoorwill (a speckled bunch pea) has competed in all these tests and its yield has been taken as a basis by which the yield of any other variety may be conveniently stated. Thus, taking the yield of grain from Whipporwill in 1897 as 100, that of Wonderful for the same year is 106, or 6 per cent. greater.

The grain yield of varieties of cowpeas.—The following table gives the results of four tests of varieties on the basis of seed production, all varieties planted in drills and cultivated. In all cases a bushel of shelled peas is assumed to weigh 60 pounds.

Yields of grain of varieties of cowpeas.

VARIETY.	Yield per acre in				Relative yield taking Whipporwill yield as 100 per cent.				
	'97	'98	'00	'01	'97	'98	'00	'01	Av.
	Bus.	Bus.	Bus.	Bus	%	%	%	%	%
Clay	....	7.6	....	14.0	....	50	....	63	58
Crowder, Brown-eye	....	....	....	19.3	....	....	....	87	....
Crowder, Large White	....	17.5	....	....	....	116	....	....	....
Crowder, Yellow	....	....	....	23.3	....	....	....	105	....
Brown-eye, White	....	2.5	....	....	....	17	....	....	....
Black, from Wood	....	21.0	....	21.2	....	140	....	96	118
Black, from Ala. Ex. St.	....	9.6	....	....	....	64	....	....	....
Black, from Hastings	....	....	7.8	....	....	....	52	....	....
Black, Large Early, from Packard	....	19.5	....	....	....	130	....	....	....
Black-eye Large (Wood)	....	15.0	....	19.0	....	100	....	86	92
Black-eye, Large White from Willett	....	9.0	....	....	....	60	....	....	....
Black-eye, Extra Early	....	16.2	....	16.6	....	108	....	75	92
Early Brown Dent	....	23.4	....	....	....	156	....	....	....
Early Bullock	....	21.8	....	....	....	145	....	....	....
Iron	....	14.9	....	....	....	99	....	....	....
Jones White	....	8.0	....	....	....	53	....	....	....
Lady	....	8.9	....	....	....	59	....	....	....
Lealand	....	17.5	....	....	....	116	....	....	....
Miller	....	8.2	....	....	....	54	....	....	....
Mush	....	17.6	....	....	....	117	....	....	....
New Era	....	22.0	....	22.0	....	146	....	104	125
Ross White	....	11.9	....	....	....	79	....	....	....
Red Ripper	....	18.5	....	20.1	....	123	....	91	107
Taylor	....	....	....	23.6	....	....	....	107	....
White Giant	....	....	10.8	15.9	....	....	75	72	74
Unknown	8.3	....	....	....	106	....	....	....	....
Wonderful	7.4	15.2	....	21.6	94	101	....	98	98
Whippoorwill	7.8	15.0	14.4	22.0	100	100	100	100	100

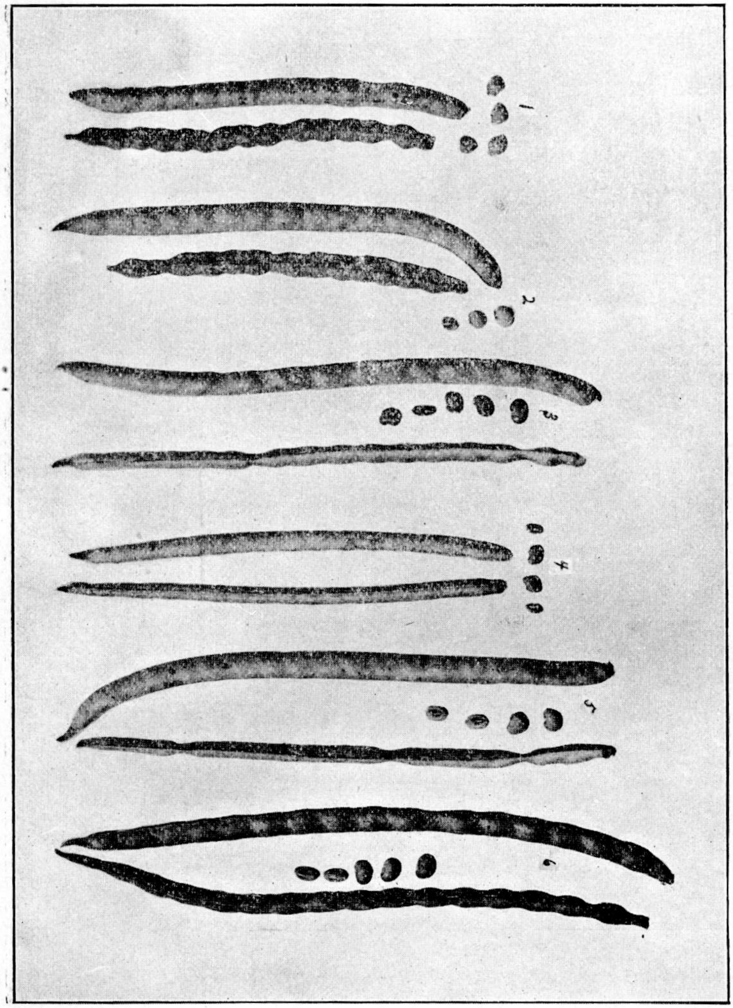
Varieties averaging large yields of seed have been New Era, Black (from Wood), and Red Ripper. Wonderful wants only 2 per cent. of equalling the average yield of Whippoorwill.

Varieties making large yields, but which have been tested only once, are Early Brown Dent, Early Bullock, Large Early Black (from Packard), Lealand, and Large White Crowder.

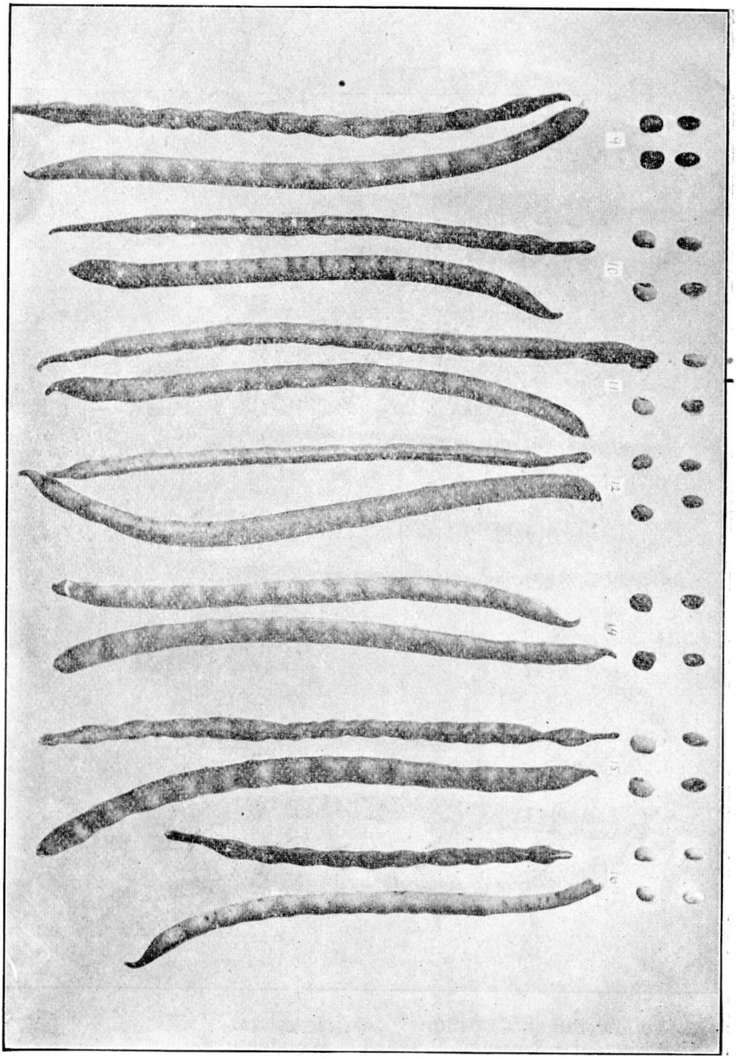
Additional tests must be made before conclusions can be drawn as to the relative values of these varieties for seed production. There is need for a variety of cowpeas that in addition to the good qualities of Whipporwill, prolificacy, upright growth, and earliness, shall be more resistant to mildew or rotting of the pods than is this standard kind. The writer will be glad to test any local varieties for which this quality is claimed.

Size of seed.—The following table gives the weight of 100 cowpeas of the varieties grown in 1901, and also the calculated number of seed in a bushel of 60 pounds:

VARIETY.	Wgt. of 100 seed	No. of seed in 1 bush. (60 lbs.)
Taylor	28.72	94,634
White Giant	25.45	106,797
Brown-eye Crowder	24.74	109,858
Yellow Sugar Crowder	23.16	117,314
Black	22.07	123,153
Red Ripper	20.89	130,110
Extra Early Black-eye	20.74	131,051
Large Black-eye	20.04	135,638
Whippoorwill	17.98	150,621
Wonderful	18.86	144,117
Clay	17.86	151,629
Jones' Perfection White	13.97	194,560
New Era	11.49	236,545
Small Black	11.30	240,531



1. Yellow Sugar Crowder.
2. Brown-eye Crowder.
3. Whippoorwill.
4. New Era.
5. Wonderful.
6. Taylor.



9. Black, from Wood.
10. Large, Black-eye.
11. Ex. Early Black-eye.
12. Clay.
14. Red Ripper.
15. White Giant
16. Jones White.

Taylor had the largest seed, of which only 94,634 were required to make a bushel. New Era has the smallest seed of any kind in the variety test, having 236,545 seed in a bushel. In rows three feet apart, and three seed per foot of drill, an acre would require about 11 pounds of New Era or about 28 pounds of Taylor seed.

Small Black, grown in another field, had seed slightly smaller than those of New Era.

Where to Get Seed.

The Station cannot undertake to supply seed. The addresses of the parties from whom this Station has obtained seed, as given below, will enable intending buyers, who cannot get seed nearer home, to correspond with seedsmen or growers.

New Era, from J. C. Little, Louisville, Ga.

Numerious varieties from H. P. Jones, Herndon, Ga.; Alexander Seed Co., Augusta, Ga.; Willett Seed Co., Augusta, Ga.; Mark W. Johnson Seed Co., Atlanta, Ga.; Curry-Arrington Seed Co., Rome, Ga.; H. C. Hastings, Atlanta, Ga.; E. G. Packard, Dover, Del.; and T. W. Wood & Sons, Richmond, Va.

The hay yield of varieties of cowpeas.—These tests were all made on poor sandy upland, though the land used for this experiment in 1897 was richer than that occupied by this test in the other years. In 1897 the seed was sown broadcast; in 1898 and 1899 the seed was planted in drills about 2½ feet apart. The yields are lower than we usually obtain in our fields sown for hay, which may be partly due to the fact that the peas in the experiments were sown late,—the last week in June,—and that the product was weighed only after the hay had become extremely dry.

Yields of hay of varieties of cowpea.

VARIETY.	Yield per Acre in			Relative yield, Whipprowill — 100 per cent.			
	'97 lbs.	'98 lbs.	'99 lbs.	'97 %	'98 %	'99 %	Av. %
Black-eye, Extra Early	....	....	1416	....	....	79	....
Black-eye, Large	....	....	....	....	....	....	....
Black	2220	2880	1618	89	105	83	92
Black, Large Early	....	....	1383	....	....	68	....
Clay	3975	3373	1209	160	121	59	113
Crowder	....	....	1308	....	....	64	....
Crowder, Large White	....	1280	2034	....	47	100	73
Iron	....	4080	2154	....	150	106	128
Lady	....	....	1401	....	....	69	....
Lealand	....	....	2206	....	....	119	....
Miller	....	....	1623	....	....	79	....
Mush	....	....	1929	....	....	95	....
New Era	....	....	2310	....	....	113	....
Ross White	....	....	2430	....	....	119	....
Red Ripper		3720	....	....	136	....	....
Whippoorwill	2485	2720	2030	100	100	100	100
Wonderful	3700	4160	1569	148	153	77	126

The largest average for three years was made by the Wonderful (or Unknown) variety, followed by Clay. Iron, which was tested only two years, surpassed all other varieties in the average yield for those two years.

The ease of harvesting varies greatly with different varieties, the running kinds affording the greatest difficulty.

The quality of the hay differs somewhat with different varieties. For example, Wonderful has larger stems than any other variety tested and hence its hay appears coarser.

Nevertheless, the large yield and erect stem make this a very popular variety for hay. It is too late to mature seed in a high latitude or when planted very late in summer.

On the whole, as a general purpose cowpea, suitable for either grain, forage, or fertilizer, we may safely plant the Wonderful or Unknown in the central and southern parts of the state until some other variety is proved to be superior. Perhaps an exception should be made of the Central Prairie Region where there is complaint that there is an extreme tendency for cowpeas to run to vine and fail to fruit properly. It is suggested that the early bunch varieties, especially New Era, planted late in June, be tried on these soils; also that when seed are desired from medium and late varieties, that they be planted early and thick in the drill.

Proportion of seed and hulls in unshelled cowpeas. The following table gives the number of pounds of seed in 100 pounds of unshelled cowpeas. In all cases the peas were not beaten out until at least several weeks after the date of picking, thus giving time for thorough drying.

Pounds seed in one hundred pounds of unshelled cowpeas.

	Yrs.	Lbs.		Yrs.	Lbs.
Brown-eye, White	1	70	Early Brown Dent	1	77
Black, from Wood	2	76	Early Bullock	1	82
Black, from Ala. Ex. Sta	3	69	Iron	5	69
Black, Large Early, from			Jones, White	2	69
Packard	1	76	Lady	3	74
Black-eye, Large, from			Lealand	3	77
Wood	2	77	Miller	1	77
from Willett	3	73	Mush	1	83
Black-eye, Large White,			New Era	2	73
Black-eye, Extra Early,			Ross White	1	69
Black-eye, Extra Early,			Red Ripper	4	71
from Wood	2	76	Taylor	1	77
Clay	4	67	White Giant	2	71
Crowder	3	75	Unknown	2	67
Crowder, Brown-eye	1	85	Wonderful	4	70
Crowder, Yellow Sugar.	1	84	Whippoorwill	4	73
Crowder, Large White	1	83			

The proportion of seed and hulls varies according to the variety. In our tests it is highest with the several Crowder varieties, and lowest with Wonderful and Clay; number of pounds of thoroughly dry unhulled peas in the pod required to make a bushel (60 pounds) of shelled peas was only 78 pounds with Brown Eye Crowder and 90 pounds with Wonderful. To get corresponding figures for any other variety the reader can divide 6,000 by the figure opposite each variety. It should be stated here that the percentage of grain in the same variety varied greatly in different years.

Effects of Lime on Cowpeas.

Two tests were made on this point, using drilled cowpeas of the variety Wonderful, fertilized with acid phosphate and cultivated several times.

In 1897, on reddish loam soil, and stiffer than that in the later tests, the yield was 5.6 bushels of peas without lime and only 5.2 bushels where slaked lime at the rate of 640 pounds per acre had been applied broadcast in February of the preceding year. Whatever lime remained in the soil was evidently of no benefit of cowpeas.

In March, 1898, water slaked lime was used as a top dressing on oats on gray sandy soil. It was used at the rate of 1,000 pounds per acre of the unslaked lime, which is equivalent to a much larger weight of the slaked material.

After the oats were cut the land was plowed and cowpeas drilled in and cultivated as necessary. The yield follows:

Plot not limed, 13 bushels cowpeas per acre.

Limed plot, 10.2 bushels cowpeas per acre.

Clearly lime was of no benefit, but apparently injurious as regards seed formation. There was no notable difference in the appearance of the vines.

Fertilizer Experiment.

This test was made in 1898 with Whipporwill cowpeas on gray or white sandy soil on a hilltop. Two cultivations were given, requiring altogether three furrows per row. The results follow:

Results of fertilizer experiment with cowpeas in 1898.

Plot No.	Fertilizer. Per acre.	Fertilizer. Kind.	Yield of seed per acre.
	Lbs.		*Bus.*
1	240	Acid phosphate	13.9
2	51	Muriate of potash	15.9
3	00	No fertilizer	16.
4	240 51	Acid phosphate Muriate of potash	15.4
5	240 51 80	Acid phosphate Muriate of potash Nitrate of soda	19.1
6	240 51	Acid phosphate Muriate of potash	16.7
7	240	Acid phosphate	15.2
8	00	No fertilizer	14.3
9	240 51	Acid phosphate Muriate of potash	14.9
10	51	Muriate of potash	15.1
Av. 3 & 8	00	No fertilizer	15.1
Av. 1 & 7	240	Acid phosphate	14.1
Av. 2 & 10	51	Muriate of potash	14.5
Av. 4, 6 & 9	......	Phosphate and muriate	15.3

Apparently none of the mineral fertilizers was decidedly advantageous, though with the complete fertilizer there was an increase of four bushels per acre. The failure of acid phosphate and muriate of potash to increase the yield is surprising, and the only explanation we can suggest is the fact that both phosphate and potash salts had been liberally used on this field during each of the preceding five years, and probably these materials had been applied annually for about fifteen years. This view implies that even on this gray light sandy soil, containing some flint stones, and underlaid by a rather stiffer sandy sub-soil, acid phosphate and potash are not wholly used up or lost during the year when they are applied but exert a considerably residual or cumulative effect.

Is Nitrogen Advantageous in a Fertilizer for Cowpeas?

Cowpeas are able to grow on poorer soil than is cotton or corn. This is because the cowpea plant, through the agency of the specific enlargements or tubercles or nodules on its roots, is able to draw a part of its nitrogen from the air, while corn, cotton, grasses, etc., are entirely dependent for their nitrogen on the soil and fertilizer.

Since the cowpea plant possesses this source of supply it is reasonable to assume that nitrogen can be omitted from its fertilizer, thus reducing the cost of fertilization. On the other hand it has been stated that during the early period in the life of this plant the tubercles afford no nitrogen, and that nitrogenous fertilizers are beneficial during this early period. One writer has recorded as his observation that cotton seed meal is a suitable fertilizer for cowpeas.

To put this latter statement to a test, four plots of drilled cowpeas in 1898 were employed. All were fertilized with 240 pounds of acid phosphate and 48 pounds of muriate of potash per acre. Two plots received in addition cotton seed meal at the rate of 100 pounds per acre. The cured hay averaged practically 2½ tons per acre, the plots with cotton seed meal affording only 40 pounds of hay per acre in excess of the others. There was a practical equality in yield, and a failure of cotton seed meal to exert any appreciable effect.

This is in accord with nearly all of the published fertilizer experiments with cowpeas.

We have found the tubercles on cowpeas when the plants were only a few inches high and a few weeks old. Apparently the nitrogen in the seed and that which even a poor soil yields is usually sufficient for the little plants up to the time when the root tubercles begin to exercise their function of supplying nitrogen.

The fertilizer test detailed in a preceding paragraph shows that with a complete fertilizer the yield of peas was 3.8 bushels per acre greater than where only phosphate and potash were used together.

This increase seems to be attributable to the use of 80 pounds of nitrate of soda.

The majority of experiments agree with the one where cotton seed meal was used in indicting that nitrogen is not a profitable constituent of the fertilizer for cowpeas.

FORMS OF PHOSPHATE FOR COWPEAS.

A test was made in 1896 of acid phosphate, crude Florida soft phosphate, and a moistened mixture of these two, which mixture should have produced reverted phosphate. The crop was a failure, probably because of injuries to the roots by nematode worms, and there were only slight differences in the yields of seed on the plots differently fertilized. This was on very poor white sandy soil.

In 1898, co-operative tests of acid phosphate in comparison with equal weights of Florida soft phosphate (crude) were made for this Station by Mr. A. A. McGregor, on a loam soil with clay sub-soil, at Town Creek, Ala., and by Mr. J. P. Slaton, on sandy soil between Notasulga and Tuskegee. Apparently the soil at Town Creek was rich in lime, the other poor in lime.

Unfortunately there was a failure to pick the peas in both the tests, but the notes made by both of the experimenters have no doubt as to the superiority of acid phosphate over insoluble phosphate as a fertilizer for cowpeas. At Town Creek, where pods did not mature, the vines made the best growth where acid phosphate was applied; no difference could be detected between the growth of the unfertilized plot and that on the plot where Florida soft phosphate was employed.

On the sandy soil near Notasulga "the plot fertilized with acid phosphate seemed to me one-third better" than the one with the raw phosphate. These observations as to the superiority of acid phosphate agree with the results of experiments made at the Georgia Experiment Station and with a test made at Auburn in 1898, the results in our test being as follows:

	Bus. seed per acre.
Cowpeas, with no phosphate	9.4
Cowpeas, with 240 lbs. Florida soft phosphate	13.9
Cowpeas, with 240 lbs. acid phosphate	15.2

Apparently the raw or Florida soft phosphate was beneficial, and the acid phosphate still more so, the increase with the latter being 5.8 bushels of seed per acre, which gives a fair profit after deducting the cost of the 240 pounds of acid phosphate used on an acre.

Fertilizing cowpeas between corn rows.—In 1900 on one plot only half of the acid phosphate was applied to corn, the remainder (120 pounds per acre) being reserved and drilled with Whippoorwill cowpeas July 7. There was practically a failure of both the corn and cowpeas on this series of plots, so that the products of the several plots were not harvested separately. However, so far as could be judged by the eye, there was never any difference in the growth of the vines directly fertilized with phosphate and those which must have drawn some of their phosphate from the fertilizer that was applied to the corn some months before.

Nutritive Value of Cowpeas and Cowpea Vines.

The high nutritive value of the seed, the hay, and the green vines of the cowpea plant may be seen from the following figures adapted from Prof. W. A. Henry's book on "Feeds and Feeding:"

	Lbs. digestible.		
	Muscle formers	Starch, etc.	Fats
100 lbs. cowpeas (shelled seed) contain*..	17.3	63.1	.7
100 lbs. cowpea hay contain	10.8	38.6	1.1
100 lbs. green cowpea vines contain	1.8	8.7	.2

*Assuming same digestibility as for meal from Canada field peas.

Cowpea hay contains almost exactly the same amounts and proportions of digestible materials as wheat bran. The seed is more nutritious than wheat bran and far richer in protein,—the so-called "muscle formers,"—than is corn. In our feeding experiments with pigs it has proved itself better than corn when constituting only a portion of the grain ration. By feeding farm teams on a liberal allowance of peavine hay the amount of corn necessary can be reduced much below that usually consumed.

Cowpeas versus velvet beans as forage.—This comparison can be made on the basis of (1) palatability and nutritive value, (2) cost of growing and harvesting a ton of each, (3) productiveness, and (4) hardiness.

The number of analyses of velvet bean hay is insufficient to give an accurate determination of its exact nutritive value, in which, however, it is probably about equal to peavine hay. In palatability the advantage is decidedly with peavines.

We have found it practically impossible to use the mower in cutting velvet beans and when both crops are cut with the scythe our records show that the velvet beans require more labor than cowpeas. Indeed we have not yet found a thoroughly practicable and economical means of cutting and handling velvet bean vines.

In regard to the yields of hay from the two plants, when grown side by side, the following are the results thus far at Auburn, the variety of cowpeas employed being the Wonderful or Unknown.

	Cowpea hay	Velvet bean hay.
Drilled crop, 1897, lbs. hay per acre	2420	3872
Drilled crop, 1897, lbs. hay per acre	8930	7300
Broadcast crop, 1898, lbs. hay per acre..........	4160	4480*
Broadcast crop, 1898, lbs. hay per acre	4160	2880†
Broadcast crop, 1898, lbs. hay per acre....	6400	5360

*128 lbs. velvet beans sown broadcast per acre; †64 lbs. velvet beans sown broadcast per acre.

On the score of productiveness our experiments are slightly in favor of cowpeas, though on other soils this result might be reversed.

As to the relative hardiness of the two plants, the velvet bean is undoubtedly superior. It suffers less from the attacks of leaf eating insects, and, though the young plants of the velvet bean are not exempt from the attacks of a fungous root rot, characterized by whitish to brownish, small, spherical, sclerotia on the stem near the surface of the ground, yet the velvet beans are much more resistant to it than are cowpeas, which in some parts of the Station farm are almost ruined by this disease. For example, in 1899, on adjoining plots, cowpeas were ruined by September 12, at least half the plants having died prematurely, the yield of seed being reduced to less than two bushels per acre, while velvet beans were perfectly healthy and extremely luxuriant.

Still more important as regards the relative hardiness of the two plants is their susceptibility to injury from the attacks of the microscopic nematode worms that infest the soil, especially in gardens and orchards, in parts of the Gulf States. These worms enter the roots of many plants, cowpeas, cotton, peaches and numerous vegetables, causing swellings, which, as they become larger, result in depriving the infected root of its function of supplying water and food to the plant.

It is important for farmers to distinguish these nematode injuries from the beneficial tubercles naturally present.

Speaking generally and disregarding the advanced cr corky stage of the nematode swelling, tubercles and nematode bumps may be distinguished by their position. The beneficial tubercles are located outside of the outer surface of the root, and to the side of the same; the injurious enlargements are usually spindle shaped and their position is such that the root seem to be growing through the center of the swelling. In other words, the root is enlarged symmetrically on all sides in the early stages of nematode injuries.

Cowpeas are very susceptible to injuries from nematodes. Velvet beans are highly resistant to such attacks, if not entirely exempt from them. We have been able to find no plain indications of nematode injuries on the roots of velvet beans.

This is a matter of much importance, especially when a choice must be made between these two legumes for growing in old garden spots, which are likely to be infested with nematodes, or with a fungus root disease.

In this connection it should be said that Orton and Webber, of the United States Department of Agriculture, found the Iron variety of cowpeas to be resistant both to nematode attacks and to cowpea wilt, the latter being a fungus disease different from the one that is most destructive at Auburn.

The remedy for all these troubles consists in practicing such a rotation as will keep susceptible plants off of the infested or infected fields for at least a few years.

In brief, the cowpea as a forage plant is superior to the velvet bean in palatability and ease of curing and only inferior in hardiness or resistance towards the attacks of certain insects and fungous diseases.

Cowpeas versus beggar weed and soja beans as forage. At Auburn the yield of cowpea hay has greatly exceeded that of beggar weed hay and has been superior in quality. The advantages in favor of beggar weed are its greater ease of curing, resulting from its more erect growth, and its practical or complete exemption from nematode injury. Beggar weed also seems resistant to the fungus root rot.

Compared with soja or soy beans, cowpeas at Auburn have averaged a heavier yield of hay and have been surpassed only in the greater ease with which the soy bean, on account of its erect growth, can be harvested. The cowpea has been able to make a fair growth on land too poor for soy beans.

Cowpeas in Various Mixtures for Hay.

The leaflets easily drop from the vines in curing unless special care is exercised. This loss can be avoided and the curing process facilitated by growing the peavines in combination with some grass that cures readily and which serves with its blades and fine stems to tie the whole mass together so that the leaflets of the legume are not lost. For this purpose crabgrass is one of the best, and the only disadvantage is that as a volunteer growth must be relied on, there is some uncertainty as to the stand and as to the grass growing to sufficient height on the poorer spots.

We have found German millet useful in this respect. for fair and good soils. This grass makes it necessary to choose an early variety of cowpeas to sow it with, else the millet will be ready for the mower while the peas are entirely too immature. Whipporwill cowpeas and German millet make a fairly satisfactory combination, and the qualities of the New Era lead us to the hope that it will make a still more desirable combination with German millet. The usual quantity of millet seed is one peck, with a bushel of peas, per acre.

Possibly the later varieties might also be suitable for sowing with German millet, if the seed of the latter could be put in the ground a few weeks after the peas had germinated.

In one case we tried this, drilling a row of millet within six inches of the pea row. The millet was sown 17 days after the peas were planted and yet it ripened before the Wonderful cowpeas were ready for haying. This was also true in the case of Japanese millet, and with two millets which were untrue to name, and which seemed to be Hungarian millet and common fox tail millet, the latter very much like German millet. Apparently the millets did not add to the yield of hay, but in the same test the yield of hay was materially increased when Amber sorghum and Wonderful peas were drilled together May 14. These two plants were ready for mowing at the same date.

In the following table are given the yields of hay afforded by cowpeas alone and in various combinations, all such mixtures being sown broadcast June 24, 1898, the peas, sorghum and corn at the rate of 64 pounds, the millet at the rate of 16 pounds per acre. The soil was a light sandy upland and no nitrogenous fertilizers were used.

Yields of hay from cowpeas alone and cowpeas in various mixtures.

Plot	COWPEAS.	MILLET, Etc.	Yield hay pr acre
3N	Whippoorwill......	German millet	4560
3 S	Whippoorwill......	Texas millet	4240
4N	Clay...............	Japanese barnyard millet	4240
4 S	Clay...............		3860
5N	Whippoorwill......	Japanese barnyard millet	4320
5 S	Clay...............	White Kafir corn	4720
6N	Clay...............	Texas millet	3840
6 S	Clay...............	Stowell's sweet corn	3520
7N	Clay...............		3780
7 S	Black..............	Texas millet	3780
8N	Clay...............	Early Amber sorghum	5440
8 S	Black..............	Early Amber sorghum	5040

The stand of all the millets and of sweet corn and Kafir corn was very poor. The Japanese and German millet ripened earlier than was desirable. Kafir corn (a non-saccharine sorghum) and Amber sorghum were the only kinds which added to the yield of hay produced by cowpeas alone. Even this increase may have been chiefly water, for our notes show that the hay from the sorghum mixture was more moist than the other kinds and doubtless in unfavorable weather it would have been more difficult to cure.

We hope to continue the search for a grass-like plant pre-eminently suitable for sowing with cowpeas. Such a plant should have a fine stem like German millet and a longer period of growth.

Until this ideal plant is found we would recommend German millet as an aid in curing the early varieties of peas and possibly as suitable for drilling in or working in with a weeder several weeks after the later varieties have been sown. Amber sorghum is recommended as a means of increasing the yield on good land, but not as a means of making curing easier.

Most Profitable Method of Utilizing Cowpeas as Stock Food.

It may be of interest to record here the fragmentary data relative to this point that are afforded by our experiments at Auburn. Only with the variety Wonderful or Unknown have we made accurate determinations of the amount of seed and the amount of hay produced when the conditions of soil, fertilization, and culture were absolutely identical, this being done by making hay of the entire growth on certain plots and by harvesting only the seed on adjacent plots.

Relative yields of seeds and hay made by Wonderful cowpeas.

	Bus. seed.	Lbs. hay.
In 1897, drilled cowpeas yielded per acre	11.0	2420
In 1898, broacast cowpeas yielded per acre........	6.7	6400
In 1899 broadcast cowpeas yielded per acre........	7.9	2004
Average three years	8.5	3608

The 8.5 bushels of seed, with accompanying hulls, would weigh only about one-fifth as much as the weight of hay recorded above. Hence, it is evident that the most profitable use of the crop as stock food would be to utilize the hay rather than to wait for all the seed to ripen.

If, however, it should be impracticable to harvest and utilize the cowpea as hay, our next recommendation would be to pasture hogs or cattle on the pea fields, of course reserving a sufficient area to produce seed for the next year's planting.

With nearly mature cowpeas utilized in this way we obtained at Auburn the following returns for an acre of cowpea pasturage, after first deducting the cost of the additional food fed while the animals were grazing on cowpeas:

	Net return from 1 acre.
With milch cows in 1900 grazing on corn stalks and drilled cowpeas between corn rows (Ala. Bul. 114); butter at 20c. and beef on foot at 2 1-2c per lb........	$4.47
With milch cows in 1901 grazing on corn stalks and drilled cowpeas between corn rows (only butter considered)	$5.28
With shoats sold at 3 cents per pound, grazed in 1897 on cowpeas yielding about 13 bush. per acre (Ala. Bul. 93)	$10.65
With shoats in 1900, sold at 4c per lb. grazed on ripe drilled cowpeas (about 10 bus. per acre)	$4.90

When the cows grazed on parts of the corn and pea field where the peas were few or small and overripe the value of the pasturage on an acre fell far below the figures given above for 1901.

We have successfully preserved peavines in the silo, and at all stages of growth from early bloom until first pods color. They should be run through a silage cutter, and the silo heavily weighted. If the vines are put in without cutting the silage is often inferior and always difficult to remove. Special care in packing and weighting uncut peavines is necessary.

Methods of Harvesting Cowpea Seed.

Picking cowpeas is slow and expensive work. The charge for picking is frequently half the crop. If picking cannot be done promptly the crop is frequently ruined by mildew or rot of pods and seed. Hence some more rapid method is desirable. Possible methods are (1) cutting the vines with scythe or reaper when most of the pods are ripe, and later running the product through the threshing machine or beating the peas out by the slow process of flailing; (2) pulling the vines when the crop is thoroughly mature and beating out the seed with a flail; and (3) the use of a peavine picking machine.

While the latter is a possibility, we are unable to report any test made here of a pea-picking machine. It is to be hoped that the pea picker may be further simplified and especially that its price, which, as quoted to us, was prohibitive, being several times that of a mower, may be greatly reduced.

In 1898 we made a test of pulling Wonderful cowpeas when fully matured and beating them out with a flail. Even with hands unaccustomed to the work, pulling was much more rapid than picking, the rate per man being one and one-fourth acres per day. The process of beating out the peas was much slower, and this tedious work, together with the increased loss from shattered peas when the vines were pulled, and the removal of the plant food contained in the roots, were serious objections to this method. Apparently under some conditions it can be used to advantage as compared with picking.

Cutting the mature vines with a scythe early in the morning when there was least danger from shattering, was quite satisfactory, especially with the New Era variety, as it doubtless would be with any bunch pea on which the pods all ripen at about the same time and from which the leaves are dropped by the time the pods are mature. Scything will doubtless be more satisfactory with peas sown late because of their more erect and less tangled condition. The blade should be kept sharp to avoid shattering.

We have not tried the mower in harvesting cowpeas for seed because so many of the peas after cutting would be trampled over by the team in making its next round. The work of the reaper in green peavines indicated that it would be a satisfactory machine for harvesting mature cowpeas where the vines are not tangled.

Preliminary tests in running peavines through a grain thresher with concave removed resulted in breaking about half the seed.

The very limited tests made here several years ago of two patterns of pea threshers, or hand machines, for beating out peas after the pods had been picked by hand, failed to show any great saving by the machines tested as compared with flailing. As the particular machines employed were afterwards claimed to be not fair represetatives of those now on the market, we must await the results of further tests before drawing conclusions.

Our purpose is to continue the experiments as to the best methods of harvesting cowpeas.

Curing Cowpea Hay.

Long exposure to sunshine causes the leaflets, the most nutritious portion of the plant, to drop. Hence cowpea hay should be cured largely in its own shade, that is, with as little exposure as practicable of the mass of the hay. This is the foundation principle in hay-curing, but its application will vary greatly according to the state of the weather and the succulence of the vines when cut. No definite rule can be given as to the necessary number of hours of sunshine, but a few examples will show the method pursued at this Station under same conditions:

1898—*Sept.* 13, A. M. Cut with scythe, leaving vines in small loose windrows. Windrows turned over with fork, having received about 8 hours of bright sunshine, and exposed leaves having become just crisp enough to rustle when touched, but not dry enough to cause any perceptible loss of leaves in handling; weather during preceding 24 hours had been dry but partly cloudy.

Sept. 14, 4-5 P. M. Piled vines in large cocks, where, the weather being fair, they were left until *Sept. 21*, when the vines, now dryer than necessary, were hauled and stored in barn.

If rain had been threatened hauling would have occurred about Sept. 15, or else canvas hay-caps would have been placed on the cocks.

1899—*Sept. 12*. Mowed Wonderful variety. Given 12 hours sunshine while spread in swath; then raked and immediately cocked, in which condition it was left 48 hours before hauling. When hauled the hay contained somewhat more moisture than was thought safe for storing in large masses, though not too much for storing in a thin layer.

1900—*Sept.* 24, A. M. Mowed Wonderful cowpeas in full bloom and having a few colored pods, growth not rank and containing some crabgrass.

Received in swath 24 hours' exposure, including about 10 of bright sunshine.

Sept. 25, A. M. Raked into windrows, and eight hours afterwards, or before night the same day, hauled.

Ordinarily it is safest not to haul direct from the windrows, but to leave the partially cured hay in cocks for several days and, if necessary, to open out these cocks an hour or two before hauling.

A part of the same field of cowpeas last referred to was employed in testing the practicability of very rapid curing and of storing hay in barn in very green condition, as is sometimes done with clover in the North, and as has been advocated for cowpeas in the South when threatening weather hastens hauling.

1900—*Sept. 24.* Immediately after the morning dew dried off, or about 8 to 9 A. M., the vines were mowed and left undisturbed and exposed on dry ground to bright sunshine for eight hours; then immediately raked, hauled, and stored 1,525 pounds of half-cured hay in small tight house.

It is claimed that when hay is stored in a very green condition it should be tightly packed and not afterwards moved, however much heat it may develop. This hay was packed in three feet deep and covered with other dryer hay, and the house closed.

The weather remained fair and dry for two weeks after this hay was stored. In five days the temperature had risen to 122 degrees at a point fifteen inches from the wall. This seemed to be the maximum temperature and by October 4 the thermometer had dropped to 110 degrees and white mould was abundant.

When the material was opened April 4, 1901, the entire mass, except for a space of about six inches next to each wall, was entirely rotten, and not simply blackened, as sometimes happens with an inferior but serviceable article of peavine silage.

The amount of material taken out was only 545 pounds, or about one-third as much as was put in, a part of the loss being moisture, but a large part of it being dry matter driven off by fermentation. This is an extreme case, but other instances where heat and white mould have developed in hay, field cured for several days, but stored too green, raises the suspicion that in our moist climate hay cannot be stored in as moist a condition as is sometimes done in the North. We should avoid both extremes, of storing hay when too green, and of exposing it too long in the field at the expense of color and nutritive value.

If urged to outline a general course of procedure founded on average results here, we would suggest cutting one day, and 24 hours later raking into windrows, where the hay may remain 24 hours; then cocking, and, if practicable, leaving these cocks in the field for two or three days, at the end of which time they may be opened for a few hours before hauling, or hauled without opening, according to the condition of the hay.

Special devices, for example, frames on which the stack or rick is to be built, or small poles with horizontal base on which the cock is built, have been recommended for use in curing peavine hay. Our experience with canvas hay caps as covering for hay cocks during wet weather is very satisfactory, though the first cost is considerable. By cutting the crop little at a time and at intervals of a week or more, the hay caps may be repeatedly used, and a few dozen caps may thus serve in the curing of a considerable area of cowpeas.

Additional experimental work in curing peavine hay is planned.

Composition of the Different Parts of the Cowpea Plant.

To obtain data as the relative value of leaves, stems, and other parts of the plant, both as food and as fertilizers, samples were taken of six of the varieties grown in 34-inch drills in the variety test of 1899. These plants had been sown in drills on June 23, so that when samples were taken September 12 they had been growing not quite three months, and in some varieties none of the pods had colored. The roots were dug out to a depth of six inches, which depth seemed to contain all the larger roots and nearly all of the smaller ones. If harvesting had been delayed a week or two, which, with all these varieties could have been done without their getting too old to make good hay, the yields would doubtless have been larger.

The average yield of the six varieties sampled was 1,745 pounds of hay per acre on the basis of the weights of the samples 41 days after the vines were cut, or 1,628 pounds of the same degree of dryness as the samples when analyzed two years later.

The following table shows in percentages what proportion of the entire plant consists of leaves, pods and blooms, coarse stems, fine stems, fallen leaves and stems, and roots with attached stubble about two inches long.

Percentages in entire air-dried plant of leaves, pods and blooms, fine stems, coarse stems, fallen leaves, and roots and stubble.

Variety.	Leaves.	Pods and blooms.	Fine stems and runners.	Coarse runners.	Total available for food	Fallen leaves & fine stems.	Roots and 2-in. stubble
	%	%	%	%	%	%	%
Miller	21.0	1.6	19.9	14.8	57.3	17.7	25.0
Whippoorwill	17.0	23.3	16.4	18.7	75.4	3.7	21.6
Iron	17.0	23.3	16.4	18.7	75.4	3.7	21.6
Wonderful	18.7	7.8	15.3	18.0	59.8	19.2	20.3
Jones White	21.3	13.0	30.5	16.2	71.0	14.3	14.5
Clay	19.9	5.9	13.0	12.3	51.1	22.9	26.0
Average, 6 varieties	19.1	12.0	16.2	16.4	63.6	15.5	21.0

The chief difference among varieties as shown in the above table is in the percentage of pods and blooms. Naturally this was greatest in the Whippoorwill, for this was the earliest variety, and when cut September 12 it had more large pods than did any other. This earlier maturity also makes the Whippoorwill show the highest percentage of its weight available for animal food, viz: 75.4 per cent. On the other extreme is Clay, which, when cut at this stage of immaturity, (only about 2 per cent. of pods having colored), had only about half the weight of the plant available for hay.

Taking the average of all varieties, 63.6 per cent. of the air-dry weight of the plant was contained in the hay.

The leaves, the most valuable portion except perhaps the pods, constituted 19 per cent. of the weight of the entire plant, or 30 per cent. of the weight of the hay.

Of the hay cut at a stage when on some varieties from 2 to 10 per cent. of the pods had colored, and when on others no pods had colored, the pods and blooms averaged 12 per cent. of its weight.

The leaves of all six varieties were mixed together after being weighed, and in like manner composite samples of the other parts of the plants were obtained.

The table below gives the composition of leaves, stems, etc., each sample being made up of a mixture of the corresponding parts of all six varieties. The analyses were made by the Chemical Department of this Station. In noting the small amounts of moisture it should be borne in mind that the samples had been kept in an office building for two years before the analyses were made. Weevil injured the pods so that they were not analyzed. The presence of considerable sand on roots and fallen leaves explains the high percentage of ash.

Composition of the parts of the cowpea plant, cut Sept. Average of 6 varieties.

	Moisture.	Ash.	Protien—(muscle formers, etc).	Nitrogen—free extract. (Starch, etc.)	Crude Fiber.	Ether extract. (Fat, etc.)
	%	%	%	%	%	%
Leaves	10.65	10.98	22.44	31.69	16.78	7.46
Fine stems, etc	8.97	6.87	11.88	30.74	43.59	1.75
Coarse stems	8.47	4.92	9.44	33.12	42.19	1.86
Fallen leaves, etc	9.75	20.78	10.44	31.96	20.45	6.62
Roots and stubble	5.25	24.75	8.63	3.82	56.25	1.48

Let the reader note that the leaves were nearly twice as rich in protein as the fine stems; we may also infer from the small amount of crude fiber in the leaves that they are much more digestible than any other parts analyzed. These considerations emphasize the importance of retaining the leaves during the curing of pea-vine hay.

(SCIENCE CONTRIBUTIONS.)

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ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

THE FLORA OF THE METAMORPHIC REGION OF ALABAMA.

By F. S. EARLE.

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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, Alabama.

THE FLORA OF THE METAMORPHIC REGION OF ALABAMA.

BY F. S. EARLE.

The following list of the ferns and flowering plants of the Metamorphic Region of Alabama is based on the collections in the herbarium of the Alabama Polytechnic Institute at Auburn. The Alabama material in this herbarium was secured as follows: First, a few plants collected prior to 1895 by Dr. P. H. Mell and his assistants. (The bulk of this earlier material was destroyed by fire); second, a few plants collected during the Fall of 1895 by Dr. L. M. Underwood; third, plants collected during the Spring and Summer of 1896 by L. M. Underwood and F. S. Earle; fourth, plants collected during the Fall of 1896, during 1897, and the Spring and Summer of 1898 by C. F. Baker and F. S. Earle; fifth, plants collected from the Fall of 1898 to the Summer of 1901 by F. S. Earle and Mrs. F. S. Earle. Prior to 1897 attention had been devoted mainly to the fungi, flowering plants being taken only incidentally. Prof. Baker first suggested the systematic collection of the flowering plants, and the greater part of the species enumerated below were taken during the period of his residence at Auburn.

As Dr. Charles Mohr was known to be working on a flora of Alabama, the collections made prior to midsummer of 1897 were all sent to him for determination, and he was permitted to retain a full set, including all uniques, for his own herbarium. These plants are frequently referred to in his recent work on The Plant Life of Alabama that was published first by the United States Department of Agriculture as Volume 6, of the Contributions from the National Herbarium (issued July 31, 1901), and later (October, 1901), was reissued as a report from the Alabama Geological Survey. After midsummer of 1897 Dr. Mohr became so occupied in the preparation of the manuscript for this great work that at his request the sending of plants was discontinued, except as he occasionally asked for material in some special group. The later collections have been determined by Dr. J. K. Small, Mr. G. V. Nash, Dr. Edward L. Greene and other specialists, and by the writer, who has recently had an opportunity to compare some of the more doubtful material with the rich collections in the herbarium of the New York Botanical Garden. Some fifty species are reported by Dr. Mohr of our collecting that are not represented in the harbarium of the Polytechnic Institute; or at least are not represented under the name by which Dr. Mohr reports them. These species are included in this list, Dr. Mohr being cited in each case as the authority. These specimens will be found either in the herbarium of Alabama plants deposited by Dr. Mohr at the State University at Tuscaloosa, or in his private herbarium, which is now incorporated with the National Herbarium at Washington. In part, at least, these species represent uniques that did not chance to be again collected by us. There are, however, too many to be wholly accounted for in this way, and it seems probable that some of them represent cases where Dr. Mohr found occasion to change his original determination of the specimens. It has not been possible to trace these cases, for since the publication of Dr. Mohr's work I have not had access to the collections. It has seemed best to include these names, but with this word of warning as to the possibility of error through including two determinations for the same plant.

It so chanced that Dr. Mohr did very little collecting in that part of the State covered by this list. He, however, made one visit to the rugged mountainous region in Clay county and secured a number of plants that were not taken by us. A few plants have also from time to time been collected in this region by various members of the State Geological Survey. Fifty-two plants from these sources are recorded by Dr. Mohr from this region that do not appear in our collections. These are included in this list, the proper credit being given. It is probable that the specimens representing them are all in the herbarium at Tuscaloosa.

The Metamorphic region of Alabama as mapped by the State Geological Survey, is a triangular area lying on the eastern side of the State. It extends from near the southeast corner of Lee county at a point nearly opposite Columbus, Ga., northerly along the State line for about a hundred miles to a point in the northern part of Cleborne county. From this point the second side of the triangle extends southwestwardly for about the same distance, to a point in Chilton county, some three miles east of the line of the Louisville & Nashville railroad, and from here another hundred miles east-southeast to the point of beginning. This area comprises the southernmost extension of the Appalachian mountain system. It is underlaid by granite and other metamorphic rocks which exert their usual influence on the topography, giving high, rugged hills and frequent exposures of bare rock. There are, however, few vertical or overhanging cliffs, such as are frequent to the north and west in the region underlaid by the coal measures. The soil varies from a light and rather coarse sandy loam to the red hornblendic soil so characteristic of the Piedmont region of Georgia. In many places it is much incumbered with angular fragment of quartz and other hard resistant rocks. The original timber growth varied from almost pure long leaf pine forests at the southern border and along the bluffs of the Tallapoosa, to pure hardwood forests on the richer areas, especially to the northward. The greater part of the area was, however, a mixed forest of hardwoods and long or short leaf pines. The region is divided into nearly equal parts by the Tallapoosa river, the portion to the south and east being the high, broad ridge that forms the divide between this stream and the Chattahoochee. The northwestern portion forming the divide between the Tallapoosa and the Coosa is more rugged and broken, and in the Talladega Mountains reaches the highest elevations to be found in the State (2,300 feet). This is one of the most interesting parts of the State, and deserves much more extended study. It was visited only once by Dr. Mohr and once by the writer.

This metomorphic region is of special interest botanically since it constitutes the southernmost extension of the Carolina Life Zone. Many of the characteristic plants of the Appalachian system find here their most southerly stations while mingling with these northern representatives are many plants that have pushed up from the Gulf region. This mingling of the two floras accounts for the large number of species found. Of the 1146 species and varieties ennumerated in the following list, 94 are new to the State, and are not included in Dr. Mohr's work. These are indicated by an asterisk (*). There are 76 others that were previously known in Alabama only from the northern part of the State. These represent an extension of the known range in the State to the southward, and are marked by a dagger (†). There are also 167 species that represent a northerly extension of the known range within the State. These are indicated by a double dagger (‡). The larger number in this latter class is accounted for by the fact that Auburn, where the greater part of the collecting was done, is on the extreme southern border of the metamorphic Region. In fact the more sandy lands of the central pine belt extend at one point to within half a mile of the College building. All the plants collected in the neighborhood of Auburn have been included in the list whether they were taken from one side or the other of this rather vaguely defined line. While most of the plants that are marked with the double dagger are undoubtedly characteristic of the central pine belt rather than of the metamorphic hills; still it is probable that almost or quite all of them are to be found at some point on the more sandy lands that are clearly within this region proper.

The ecological relations of the flora have not in all cases been critically studied. The topographical features of the country will, of course, limit the plant societies or formations. The following situations have each a more or less clearly marked flora, and the brief note on habitat following each species in the list will, in most cases, indicate the nature of the locality where the plant should be sought. Beginning with the hydrophytes we may distinguish, first, the plants of the rapidly moving streams with which the region is abundantly supplied. Second, plants of pools and ponds. Ponds are not frequent, those found being mostly artificial. Third, marsh plants, inhabiting certain open miry places, and the open boggy banks of streams. Such areas are restricted and rather infrequent, but certain plants are found only in such localities. Fourth, swamp plants of the poorly drained timbered land along streams. In clay land there are likely to be "alder swamps," the prevailing growth being alder (*Alnus ru-*

gosa) and willow (*Salix nigra*) frequently with a dense undergrowth of cane (*Arundinaria tecta*). In sandy land swamps are more often "bay heads" with a prevailing growth of white bay (*Magnolia Virginiana*), red bay (*Persea pubescens*) and maple (*Acer rubrum.*). In places these "bay heads' 'develop into "Sphagnum bogs," where the ground is carpeted with peat moss (*Sphagnum sp.*). Each of these varieties of swamp has its own peculiar association of plants. Of mesophyte associations we have, 1st, the plants of the better drained creek and river bottoms, and, 2nd, the moister and richer northern slopes of the uplands. Such locations are usually heavily timbered mostly with hard woods, but occasionally mixed with loblolly pine (*Pinus Iaeda*) in the lowlands, and with the short leaf pine (*Pinus echinata*) in the uplands. These associations are rich in the number of species and include most of the more northern types. The plants from the Gulf region are to be sought on the dryer, more sandy uplands, and in the sandy bay heads and Sphagnum bogs. More or less distinctly zerophytic associations occupy the greater part of the upland area. Here we may distinguish. 1st, plants of the dry hardwood forests. These are usually found on the south slopes of the red clay hills; 2nd, plants of mixed woods, including long or short leaf pines and hard woods. This type of forest is the prevailing one over a large part of the entire region; 3rd, plants of the long leaf pine (*Pinus palustris*) forests. These are confined to the extreme southern border and to a strip along the hills bordering the Tallapoosa river. A large number of southern species are found in this long leaf pine association; 4th, an extremely zerophytic association found on exposed granite outcrops. Occasionally granite outcrops occur where they are somewhat moisted by a stream or spring and here we find still a different association of plants. Besides these which may be considered as constituting the natural plant covering of the region we have other associations whose advent is determined by the presence of man. Among these we may distinguish, 1st, the weeds of cultivated fields and gardens; 2nd, the weeds of pastures, roadsides and waste places; 3rd, the plants of abandoned or "turned out" fields, and, 4th, the plants of the second growth woods that ultimately reclothe these abandoned fields. The loblolly pine (*Pinus Taeda*) usually plays the leading part in this forestization, though with it are associated sweet gum (*Liquidambar*) black gum (*Nyssa sylvatica*), persimmon (*Diospyros*) and occasional individuals of numerous other trees.

OPHIOGLOSSACEAE.

‡Botrychium biternatum (Lam.) Underw.

A single specimen, upland pasture, Auburn, (in Underwood Herbarium.)

Botrychium obliquum Muhl.

Frequent, creek-bottom woods.

Botrychium Virginianum (L.) Sw.

Occasional, creek-bottom woods.

Ophioglossum crotalophoroides Walt.

Occasional, grassy creek-bottom pastures.

OSMUNDACEAE.

Osmunda cinnamomea L.

Common, swampy places.

Osmunda regalis L.

Common, swamps.

POLYPODIACEAE.

†Adiantum pedatum L.
Moist, shaded hillsides, river hills, Tallapoosa county.

Asplenium Bradleyi, D. C. Eaton.
Clay county (Mohr's Plant Life.)

Asplenium Filix-foemina (L.) Bernh.
Common, moist woods, variable.

Asplenium parvulum Mart. & Gall.
Clay county (Mohr's Plant Life.)

Asplenium platyneuron (L.) Oakes.
Common, rocky hillsides, granite outcrops.

Asplenium Irichomanes L.
Clay county (Mohr's Plant Life.)

Cheilanthes lanosa (Michx.) Watt.
Common, cliffs, granite outcrops.

Dryopteris Floridana (Hook.) O. Kuntze.
A single station, a swamp 6 miles south of Auburn, Lee co.

Dryopteris marginalis (L.) A. Gray.
Clay county (Mohr's Plant Life.)

†Dryopteris Noveboracensis (L.) A. Gray.
Clay county, creek bottoms.

‡Dryopteris Thelypteris (L.) A. Gray.
Occasional, creek bottoms, moist rich woods.

‡Onoclea sensibilis L.
Occasional, creek bottoms, clay land.

†Phegopteris hexagonoptera (Michx.) Fee.
Occasional, moist woods, creek bottoms.

Polypodium polypodioides (L.) A. S. Hitchcock.
Common, rocks, tree trunks.

Polystichum acrostichoides (Michx.) Schott.
Common, rocky hillsides in woods.

‡Pteridium aquilinum pseudocaudatum Clute.
Common, dry pine woods.

†Woodsia obtusa (Spreng.) Torr.
Frequent, rocky banks, granite outcrops.

Woodwardia areolata (L.) Moore.
Common, creek bottom swamps.

‡Woodwardia Virginica (L.) Smith.
A single collection, Auburn.

LYCOPODIACEAE.

Lycopodium pinnatum (Chapm.) Lloyd & Underw.
Frequent, sphagnum bogs.

SELAGINELLACAE.

Selaginella apus (L.) Spring.
Frequent, on the ground in swamps.

PINACEAE.

Juniperus Virginiana L.
Frequent, especially along roadsides.

Pinus echinata Mill.
The short leaf pine; common in mixed upland woods.

Pinus palustris Mill.
The long leaf pine; the prevailing timber on sandy lands, Lee county, and on dry rocky ridges bordering the Tallapoosa River.

Pinus Taeda L.
Loblolly pine, old field pine, swamp pine; common, swamps and uplands, especially as a second growth in abandoned fields.

TYPHACEAE.

Typha latifolia L.
Frequent, marshy places and shallow ponds and ditches.

SPARGANIACEAE.

Sparganum androcladum (Engelm.) Morong.
Occasional, marshy places.

ALISMACEAE.

‡Sagittaria latifolia Willd.
Common, marshes and ditches.

‡Sagittaria pubescens Muhl.
A single collection, swamp in river hills, Elmore county.

POACEAE.

Agrostis Elliottiana Schult.
Common, dry open places.

Agrostis hyemalis (Walt.) B. S. P.
Common, dry open places.

‡Agrostis intermedia Scribn.
A single collection, Auburn.

Aira caryophylla. L.
Common, dry open places.

Alopecurus geniculatus L.
Occasional, wet open places.

Andropogon argyraeus Schultes.
Common, dry woods and fields.

*Andropogon corymbosus (Chapm.) Nash.
Occasional, wet swampy places.

‡Andropogon Elliottii Chapm.
Occasional, dry woods.

Andropogon furcatus Muhl.
Infrequent, dry woods and roadsides.

‡Andropogon glomeratus (Walt.) B. S. P.
Frequent, wet swampy places. A smaller form with narrow panicles occurs in moist, upland woods.

Andropogon scoparius Michx.
Very common and variable. As here recognized it probably includes more than one species.

Andropogon Tracyi Nash.
Frequent, sandy uplands fields or thin woods.

Andropogon Virginicus L.
Very common, especially in old fields. (Broom sedge). Variable.

‡Anthaenatia villosa Beauv.
Occasional, moist sandy lands, south of Auburn.

Aristida lanosa Muhl.
Frequent, dry sandy lands, south of Auburn.

Aristlda purpurascens Poir.
A single collection, Auburn.

Arrhenatherum elatius (L.) Beauv.
A single collection, Auburn.

Arundinaria tecta (Walt.) Muhl.
Common, creek bottom swamps (Cane.)

Bromus unioloides (Willd.) H. B. K.
Occasional, fields, roadsides, etc. (escaped.)

†Brachyelytrum erectum (Schreb.) Beauv.
Occasional, rich upland woods.

Campulosus aromaticus (Walt.) Scrib.
Gold Hill, Lee county (Mohr's Plant Life.)

Capriola Dactylon (L.) O. Kuntze.
Abundantly introduced (Bermuda grass.)

‡Cenchrus echinatus L.
Occasional, sandy fields.

Chaetochloa glauca (L.) Scribn.
Common, cultivated fields.

*Chaetochloa perennis (Curtiss) Bicknell.
A single collection, Auburn.

Chrysopogon avenaceus (Michx.) Benth.
Common, upland woods and open places.

‡Chrysopogon nutans (L.) Benth.
Common, upland woods and open places.

Cinna arundinacea L.
Occasional, wet swampy places.

Dactyloctenium Aegypticum (L.) Willd.
Common, cultivated fields.

Danthonia sericea Nutt.
Frequent, dry woods and open places, clay or sand.

†Danthonia spicata (L.) Beauv.
Rocky hillsides, clay land, north of Auburn.

Eatonia filiformis (Chapm.) Vasey.
Frequent, dry woods.

Eatonia nitida (Spreng.) Nash.
Common, dry woods.

*Eatonia Pennsylvanica (D C.) A. Gray.
Dry open hillsides, Auburn.

*Eatonia Pennsylvanica (D C.) A. Gray.
A single collection, Auburn, creek bottom woods.

Echinochloa Crus-galli (L.) Beauv.
Occasional, gardens and barnyards.

Eleusene Indica (L.) Gaertn.
Common, cultivated fields.

*Elymus galbriflorus (Vasey) Scribn. & Ball.
Occasional, dry woods.

Elymus strictus Willd.
Lee county. Earle & Baker (Mohr's Plant Life.)

Elymus Virginicus L.
Lee County, (Mohrs Plant Life.)

‡Eragrostis hirsuta (Michx.) Nash.
Frequent, dry, open places.

Eragrostis major (L.) Host.
Common, cultivated fields.

Eragrostis pectinacea (Michx.) Steud.
Common, dry open places.

Eragrostis Purshii Schrad.
Occasional, cultivated fields.

‡Eragrostis refracta (Muhl.) Scribn.
Common, dry open places.

Erianthus alopecuroides (L.) Ell.
Common, upland woods, usually on clay.

*Erianthus compactus Nash.
Common, upland woods, usually on clay.

*Erianthus contortus Ell.
Common, poor usually sandy woods.

Festuca nutans Willd.
Frequent, moist woods.

*Festuca obtusa Spreng.
A single collection, Chambers county.

Festuca octoflora Walt.
Common, dry open places.

Festuca octoflora aristata (Torr.) Dewey.
Lee county, Earle & Baker (Mohr's Plant Life.)

Festuca sciurea Nutt.
Lee county, Earle & Baker (Mohr's Plant Life.)

Festuca Shortii Knuth.
Lee county, Earle & Baker (Mohr's Plant Life.)

‡Gymnopogon ambiguus (Michx.) B. S. P.
Frequent, dry sandy woods.

Homalocenchrus Virginicus (Willd.) Britt.
Frequent, wet swampy places.

Panicularia nervata (Willd.) O. Kuntze.
Occasional, cultivated fields.

Melica mutica Wall.
Frequent, upland woods.

Muhlenbergia capillaris (Lam.) Trin.
Frequent, dry open places.

†Muhlenbergia diffusa Schreb.
A single collection, Auburn.

Oplismenus hirtellus (L.) R. & S.
Occasional, moist sandy places in shade.

Panicularia nervata (Willd) O. Kuntze.
Common, wet shady places.

Panicum agrostoides Muhl.
Clay county (Mohr's Plant Life.)

—*Panicum Alabamense Ashe.
Collected once, Auburn, swamp. This is very close to P. lucidum Ashe, and is probably identical with that species.

Panicum angustifolium Ell.
Very common, dry upland woods and roadsides.

†Panicum Auburne Ashe.
Collected once, Auburn, uplands. This is probably only a small form of P. sphaerocarpon. Ell.

Panicum barbulatum Michx.
Common, wet, swampy woods.

—*Panicum Rogueanum Ashe.
Collected once, Auburn, uplands.

Panicum clandestinum L.
Occasional, alder swamps, clay land.

Panicum commutatum Schult.
Common, dry sandy uplands, roadsides, old fields and thin woods; often forming a dense sod.

Panicum depauperatum Muhl.
Common, dry uplands.

Panicum dichotomum L.

Very common, moist or dry land.

Panicum Earlei Nash.

Occasional, sandy swamps.

Panicum elongatum Pursh.

Occasional, damp places.

*Panicum hians Ell.

Frequent, low, wet places.

Panicum lanuginosum Ell.

Collected once, Chambers county.

‡Panicum laxiflorum Lam.

Very common, moist places. A form has been called P. caricifolium Scribn.

Panicum lucidum Ashe.

Frequent, wet places, sphagnum bogs, etc.

Panicum melicarium Michx.

Lee county, Earle & Baker (Mohr's Plant Life.)

Panicum microcarpon Muhl.

Frequent, moist uplands.

*Panicum mutabile Scribn. & Merrill.

Occasional, dry woods. These specimens have been determined as P. Joori Vasey.

Panicum neuranthum Greiseb.

Collected once, Auburn.

Panicum oliganthes Schult.

Occasional, sandy uplands.

Panicum Porterianum Nash.

Common, rich uplands.

Panicum pseudopubescens Nash.

Very common, dry uplands.

‡Panicum pubifolium Nash.

Frequent, sandy uplands.

Panicum pyriforme Nash.

Lee county, Earle & Baker (Mohr's Plant Life.)

Panicum Ravenelii Scribn. & Merrill.

Frequent, sandy uplands.

Panicum rostratum Muhl.

Common, uplands.

Panicum scoparium Lam.
Common, open sandy creek bottoms.

†Panicum Scribnerianum Nash.
Collected once, Auburn.

Panicum sphaerocarpon Ell.
Frequent, ditch banks and uplands.

Panicum Texanum Buckl.
Common, fields, introduced.

Panicum trifolium Nash.
Frequent, swamps.

‡Panicum verrucosum Muhl.
Common, shaded swamps.

Panicum virgatum L.
Common and variable, uplands and creek bottoms.

‡Panicum Webberianum Nash.
Common, dry exposed uplands, clay or sand.

—*Panicum Yadkinensis Ashe.
Collected once, creek bottom, Auburn.

—*Paspalum augustifolium Le Conte.
Frequent, upland woods, often confused with P. *laeve*. Michx.

Paspalum Boscianum Fleugge.
Common, cultivated fields.

Paspalum ciliatifolium Michx.
Common, upland woods.

Paspalum compressum (Sw.) Nees.
Common, wet pastures (Carpet grass.)

‡Paspalum dilatatum Poir.
Frequent, wet pastures and roadsides.

‡Paspalum distichum L.
Occasional, wet creek bottoms.

‡Paspalum Floridanum Michx.
Occasional, sandy uplands.

Paspalum laeve Michx.
Occasional, upland woods.

‡Paspalum longipedunculatum Le Conte.
Occasional, sandy uplands.

Poa annua L.
Common, dooryards, pastures and waste places.

Poa autumnalis Muhl.
Frequent, swampy woods.

†Poa pratensis L.
Occasional, roadsides and open woods.

‡Sorghum Halapense (L.) Pers.
Frequent, fields and waste places, (Johnson grass.)

Sporobolus asper (Michx.) Kunth.
Frequent, sandy woods and roadsides.

Sporobolus Indicus (L.) R. Br.
Common, pastures and door-yards, (Smut grass.)

Sporobolus punceus (Michx.) Kunth.
Frequent, dry sandy woods south of Auburn.

Stipa avenacea L.
Frequent, upland woods, sand or clay.

‡Syntherisma fimbriatum (Link) Nash.
Common, cultivated fields, (Crab grass.)

‡Syntherisma villosum Walt.
Occasional, cultivated fields.

Tricuspis seslerioides (Michx.) Torr.
Common, upland woods and open places.

Tripsacum dactyloides L.
Frequent, ditch banks and borders of moist fields.

*Trisetum aristatulum (Scribn. & Merrill) Nash.
Dry clay woods, Tallapoosa county.

†Trisetum Pennsylvanicum (L.) Beauv.
Frequent, moist woods.

Uniola latifolia Michx.
Frequent, rich upland woods.

Uniola laxa (L.) B. S. P.
Collected once, Auburn.

Uniola longifolia Scribn.
Frequent, upland woods and creek bottoms.

CYPERACEAE.

Carex Atlantica Bailey.
Frequent, rich woods.

Carex cephalophora Muhl.
Frequent, dry wooded hillsides.

Carex crinita Lam.
A single collection, Auburn.

Carex debilis Michx.
Frequent, wet woods.

Carex granularis Muhl.
Lee county, Earle & Baker (Mohr's Plant Life.)

*Carex gynandra Schw.
Occasional, upland woods, Lee county, Tallapoosa county.

Carex interior Bailey.
Lee county, Earle & Baker (Mohr's Plant Life.)

Carex intumescens Rudge.
Frequent, swamps and ditch banks.

Carex laxiflora Lam.
Common, upland woods.

Carex laxiflora varians Bailey.
Lee county, Earle & Baker (Mohr's Plant Life.)

Carex leptalea Wahl.
Common, swamps.

Carex lurida Wahl.
Frequent, swamps and marshy places.

†Carex nigro-marginata Schw.
Frequent, dry rocky hillsides and granite outcrops. The most southerly known station for this rare *Carex.*

Carex oblita Steud.
Frequent, swamps.

*Carex ptychocarpa Steud.
Frequent, creek bottom swamps.

Carex sterilis Willd.
Frequent, swampy creek bottoms.

Carex stipata Muhl.
Frequent, wet open places.

*Carex tenera Dewey.
Common, rich woods.

†Carex Texensis (Torr.) Bailey.
Occasional, Auburn.

Carex triceps Michx.
Common dry upland woods.

Carex verrucosa Muhl.
Frequent, swamps, matures in midsummer. (=C. glaucescens Ell. of Mohr's Plant Life.)

Carex vulpinoidea Michx.
Common, wet places, ditch banks, etc.

Cyperus cylindricus (Ell.) Britt.
Frequent, sandy fields, etc.

Cyperus echinatus (Ell.) Wood.
Common, sandy uplands.

Cyperus filiculmis Vahl.
Frequent, sandy lands.

Cyperus Haspan L.
Frequent, marshy grass lands.

Cyperus Lancastriensis Porter.
Occasional, Lee county, Tallapoosa county.

Cyperus ovularis (Michx.) Torr.
Frequent, dry uplands.

Cyperus pseudovegetus Steud.
Frequent, swampy places.

Cyperus retrofractus (L.) Torr.
Common, dry sandy uplands.

Cyperus rotundus L.
Nut grass, a garden pest, locally abundant.

Cyperus stenolepis Torr.
Lee County, Earle & Baker. (Mohr, Plant Life.)

Cyperus strigosus L.
Common, fields and marshy places.

Eleocharis obtusa Schultes.
Common, marshy places.

Eleocharis prolifera Torr.
Occasional, marshy places.

Eleocharis tuberculosa (Michx.) R. & S.
Occasional, marshy places.

Fimbristylis autumnalis (L.) R. & S.
Common, marshy places and sandy fields.

*Fimbristylis laxa Vahl.
A single collection, Auburn.

*Fuirena squarrosa Michx.
Common, marshy places.

‡Fuirena squarrosa hispida (Ell.) Chapm.
Frequent, sphagnum swamps, etc.

‡Hemicarpa micrantha (Vahl) Britt.
Frequent, marshy places.

Kyllinga pumila Michx.
Common, wet places.

Rynchospora axillaris (Lam.) Britt.
Occasional, marshy places.

‡Rynchospora corniculata (Lam.) A. Gray.
Frequent, borders of ponds, etc.

Rynchospora cymosa Ell.
Frequent, marshy places.

Rynchospora filifolia Torr.
A single collection, Auburn.

Rynchospora glomerata (L.) Vahl.
Occasional, marshy places.

Rynchospora golmerata paniculata (A. Gray) Chapm.
Common, moist or dry open places, roadsides, etc.

*Rynchospora microcephala Britt.
A single collection, Auburn.

*Rynchospora patula A. Gray.
A single collection, Macon's Mill, Lee county.

Rynchospora rariflora Ell.
Occasional, marshy places.

‡Scirpus Eriophorum Michx.
Occasional, wet places, clay land.

Scleria ciliata Michx.
Frequent, upland woods.

Scleria oligantha Michx.
Frequent, upland woods.

*Scleria pauciflora Muhl.
A single collection, Auburn.

‡Scleria pauciflora glabra Chapm.
Frequent, moist woods.

Scleria triglomerata Michx.
Frequent, upland woods.

Stenophyllus capillaris (L.) Britt.
Frequent, sandy fields and marshy places.

PALMACEAE.

Rhapidophyllum hystrix (Fraser) Wendl. & Drude.
Rare, swamps, Lee county, clay and sand.

†Sabal Adansonii Guerns.
Rare, swamps, Lee count, in sand.

ARACEAE.

Arisaema quinatum (Nutt.) Schott.
Occasional, swamps and wet woods.

Arisaema triphyllum (L.) Torr.
Occasional, wet woods.

Orontium aquaticum L.
Clay county (Mohr's Plant Life.)

Peltandra Virginica (L.) Kunth.
Occasional, swamps and wet woods.

MAYACAEAE.

‡Mayaca Aublètii Michx.
Frequent, sandy swamps, usually with sphagnum.

XYRIDACEAE.

‡Xyris ambigua Beyrich.
A single collection, Auburn.

Xyris Caroliniana Walt.
Frequent, sandy borders of ponds, etc.

Xyris communius Kunth.
Lee county, J. D. Smith (Mohr, Plant Life.)

Xyris flexuosa Muhl.
Occasional, sandy swamps.

Xyris iridifolia Chapm.
Occasional, sandy swamps.

Xyris torta Smith.
Frequent, sandy swamps.

Bromeliaceae.

‡Tillandsia usneoides L.
Occasional on trees in creek bottoms. All killed by the "freeze" of February. 1899.

Commelinaceae.

Commelina communis L.
Escaped, ditch banks, Auburn.

Commelina erecta L.
Frequent, dry hillsides.

Commelina hirtella Vahl.
Frequent, swampy creek bottoms.

‡Tradescantia hirsuticaulis Small.
River hills, Elmore county; also sandy woods, Lee county.

Tradescantia montana Shuttlw.
Rich upland woods, Clay county, Coosa county.

Tradescantia reflexa Raf.
Frequent, dry rocky hillsides, granite outcrops.

Juncaceae.

Juncoides echinatum Small .
Frequent, wooded hillsides.

Juncus acuminatus Michx.
Frequent, wet open places.

Juncus acuminatus debilis (A. Gray) Engelm.
Frequent, wet open places.

Juncus Canadensis A. Gray.
Occasional, Auburn.

‡Juncus diffusissimus Buckl.
Shallow pool in swamp, Auburn.

*Juncus Dudleyi Wiegand.
Frequent, dry woods and roadsides.

Juncus effusus L.
Frequent, wet, open places.

Juncus marginatus Rostk.
Frequent, wet, open places.

Juncus marginatus aristulatus (Michx.) Coville.
Common, wet open places.

‡Juncus polycephalus Michx.
Frequent, wet, open places.

‡Juncus repens Michx.
Sandy borders of ponds, in or out of water.

*Juncus robustus (Englm.) Coville.
A single collection, Auburn.

‡Juncus scripoides Lam.
Common, wet open places.

Juncus setaceus Rostk.
Common, wet open places.

Juncus tenuis Willd.
Common, especially along paths and woods roads.

Juncus Torreyi Coville.
Lee county, Earle & Baker (Mohr, Plant Life.)

Juncus trigonocarpus Steud.
A single collection, Auburn.

Liliaceae.

‡Aletris farinosa L.
Occasional, borders of sandy swamps.

Allium mutabile Michx.
Common, creek bottoms, clay land, often in fields.

Allium veneale L.
Introduced, fields, etc., Auburn.

*Chamaelirium obovale Small.
Occasional, rich upland woods.

Chrosperma muscaetoxicum (Walt.) O. Kuntze.
Rare, taken once near Auburn.

Lilium Carolinianum Michx.
Occasional, rich upland woods.

Medeola Virginica L.
Occasional, moist, rich woods.

Melanthium Virginianum L.
Rare, taken once near Auburn.

Nothoscordium bivalve (L.) Britt.
(=Allium stratum.)
Common, dry rocky hillsides, granite outcrops, etc.

Polygonatum biflorum (Walt.) Ell.
Frequent, moist rich woods and creek bottoms.

†Polygonatum commutatum (R. & S.) Dietr.
Occasional, moist, rich woods, creek bottoms, etc.

*Triantha glutinosa (Michx.) Baker.
(=Tofeldia glutinosa Michx.)
Occasional, open marshy places.

Trillium stylosum Nutt.
Frequent, rich, moist woods, uplands or creek bottoms, usually on clay

Trillium Underwoodii Small.
Common, wooded creek bottoms, clay land north of Auburn, the type locality. A taller form with less conspicuously mottled shorter leaves occurs in sandy swanmps south of Auburn.

Uvularia perfoliata L.
Frequent, rich, moist woods, uplands or creek bottoms.

Uvularia sessilifolia L.
Frequent, rich, moist woods, creek bottoms, etc.

Vagnera racemosa (L.) Morong.
Frequent, rich, moist woods, creek bottoms, etc.

Yucca filamentosa L.
Occasional, roadsides and waste places.

SMILACACEAE.

Smilax Bona-nox L.
Occasional, fence rows and thickets.

*Smilax cinnamomifolia Small.
In dry woods and old fields.

Smilax ecirrhata (Engelm.) Wats.
Frequent, rich upland woods.

Smilax glauca Walt.
Upland woods and old fields.

†Smilax herbacea L.
Frequent, rich woods.

Smilax hispida Muhl.
Frepuent, thickets, etc.

‡Smilax lanceolata L.
Frequent, moist thickets. (Jackson vine.)

‡Smilax laurifolia L.
Common, swamps (Bamboo vine.)

Smilax Pseudo-China L.
Occasional, fence rows and thickets.

Smilax pumila Walt.
Frequent, dry hillsides.

Smilax rotundifolia L.
Common, fence rows and thickets.

‡Smilax Walteri Pursh.
Occasional, swamps, sandy land.

AMARYLLIDACEAE.

‡Atamosco Atamasco (L.) Greene.
Common, creek bottoms.

Hymenocallis occidentalis Kunth.
Rare, sandy creek bottoms.

Hypoxis hirsuta (L.) Coville.
Common, upland woods.

Manfreda Virginica (L.) Salisb.
(=Agave Virginica L.)
Frequent, dry rocky hillsides and granite outcrops.

DIOSCOREACEAE.

Dioscorea villosa L.
Common, a climbing vine in rich woods.

IRIDACEAE.

Gemmingia Chinensis (L) O. Kuntze.
Occasional, roadsides, etc.

†Iris cristata Ait.
Long-leaf pine woods, Tallapoosa county.

‡Iris verna L.
Long leaf pine woods, Tallapoosa county.

Sisyrinchium Carolinianum Bicknell.
Frequent, upland woods.

*Sisyrinchium flaccidum Bicknell.
Occasional, banks of streams.

‡Sisyrinchium grammoides Bicknell.
Frequent, upland woods.

BURMANNIACEAE.

‡Burmannia biflora L.
A single collection, swampy creek bottoms, sandy land.

ORCHIDACEAE.

Achroanthes unifolia (Michx.) Raf.
Rare, creek bottom swamps.

†Corallorhiza odontorhiza (Willd.) Nutt.
A single collection, Auburn.

Cypripedium parviflorum Salisb.
Clay county (Mohr's Plant Life).

Gyrostachys cernua (L.) O. Kuntze.
Frequent, moist places, creek bottoms, etc.

Gyrostachys gracilis (Bigel.) O. Kuntze.
Common, dry pine woods.

*Gyrostachys simplex (A. Gray) O. Kuntze.
A single collection, Auburn, dry pine woods.

*Gyrostachys vernalis (Engelm.) Small.
Occasional, pine woods.

Habenaria ciliaris (L.) R. Br.
Frequent, creek bottom woods, usually sand.

Habenaria clavellata (Michx.) Spreng.
Frequent, creek bottom woods, clay or sand.

Habenaria cristata (Michx.) R. Br.
Frequent, creek bottoms, sandy land.

Habenaria flava (L.) A. Gray.
Lee county, Underwood & Earle (Mohr's Plant Life.)

Habenaria lacera (Michx.) R. Br.
A single collection, Auburn.

†Habenaria quinquiseta (Michx.) Mohr.
(=H. Michauxii Nutt.)
A single collection, Auburn.

Hexalectris aphyllus (Nutt.) Raf.
Occasional, wooded hillsides, Lee county, Clay county, Elmore county.

Leptorchis lilifolia (L.) O. Kuntze.
Rare, creek bottom swamps.

Leptorchis Loeselii (L.) MacM.
Rare, creek bottom swamps, clay.

Limodorum tuberosum L.
Occasional, swamps, sphagnum bogs, etc., sand.

*Listera australis Lindl.
A single speciment, sandy swamp, south of Auburn.

Pogonia ophioglossoides (L.) Ker.
Frequent, sphagnum bogs, etc.

Tipularia unifolia (Muhl.) B. S. P.
Occasional, moist woods, Lee county, Elmore county.

SAURURACEAE.

Saururus cernuus L.
Frequent, swamps.

JUGLANDACEAE.

Hicoria alba (L.) Britt.
Occasicnal, uplands.

Hicoria glabra (Mill.) Britt.
Common, dry upland woods, clay or sand.

Juglans nigra L.
Occasional, rich woods, usually clay.

MYRICACEAE.

‡Myrica cerifera L.
Occasional, sandy swamps.

SALICEAE.

Populus deltoides Marsh.
Occasional, creek and river bottoms.

Salix nigra Marsh.
Common, alder swamps, etc.

Betulaceae.

Alnus rugosa (Du Roi) Koch.

Very common in wet, swampy creek bottoms, the characteristic growth in such locations.

Betula lenta L.

Clay county (Mohr's Plant Life).

Betula nigra L.

Frequent along streams, clay land.

Carpinus Caroliniana Walt.

Frequent, creek bottoms.

Ostrya Virginiana (Mill.) Willd.

Frequent, creek bottoms.

Fagaceae.

Castanea dentata (Marsh.) Borkh.

Rare near Auburn, frequent further north, Chambers county, Tallapoosa county, etc.

Castanea pumila (L.) Mill.

Frequent, dry thickets.

Corylus rostrata Ait.

Clay county, Tallapoosa county, Randolph county (Mohr's Plant Life). It does not occur near Auburn.

Fagus Americana Sweet.

Common, moist woods, usually creek bottoms.

Quercus acuminata (Michx.) Sargent.

On high hills, Clay county; not seen about Auburn.

Quercus alba L.

Frequent, rich upland woods, clay land.

‡Quercus brevifolia (Lam.) Sargent.

Occasional, dry white sands south of Auburn.

†Quercus coccinea Wang.

Occasional, clay uplands, more abundant northward.

Quercus digitata (Marsh.) Sudw.

Very common, uplands, sand or clay.

*Quercus Margaretta Ashe.

Common, white sandy soils south of Auburn, but strictly confined to such locations. Very distinct from *Q. minor*, with which it has been confused.

Quercus Marylandica Muench.

(=Q. nigra of authors.) (Black jack.)

Very common, dry, sandy uplands, also on clay.

Quercus minor (Marsh.) Sargent.

Very common, dry uplands, sand or clay.

Quercus Phellos L.

Common, creek bottoms.

*Quercus prinoides Willd.

Occasional, creek bottoms.

†Quercus rubra L.

Occasional, moist clay uplands.

Quercus Schneckii Britton.

Common, uplands, clay or sand.

(=D. Texana Sargent, not Buckl.)

Quercus velutina Lam.

Occasional, clay uplands, frequent in upper counties.

ULMACEAE.

*Celtis Georgiana Small.

Common, dry woods, fence rows, etc., a shrub.

Celtis occidentalis L.

Clay county (Mohr's Plant Life).

Ulmus alata Michx.

Common, dry uplands.

Ulmus Americana L.

Occasional, moist woods, creek bottoms.

MORACEAE.

Morus rubra L.

Occasional, rich woods, thickets.

URTICACEAE.

Adicea pumila (L.) Raf.

Occasional, swamps.

Boehmeria cylindrica (L.) Willd.

Occasional, swamps.

Urticastrum divaricatum (L.) O. Kuntze.

A single collection, Clay county.

LORANTHACEAE.

Phorodendron flavescens (Pursh) Nutt.
Frequent, usually on oaks.

SANTALACEAE.

Nestronia umbellulata Raf.
(=Darbya umbellulata. A. Gray.)
A single station, creek bank, 3 miles northwest of Auburn.

ARISTOLOCHIACEAE.

Aristolochia Nashii Kearney.
Occasional, moist, rocky banks.

Aristolochia Serpentaria L.
Occasional, moist rocky banks.

‡Hexastylis arifolium (Michx.) Small.
(=Asarum arifolium Michx.)
Common, rich upland woods.

*Hexastylis Ruthii (Ashe) Small.
Occasional, rich woods. (Specimen in Herb. N. Y. Bot. Gard.)

†Hexastylis Shuttleworthii (J. Britt.) Small.
Frequent, borders of sphagnum swamps.

POLYGONACEAE.

Brunnichia cirrhosa Banks.
A single collection, Tallapoosa county, river bank

Polygonum Convolvulus L.
Single collection, Opelika, on the railroad.

†Polygonum Hydropiper L.
Occasional, wet places, Lee county, Clay county.

Polygonum Opelousanum Riddell.
Common, moist fields, ditch banks, etc.

Polygonum Pennsylvanicum L.
Common, moist cultivated fields, etc.

Polygonum punctatum Ell.
Common, swamps and wet fields, often growing in standing water.

Polygonum sagittatum L.
Frequent, moist places, ditch banks.

Polygonum setaceum Baldw.
Common, swamps.

Polygonum Virginianum L.
Occasional, swampy woods.

Rumex Acetocella L.
Infrequent, pastures and waste places.

Rumex crispus L.
Common, roadsides and waste places.

‡Rumex hastatulus Muhl.
Very common, fields and waste places. A characteristic growth in abandoned fields.

Rumex obtusifolius L.
Occasional, fields and waste places.

‡Rumex pulcher L.
Streets of Auburn.

CHENOPODIACEAE.

Chenopodium album L.
Frequent, a weed in gardens and rich fields.

Chenopodium anthelminticum L.
Occasional, a weed in waste places.

AMARANTHACEAE.

Amaranthus hybridus paniculatus (L.) U. & B.
Common, a weed in gardens and rich fields.

Amaranthus spinosus L.
Frequent, a weed in gardens and rich fields.

PHYTOLACCACEAE.

Phytolacca decandra L.
Common, rich fence rows and waste places.

NYCTAGINACEAE.

‡Boerhaavia erecta L.
Frequent, a weed in gardens and waste places.

Aizoaceae.

Mollugo verticellata L.
Common, a weed in gardens and fields.

Portulacaceae.

†Claytonia Virginica L.
One locality, wet, swampy woods 6 miles south of Auburn.

Portulacca oleracea L.
Occasional, a weed in rich gardens, not found in poor fields.

Talinum teretifolium Pursh.
Locally common, dry granite outcrops.

Caryophyllaceae.

Alsine media L.
Common, a winter weed in gardens and waste places.

†Alsine pubera (Michx.) Britton.
Rich wood, river hills Tallapoosa county.

Anychia dichotoma Michx.
Clay county (Mohr's Plant Life).

†Arenaria brevifolia Nutt.
Locally common, granite outcrops.

*Cerastium brachypodum (Engelm.) Robinson.
Occasional, fields.

†Carastium longipedunculatum Muhl.
Occasional, fields.

Cerastium viscosum L.
Common, gardens, fields and waste places.

Cerastium vulgatum L.
Common, gardens, fields and waste places.

Sagina decumbens (Ell.) T. & G.
Common, fields and gardens.

Saponaria officinalis L.
Occasional, roadsides, introduced.

Silene antirrhina L.
Occasional, fields and waste places.

Silene stellata (L.) Ait.
Occasional, rich woods, rocky banks of streams.

Silene Virginica L.
Frequent, rich upland woods, clay.

†Spergula arvensis L.
A single collection, Auburn (1894).

NYMPHAEACEAE.

Brasenia purpurea (Michx.) Casp.
In pond south of Auburn (Vaughn's Mill).

Nymphaea advena Soland.
Frequent, ponds and slow streams.

MAGNOLIACEAE.

‡Illicium Floridanum Ell.
Occasional, banks of streams, Lee county, south of Auburn.

Liriodendron Tulipifera L.
Frequent, moist hillsides and creek bottoms.

Magnolia macrophylla Michx.
Frequent, river hills, Tallapoosa county, Clay county.

Magnolia Virginiana L.
Common, sandy swamps.

ANONAECAE.

Asimina parviflora (Michx.) Dunal.
Frequent, dry or moist places.

Asimina triloba (L.) Dunal.
Banks of Tallapoosa river, Elmore county.

RANUNCULACEAE.

Actaea alba (L.) Mill.
Lee county, Baker & Earle (Mohr's Plant Life).

†Anemone Caroliniana Walt.
Rare, rocky hillsides (Wright's Mill.)

Anemone quinquefolia L.
Frequent, moist wooded hillsides.

Anemone Virginiana L.
A single collection, Chambers county.

‡Clematis crispa L.
Occasional, sandy swamps.

*Clematis glaucophylla Small.
Occasional, dry banks, Tallapoosa county, Elmore county. The leaves are less glancus than in the type and the achenes are narrower.

†Clematis reticulata Walt.
Rocky banks, Tallapoosa river, Elmore county.

Clematis Virginiana L.
Frequent, swamps, clay land.

Delphinium Carolinianum Walt.
Occasional, dry wooded hillsides.

†Hepatica Hepatica (L.) Karst.
Occasional, rich wooded hillsides.

Ranunculus abortivus L.
Frequent, fields and waste places.

Ranunculus hispidus Michx.
Frequent, moist or dry woods.

‡Ranunculus parviflorus L.
Occasional, wet, swampy places.

Ranunculus pusillus Poir.
Occasional, wet, swampy places.

Ranunculus pusillus Lindheimeri A. Gray.
Frequent, wet swampy places.

Ranunculus recurvatus Poir.
Occasional, creek bottom woods.

Ranunculus tener Mohr.
Lee county, Baker & Earle (Mohr's Plant Life).

†Syndesmon thalictroides (L.) Hoffmg.
Frequent, moist wooded hillsides.

Thalictrum clavatum D. C.
Clay county (Mohr's Plant Life).

Thalictrum purpurascens L.
Swampy places, Chambers county, Tallapoosa county.

†Trautvetteria Carolinensis (Walt.) Vail.
A single collection, shaded spring branch, river hills, Elmore county.

Xanthorrhiza apiifolia L. Her.
Frequent, along streams, often on rocky banks.

Berberidaceae.

†Caulophyllum thalictroides (L.) Michx.

One locality, 3 miles northwest of Auburn. Moist, wooded hillside.

Podophyllum peltatum L.

Occasional, creek bottoms.

Menispermaceae.

Calycocarpum Lyoni (Pursh) Nutt.

Rare, creek bottoms.

Cebatha Carolina (L.) Britt.

Frequent, thickets, becoming a troublesome weed in cultivated fields.

Calycanthaceae.

‡Butneria florida (L.) Kearney.

Frequent, moist, rich woods (Mohr's Plant Life credits *Butneria fertilis* to Lee county, but this seems to be an error.)

Lauraceae.

‡Persea pubescens (Pursh) Sargent.

Frequent, swamps, usually sand

Sassafras Sassafras (L.) Karst.

Occasional, mixed woods and cultivated fields.

Papaveraceae.

Sanguinaria Canadensis L.

Occasional, rich woods.

Cruciferae.

†Arabis Canadensis L.

Occasional, rocky creek banks, granite outcrops.

Arabis Virginica (L.) Trelease.

Very common, a winter weed in cultivated fields.

*Brassica juncea (L.) Cosson.

Streets of Auburn, introduced.

Bursa Bursa-pastoris (L.) Britt.
Common, fields and waste places.

Cardamine bulbosa (Schreb.) B. S. P.
Occasional, swampy woods, Lee county, Tallapoosa county.

‡Cardamine Pennsylvanica Muhl.
Occasional, rocky hillsides, granite outcrops.

Coronopus didymus (L.) J. E. Smith.
Common, upland fields and gardens.

Draba brachycarpa Nutt.
Common, upland fields, granite outcrops.

*Draba verna L.
Common, upland fields (*Draba Carolinia* is credited to Lee county in Mohr's Plant Life. This is an error, as the species is clearly *D. verna.*)

Lepidium Virginicum L.
Common, a weed in fields and gardens.

CAPPARIDACEAE.

Polanisia trachysperma T. & G.
Tallapoosa county (Mohr's Plant Life).

DROSERACEAE.

‡Drosera brevifolia Pursh.
Frequent, borders of sphagnum bogs.

PODOSTEMACEAE.

Podostemon ceratophyllum Michx.
Lee county, Baker & Earle (Mohr's Plant Life).

CRASSULACEAE.

†Diamorpha pusilla (Michx.) Nutt.
Locally abundant, granite outcrops.

PENTHORACEAE.

Penthorum sedoides L.
Occasional, swamps.

Saixfragaceae.

†Heuchera Americana L.
Frequent, dry rocky hillsides, granite outcrops.

Heuchera hispida Pursh.
Metamorphic hills, Talledega county (Mohr's Plant Life).

Parnassia asarifolia Vent.
Clay county (Mohr's Plant Life.)

Philadelphus grandiflorus Willd.
Lee county Underwood & Earle (Mohr's Plant Life). Very rare, seen only once.

†Saxifraga Virginiensis Michx.
Rare, in rock crevices, a single locality two miles northwest of Auburn.

Tiarella cordifolia L.
Occasional, moist, rocky woods, near springs.

Hydrangeaceae.

Decumaria barbata L.
Frequent, a high climbing vine in moist woods.

Hydrangea arborescens L.
Occasional, moist woods and rocky banks.

Hydrangea arborescens cordata (Pursh) T. & G.
Clay county (Mohr's Plant Life).

Hydrangea quercifolia Bartr.
Frequent, moist or dry woods.

Iteaceae.

Itea Virginica L.
Frequent, sandy swamps.

Hamamelidaceae.

Hamamelis Virginiana L.
Frequent, moist woods.

Liquidambar Stryaciflua L.
Common, a tree in mixed woods, both swamps and uplands, also in old fields and second growth timber.

PLATANACEAE.

Platanus occidentalis L.
Occasional, a large tree in creek bottoms.

ROSACEAE.

†Agrimonia mollis (T. & G.) Britt.
Common, moist woods.

Agrimonia parviflora Soland.
Moist woods, Clay county. Not seen at Auburn.

‡Agrimonia pumila Muhl.
Frequent, sandy creek bottoms.

‡Agrimonia striata Michx.
Occasional, moist woods, Lee county, Clay county, Coosa county.

†Amelanchier Botryapium (L.) D C.
Occasional, creek banks and borders of swamps.

*Amygdalus Persica L.
Freely escaped, roadsides, old fields and second growth woods. (Peach.)

Aronia arbutifolia (L. f.) Ell.
Common, swamps.

†Aruncus Aruncus (L.) Karst.
Rare, moist woods, Auburn.

‡Cotoneaster Pyracantha (L.) Spach.
Sparingly escaped, roadsides, Auburn.

Crataegus apiifolia (Marsh.) Michx.
Occasional, creek bottoms.

Crataegus collina Chapm.
Common, dry woods, usually sand.

Crataegus punctata Jacq.
Lee county, Baker & Earle (Mohr's Plant Life).

*Crataegus rubescens Ashe.
Frequent, dry woods, Auburn—the type locality.

Crataegus spathulata Michx.
Common, upland woods and granite outcrops.

Crataegus uniflora Moench.
Frequent, dry woods, sand or clay.

‡Duchesnea Indica (Andr.) Focke.
Common, creek bottoms.

Fragaria Virginiana L.
Common, dry open woods, usually on clay.

†Geum Canadense Jacq.
A single collection, Clay county.

Malus augustifolia (Ait.) Michx.
Frequent, along streams.

Opulaster opulifolius (L.) O. Kuntze.
Locally abundant, creek bottoms, Wright's Mill.

Porteranthus stipulatus (L.) Britt.
A single collection, Tallapoosa county.

Potentilla Canadensis L.
Frequent, dry banks and open woods.

*Potentilla humilis Poir.
A single collection, river hills, Tallapoosa county.

Prunus Americana Marsh.
Clay county (Mohr's Plant Life).

Prunus augustifolia Marsh.
Very common, old fields, roadsides (Old field plum.)

Prunus Caroliniana (Mill.) Ait.
Planted as an ornamental tree and sparingly escaped ("mock orange.")

Prunus gracilis Engelm.
Lee county, Baker & Earle (Mohr's Plant Life).

‡Prunus hortulana Bailey.
Frequent, rich clay woods, upland or creek bottoms. A large tree with loose, shelling bark.

Prunus injucunda Small.
Common, dry land, sand or clay. A small tree with close dark bark. (Southern sloe.)

Prunus serotina Ehrh.
Frequent, rich woods, clay or sand.

Prunus serotina neo-montana Sudw.
Clay county (Mohr's Plant Life).

Rosa humilis Marsh.
Common, dry woods and roadsides.

‡Rosa laevigata Michx.
Occasional, roadsides, introduced.

Rosa rubiginosa L.
Roadsides, Chambers county, introduced.

Rubus argutus Link.
Very common, creek bottoms, also uplands. Exceedingly variable, the common high bush blackberry.

Rubus argutus floridus (Tratt.) Bailey.
Occasional, dry uplands.

Rubus cuneifolius Pursh.
Very common, sandy uplands, the "old field" blackberry.

Rubus Enslenii Tratt.
Frequent, pine and mixed woods in shade.

Rubus invisus Bailey.
Frequent, rich woods and open places (dewberry).

Rubus trivialis Michx.
Common, roadsides and fields, evergreen dewberry. (Mohr's Plant Life credits *Rubus hispidus* to Lee county. This is certainly a mistake. The specimens so determined being forms of *R. trivialis.*)

MIMOSACEAE.

‡Albizzia Julibrissin Durazz.
Abundantly escaped, roadsides and woods. A good sized tree.

Morongia augustata (T. & G.) Britt.
Common, dry sandy woods.

CESALPINACEAE.

Cassia Marylandica L.
Occasional, fields and roadsides, Clay county.

Cassia occidentalis L.
Very common, a weed in cultivated fields.

Cassia Tora L.
Very common, a weed in cultivated fields.

Cercis Canadensis L.
Occasional, rich woods.

Chamaecrista multipinnata (Pollard) Greene.
Common, moist or dryish woods and thickets.

†Chamaecrista nictitans (L.) Moench?
A single doubtful specimen, Clay county.

Chamaecrista robusta Pollard.
Common, moist woods and thickets, creek bottoms.

Gleditsia triacanthos L.
Occasional, rich woods.

PAPILIONACEAE.

Amorpha fruticosa L.
Banks of Tallapoosa, Elmore county.

Amorpha virgata Small.
Clay county (Mohr's Plant Life).

Apios Apios (L.) MacM.
Occasional, rich woods and thickets, usually clay.

Baptisia megacarpa Chapm.
Tallapoosa county (Mohr's Plant Life).

‡Bradburya Virginiana (L.) O. Kuntze.
Frequent, thickets, etc. usually sand.

Chrysaspis dubia (Sibth.) Greene.
Occasional, roadsides and waste places.

†Chrysaspis procumbens (L.) Desv.
Occasional; roadsides and waste places.

Clitoria Mariana L.
Common, dry woods.

Cracca spicata (Walt.) O. Kuntze.
Common, dry woods.

Cracca Virginiana L.
Common, dry woods.

‡Crotalaria Purshii D. C.
A single collection, dry pine woods, Auburn.

Crotalaria rotundifolia (Walt.) Poir.
Frequent, dry woods and open places.

Crotalaria sagittalis L.
Occasional, dry woods and open places.

Dolicholus erectus (Walt.) Vail.
Frequent, dry pine or mixed woods.

†Dolicholus simplicifolius (Walt.) Vail.
Frequent, sandy pine woods.

†Dolicholus tormentosus (L.) Vail.
Occasional, sandy pine woods.

Falcata Pitcheri (T. & G.) O. Kuntze.
Cleburne county (Mohr's Plant Life.)

Galactea volubilis (L.) Britt.
Common, dry woods and thickets.

Lespedeza capitata Michx.
Occasional, sandy open woods.

†Lespedeza frutescens (L.) Britt.
Common, dry open woods.

Lespedeza hirta (L.) Ell.
Common, dry open woods.

Lespedeza Nuttallii Darl.
A single collection, Auburn.

Lespedeza procumbens Michx.
Common, dry open woods.

Lespedeza repens (L.) Bart.
Common, dry open woods.

Lespedeza striata (Thunb.) H. & A.
Common, old fields, roadsides and waste places (Japan clover).

*Lespedeza Stuvei Nutt.
Common, dry open woods.

Lespedeza Virginica (L.) Britt.
Common, dry open woods.

‡Medicago Arabica All.
Sparingly introduced, fields and roadsides (Bur clover.)

Meibomia arenicola Vail.
Frequent, dry sandy or rocky woods.

*Meibomia Dillenii (Darl.) O. Kuntze.
Common, fields and open woods.

Meibomia grandiflora (Walt.) O. Kuntze.
Rich woods, Coosa county. Not seen at Auburn.

Meibomia laevigata (Nutt.) O. Kuntze.
Common, rich shady woods.

†Meibomia Marylandica (L.) O. Kuntze.
Occasional, moist woods.

Meibomia Michauxii Vail.
Frequent, dry woods, usually on rocky hillsides.

Meibomia nudiflora (L.) O. Kuntze.
Occasional, moist rich woods, usually clay.

Meibomia obtusa (Muhl.) Vail.
Frequent, dry sandy woods.

Meibomia paniculata (L.) O. Kuntze.
Common, moist to dry woods.

*Meibomia paniculata Chapmani Britt.
Frequent, moist to dry woods.

*Meibomia paniculata pubens (T. & G.) Vail.
Occasional, dry woods.

†Meibomia rhombifolia (Ell.) Vail.
Frequent, dry woods.

Meibomia rigida (Ell.) O. Kuntze.
Occasional, dry woods.

‡Meibomia stricta (Pursh) O. Kuntze.
Occasional, sandy woods and roadsides.

‡Meibomia viridiflora (L.) O. Kuntze.
Occasional, pine or mixed woods.

Melilotus alba Desv.
Sparingly introduced, roadsides.

Phaseolus polystachyus (L.) B. S. P.
Occasional, rich woods.

Psoralea pedunculata (Mill.) Vail.
Common, pine or mixed woods.

Robinia hispida L.
Clay county (Mohr's Plant Life).

Robinia Pseudacacia L. ?
Rare, a shrub in dry woods (Wright's Mill).

‡Sesban macrocarpa Muhl.
Introduced, an occasional weed in sandy fields.

Strophostyles umbellata (Muhl.) Britton.
Frequent, dry open places.

Stylosanthes biflora (L.) B. S. P.
Frequent, dry woods and open places.

Stylosanthes riparia Kearney.
Frequent, woods and banks.

‡Trifolium Carolinianum Michx.
Common, roadsides and grassy places.

Trifolium pratense L.
Sparingly introduced, streets of Auburn.

Trifolium reflexum L.

Occasional, dry woods, often in rocky places.

Trifolium repens L.

Sparinginly introduced, streets and roadsides.

Vicia Hugeri Small.

Frequent, rich mixed woods. (*V. micrantha* Nutt in credited to Lee county, Mohr's Plant Life. This is an error, the plant being a narrow leaved form of V. *Hugeri.*)

Vicia sativa L.

Introduced, streets of Auburn.

Geraniaceae.

Geranium Caroliniaum L.

Common, fields and waste places.

Geranium maculatum L.

Occasional, swampy woods.

Oxalidaceae.

Oxalis recurva Ell.

Very common, dry pine and mixed woods, (*Oxalis cymosa* and *O. grandis* are both credited to Lee county, Mohr's Plant Life. Probably in each case this is an error.)

Oxalis stricta L.

Very common, fields and waste places.

Oxalis violacea L.

Common, dry open woods and rocky hillsides.

Linaceae.

Linum Floridanum (Planch.) Trelease.

Occasional, open sandy places.

Linum striatum Walt.

Occasional, moist woods, usually clay.

Rutaceae.

†Ptelea trifoliata L.

Occasional, river banks, Tallapoosa county, Clay county.

SIMAROUBACEAE.

Ailanthus glandulosa Desf.
Occasional, roadsides, etc., introduced.

MELIACEAE.

‡Melia Azederach L.
Abundant, roadsides, fence rows and old fields, introduced.

POLYGALACEAE.

Polygala ambigua Nutt.
Frequent, dry woods, Clay county, Tallapoosa county.

Polygala Boykini Nutt.
A single collection, Clay county. (Not Lee county, as stated in Mohr's Plant Life.)

Polygala cruciata L.
Occasional, sandy swamps.

Polygala Curtissii A. Gray.
Occasional, pine woods, Lee county, Clay county.

‡Polygala grandiflora Walt.
Frequent, dry pine and mixed woods.

Polygala incarnata L.
Occasional, dry pine and mixed woods.

Polygala Mariana Mill.
A single collection, Auburn.

‡Polygala nana (Michx.) D C.
Occasional, sandy land south of Auburn.

Polygala Nuttallii T. & G.
A single collection, Auburn.

Polygala polygama Walt.
Frequent, rich woods, usually clay.

Polygala verticillata L.
A single collection, Auburn. (S. M. Tracy.)

EUPHORBIACEAE.

Acalypha gracilens A. Gray.
Common, dry woods.

‡Acalypha ostryaefolia Riddell.
Occasional, fields and gardens.

Acalypha Virginica L.
One collection, Clay county, one Lee county.

Croton glandulosus septentrionalis Muell. Arg.
Occasional, roadsides and waste places.

Croton Texensis (Klotsch.) Muell. Agr.
Tallapoosa county (Mohr's Plant Life.)

Crotonopsis linearis Michx.
Frequent, dry roadsides and granite outcrops.

*Euphorbia apocynifolia Small.
Common, moist woods.

Euphorbia corollata L.
Common, dry woods.

*Euphorbia corollata paniculata Ell.
Common, dry woods.

Euphorbia maculata L.
Common, dry fields and waste places.

*Euphorbia olivacea Small.
Occasional, dry woods.

Euphorbia Preslii Guss.
Common, cultivated fields.

‡Jatropha stimulosa Michx.
Frequent, dry open woods, usually sand.

‡Stillingia ligustrina Michx.
Banks of Tallapoosa river, Tallapoosa county.

‡Stillingia sylvatica L.
Common, dry sandy land.

Tragia nepetaefolia Cav.
Frequent, rocky turned out fields.

‡Tragia urens L.
Occasional, dry open places.

CALLITRICACEAE.

Callitriche Austini Engelm.
Frequent, bare ground in old fields.

Callitriche heterophylla Pursh.
Frequent, floating in running water.

ANACARDIACEAE.

Rhus aromatica Ait.
Clay county (Mohr's Plant Life).

Rhus copallina L.
Common and variable, poor to rich soil, clay or sand.

Rhus glabra L.
Frequent, rich woods and thickets.

Rhus radicans L.
Common, a high climbing vine, (poison ivy, poison oak).

Rhus Toxicodendron L.
Frequent, dry rocky or sandy hills, a low shrub.

Rhus vernix L.
Frequent, sandy swamps, (Thunderwood).

CYRILLACEAE.

‡Cyrilla racemiflora L.
Frequent, creek bottom swamps, sand or clay.

AQUIFOLIACEAE.

*Ilex Beadlei Ashe.
Occasional, dry sand hills, south of Auburn.

Ilex decidua Walt.
Occasional, moist thickets.

‡Ilex glabra (L.) A. Gray. 1.
Frequent, sandy swamps.

‡Ilex glabra (L.) A. Gray. 2.
Occasional, banks of streams, clay land.

Ilex opaca Ait.
Common, moist to dry woods, usually sand.

Ilex monticola mollis (A. Gray) Britt.
A single collection, south of Auburn, sandy swamp.

CELASTRACEAE.

Euonymus Americanus L.
Frequent, moist thickets.

1. Mohr's Plant Life, 604, credits *Ilex coreacea* (Pursh) Chap. to Lee county . This seems to be an error. The specimens cited prove to be a broad leaved form of *I. glabra*.

ACERACEAE.

‡Acer Floridanum (Chapm.) Pax.
Occasional, moist creek banks (Wright's Mill).

Acer leucoderme Small.
Frequent, moist rocky banks, etc., not in swamps.

†Acer Negundo L.
Local, Wright's Mill. Lee county.

Acer rubrum L.
Common, swamps.

Acer saccharum barbatum (Michx.) Trelease.
Clay county (Mohr's Plant Life).

HIPPOCASTANACEAE.

Aesculus parviflora Walt.
Occasional, northern edge of Lee county and northward, clay.

Aesculus Pavia L.
Common. dry woods.

BALSAMMACEAE.

Impatiens biflora Walt.
Frequent, swamps. clay land.

SAPPINDACEAE.

Cardiospermum halicacabum L.
Clay county (Mohr's Plant Life).

RHAMNACEAE.

‡Berchemia scandens (Hill) Trelease.
Frequent, moist thickets.

Ceanothus Americanus L.
Common, dry woods.

Rhamnus Caroliniana Walt.
Clay county (Mohr's Plant Life).

‡Ampelopsis arborea (L.) Rusby.
Occasional, south of Aubcrn (Wright's Mill).

Parthenocissus quinquefolia (L.) Planch.
Frequent, moist woods and thickets.

Vitis aestivalis Michx.
Frequent, dry or moist woods.

Vitis bicolor LeConte.
Clay county (Mohr's Plant Life).

Vitis cordifolia Michx.
Frequent, uplands, usually clay.

Vitis rotundifolia Michx.
Common, moist woods, creek bottoms, etc.

TILIACEAE.

Tilia heterophylla Vent.
Occasional, creek banks.

MALVACEAE.

Malvastrum angustum A. Gray.
Tallapoosa county (Mohr's Plant Life).

‡Modiola Caroliniana (L.) Don.
Frequent, roadsides and waste places.

‡Sida Elliottii T. & G.
Frequent roadsides, Tallassee; also Lee county, sandy land.
land.

Sida spinosa L.
Common, gardens and cultivated fields.

HYPERICACEAE.

‡Ascyrum hypericoides L.
Occasional, dry woods.

Ascyrum multicaule Michx.
Frequent, dry woods.

Ascyrum stans Michx.
Occasional, dry woods.

Hypericum Drummondii (Grev. & Hook.) T. & G.
Common, dry open places, roadsides, old fields, etc.

Hypericum maculatum Walt.
Frequent, rich woods.

Hypericum mutilum L.
Common, ditch banks, open moist places.

*Hypericum nudiflorum Michx.
A single collection, Auburn.

*Hypericum virgatum Lam.
Occasional, creek banks, Lee county, Clay county.

Sarothra gentianoides L.
Common, dry open places, roadsides, old fields, etc.

‡Triadenum petiolatum (Walt.) Britt.
A single collection, Tallapoosa county.

‡Triadenum Virginicum (L.) Raf.
A single collection, sandy land south of Auburn.

CISTACEAE.

‡Helianthemum Carolinianum Michx.
Occasional, dry open places, sandy land.

Lechea Leggettii Britt. & Hollick.
Frequent, sandy lands.

Lechea racemulosa Michx.
Occasional, dry open places.

Lechea villosa Ell.
Common, dry open places, roadsides, old fields etc.,

VIOLACEAE.

Cubelium concolor (Forst.) Raf.
Rich woods, Clay county.

‡Viola Caroliniana Greene.
Common, sandy woods and open grassy places.

*Viola cucullata Ait.
A single collection, river hills, Tallapoosa county.

Viola multicaulis (T. & G.) Britt.
Occasional, moist upland woods, clay.

Viola palmata dilatata Ell.
Frequent, rich upland woods.

Viola papilionacea Pursh.
Common, creek bottoms and moist ditch banks.

Viola pedata L.
Common, dry upland woods, clay or sand.

Viola pedata bicolor Pursh.
Occasional, with the last.

‡Viola primulaefolia australis Pollard.
Locally common, open marshy places, Lee county, Tallapoosa county.

Viola Rafinesquii Greene.
Very common, fields and waste places.

Viola striata Ait.
Clay county (Mohr's Plant Life).

‡Viola vicinalis Greene.
Frequent, open sandy woods, not found on clay.

Viola villosa Walt.
Rare, dry pine woods, Auburn.

PASSIFLORACEAE.

Passiflora incarnata L.
Common, a troublesome weed in fields, especially clay. A white flowered form is occasionally seen.

Passiflora lutea L.
Occasional, dry thickets.

CACTACEAE.

Opuntia humifusa Raf.
Frequent, roadsides and sandy land.

LYTHRACEAE.

‡Lagerstroemia Indica L.
Frequent, roadsides escaped, (Crape myrtle.)

Rotala ramosior (L.) Koehne.
A single collection, Clay county.

MELASTOMACEAE.

‡Rhexia ciliosa Michx.
A single collection, south of Auburn.

Rhexia lanceolata Walt.
Occasional, wet sandy places.

Rhexia Mariana L.
Frequent, wet sandy places.

‡Rhexia stricta Pursh.
A single collection, Auburn. (P. H. Mell.)

Rhexia Virginica L.
Frequent, wet sandy places, also on clay.

ONAGRACEAE.

Epilobium coloratum Muhl.
Cleburne county (Mohr's Plant Life).

Gaura Michauxii Spach.
Frequent, dry woods and roadsides.

‡Hartmannia speciosa (Nutt.) Small.
Common, roadsides escaped.

Isnardia palustris L.
Occasional, ditches and running streams.

Jussiaea decurrens (Walt.) D. C.
Frequent, ditches and wet open places.

Jussiaea leptocarpa Nutt.
Frequent, ditches and wet open places.

‡Kneiffia linearis (Michx.) Spach.
A single collection, Chilton county.

*Kneiffia linifolia (Nutt.) Spach.
A single collection, Lee county.

*Kneiffia longipedicellata Small.
Common, dry open mixed woods, also in second growth woods, clay or sand.

*Kneiffia subglobosa Small.
Frequent, moist open sandy places.

Ludwigia alternifolia L.
Common, wet places, clay or sand.

‡Ludwigia hirtella Raf.
Swampy margins of ponds, sandy land.

‡Ludwigia linearis Walt.
Frequent, wet places, sandy land.

‡Oenothera laciniata Hill.
Common, fields and roadsides, a winter weed.

Oenothera laciniata grandis Britt.
A single collection, fields near Auburn.

Onagra biennis (L.) Scop.
Common, fields and roadsides.

HALORAGIDACEAE.

Myriophyllum sp.
Immature plants from a stream south of Auburn.

Proserpinaca pectinata Lam.
A single collection, roadside ditches, sandy land.

ARALIACEAE.

Aralia spinosa L.
Frequent, rich woods and thickets.

UMBELLIFERAE.

Angelica villosa (Walt.) B. S. P.
Frequent, dry pine and mixed woods, clay or sand.

Chaerophyllum Tainturieri Hook.
Common, a street and roadside weed, also in sandy swamps.

Centella Asiatica (L.) Urban.
Lee county (S. M. Tracy.) Specimen in herb. New York Bot. Garden.

*Cicuta maculata L.
Common, swamps, etc.

‡Daucus pusillus Michx.
Frequent, fields, roadsides and waste places

Deringa Canadensis (L.) O. Kuntze.
Rich woods, Clay county, Coosa county.

‡Hydrocotyle verticellata Thurnb.
Frequent, shaded thickets, clay or land.

Eryngium yuccaefolium Michx.
Common, dry woods and fields.

Oxypolis rigidus (L.) Raf .
Frequent, sandy swamps.

†Ligusticum Canadense (L.) Britt.
Frequent, open marshy places.

1. This is included under *E. integrifolum* Walt. in Mohr's Plant Life, 644, but it seems to differ from the pine-barren plant in more diffuse habit and broader leaves.

Oxypolis rigidus (L.) Britt.

Frequent, open marshy places.

Polytaenia Nuttallii D. C.

Lee county. Baker & Earle) (Mohr's Plant Life).

‡Ptilimnium capillaceum (Michx.) Hollick.

Common, sandy swamps.

Sanicula Canadensis L.

Common, moist to rather dry woods.

*Sanicula Floridana Bicknell. 1.

Frequent, dry upland woods.

Sanicula Marylandica L.

Occasional, moist woods.

Sanicula Smallii Bicknell.

Frequent, creek bottom woods.

Thaspium barbinode (Michx.) Nutt.

Occasional, moist thickets, etc

Thaspium trifoliatum aureum (Nutt.) Britt.

Occasional, creek bottom woods.

*Zizia aurea (L.) Koch.

A single collection, Clay county.

Zizia cordata (Walt.) D C.

Frequent, upland woods, sand or clay.

CORNACEAE.

Cornus Amomum Mill.

Common, along streams.

Cornus stricta Lam.

Lee county Earle & Baker (Mohr's Plant Life).

Cornus florida L.

Common, upland woods, clay or sand.

‡Nyssa biflora Walt.

Common, swamps.

1. Mohr's Plant Life, 645, includes this *with S. Canadensis.* The two seem sufficiently distinct. The shape of the leaves and the general aspect are so different that they can be distinguished at a glance.

Nyssa sylvatica Marsh.
Common, upland woods, usually clay.

PYROLACEAE.

†Chimaphila maculata (L.) Pursh.
Occasional, dry pine woods.

MONOTROPACEAE.

Monotropa uniflora L.
Occasional, rich woods.

ERICACEAE

Azalea arborescens Pursh.
Rare, along streams, clay land

Azalea nudiflora L.
Common, rich woods.

Azalea viscosa L.
Common, swamps, variable.

Azalea viscosa glauca (L.) Michx.
Lee county, Earle & Underwood (Mohr's Plant Life).

Bathodedron arboreum (Marsh.) Nutt.
Common, dry woods (Vaccinum Arboreum Marsh.)

Epigaea repens L.
Rare, dry hillsides, Lee county, Tallapoosa county.

Gaylussacia dumosa (Andr.) T. & G.
Common, dry hillsides.

Gaylussacia frondosa (L.) T. & G.
Frequent, dry rocky hillsides.

*Gaylussacia nana (A. Gray) Small.
Frequent, dry rocky hills.

Kalmia latifolia L.
Common, along streams.

†Leucothoë racemosa (L.) A. Gray.
Border of ponds, sandy land.

Oxydendron arboreum (L.) D C.
Frequent, dry or moist woods.

‡Pieris nitida (Bartr.) B. & H.
Frequent, sandy swamps.

Polycodium melanocarpum (Mohr) Greene.
Occasional, dry upland woods.

Polycodium melanocarpum candicans (Mohr).
Occasional, dry upland woods.

Polycodium stamineum (L.) Greene.
Frequent, dry woods.

*Rhododendron punctatum Andr.
A single collection, river hills, Tallapoosa county.

‡Vaccinium amoenum Ait.
Occasional, dry hillsides.

Vaccinium corymbosum L.
Occasional, open woods.

Vaccinius Elliottii Chapm.
Common, banks of streams.

‡Vaccinium fuscatum Ait.
Common, sphagnum bogs.

Vaccinium Myrsinites Lam.
Common, dry rocky hills.

Vaccinium Myrsinites glaucum A. Gray.
Occasional, with the type.

Vaccinium tenellum Ait.
Occasional, moist hillsides.

Vaccinium vacillans Kalm.
Frequent, dry rocky hills.

‡Vaccinium virgatum Ait.
Occasional, banks of streams.

Xolisma ligustrina (L.) Britt.
Frequent, moist woods, banks of streams.

PRIMULACEAE.

†Lysimachia quadrifolia L.
A single collection, Talladega county.

Samolus floribundus H. B. K.
Frequent, swamps.

Steironema ciliatum (L.) Raf.
Frequent, moist woods.

Steironema lanceolatum (Walt.) A. Gray.
Occasional, moist woods.

Steironema lanceolatum augustifolum A. Gray.
Lee county. (Earle & Baker) (Mohr's Plant Life).

*Steironema quadriflorum (Sims) A. S. Hitchcock.
A single collection, moist woods, Auburn, clay land.

Steironema tonsum (Wood) Bicknell.
A single collection, Clay county.

EBENACEAE.

Diospyros Virginiana L.
Common, dry woods (=Vaccinum Arboreum Marsh.)

SIMPLOCACEAE.

Symplocos tinctoria (L.) L'Her.
Frequent, moist hillsides and along streams.

STYRACEAE.

Mohrodendron Carolinum (L.) Britt.
Common, along streams.

†Mohrodendron dipterum (Ell.) Britt.
Banks of Tallapoosa river, Elmore county, Tallapoosa county.

Styrax Americana Lam.
Common, along streams.

Styrax grandifloria Ait.
Rare, upland woods, clay land.

OLEACEAE.

Chionanthus Virginica L.
Occasional, moist woods and along streams.

Fraxinus lanceolata Borck.
Occasional, creek and river bottoms.

†Osmanthus Americanus (L.) B. & H.
Frequent, along streams and moist hillsides.

LOGANIACEAE.

*Buddleia Japonica Hemsl.
Sparingly escaped, roadsides.

Gelsemium sempervirens (L.) Ait.
Frequent, climbing over trees in moist or dry thickets, sand or clay (Yellow jasmine.)

Polypremum procumbens L.
Common, dry field and waste places.

Spigelia Marylandica L.
Frequent, rich, shady woods.

GENTIANACEAE.

Bartonia Virginica (L.) B. S. P.
Rare, sphagnum swamps.

†Gentiana Saponaria L.
Frequent, along creek banks.

Gentiana villosa L.
Occasional, dry woods, usually clay.

Sabbatia angularis (L.) Pursh.
Occasional, dry rich woods, usually clay.

Sabbatia Boykinii A. Gray.
Rare, dry woods, Clay county, Coosa county.

MENYANTHACEAE.

‡Linmanthemum lacunosum (Vent.) Griseb.
Ponds south of Auburn.

APOCYNACEAE.

Amsonia Amsonia (L.) Britt.
Frequent, creek bottom woods.

Apocynum cannabinum L.
Rare, sandy fields, south of Auburn.

ASCEPIADACEAE.

‡Asclepias amplexicaulis Michx.
Occasional, dry sand hills south of Auburn, never in clay.

Asclepias obtusifolia Michx.
Occasional, thin upland woods, clay or sand.

Asclepias tuberosa L.
Common, dry woods and roadsides.

Asclepias variegata L.
Frequent, dry woods and roadsides, sand or clay.

Asclepias verticillata L.
Frequent, dry woods and roadsides, sand or clay.

Vincetoxicum hirsutum (Michx.) Britt.
Occasional, rich woods, usually clay.

CONVOLVULACEAE.

‡Breweria humistrata (Walt.) A Gray.
Frequent, dry sandy pine woods.

‡Convolvulus repens L.
Frequent, dry woods, sand or clay.

Ipomoea barbigera (Don.) Sweet.
Common, upland fields.

Ipomoea hederacea Jacq.
Lee county, Earle (Mohr's Plant Life).

Ipomoea lacunosa L.
Occasional, creek bottom fields.

Ipomoea pandurata (L.) Meyer.
Frequent, dry woods and roadsides.

Ipomoea purpurea (L.) Roth.
Lee county, Earle (Mohr's Plant Life).

‡Jacquemontia tamnifolia (L.) Griseb.
Common, a weed in fields.

†Quamoclit coccinea (L.) Moench.
Occasional, cultivated fields.

CUSCUTACEAE.

Cuscuta arvensis Beryrich.
Lee county, Earle (Mohr's Plant Life).

Cuscuta sp.
Other species occur, but the specimens have not been determined.

POLEMONIACEAE.

Phlox amoena Sims.
Frequent, dry pine and mixed woods.

Phlox glaberrima L.
Frequent, dry mixed woods.

Phlox maculata L.
Occasional, upland woods.

Phlox paniculata L.
A single collection, Coosa county.

Phlox paniculata acuminata (Pursh) Chapm.
Lee county, Baker & Earle (Mohr's Plant Life).

Phlox pilosa L.
Frequent, moist mixed woods.

HYDROPHYLLACEAE.

‡Nana quadrivalvis (Walt.) O. Kuntze.
Margin of pond south of Auburn.

Phacelia dubia (L.) Small.
Locally abundant, dry granite outcrops.

BORAGINACEAE.

Heliotropium Indicum L.
Occasional, roadsides and waste places.

Lappula Virginica (L.) Greene.
Occasional, moist woods, clay land.

Collinsonia scabriuscula Ait.
Occasional, open grassy places.

Onosmodium Carolinianum (Lam.) A. D C.
Occasional, dry sandy fields and open woods.

VERBENACEAE.

Callicarpa Americana L.
Common, dry woods, sand or clay. A form with white fruit occurs.

Verbena bracteosa Michx.
Occasional, roadsides and waste places.

‡Verbena Caroliniana Michx.
Frequent, dry sandy woods.

*Vitex Agnus-castus L.
Freely escaped, roadsides, etc.

1. Immature specimens of this plant were determined as Myosotis Virginica and were so reported in Mohr's Plant Life, 691. The true M. Virginica has not so far been found.

Labiatae.

†Blephila ciliata (L.) Raf.
Frequent, dry hillsides, clay land.

†Clinopodium Nepeta (L.) O. Kuntze.
A single collection, Clay county.

Clinopodium Carolinianum (Michx.) Heller.
Locally common, dry sandy flats, banks of Tallapoosa river, Tallapoosa county.

Collinsonia anisata Pursh.
Common, dry pine and mixed woods.

*Collinsonia Canadensis punctata A Gray.
A single collection, swamp south of Auburn.

Collinsonia scabriuscula Ait.
Opelika, Lee county (Mohr's Plant Life).

Hedeoma pulegioides (L.) Pers.
Tallapoosa county, Clay county, not found at Auburn.

‡Koellia albescens (T. & G.) O. Kuntze.
A single collection, Clay county.

Koellia flexuosa (Walt.) Mac M.
Occasional, moist open places.

*Koellia incana (L.) O. Kuntze.
Common, dry open woods.

Koellia pycnanthemoides (Leavenw.) O. Kuntze.
Common, dry open woods.

Lamium amplexicaule L.
Common, fields and gardens, a Winter weed.

Lycopus Virginicus L.
Common, wet swampy thickets.

Mentha piperata L.
Spring branches, Tallapoosa county.

‡Mesosphaerum rugosum (L.) Pollard.
Frequent, sandy swamps.

*Monarda mollis L.
Frequent, Clay county, not seen at Auburn.

Monarda punctata L.
Frequent, dry thickets.

Nepeta cataria L.
Clay county (Mohr's Plant Life).

Prunella vulgaris L.
Frequent, moist places.

Salvia azurea Lam.
Frequent, open sandy places, roadsides, etc.

Salvia lyrata L.
Common, dry or moist woods.

Salvia urticifolia L.
Frequent, dry open woods.

Scutellaria cordifolia Muhl.
Occasional, mixed woods, clay land.

Scutellaria integrifolia major Chapm.
Frequent, moist creek bottoms, usually sandy land.

*Scutellaria hyssopifolia L.
A single collection, Auburn.

Scutellaria laterifolia L.
A single collection, Auburn.

Scutellaria pilosa Michx.
Frequent, dry mixed woods.

*Scutellaria venosa Kearney.
Collected once, Tallapoosa county.

Trichostema dichotomum L.
Frequent, Clay county, not seen at Auburn.

‡Trichostema lineare Nutt.
Frequent, open sandy woods.

SOLANACEAE.

Datura Tatula L.
Common, barnyards and rich gardens.

Physalis angulata L.
Occasional, gardens and fields.

*Physalis ———
Occasional. This is a striking species, the plant covered with long whitish hairs. Dr. Rydberg considers it new and will soon publish a description. An unnamed fragment of the same thing collected by Dr. Chapman is in the Columbia University herbarium.

Physalis Virginiana Mill.
Frequent, dry open woods, clay or sand.

Physalodes Physalodes (L.) Britt.
Occasional, gardens and rich fields.

Solanum Carolinense L.
Common, fields and gardens.

Solanum nigrum L.
Common, rich fields and gardens.

Solanum pseudocapsicum L.
Occasional, roadsides.

SCROPHULARIACEAE.

‡Afzelia cassinoides (Walt.) Gmel.
A single collection Clay county.

Afzelia pectinata (Pursh) O. Kuntze.
Frequent, dry pine or mixed woods.

Buchnera Americana L.
Rare, moist open places.

Chelone glabra L.
Rare, moist thickets.

*Dasystoma bignoniflora Small.
A single collection, Clay county.

Dasystoma flava (L.) Wood.
Frequent, dry woods.

Dasystoma pectinata (Nutt.) Benth.
Lee county, Baker & Earle (Mohr's Plant Life).

Dasystoma laevigata (Raf.) Chapm.
Frequent, dry woods.

†Dasystoma Virginica (L.) Britt.
Frequent, rich woods.

*Gerardia microphylla (A. Gray) Small.
Occasional, sandy pine woods.

Gerardia Plukenetii Ell.
Frequent, dry upland woods, clay or sand.

Gerardia purpurea L.
Occasional, wet swampy places.

Frequent, dry woods.

Gratiola Floridana Nutt.
Locally abundant, swamps. Lee county, Tallapoosa county.

‡Gratiola pilosa Michx.
Frequent, moist open places.

‡Gratiola sphaerocarpa Ell.
Frequent, boggy places.

Ilysanthes attenuata (Muhl.) Small.
A single collection, bank of pond south of Auburn.

†Ilysanthes refracta (Ell.) Benth.
Occasional, moist granite outcrops.

Linaria Canadensis (L.) Dumort.
Common, fields and gardens.

‡Micranthemum emarginatum Ell.
A single collection, border of pond south of Auburn.

*Mimulus ringens. L
Frequent, wet ditch banks, etc., clay land.

Monniera acuminata (Walt.) O. Kuntze.
Frequent, wet, swampy woods.

Pedicularis Canadensis L.
Occasional, moist pine or mixed woods.

Penstemon hirsutus (L.) Willd.
Common, dry woods.

Scrophularia Marylandica L.
Infrequent, the only collection from Coosa county.

Verbascum Blattaria L.
Rare about Auburn, becoming common farther north.

Verbascum Thapsus L.
Occasional, roadsides and waste places.

‡Veronica arvensis L.
Occasional, fields and waste places.

Veronica peregrina L.
Frequent, fields and waste places.

LENTIBULARIACEAE.

†Utricularia fibrosa Walt.
In mud border of pond south of Auburn ,

‡Utricularia subulata L.
Frepuent, sandy swamps.

Orobranchaceae.

†Conopholis Americana (L.) Walt.
Frequent, moist woods, growing on oak, beech and sweet gum roots.

†Leplamnium Virginianum (L.) Raf.
Frequent, moist woods.

†Thalesia uniflora (L.) Britt.
Rare, mixed woods.

Bignoniaceae.

Bignonia crucigera L.
Frequent, along streams.

Campsis radicans (L.) Seem.
(=Tecoma radicans D C.)
Common, thickets, roadsides and fields.

Catalpa Catalpa (L.) Karst.
Occasional, along streams.

Acanthaceae.

Dianthera Americana L.
Frequent, in running streams.

Ruellia ciliosa hybrida (Pursh) A. Gray.
Lee county, Baker & Earle (Mohr's Plant Life).

Ruellia ciliosa parviflora (Nees) Britt.
Occasional, roadsides and mixed woods, clay land, also on granite outcrops.

Ruellia strepens L.
Clay county (Mohr's Plant Life).

Plantaginaceae.

Plantago aristata Michx.
Common, roadsides and waste places.

*Plantago elongata Pursh.
Collected once, creek bottom pasture, Auburn.

Plantago heterophylla Nutt.
Common, fields and waste places.

Plantago lanceolata L.
Occasional, roadsides and grassy places.

Plantago Rugelii Dce.
Occcasional, moist pastures and roadsides.

Plantago Virginica L.
Common, fields, pastures and waste places.

RUBIACEAE.

Cephalanthus occidentalis L.
Common, swamps and moist thickets.

Diodia teres Walt.
Very common, old fields, roadsides, etc.

Diodia Virginiana L.
Common, ditch banks and wet fields.

Galium aparine L.
Occasional, gardens and moist places.

Galium circaezans Michx.
Collected once, Auburn, not typical.

*Galium Claytoni Michx.
Collected once, shaded spring bog, Auburn.

Galium pilosum Ait.
Frequent, pine and mixed woods.

‡Galium pilosum puncticulosum (Michx.) T. & G.
Frequent, dry pine woods.

‡Galium uniflorum Michx.
Collected once, moist, rich woods, Auburn.

*Galium tinctorium L.
Occasional, moist woods.

†Galium triflorum Michx.
Occasional, rich woods, Lee county, Clay county.

Houstonia calycosa (Shuttly.) Mohr.
Tallapoosa county (Mohr's Plant Life).

Houstonia coerulea L.
Common, open pine and mixed woods.

Houstonia longifolia Gaertn.
Occasional, moist, rocky banks.

‡Houstonia minor (Michx.) Britt.
Common, pastures and open places.

Houstonia purpurea L.
Common, rich woods, usually on clay.

Houstonia tenuifolia Nutt.
Frequent, dry open, diciduous woods clay land.

Mitchella repens L.
Common, moist creek banks and sandy swamps.

‡Oldenlandia uniflora L.
Frequent, borders of sphagnum swamps.

‡Richardia scabra L.
Common, sandy cultivated fields, Lee county, Elmore county.

CAPRIFOLIACEAE.

Lonicera flava Sims.
Clay county (Mohr's Plant Life).

Lonicera Japonica Thunb.
Abundantly escaped roadsides, fields and thickets.

Lonicera sempervirens L.
Frequent, climbing in moist thickets.

Sambucus Canadensis L.
Common, thickets and roadsides.

†Symphoricarpus Symphoricarpus (L.) MacM.
Collected once, Clay county.

Viburnum acerifolium L.
Clay county (Mohr's Plant Life).

Viburnum nudum L.
Common, sandy swamps.

Viburnum rufotomentosum Small.
Occasional, moist or dry open woods.

VALERIANACEAE.

Valerianella radiata (L.) Dufr.
Common, creek bottom fields.

CAMPANULACEAE.

Campanula Americana L.
Collected once, Coosa county.

Campanula divaricata Michx.
Frequent, granite ledges Lee county, Tallapoosa county.

‡Specularia biflora (R. & P.) A. Gray.
Common sandy pastures and roadsides.

Specularia perfoliata (L.) A. DC.
Common, fields and roadsides.

LOBELIACEAE.

Lobelia amoena Michx.
Frequent, sandy swamps.

Lobelia cardinalis L.
Frequent, swampy creek bottoms, often on clay.

Lobelia inflata L.
Creek bottoms, Clay county, rare at Auburn.

Lobelia leptostachys A. D C.
Clay county (Mohr's Plant Life).

Lobelia Nuttallii Roem. & Schult.
Clay county (Mohr's Plant Life).

Lobelia puberula Michx.
Common, open woods, often near streams.

Lobelia spicata Lam.
Dry woods, Elmore county Coosa county Clay, county **not** seen at Auburn.

Lobelia syphilitica L.
Clay county (Mohr's Plant Life).

CHICORIACEAE.

Adopogon Carolinianum (Walt.) Britt.
Common, fields, roadsides and waste places.

Hieracium Greenii Porter & Britt.
Lee county. (Baker & Earle.) Mohr's Plant Life.)

Hieracium Gronovii L.
Frequent, dry pine and mixed woods.

Hieracium Marianum Willd.
Occasional, dry hillsides.

Hieracium Scribneri Small.
Tallapoosa county (Mohr's Plant Life).

Hieracium venosum L.
Common, dry rocky wooded hillsides.

Lactuca Canadensis L.
Common, pine woods and open places.

Lactuca Floridana (L.) Gaertn.
Collected once, Auburn.

Lactuca graminifolia Michx.
Occasional, sandy pine woods.

†Lactuca hirsuta Muhl.
Occasional, pine woods.

Lactuca sagittifolia Ell.
Clay county (Mohr's Plant Life).

‡Lactuca villosa Jueq.
Occasional, roadsides.

†Nabalus altissimus (L.) Hook.
Occasional, moist, rich woods, usually creek bottoms.

Nabalus Serpentaria (Pursh) Hook.
Frequent, moist, dry woods, often uplands.

*Nabulus trifoleatus Cass.
Collected once, Auburn, in a garden.

Serinea oppositifolia (Raf.) O. Kuntze.
Occasional, creek bottom fields.

Sitilias Caroliniana (Walt.) Raf.
Common, fields, roadsides and open places. A white flowered form occurs.

Sonchus asper (L.) All.
Frequent, fields and waste places.

CARDUACEAE.

‡Acanthospermum australe (L.) O. Kuntze.
Frequent, along railroad embankments.

Ambrosia artemisiaefolia L.
Common, fields, etc. (dog weed).

*Antennaria nemoralis Greene.
Frequent, dry rocky hillsides and granite outcrops.

Antennaria plantaginifolia (L.) Richards.
Lee county (Mohr's Plant Life).

Anthemis Cotula L.
Occasional, roadsides and waste places, usually not abundant.

Aster Camptosorus Small.
Common, shaded, rocky hillsides.

Aster concolor L.
Common, dry sandy roadsides and open woods.

†Aster divaricatus L.
Collected once, Clay county.

Aster dumosus L.
Occasional, borders of fields and thickets. ,

Aster ericoides L.
Common, swamps and waste places.

Aster ericoides platyphyllus T. & G.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Aster ericoides pilosus (Willd.) Porter.
Common, fields, roadsides and waste places.

*Aster hirsuticaulis Lindl.
Collected once, Auburn.

*Aster ianthinus Burgess.
Collected once, Auburn.

Aster laevis L.
Lee county Mohr's Plant Life).

Aster lateriflorus (L.) Britt.
Common, alder swamps, wet thickets and borders of fields.

Aster oblongiolius Nutt.
Lee county (Mohr's Plant Life).

Aster patens Ait.
Common, roadsides and dry woods, clay land.

Aster puniceus L.
Common, alder swamps and moist thickets.

‡Aster purpuratus Nees.
Frequent, clay roadsides.

Aster sagittifolius Willd.
Collected once, Auburn.

Aster Shortii Hook.
Rocky banks, Tallapoosa river, Elmore county.,

Aster Tradescanti L.
Frequent, moist, shady woods.

‡Aster dumosus cordifolius (Michx.) T. & G.
Very common, dry rocky hillsides. Exceedingly variable. Our collections probably include several of the named varieties.

Aster vimineus foliosus (Ait.) A. Gray.
Lee county (Mohr's Plant Life).

Aster undulatus L.
Common, cultivated fields and waste places.

Bidens frondosa L.
Common, fields and swampy places.

†Brauneria purpurea (L.) Britt.
Collected once, clay roadsides, Chambers county.

Carduus altissimus L.
Common, moist thickets, etc.

*Carduus discolor (Muhl.) Nutt.
Occasional, moist thickets and open woods.

Carduus lanceolatus L.
Clay county (Mohr's Plant Life.)

‡Carduus spinosissimus Walt.
Rare, open sandy land.

Carduus spinosissimus Elliotti (T. & G.) Porter.
Common, old fields, roadsides and open woods, mostly on clay. Worthy of specific rank, often reaches more than three feet in height.

Carduus Virginianus L.
Occasional, sandy roadsides.

‡Chrysogonum Virginicum L.
Occasional, deciduous woods, clay land.

Chysopsis graminifolia (Michx.) Nutt.
Very common, pine and mixed woods, especially on sand.

Chrysopsis Mariana (L.) Nutt.
Common, pine and mixed woods.

Cnicus benedictus L.
Collected once, railroad tracks, Auburn.

‡Coleosanthus cordifolius (Ell.) O. Kuntze.
Occasional, sandy woods and roadsides.

Coreopsis auriculata L.
Common, moist pine and mixed woods, clay or sand.

*Coreopsis bicolor.
Collected once, fields south of Auburn, escaped.

Coreopsis delphinifolia Lam.
Collected once, fields, Chambers County.

Coreopsis grandiflora Hogg.
Locally abundant, moist granite outcrops.

Coreopsis lanceolata L.
Frequent, open pine woods, usually sand.

Coreopsis major Walt.
Common, dry pine and mixed woods.

Coreopsis Oemleri Ell.
Frequent, dry-pine and mixed woods. It intergrades freely with the last species and can hardly be considered distinct.

Coreopsis pubescens Ell.
Collected once, Tallapoosa County.

Coreopsis tripteris L.
Occasional, ditch banks and margins of creek bottom fields, clay land.

Coreopsis verticillata L.
Lee county, (Mohr's Plant Life).

‡Doellingeria humilis (Willd.) Britt.
Occasional, creek bottom woods.

†Doellingeria infirma (Michx.) Greene.
Collected once, Lee County; once, Clay County.

Elephantopus Carolinianus Willd.
Frequent, creek bottom woods and thickets, clay or sand.

*Elephantopus elatus Bertol.
Collected once, Auburn; once Macon County.

Elephantopus nudatus A. Gray.
Common, shaded creek bottoms, sandy land.

Elephantopus tomentosus L.
Common, creek bottoms and dryer locations, in shade or exposed, clay or sand.

Erechtites hieracifolia (L.) Raf.
Frequent, rich newly-cleared fields and waste places.

Erigeron annuus (L.) Pers.
Occasional, moist creek bottom fields and waste places.

Erigeron Philadelphicus L.
Collected once, Auburn; moist woods, clay.

†Erigeron pulchellus Michx.
Frequent, rich woods.

†Erigeron ramosus (Walt.) B. S. P.
Common, fields roadsides and waste places.

Erigeron ramosus Beyrichii (F. & M.) Smith & Pound.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium ageratoides L.
Occasional, creek bottom swamps.

Eupatorium album L.
Common, dry woods, clay or sand.

Eupatorium amoenum Pursh.
Clay county, (Mohr's Plant Life.)

Eupatorium aromaticum L.
Common, dry pine and mixed woods.

Eupatorium capillifolium (Lam.) Small.
Very common, pastures, old fields, roadsides and waste places, usually in moist land.

‡Eupatorium coelestinum L.
Occasional, swamps.

Eupatorium compositifolium Walt.
Frequent, dry old fields and open woods.

Eupatorium cuneifolium Willd.
Frequent, dry sandy pine woods.

Eupatorium hyssopifolium L.
Occasional, dry sandy woods.

Eupatorium linearifolium Walt.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium perfoliatum L.
Common, swampy places, clay or sand.

*Eupatorium petaloideum Britt.
Collected once, Auburn.

Eupatorium pinnatifidum Ell.
Rare, dry open woods.

Eupatorium pubescens Muhl.
Lee count. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium purpureum L.
Common, creek bottoms and swamps, especially clay land.

Eupatorium rotundifolium L.
Common, creek bottoms, usually sandy land.

‡Eupatorium semiserratum D C.
Frequent, sandy pine woods.

Eupatorium serotinum Michx.
Occasional, moist roadsides and waste places.

Eupotorium Smithii Greene & Mohr.
Chambers County. (Mohr, Plant Life.)

*Eupatorium Torreyanum Short.
Clay roadsides, Chambers county.

‡Eupatorium tortifolium Chapm.
Frequent, dry sandy pine woods.

Eupatorium verbenaefolium Michx.
Common, swampy woods, sandy land.

‡Gaillardia lanceolata Michx.
Common, open sandy pine woods, etc.

†Gnaphalium Helller Britt.
Common, open pine and mixed woods.

Gnaphalium purpureum L.
Common, a winter weed in fields and waste places.

Gnaphalium obtusifolium L.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

†Gnaphalium Helleri Britt.
Collected once, banks of Tallapoosa river.

Helenium autumnale L.
Common, with the last.

‡Helenium Nuttallii A. Gray.
Frequent, alder swamps and creek bottoms.

‡Helenium tenuifolium Nutt.
Very common, fields, pastures and roadsides; (bitter weed.)

Helianthus angustifolius L.
Common, open swampy places.

Helianthus atrorubens L.
Occasional, roadsides and woods, clay land.

Helianthus divaricatus L.
Frequent, dry woods and roadsides.

Helianthus hirsutus Raf.
Frequent, dry woods and roadsides.

Helianthus hirsutus trachyphyllus T. & G.
Clay county. (Mohr's Plant Life.)

Helianthus microcephalus T. & G.
Common, dry woods and roadsides.

Helianthus Sweinitzii T. & G.
Lee County, (Mohr, Plant Life.)

Helianthus tomentosus Michx.
Frequent, rich mixed woods.

Heliopsis gracilis Nutt.
Occasional, moist upland woods.

Heliopsis helianthoides (L.) B. S. P.
Collected once, Tallapoosa County.

Ionactis linariifolia (L.) Greene.
Common, roadsides and open pine woods, sandy land.

Isopappus divaricatus (Nutt.) T. & G.
Very common, old fields, pastures and roadsides.

Kuhnia eupatorioides L.
Common, dry open woods, usually on sandy land.

*Lacinaria Earlei Greene.
Auburn. (F. S. Earle, 1896.)

‡Lacinaria elegans (Walt.) O. Kuntze.
Locally abundant, sandy pine woods, south of Auburn.

*Lacinaria elegantula Greene.
Auburn. (F. S. Earle, 1896.)

†Lacinaria graminifolia (Walt.) O. Kuntze.
Common, dry pine and mixed woods. A form with white flowers occurs.

†Lacinaria scariosa squarrulosa (Michx.) Small.
Collected once, Auburn.

‡Lacinaria spicata (L.) O. Kuntze.
Occasional, pine woods.

Lacinaria squarrosa (L.) Hill.
Occasional, dry woods.

Leptilon Canadense (L.) Britt.
Common, cultivated fields.

‡Mariana Mariana (L.) Hill.
Collected once, streets of Auburn.

Marshallia lanceolata Pursh.
Frequent, open pine and mixed woods.

Marshallia trinerva (Walt.) Porter.
Occasional, thickets along small streams.

Mesadenia atriplicifolia (L.) Raf.

Banks of Tallapoosa river, Tallapoosa county.

†Mesadenia ovata (Walt.)

Frequent, moist mixed woods.

†Mesadenia renifornis (Muhl.) Raf.

Collected once, Clay county.

Parthemium integrifolium L.

Clay county, Tallapoosa county, Lee county, (Mohr, Plant Life.)

†Pluchea foetida (L.) B. S. P.

Occasional, swamps and creek bottoms.

Pluchea petiolata Cass.

Common, creek bottoms and swamps.

Polymnia Canadensis L.

Clay county (Mohr's Plant Life.)

Polymnia Canadensis radiata A. Gray.

Top of Talladega mountains, Clay county.

Polymnia Uvedalia L.

Occasional, roadsides and moist open woods.

Rudbeckia fulgida Ait.

Frequent, moist upland woods.

Rudbeckia hirta L.

Common, dry open woods.

Rudbeckia laciniata L.

Frequent, creek bottoms and swamps.

Rudbeckia spathulata Michx.

Clay county, Talladega county, Lee county, (Mohr's Plant Life.)

Rudbeckia triloba L.

Collected once, northern Lee county.

Rudbeckia truncata Small.

Collected once, Auburn.

Senecio Earlei Small.

Very common, dry open woods and waste places.

Senecio lobatus Pers.

Very comon, creek bottoms.

Senecio Memmingeri Britt.

Lee county. (Underwood & Earle.) (Mohr's Plant Life.)

Senecio obovatus Muhl.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Senecio Smallii Britt.
Clay county, Tallapoosa county, Lee county, (Mohr's Plant

Sericocarpus asteroides (L.) B. S. P.
Common, dry pine and mixed woods.

Sericocarpus bifoliatus (Walt.) Porter.
Occasional, dry sandy pine woods.

Sericocarpus linifolius (L.) B. S. P.
Common, dry pine or mixed woods.

Silphium asperimum Hook.
Clay county. (Mohr's Plant Life.)

Silphium asteriscus L.
Common, upland woods, clay or sand.

Silphium compositum Michx.
Common, upland woods, clay or sand.

Silphium dentatum Ell.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Silphium laevigatum Pursh.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Silphium trifoliatum L.
Clay county (Mohr's Plant Life.)

†Solidago amplexicaulis T. & G.
Frequent, rocky hillsides, mixed woods.

Solidago arguta Ait.
Clay County. (Mohr, Plant Life.)

Solidago Boottii Hook.
Common, creek bottom woods.

Solidago brachyphylla Chap.
Lee county. (Earle.) (Mohrs' Plant Life.)

†Solidago caesia L.
Common, moist rich woods.

Solidago Canadensis L.
Very common, fields and waste places.

†Solidago erecta Pursh.
Frequent, dry sandy creek bottoms.

‡Solidago fistulosa Mill.
Collected once, Clay county.

Solidago neglecta T. & G.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Solidago nemoralis Ait.
Very common, dry roadsides, old fields and dry open second-growth woods.

Solidago odora Ait.
Very common, dry pine and mixed woods.

Solidago pallescens Mohr.
Common, dry rocky hillsides, mixed woods.

Solidago patula strictula T. & G.
Frequent, moist woods, creek bottoms, etc.

Solidago petiolaris Ait.
Common, sandy pine woods.

Solidago rugosa Mill.
Common, creek bottoms, alder swamps.

Solidago salicina Ell.
Lee county (Mohr's Plant Life.)

*Solidago serotina Ait.
Common, creek bottom fields and moist places.

Solidago ulmifolia Muhl.
Common, creek bottom woods.

Solidago Vaseyi Heller.
Clay county (Mohr's Plant Life.)

‡Tetragonotheca helianthoides L.
Common, dry open woods and roadsides, usually sandy land.

Verbesina alternifolia (L.) Britt.
Clay county (Mohr's Plant Life.)

Verbesina aristata (Ell.) Heller.
Common, dry pine and mixed woods.

‡Verbesina Virginica L.
Frequent, dry open creek bottom woods.

Vernonia angustifolia Michx.
Common, sandy pine woods, occasional on clay.

*Vernonia Baldwini Torr.
Collected once, Auburn.

*Vernonia flaccidifolia Small. 1.
Occasional, upland clay woods.

*Vernonia glauca (L.) Britt.
Collected once, Auburn.

†Vernonia maxima Small. 2.
Frequent, alder swamps, etc., reaching 10 or 12 feet.

*Vernonia Noveboracensis (L.) Willd.
Occasional, fields, pastures and roadsides.

*Vernonia ovalifolia T. & G. 3.
Common, dry sandy woods.

Willoughbia scandens (L.) O. Kuntze.
Common, climbing in swamps.

Xanthium glabratum (D C.) Britt.
(=*X.* strumosum.)

1.—Some of these specimens were at first determined as *Vernonia fascicularis* Michx. and are so reported by Mohr, Plant Life, 758.

2.—This is the Vernonia gigantea (Walt.) Britt, reported from Clay county, Mohr, Plant Life.

3.—Distributed as Vernonia Drummondii.

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ALABAMA.

Agricultural Experiment Station

OF THE

Agricultural and Mechanical College,

AUBURN.

THE COW PEA AND THE VELVET BEAN AS FERTILIZERS.

By J. F. DUGGAR.

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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, Alabama.

THE COWPEA AND THE VELVET BEAN AS FERTILIZERS.

BY J. F. DUGGAR.

Summary.

This bulletin records the results of more than fifty experiments conducted at Auburn during the past five years, to ascertain the effects of cowpeas and velvet beans in the improvement of the soil. The amount of soil improvement has been determined by the increase in the yields of cotton, corn, oats, wheat and sorghum, grown as first, second, third or fourth crops after the stubble and roots of cowpeas or velvet beans or after vines, stubble and roots of these plants have been plowed under. The basis for determining this increase has been the yield of each crop on plots where no leguminous plant has recently grown.

The fertilizing value of different varieties of cowpeas was found to vary considerably, and is probably in proportion to the luxuriance of growth.

In two tests there was a slightly larger yield of corn from plowing in cowpea vines very late in the fall than from postponing the plowing until April; but it is regarded as generally best to plow in the vines not more than a few weeks before the next crop is planted.

The average for six varieties showed that when cowpeas were at a suitable stage for mowing 36.6 per cent. and in another case 39 per cent. of the dry weight of the plant was available for fertilizing uses in stubble, roots and fallen leaves. In the entire growth of cowpeas on one acre there was contained in one case 53.7 pounds of nitrogen, in another 69.8, and in another 87.2, an average of 70.2 pounds of nitrogen per acre,

which is equivalent to the nitrogen in 1,003 pounds of cotton seed meal.

In the roots, stubble and fallen leaves on an acre there were, respectively, 11.65, 16.2 and 31.4 pounds of nitrogen, an average of 19.75 pounds of nitrogen per acre, which is equivalent to that contained in 282 pounds of cotton seed meal.

The average of three tests shows that 28 per cent. of the total nitrogen was contained in the roots, stubble and fallen leaves after the removal of the hay.

The average increase in the yields of succeeding crops was practically identical whether the fertilizing material was supplied by cowpeas or by velvet beans. Equal areas of these two plants were of practically equal value for soil improvement.

The word vines is here used as synonymous with the entire plant of the velvet bean, and with the entire plant of the cowpea after the pods are picked.

The increase in the yield of seed cotton produced in the year immediately following the plowing in of the vines of cowpeas or velvet beans averaged in four tests 567 pounds per acre, worth (at $6\frac{3}{4}$ cents per pound for lint and $7.50 per ton for seed) $14.17. The increase in the first cotton crop after the use as fertilizers of the vines of the summer legumes was never less than 32 per cent. and averaged 63 per cent.

In one test with corn the increase in the first crop where velvet bean vines had been plowed in was 81 per cent., of 12.3 bushels, worth at least $6.15 per acre. With oats the average increase from the vines of the summer legumes in three tests averaged 17 bushels per acre, and with wheat the corresponding increase in two tests was 5.65 bushels per acre.

The increase in the yield of sorghum hay after cowpea and velvet bean vines averaged 87 per cent., or an average gain of 2.1 tons of hay per acre, worth, at $6.67 per ton, $14.02.

When the vines of the cowpea or velvet bean were utilized as hay and only the roots and stubble employed as fertilizer the increase in the yield per acre of the crop immediately succeeding the stubble was as follows:

208 pounds of seed cotton, or 18 per cent., worth $5.20.
4.3 bushels of corn, or 32 per cent.;
28 bushels of oats, or 334 per cent.;
6.7 bushels of wheat, or 215 per cent.;
2.08 tons of sorghum hay, or 57 per cent.

The largest *percentage increase* from either the vines or stubble of cowpeas or velvet beans was made by wheat and fall sown oats, probably because these best prevented the washing away or leaching out of the fertilizing material in the stubble or vines of the legumes.

Generally on sandy soil those crops most completely utilize the fertilizing value of the legumes which leave the land unoccupied for the shortest interval. It is generally unadvisable for legumes to immediately succeed legumes in the rotation of crops, for non-leguminous plants like cotton, corn, the small grains, grasses, etc., make better use of the nitrogen of the fertilizing crop.

The *value* of the increased product resulting from the use of the entire legume for fertilizer was greater with cotton and sorghum than with corn, oats or wheat.

These experiments emphasize the importance of such a rotation of crops as will require a large proportion of the cultivated land of every farm to be devoted to some leguminous plant.

Comparing the fertilizing effect of the vines with that of the stubble of the cowpea and the velvet bean, the excess in the next crop in favor of the vines averaged as follows:

6.6 bushels of corn per acre, or..........49 per cent.
.5 ton of sorghum hay, or .... 9 per cent.
452 pounds of seed cotton per acre, or....40 per cent.

With these three crops the average increase in value per acre was $5.98 greater from vines than from stubble. With oats and wheat the vines of these summer legumes were not superior to the stubble when the small grains were sown immediately after the legumes matured.

The fertilizing effect of the *stubble* of cowpeas or velvet beans was very transitory on sandy land, the average increase in the second crop of corn after the stubble being only 1.34 bushels per acre, or 12 per cent., as compared with the yield of a plot that had not borne legumes.

The fertilizing effect of the *vines* of cowpeas and velvet beans was less transitory than that of the stubble, and the increase was 24 to 54 per cent. in the second crop, 14 per cent. in the third crop (oats), and the favorable effect was even perceptible in the fourth crop (sorghum) grown in the same year as the third. The total increase in value of the four crops occupying certain plots during the three years after the plowing under of the vines of cowpeas and velvet beans was $42.97 per acre, an annual increase of $14.32 per acre.

On the other hand, on very light soil the fertilizing effects of both stubble and vines had practically disappeared within twelve months after the plowing in of the legumes.

Corn as the second crop yielded 14 per cent., or 2.1 bushels more after legume vines than after legume stubble, this representing a value of $1.05. The permanency of effect of legumes in soil improvement seems to be in proportion to the stiffness of the soil and to the mass of vegetable matter afforded by the legume, and the favorable influence of leguminous vines is apparently not less permanent than that of stable manure.

INTRODUCTORY.

The improvement of the soil should be one of the chief aims of every farmer. Every increase in productiveness brings an even more marked increase in profits. Given rich soil, and almost any crop will pay if adapted to the local conditions and markets. Labor spent in the cultivation of corn or cotton on extremely poor soil usually earns scant reward or none.

Fortunately much of the poorest worn land can be brought to a fair degree of productiveness. The means of soil improvement are various. Most thoroughly tested by long experience in Europe and America is that system of farming which depends for soil enrichment on the manure from a large number of livestock maintained on the farm, partly for immediate profit, but largely for use as manufacturers of fertilizers. This system should be much more generally followed in Alabama. However, its introduction will be gradual because of limited capital, inexperience, and the small number and poor quality of the native livestock that must serve as a foundation for stock raising.

Meantime the most immediately available method of increasing the fertility of the soils of the South consists in the free use of that class of leguminous plants, or legumes, which embraces cowpeas, velvet beans, soy beans, beggar weed, peanuts, hairy vetch, crimson clover, and numerous others.

When these plants are grown under suitable conditions specific enlargements occur on their roots and these are called root tubercles, or root nodules. The microscopic organisms which live within these tubercles are able to assimilate the nitrogen of the air that circulates through the upper layers of the soil. This nitrogen while a part of the air was useless to plant life, but within the tubercles it is changed into available fertilizer and is carried by the sap to every part of the leguminous plant. Hence we may speak of these tubercles as fertilizer factories where nitrogenous fertilizers are manufactured and whence they are sent to every part of the cowpea or velvet bean, or other leguminous plant. The plowing in of the legume gives this nitrogen to the soil for the use of other plants. Nitrogen when purchased in the form of cotton seed meal costs 12 to 15 cents per pound, but when it is furnished by legumes it is many times cheaper, the principal outlay being for seed and labor.

Great as is the need of the South for varied industrial development, the factories most urgently needed and paying largest dividends are those which every farmer can bring into being by the millions on the roots of such legumes as cowpeas, velvet beans, vetch, crimson clover, melilotus, bur clover, and alfalfa.

These crops afford nitrogen and vegetable matter, thus supplying the principal deficiencies of southern soils, and they may be either used directly and exclusively for this purpose, or with greater profit the tops may first be fed to livestock, thus affording a two-fold profit in animal products and fertilizer, while the stubble and roots are immediately available for soil improvement.

The stubble alone usually causes a sufficient increase in the yield of the following crop to more than pay the cost of seed, fertilizer, and cultivation of the legume, leaving the food value of the tops as a net gain.

The principal part of this bulletin is occupied with data obtained at Auburn during the past five years and bearing on the extent and permanency of the fertilizing effect of cowpeas and velvet beans.

The following conditions prevailed in all of these tests, unless otherwise specifically stated:

The legumes were grown in drills and cultivated and moderately fertilized with acid phosphate or with phosphate and some potash salt. The crops, corn, cotton, oats, wheat, sorghum, and rye, used to measure the fertilizing effects of the legumes, have received no application of nitrogen, but have been fertilized with phosphate and potash.

The soil in all tests is rather poor to extremely poor deep sandy upland, the white or gray being almost a pure sand and the reddish soil approaching a loam with clayey loam subsoil in the latter case.

The vines or stubble of the legumes have been plowed under just before the planting of the next crop.

The variety of cowpeas employed was the Wonderful or Unknown.

In valuing the crops the endeavor has been made to use conservative average prices, the error, if any, being in putting them too low rather than too high. Lint cotton has been rated at $6\frac{3}{4}$ cents per pound, cotton seed at $7.50 per ton, sorghum hay at $6.67 per ton, corn at 50 cents, oats 40 cents, and wheat 80 cents per bushel. No record is here made of the increase in the yields of grain, straw or corn stover, assmuing that this has been about sufficient to cover the increased cost of harvesting and threshing.

Time to Plow in Cowpea Vines.

On a gray sandy upland soil the vines of drilled cowpeas were plowed under in the late fall of 1898 and 1900, while on other plots plowing was deferred until nearly planting time.

The yields of corn were as follows:

Bushels of corn per acre following cowpea vines plowed under in late fall or early spring.

	Bus. per acre.		
	1899	1901	Av. 2 yr.
Fall plowed	23.8	30.6	27.2
Spring plowed	20.8	29.7	25.3
Difference	3.0	0.9	1.9

The results are slightly in favor of plowing under peavines in the latter part of the fall rather than in spring. As the plots were not strictly uniform, further experiments are needed before definite conclusions can be drawn. It should be said that on July 5, 1899, the foliage of the corn plant was much greener where the vines had been turned under in the fall than on the other plots, though the ears were not discernably different.

It is usually regarded as best to avoid fall plowing on sandy land in the South unless a winter crop is to be grown. On heavy soils where fall plowing may otherwise be desirable, the legumes should first be allowed to mature.

Unless otherwise stated the time of plowing under cowpea and velvet bean vines referred to in this bulletin is a few days or weeks before the planting of the new crop that is to occupy the ground.

Relative Fertilizing Values of Different Varieties of Cowpeas.

Corn was grown in 1898 and 1901 immediately following different varieties of drilled cowpeas which had been picked and in spring the vines plowed under.

Excess of yield of corn in bushels per acre on vine plots as compared in 1898 with no-legumes plot and in 1901 with plot where only pea stubble had been plowed under.

Variety of cowpeas.	1898. Bus.	1901. Bus.
Wonderful (or Unknown)	2.7	0.6
Whippoorwill	2.9	—1.5
Clay	4.3	0.7
Black, from Hastings		—2.9
Red Ripper		5.9
New Era		—3.2
White Giant		0.6
Jones White		1.9
Large White Crowder		5.3
Lady		6.8
Average	3.3	1.4

These figures are given merely as a matter of record, and no conclusions are yet warranted. As a matter of common experience any variety of cowpeas affords in its vines as much or more nitrogen than the following corn crop can utilize. For crops requiring a larger amount of nitrogen or for larger supplies of vegetable matter we may safely value the numerous varieties of cowpeas in proportion to the yeild of hay which they would afford if thus utilized. As noted in Bulletin 118 Wonderful (or Unknown), Clay, and Iron are among the varieties making large yields of hay, and hence of fertilizing material. The Wonderful, by reason of its large yeild, large stems and roots, and varied usefulness, is especially recommended for fertilizing purposes. It is possible, however, that future investigations may show some advantage for varieties that run along the ground and thus by the tangle of runners hold in place on sloping ground in winter a larger proportion of the leaves than is done by an erect variety like Whippoorwill or Wonderful.

Cowpea Vines, Effect on Following Cotton Crop of 1899.

On a reddish loam upland soil of fair quality drilled Wonderful cowpeas and cotton, similarly fertilized were grown in 1898. The peas were picked, yielding 11.8 bushels per acre, and the vines were plowed under the next spring, when both areas were planted with cotton. The corrected yield of cotton in 1899 was 367 pounds, or 32 per cent. greater on the area where the peavines had been plowed in than on the plots where the preceding crop had been cotton.

Cowpea vines, residual fertilizing effect on second crop, viz., oats grown in 1900.—Burt oats were sown in February, 1900, on the same plots as above to test the residual or second-year effects of cowpea vines. On some plots the oats received no nitrogenous fertilizer, on others 76 pounds of nitrate of soda was used per acre.

The yields of oats, in bushels per acre, were as follows:

Fertilizing effects on oats of cowpeas grown two years before.

	After cotton in '98 and '99	After cowpeas in '98 & cotton in '99.	Increase attributable to cowpeas of '98.	
	Bus.	Bus.	Bus.	%
Yield of oats per acre with nitrate of soda..	19.7	25.5	5.8	29
Yield of oats per acre without nitrogenous fertilizer	12.3	22.0	9.7	79

In this case we have an increase of 9.7 bushels, or 79 per cent., as the effect of cowpea vines on oats grown as the second crop after cowpeas. So strong was this fertilizing effect of cowpeas that it was not entirely obscured even when nitrate of soda was also employed, the increase in the yield of oats under these conditions being 29 per cent.

Cowpeas as fertilizer on lime land.—A co-operative fertilizer experiment was conducted for this Station by Capt. A. A. McGregor on lime land at Town Creek, in North Alabama. In his experiment the cowpea was the legume employed.

In 1898 cowpeas were grown on certain plots and cotton on others. The cowpea vines, on which no fruit had matured, were plowed under in the spring of 1899. Cotton was planted on plots which had borne a crop of cotton in 1898 and on others which had grown cowpeas for fertilizing purposes. All cotton plots referred to in this paragraph were unfertilized in 1899, and the fertilization of cowpeas and cotton in 1898 had been identical, only phosphate having been used with either crop.

The weather was exceedingly unfavorable in 1899, so that the full measure of the fertilizing value of cowpeas was not revealed in this test.

In this case the average increase in the yield of seed cotton, which we may attribute to the cowpea vines is, even under very adverse conditions, 58 per cent., or 125 pounds, worth at 2½ cents per pound, $3.92 per acre. Doubtless later crops have also been benefited by the fertilization with cowpeas.

There is reason to expect a larger increase than the above when cowpeas are plowed under on the lime lands of either the Tennessee Valley or of the Central Prairie Region of Alabama. Especially in the prairie soils the principal need is for vegetable matter to lighten the soil and to add nitrogen, and for these purposes the choice must usually be made between melilotus (the so-called lucern) and cowpeas.

Fertilizing Effects of Vines of Cowpeas and Velvet Beans as Shown by Sorghum in 1897.

In 1897 sorghum was grown on three plots following, respectively, velvet bean vines plowed under, cowpea vines plowed under, and fallow, or clean cultivation without crop in 1896.

In 1897 the yields of sorghum hay per acre were as follows:

	Yield. Lbs.	Increase Lbs.	%
After fallow	3,792		
After cowpeas, plowed in	7,008	3,216	85
After velvet beans, plowed in	7,064	3,272	86

The effect of the legumes was to nearly double the crop of sorghum hay.

Fertilizing Materials in Leaves, Stems, and Roots of the Cowpea.

In September, 1899, just 81 days after the planting of the seed, samples were taken of six varieties of cowpeas growing in 34-inch drills on poor gray sandy land. The sample in each case comprised the entire growth on a measured area of land, including the roots growing in the upper 6 inches of soil, which stratum contained nearly all the roots.

After curing, the leaves, blooms and pods, coarse stems ,fine stems (including runners, leafstalks, etc.), fallen leaves and leafstalks,and roots with attached stubble about two inches long, were carefully separated. Analyses were made in the chemical department of a composite sample representing all six varieties, the material analyzed being extremely dry. (For analysis of same samples showing food value see Alabama Station Bulletin No. 118, page 37.)

The following table shows what percentage of the total air-dry weight of the plants of each variety was available for fertilizing purposes after the removal of the hay.

Per cent. of the entire weight of the cowpea plant in stubble and roots and in fallen leaves and leaf stalks.

Variety.	Fallen leaves, etc.	Roots and 2-inch stubble.	Total.
	%	%	%
Miller	17.7	25.0	42.7
Whippoorwill	3.7	21.6	25.3
Iron	15.4	19.0	34.4
Wonderful	19.2	20.3	39.5
Jones White	14.3	14.5	28.8
Clay	22.9	26.0	48.9
Average, 6 varieties	**15.5**	**21.1**	**36.6**

The average for the six varieties shows that in each 100 pounds of dry plants there were 15.5 pounds of fallen leaves and leaf stalks, and 21.1 pounds of roots and stubble, making a total of 36.6 pounds, more than one-third of the entire plant being thus left on the ground for fertilizer after the hay was cut.

Analyses of the different parts of the plant made by Prof. C. L. Hare, of the chemical department of this station, are recorded in the following table.

Composition of parts of the air-dry cowpea plant.

	Water.	Nitrogen.	Phosp'ric Acid.	Potash.
	%	%	%	%
Leaves	10.65	3.59	.78	1.49
Fine stems	8.97	1.90	.64	.68
Coarse stems	8.47	1.51	.42	1.49
Fallen leaves and leaf stalks	9.75	1.67	.37	1.09
Roots and 2-inch stubble	5.25	1.38	.26	1.11

Let us direct our attention to the nitrogen, since this is the only one of the three precious elements that the plant obtains (in part) from the air, and the only one in which the soil is enriched by the growing of cowpeas. The growing leaves in the air-dry condition contain nearly twice as large a percentage of nitrogen as the fine stems, and more than twice as much as the coarse stems and roots and fallen material.

Amounts of air-dry material and nitrogen afforded by different parts of the cowpea plant on one acre (average of six varieties)

	Air dry material.	Nitrogen.
	Lbs.	Lbs.
In leaves retained on vines	501.0	18.00
In fine stems	401.6	7.66
In coarse stems	438.8	6.61
In pods, blooms, etc	325.0	*9.75
In fallen leaves and leaf stalks	357.3	5.97
In roots and 2-inch stubble	411.7	5.68
Total	2435.4	53.67

*Assuming 3% of nitrogen in thoroughly air-dry pods.

The amount of nitrogen stored up by a poor crop of cowpeas growing on an acre, 53.67 pounds, is equivalent to that contained in 767 pounds of cotton seed meal. It should be remembered that an undetermined portion of this nitrogen came from the soil, though on a soil as poor as this the nitrogen derived from the air probably constituted by far the larger portion of the total nitrogen utilized by the plant.

In the stubble, roots, and fallen material there was 11.65 pounds of nitrogen per acre or the same amount as is contained in 162 pounds of cotton seed meal.

Of the total nitrogen in the entire plant 22 per cent. was found in the roots, stubble and fallen material.

An experiment somewhat similar to the preceding was made in 1900, using only a single variety, Wonderful or Unknown. The seed were planted in drills 2½ feet apart on poor gray sandy soil. Four samples were taken from two plots, each sample consisting of the entire growth on an area of four square yards; the roots were obtained by digging and sifting the soil to a depth of six inches, to which stratum all the principal roots were apparently confined.

That the samples were accurately taken is indicated by the close agreement of the duplicate samples; hence only average results are given below. The vines were cut, the fallen leaves and leaf stalks collected, and the roots sifted out on September 5. This was 106 days after the date of planting on one plot and 78 days after planting on the other.

When harvested the more mature sample was slightly past its prime for hay, as shown by the unduly large amount of fallen leaves, while the other sample was too immature and succulent for easy curing.

The yields per acre of extremely dry hay according to the weight of the samples taken after being stored in an office for seven months, were 2,269 pounds on the plot cut at a late stage, and 2,087 pounds of the less mature material. These are equivalent to about $1\frac{1}{4}$ and $1\frac{1}{8}$ tons per acre of cowpea hay with the usual amount of moisture.

Weights (air-dry) per acre of hay, roots, and stubble, and fallen leaves of the cowpea.

	Air dry material, per acre.	
	Ripening stage.	Blooming stage.
	Lbs.	Lbs.
Vines, including stems, leaves, pods, etc	2,269	2,087
Roots, and stubble about 2 in. long...	714	502
Fallen leaves and leaf stalks	1,385	804
Total............................	4,368	3,393

The following table shows what proportion of the entire plant consisted of roots, fallen material, and hay, in the plants harvested when ripening or when in bloom.

	Ripening stage.	Blooming stage.
	%	%
Tops	52	61
Roots and stubble	16	15
Fallen leaves, etc	32	24

When hay was made of cowpeas past their prime there was left on the ground in roots, stubble, and fallen material 48 per cent. of the weight of the plant, and when mowing occurred when the vines were in bloom 39 per cent. of the total weight remained as fertilizer material.

Analyses made by Prof. J. T. Anderson, Associate Chemist of this Station, are recorded below:

Composition of hay, fallen material, and roots and stubble of the cowpea.

	Water.	Nitrogen.	Phosph'ric Acid.	Potash.
In ripening stage:	%	%	%	%
Hay	9.05	2.46	.85	2.14
Fallen leaves and leaf stalks	7.80	1.83	.64	1.45
Roots and stubble ..	7.77	1.17	.48	1.51
In blooming stage:				
Hay	8.15	2.57	.81	2.86
Fallen leaves, etc. ..	6.80	1.36	.59	1.15
Roots and stubble ..	7.00	1.05	.41	2.11

From this table it may be seen that the hay is more than twice as rich as the roots and stubble in nitrogen, and also richer in phosphoric acid and potash.

The amounts of nitrogen contained in the hay, fallen material, and roots and stubble on one acre were as follows:

	Ripening stage. Lbs. nitrogen.	Blooming stage. Lbs. nitrogen.
In hay	55.8	53.6
In fallen leaves, etc	23.1	10.9
In roots and stubble	8.3	5.3
Total per acre	87.2	69.8

The total amounts of nitrogen stored up by the cowpea plant on one acre was in one case 87.2 pounds, in the other 69.8 pounds, equivalent, respectively, to the nitrogen in 1,246 and 997 pounds of cotton seed meal.

Of this amount there was left in and on the soil when mowing occurred late 31.4 pounds of nitrogen; and from the younger plants 16.2 pounds per acre. This is equivalent to the statement that the nitrogen per acre remaining after the vines were removed was equal to the amount contained in 446 or 231 pounds of cotton seed meal.

Of the total nitrogen in the plant, the roots, stubble, and fallen material contained 34 per cent. at the ripening stage, and 23 per cent. at the blooming period.

Considering the three tests together the total amounts of nitrogen per acre of cowpeas was 70.2 pounds in the entire growth, of which the average amount in the stubble was 19.75 pounds, or 28 per cent.

Cowpea Stubble versus Cowpea Vines as Fertilizer for Corn in 1901.

Corn was grown in 1901 on sandy loam land, which, in 1900 had borne a light crop of drilled cowpeas, planted after the removal of the oat crop of 1900.

Three plots were employed. On one the peavines had been cut the previous September, yielding 1,648 pounds of hay per acre. On the other two plots no vines nor peas were harvested but the entire growth, which was only about half of a normal yield, was plowed under March 14, at which time the stubble plot was also plowed.

On the stubble plot and on one of the others corn was fertilized with 100 pounds of acid phosphate per acre, which fertilizer was omitted from the third plot. The stand was uniform. The yields of corn in bushels per acre were as follows:

	Bus.
Pea stubble and phosphate as fertilizer	11.40
Pea vines and phosphate as fertilizer	20.28
Pea vines as fertilizer, no phosphate	21.74

The yield of corn following pea vines was 78 per cent. greater than the yield on the plot where the stubble only had been plowed under, the increase being 8.88 bushels per acre.

In the presence of a considerable amount of rich vegetable matter furnished by pea vines, phosphate was not needed on this soil where acid phosphate had been applied annually for many years.

In a different field on more permeable gray sandy soil corn grown in 1901 on a plot where the stubble of Wonderful cowpeas had been plowed under for hay yielded 25.3 bushels per acre. The average yield of corn on two adjacent plots—where cowpea vines of the varieties Lady and White Giant, both luxuriant growers, had been plowed under, was 25.9 bushels per acre. Here there was practically no superiority of vines over stubble as a fertilizer for corn.

Note should also be taken of the increase in the corn crop due to plowing in either stubble or vines of a number of varieties as recorded in the table on page 131.

Velvet Bean Stubble and Vines as Fertilizers for Corn in 1901.

The fertilizing effect of velvet bean stubble, of velvet bean vines, and of velvet bean vines in connection with acid phosphate, was tested in 1901 on four plots of very poor, deep white sandy soil. On one plot the proceding crop had been corn. On the other three plots drilled velvet beans planted June 13, after the harvesting of the oat crop, had made only a moderate growth in 1900. On one of these plots the velvet bean vines were cut September 10, 1900, yielding 3,632 pounds of hay per acre.

On the other two plots the vines were left on the land all winter. In the latter part of the winter all four plots were plowed, a disc harrow having first been run over the field while the vines were frozen in order to cut them and thus render it easier to plow them in.

The corn on three of the plots was fertilized with 100 pounds of acid phosphate per acre, but this fertilizer was omitted on one of the plots where velvet bean vines had been plowed in.

Yield of corn in 1901 following corn, velvet bean stubble, or velvet bean vines.

	Bus.
Phosphate (but no legume), as fertilizer......	13.58
Velvet bean stubble and phosphate as fertilizer..	17.93
Velvet bean vines and phosphate as fertilizer...	25.90
Velvet bean vines (no phosphate), as fertilizer..	21.48

The increased yield per acre, as compared with the yield on the plot on which the previous crop had been corn, was 4.35 bushels, or 32 per cent., with velvet bean stubble, and 12.32 bushels, or 81 per cent., with velvet bean vines.

The increase attributable to 100 pounds of acid phosphate was 4.42 bushels, which made the use of this mineral fertilizer decidedly profitable for corn on very poor white sandy soil, when used in connection with a large mass of rich vegetable matter. On the other hand, on a spot about 100 yards distant, where the soil was less sandy and in better condition, phosphate did not increase the yield of corn when added to pea vines plowed under. (See page 140.)

Immediate Fertilizing Effect on Sorghum of Cowpea and Velvet Bean Vines and of Cowpea and Velvet Bean Stubble.

The soil on which the following experiment was made is a sandy loam, containing many small flint stones, and underlaid by a stiffer subsoil.

In 1898 eight uniform plots were planted, 2 plots with velvet beans, 5 with Wonderful cowpeas (most plots broadcast), and 1 with drilled Orange sorghum. The growth of the several plots was either cured for hay or used as a fertilizer, as indicated in the next table.

March 9, 1899, all plots were plowed and in due time sorghum was planted in drills on all plots, and the two cuttings of this crop at the proper season were cured for hay.

The yields per acre of sorghum hay at two cuttings, the first growth having become too coarse, but the second being of good quality, averaged as follows:

First year effects on sorghum of stubble or vines of cowpeas or velvet beans.

	Yield per acre.	Increase from legumes.
	Tons.	Tons.
Sorghum hay after sorghum stubble..	3.65	.
Sorghum hay after cowpea stubble..	5.66	2.01
Sorghum hay after velvet bean stubble	5.80	2.15
Sorghum hay after cowpea vine, pckd	5.72	2.07
Sorghum hay after velvet bean vines	6.76	3.11

As a fertilizer for sorghum velvet bean vines proved superior to cowpea vines, and to velvet bean stubble.

The stubble of cowpeas and of velvet beans was of practically equal fertilizing value.

Residual fertilizing effect of legumes on corn grown as the second crop after cowpea and velvet bean vines and cowpea and velvet bean stubble.

March 17, 1900, the sorghum stubble in the experiment just discussed was turned with a one-horse plow and March 29 corn was planted on all plots.

"Fertilizing effects in 1900 of stubble and vines of cowpeas and velvet beans grown in 1898.

Plot.	Crop in 1898.	Portion used for fertilizer.	Corn per acre in 1900.		
			Yield.	Increase over sorghum plot of 1898.	Increase, vines over stubble.
			Bus.	*Bus.*	*Bus.*
8	Sorghum. . .	Stubble............	24.1	....	....
4 & 7	Cowpeas....	Stubble	25.7	1.6	....
3 & 6	Cowpeas	Vines. after picking	27.7	3.6	2.0
2	Velvet beans.	Stubble............	23.9	0.2	....
1	Velvet beans.	Entire growth......	26.8	2.6	2.4

Let it be noted that the heavy growth of sorghum in 1899 did not utilize all of the fertility derived from the preceding crop of legumes. Although sorghum is a plant that is especially exhaustive to soil fertility, there still remained for the corn crop of 1900 a residue of nitrogen from the cowpea and velvet bean vines of 1898 sufficient to increase the yield of corn to the extent of 3.6 bushels per acre where cowpeas had grown two years before, and 2.6 bushels where velvet beans had grown. This is an average of 3.2 bushels per acre as the residual fertilizing effect of these legumes.

The fertilizing effects of the stubble and roots of these two plants was far more transitory, the first succeeding crop, sorghum, practically exhausting them, leaving sufficient in the soil to increase the corn crop of 1900 by only an inconsiderable amount, viz.: 1.6 bushels and .2 bushel, an average of .9 bushel per acre." (From Bulletin No. 111, Alabama Experiment Station.)

Immediate Fertilizing Effect on Corn in 1900 of Cowpea and Velvet Bean Vines.

This experiment was made on a white, sandy soil, poorer than that used in the last mentioned experiment.

In the late spring and early summer of 1899 velvet beans had been planted in drills on certain plots and beggar weed had been sown broadcast on others. The beggar weed and a portion of the velvet beans was used exclusively for fertilizer. On other plots velvet beans were cut, thus leaving only the stubble as fertilizer for corn.

"These various fertilizing materials were all plowed under March 31, 1900, and Mosby corn planted April 5, using per acre 240 pounds of acid phosphate and 40 pounds of muriate of potash.

Vines versus stubble of velvet beans as fertilizer for corn in 1900.

Plots.	Material used for green manuring.	Yield of corn per acre.	Increase over stubble plot.
		Bus.	Bus.
4 & 9	Stubble of velvet beans	15.6	
3 & 8	Entire growth of velvet beans	27.5	11.9
2 & 7	Entire growth of beggar weeds........	18.7	3.1

The entire growth of velvet beans afforded a yield of corn greater by 11.9 bushels per acre, or 76 per cent., than the yield where only the stubble was employed as fertilizer." (Alabama Station Bulletin No. 111.)

Residual fertilizing effects of velvet bean vines and stubble on the second crop of corn grown in 1901.

The same poor, white, sandy hilltop was again planted in corn in 1901 without any nitrogenous fertilizer. The yield of corn per acre were 15 bushels where velvet bean vines growing in 1899 had been plowed under and only 11.1 bushels where velvet bean stubble had been turned under at the same time. The residual or second-year fertilizing effect of the vines was greater than that of the stubble by 3.9 bushels per acre, or 33 per cent.

The total fertilizing value of the vines during the two seasons following the date when they were plowed in exceeded that of the stubble to the extent of 59 per cent., or 15.8 bushels of corn per acre. This amount of corn would usually be worth more than the net value of the 2,800 pounds of velvet bean hay obtained from the stubble plot at considerable expense for curing.

In this case it was more profitable to plow under velvet bean vines for fertilizer than to harvest them for hay. Judging from other corresponding tests it would have been still more profitable to have grazed cattle on the vines, either in their green or winter-killed condition.

Cowpea and Velvet Bean Vines, Immediate Fertilizing Effects on Cotton Grown in 1899.

In 1898 on a reddish loam soil, abounding in flint stones and underlaid by a red loam subsoil there were grown on adjacent plots cowpeas, velvet beans, and cotton, all fertilized alike with acid phosphate and kainit. The cowpeas and velvet beans were planted thickly in drills, using per acre 112 pounds of cowpeas and 120 pounds of velvet beans. The variety of cowpeas used was the Unknown or Wonderful. Both cowpeas and velvet beans were picked and removed from the field, though the latter did not fully mature. The vines were turned under in March, 1899, and all plots were planted to cotton; each plot of cotton was fertilized at the rate of 240 pounds of acid phosphate and 96 pounds of kainit per acre.

The yield of seed cotton per acre in 1899 was 1,533 pounds following cowpeas, 1,373 pounds following velvet beans, and 837 pounds following cotton.

These figures show that the increased yield of seed cotton attributable to manuring with cowpea vines was 696 pounds per acre; the gain apparently due to the fertilization with velvet beans was 546 pounds per acre. In percentages the increase is 83 and 64 per cent., respectively. Valuing seed cotton at 2½ cents per pound (which is equivalent to 6¾ cents per pound of lint and $7.50 per ton of seed), the gain with cowpeas and velvet beans is worth, respectively, $17.40 and $13.65 per acre.

Surely it was more profitable to grow cotton every alternate year at the rate of a bale per acre than to grow continuous cotton crops of about one-half bale per acre. Additional proof of this is found in the fact that one of these plots afforded in 1898 a yield of 18¼ bushels of cowpeas per acre, besides increasing the cotton crop of the following year to the extent of $17.40 per acre.

Residual fertilizing effects of cowpeas and velvet beans on sorghum, oats, and late sorghum grown as second, third and fourth crops after these legumes.

These same plots were planted with drilled sorghum without any nitrogenous fertilizer in April, 1900; with red oats without nitrogenous fertilizer in November, 1900, and again with drilled sorghum without any nitrogenous fertilizers, July 18, 1901.

Fertilizing effects of cowpeas and velvet bean vines grown in 1898 on sorghum in 1900 and as a second crop in 1901.

Preceding crop.	Sorghum hay per acre, 1900.	Sorghum hay per acre, 1901.	Total increase after legumes.
	Tons.	Tons.	Tons.
Cotton in '98 and '99	5.1	1.0	
Cowpeas in '98 (picked), and cotton in '99	8.1	1.5	3.5
Velvet beans in '98, and cotton in '99	8.2	1.6	3.7

As compared with the plot not recently in legumes the increase of sorghum hay per acre in 1900 from cowpeas grown two years before was 3 tons per acre, or 59 per cent.; from velvet beans two years before the increase in 1900 was 3.1 tons of hay, or 61 per cent.

The increased yield with late sorghum, which was the fourth crop after the plowing in of the vines of the legumes, was, after cowpeas, .5 of a ton, and after velvet beans .6 of a ton. In the two sorghum crops the total increase in yield attributable to legumes was, with cowpeas, 3.5 tons of hay, and with velvet beans 3.7 tons of sorghum per acre.

Now let us go back a few months and note the yield of the oat crop coming between the sorghum crops of 1900 and 1901.

Yield of oats in 1901 grown as the third crop after legumes.

Preceding crops:	Yield, oats per acre.	Increase after legumes.	
	Bus.	Bus.	%
Cotton in '98; cotton in '99; sorghum in 1900	23.3		
Cowpeas in '98; do do	26.5	3.2	14
Velvet beans in '98; do do	37.2	13.9	59

The fertilizing effect of the legumes was apparent in the third crop after the legumes, the increase where cowpeas had once grown being 3.2 bushels of oats per acre, or 14 per cent. The increase where velvet beans had been is suspiciously large, and in subsequent calculations it will be assumed that the increase in the yield on this plot if not influenced by accidental conditions would have been no greater than that on the plot once in cowpeas, viz., 3.2 bushels per acre.

Financial results of using cowpea vines as fertilizers for cotton, sorghum, oats, and late sorghum.

Let us convert these yields of cowpeas, cotton, sorghum, and oats into their money values to learn whether the introduction of cowpeas or velvet beans into the rotation has been profitable.

Value of crops per acre in three years (1) following cotton and (2) following cowpea vines.

	Value of crops per acre in			
	1899.	1900.	1901.	Total for 4 crops in 3 years.
Plot 3—No legume in 5 years:				
In '99, 837 lbs. seed cotton, at 2½c*	$20.92			
In '00, 5.1 tons sorghum hay, at $6.67 per ton		$33.02		$69.93
In 1901, 23.3 bus. oats, at 40c....			$9.32	
In 1901, 1 ton sorghum hay			$6.67	
Plot 1, cowpeas in '98, picked and vines plowed under:				
In '99, 1,533 lbs. seed cotton at 2½c	$38.30			
In 1900, 8.1 tons sorghum hay....		$54.00		$112.90
In 1901, 26.5 bus. oats, at 40c....			$10.60	
In 1901, 1.5 tons sorghum hay			$10.00	
Difference in 3 years				$42.97
Average difference per year peracre				$14.32

*Equal to 6¾ cents per pound of lint, and $7.50 per ton of seed.

The total value of the products grown in three years on an acre was $69.93 on the plot where no legume had been grown for many years and $112.90 per acre on the plot where one crop of cowpeas had been grown once in four years, and where the vines, after the picking of the peas, had been plowed under at the beginning of the three-year period under consideration. The difference in the value of the crops for three years is $42.97; the average annual difference is $14.32 per acre in favor of the plot where cowpeas had been grown

The figures showing the financial advantages of using one crop of velvet beans for fertilizer during the same period so nearly correspond with those for cowpeas that the calculation need not be repeated.

On this land the plowing under of the vines of the cowpeas and velvet beans was exceedingly profitable. The soil of these plots is a reddish, clayey loam, stiffer and probably more retentive of fertilizer nitrogen and humus than the greater portion of the soil on the Station Farm.

Lest any should misapprehend the lessons of this experiment it is necessary to state that at no time in the three-year period was any nitrogenous fertilizer applied to any crop on any of these plots, but that each crop was supplied with phosphate and potash.

The yearly application of cotton seed meal would have lessened the differences between the plots, as it has done in our unpublished rotation experiments, and would have made the advantage in favor of legumes less striking than in the exhibit above.

Immediate Fertilizing Effects on Cotton of Velvet Bean Vines.

On poor soil at Auburn an effort was made in 1898 and 1899 to ascertain the manurial value of the vines and stubble of velvet beans.

In 1898 cotton was grown on certain plots and velvet beans on others. The fertilization of all plots in 1898 was not identical, but for a given fertilizer applied to cotton there was a plot of velvet beans receiving the same fertilizer. The velvet beans grew in drills 3½ feet apart; the vines formed a dense mat of vegetation, but did not mature seed. In March, 1899, velvet beans and cotton stalks were plowed in and soon afterwards all plots were fertilized alike with a mixture of 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre.

Russell cotton was planted in 3½ feet drills on all plots on April 21. From midsummer forward there was a remarkable difference in the appearance of the two sets of plots, the cotton plants being much larger, greener, and more luxuriant on the plots where velvet beans had grown the year before.

Av. yield of seed cotton per acre following velvet bean vines	1,578 lbs.
Av. yield of seed cotton per acre following cotton	918 lbs.
Increase from velvet bean vines.......	660 lbs.

The average increase attributable to velvet beans used as a fertilizer was 660 pounds of seed cotton per acre, a gain of 72 per cent. as compared with the average yield on plots where the preceding crop had been cotton. At $2\frac{1}{2}$ cents per pound of seed cotton (equivalent to $6\frac{3}{4}$ cents per pound for lint and $7.50 per ton for seed) this increase is worth $16.50 per acre.

Residual fertilizing effects on corn of velvet bean vines.

The residual ,or second-year, effects were tested on corn planted on these plots March 29, 1900, without nitrogenous fertilizer.

Where cotton had grown in 1898 the yield of corn in 1900 was 18 bushels per acre; on the next plot, where velvet beans had been grown for fertilizer in 1898, the yield of corn in 1900 was 25.5 bushels. This gain of 7.5 bushels per acre, or 42 per cent., represents the residual or second-year effect of using the entire growth of velvet beans as a fertilizer.

Immediate and Residual Effects of Velvet Bean Stubble on Cotton and Corn.

In the same field the velvet beans on one plot were cut for hay October 12, 1898. The stubble and roots were plowed in at the same time as the vines on the other plots referred to above.

Cotton on the plot where only roots and stubble were plowed in yielded in 1899 1,126 pounds of seed cotton per acre, an increase when compared with the plots where cotton had grown the previous year of 208 pounds, or 49 per cent.

Comparing velvet bean vines with velvet bean stubble the difference in favor of the vines was 452 pounds of seed cotton per acre in the first crop.

Corn in 1900 on this plot yielded 14 per cent., or 2.6 bushels per acre more than did corn on the nearest plot where in 1898 cotton instead of velvet beans had grown. As the stubble plot was slightly lower down on the hillside we suspect that the increase was partly due to this disturbing condition and not wholly to the residual effects of the velvet bean stubble of 1898.

It was on this stubble plot that in 1898 the velvet bean hay (8,240 pounds per acre) contained 188.7 pounds of nitrogen and the roots and stubble and fallen leaves only 12.5 pounds of nitrogen per acre. (See Alabama Station Bulletin, No. 104, page 336.)

Immediate Fertilizing Effects of Cowpeas on Oats in 1897.

"On sandy soil in 1896 several plots were sown broadcast with the Wonderful variety of cowpeas, and an adjacent plot was sown broadcast with German millet. The German millet was plowed under, as were also the peavines, the peas having been previously picked.

February 18, 1897, Red Rust Proof oats were sown after the above mentioned crops, using in both cases 100 pounds of acid phosphate and 80 pounds of nitrate of soda per acre.

After cowpeas the oat straw grew to be three to four inches taller than on the plot preceded by German millet. The yields were as follows:

Oats following cowpeas and German millet, 1897.

	Yield per acre.	
	Bus. Grain.	Lbs. Straw.
Oats after cowpeas, vines plowed under.....	22.8	788
Oats after German millet, plowed under.....	12.4	559
Difference per acre	10.4	229

In this case cowpeas were more valuable than German millet as fertilizer for the following oat crop, the difference in favor of cowpeas being 10.4 bushels of oats per acre and 229 pounds of straw." (From Bulletin No. 95, Alabama Experiment Station.)

This is an increase of 84 per cent. in grain.

Immediate Fertilizing Effect of Cowpea and Velvet Bean Vines and Stubble on Oats in 1898.

This experiment is descibed in the following quotation from Bulletin No. 95 of this Station:

"May 14, 1897, on poor sandy soil Wonderful cowpeas were sown on two plots, velvet beans on two plots, and German millet on a fifth plot. A sixth plot was prepared and fertilized but left without seed, to grow up in crab grass, poverty weed, etc. Cowpeas and velvet beans were sown in drills two feet apart, German millet broadcast. The millet was cut for hay July 16, yielding 994 pounds per acre. The cowpeas on one plot were picked September 10, yielding 11 bushels per acre.

The velvet beans did not mature seed.

In September, 1897, cowpeas on one plot and velvet beans on one plot were cut for hay and the stubble plowed under. The vines of cowpeas on one plot and of velvet beans on another were also plowed under on the above mentioned date. Then oats were sown at a uniform rate on all four plots, also on the plot where the German millet stubble had been plowed under and on the one where crab grass and various weeds had just been buried by the plow.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

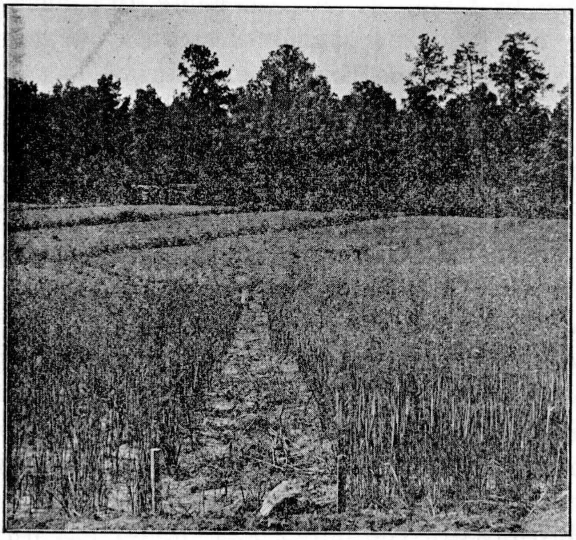

FIGURE 1. Oats following cowpea stubble on the right; on the left oats after crabgrass.

Yield per acre of oats grown immediately after stubble or vines of cowpeas, velvet beans, etc.

Plot No.		Yield per acre. Grain.	Straw.
		Bus.	Lbs.
1	Oats after velvet bean vines..................	28.6	1206
6	Oats after velvet bean stubble..............	38.7	1672
	Average after velvet bean vines and stubble	33.6	1439
4	Oats after cowpea vines	28.8	1463
3	Oats after cowpea stubble	34.4	2013
	Average after cowpea vines and stubble....	31.6	1738
2	Oats after crab grass and weeds	7.1	231
5	Oats after German millet	9.7	361
	Average, after non-leguminous plants......	8.4	296

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble or vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass. The difference in the height and thickness of the oats on some of the plots is shown in figures 1 and 2.

May 18, 1898, oats on all plots were cut.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab grass, weeds and German millet.)

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous or soil-improving plants, instead of non-leguminous plants, during the preceding season.

Undoubtedly this is an extreme, and not an average, case. If cotton seed meal, or other nitrogenous fertilizer, had been used on all the plots of oats, the plants on plots 2 and 5 would have made better growth, and the difference in favor of the leguminous plants would have been reduced.

A gain of five to fifteen bushels of oats per acre as a result of plowing under cowpea stubble or vines would make the growing of cowpeas for fertilizer a profitable operation, and it is far safer to count on such an increase as that obtained in our first experiment (10.4 bushels), rather than to expect such an exceptional increase as that obtained in this last experiment.

An unexpected result of this experiment is the larger crop on the plots where only the stubble was left than on those where the vines of cowpeas and velvet beans were plowed under. The plots were of nearly uniform fertility, as judged by the location and by the uniform growth of cotton on all plots in 1896. While admitting the possibility that the two west plots (plots 3 and 6) were slightly richer than the two on the east (plots 1 and 4), the writer thinks that the difference in yield was almost wholly due (1) to the fact that the vines (especially those of the velvet beans) were not properly buried by the small plow employed, and (2) that the seed bed for oats was more compact where only stubble was plowed under, a point of advantage, doubtless, in such a dry winter as that of 1897-98. It does not follow that the land will be permanently benefitted by cowpea stubble to a greater extent than by cowpea vines. The reverse is probably true." (From Bulletin No. 95, Alabama Experiment Station.)

Residual fertilizing effect on late corn of cowpea and velvet bean vines and stubble.

On June 20, 1898, or a month after the harvesting of the oats in the last mentioned experiment, all six of these plots were planted in corn without nitrogenous fertilization, which crop, as usual with very late corn on poor upland, was a failure.

The yields were as follows:

Yields of late corn grown as the second crop after legumes.

Crop in 1897:	Yield per acre.	Increase after legumes.
	Bus.	
Crab grass, plowed in	4.3	
German millet, stubble plowed in	7.3	
Cowpeas, stubble plowed in	6.2	.4
Velvet beans; stubble plowed in	7.7	1.9
Cowpeas, picked; vines plowed in	6.7	.9
Velvet beans; vines plowed in	7.9	2.1

The fertilizing effects of both stubble and vines of cowpeas was scarcely perceptible in the late corn planted eight months after and harvested thirteen months after the plowing under of the large amounts of nitrogen furnished by the legumes. Apparently the crop failure was not due to deficient rainfall, for this was ample except for about two weeks about the middle of August. The small size of stalks leads to the suspicion that there was a deficiency of nitrogen on all plots. If this nitrogen was lost by being leached out in the draining water this loss must have occurred almost entirely after corn was planted or in July and August; for in 1898 April, May, and June were unusually dry months. On the other hand there was a period of excessive rainfall July 4 to 11 and of still greater excess July 28 to August 6. During this latter period 7.59 inches of rain fell in a space of ten days.

The experiment seems to teach that on very light, gray, sandy upland, subject also to surface washing, the fertilizing effects of even large amounts of nitrogen furnished by preceding crops of legumes may be removed from the soil within twelve months after the legume has been plowed in. The lesson might also be drawn that on such soils the planting of any non-leguminous crop after small grain is risky, but that if such a crop is employed the seed should be put into the ground as soon as possible after the removal of the grain crop.

An experience like this in which the fertilizing effect of the entire or nearly entire growth of the legume was no greater than that of the stubble on either the first or on the second succeeding crop emphasizes the wisdom of utilizing the vines of cowpeas, etc., for food, leaving only the roots and stubble to fertilize the next crop.

Immediate Fertilizing Effect on Wheat of Cowpea and Velvet Bean Vines and Stubble.

All the plots of the last mentioned experiment were in oats from February to June, 1900.

June 23, 1900, certain plots were planted with drilled cowpeas, certain others with drilled velvet beans, and yet others were merely plowed and fertilized with minerals, as were the legumes.

Of the two plots of cowpeas, one was cut for hay, yielding 2,004 pounds per acre; on the other 7.9 bushels of seed per acre were picked. One plot of velvet beans was cut for hay, while on the other the vines were left on the ground for fertilizer. The cowpea plants, variety Wonderful, were somewhat injured by a fungous disease of the roots; velvet beans, by reason of late date of planting and deficiency in stand, did not make an entirely satisfactory growth.

November 9 all plots were plowed, turning under either volunteer grass and rag weeds, or cowpea vines, or velvet bean vines, or cowpea stubble, or velvet bean stubble. The plowing was poorly done with a one-horse turn plow and in sowing the wheat a few days later some of the velvet bean vines were pulled up. The wheat received only mineral fertilizers, and, indeed, practically no nitrogen had been applied to these plots for three years.

The yields of wheat in 1900 were as follows:

Bushels of wheat per acre after leguminous and non-leguminous crops:

Crop in 1899.	Yield per acre.	Increase by use of legumes.	
	Bus.	*Bus.*	%
Crab grass and weeds; plowed in	3.1		
Cowpeas; stubble plowed in	11.8	8.7	280
Velvet beans; stubble plowed in........	7.8	4.7	151
Cowpeas, picked; vines plowed in	9.0	5.9	190
Velvet beans; vines plowed in........	8.5	5.4	174

Both the stubble and the vines of the legumes practically trebled the yield obtained on the plots where no legume had grown. The stubble was at least as effective as the vines, pointing to the greater economy of utilizing the vines for hay or pasturage.

June 19, 1900, all these plots were planted with Mosby corn, fertilized only with phosphate and muriate of potash. The crop was a failure on all plots, the yield of cured fodder corn ranging from 1,540 to 2,200 pounds per acre, the plots where vines had been plowed in the previous fall showing no superiority over the stubble plots, and very little increase as compared with the plot where no legume had grown. It is impossible to ascertain whether the failure with corn was due to the protracted drought during almost the whole of July or to the leaching out of the nitrogen of the legumes during the last few days in June, when 5.20 inches of rain fell within a period of four days. The latter explanation seems more probable in view of the fairly favorable rainfall after August 1, 1900, and because of similar failure of the late corn crop on the same field in 1898, when there was no long period of drought, but a brief one of even more excessive rainfall.

The history of these six plots for these four years ending with 1900 as just detailed shows very plainly that the fertilizing effects of nitrogen very quickly disappear on this light sandy sloping field, not underlaid by a clay or clayey loam subsoil; and that on such soils the stubble of cowpeas or velvet beans was as efficient as the vines, not only for the immediately succeeding crop, but for later crops as well. This narrative should add force to the recommendation we have so often given that as far as possible the stems, foliage and seed of legumes be utilized as food for animals and only what remains be employed as fertilizer.

Fertilizing Effects of Velvet Beans, and Peanuts; as Compared with Corn, Sweet Potatoes and Chufas.

On a gray sandy upland soil, free from stones and underlaid by a sandy subsoil, various crops were grown in 1899, for the double purpose of comparing them as to the amount of hog food produced and as to their effect in enriching or depleting the soil. The chufas and a part of the Spanish peanuts were consumed by shoats penned on the field. As the running variety of peanuts failed this season to make any nuts the luxuriant growth of vines was plowed under in the fall, as was also done with the vines of velvet beans and with cowpea vines after the latter had been picked. Only the ears of corn were removed from the land, and only the roots of sweet potatoes.

Rye, sown broadcast on November 13, 1899, on all plots, was employed as the crop for determining what effect the various summer crops had exerted on the fertility of the soil. The fertilizer for rye consisted of the following amounts per acre:

80 pounds of cotton seed meal.
160 pounds of ammoniated acid phosphate.
64 pounds of muriate of potash.

The effects of the legumes as fertilizers for rye would have been more striking if no cotton seed meal or ammoniated guano had been employed, but the poverty of this sandy soil made some nitrogen indispensible if absolute failure of crop was to be avoided on the plots where sweet potatoes, chufas and corn had grown.

The rye was cut April 13 and April 16, and the green forage at once weighed. No second cutting of rye was made, but the land was turned to other uses.

Yields of rye following sweet potatoes, corn, chufas, peanuts, cowpeas and velvet beans.

Preceding crop.	Yield per acre.	Increase from legumes as compared with sweet potatoes.	
	Lbs.	Lbs.	%
Rye, after sweet potatoes dug (av. 2 plots) ..	2360		
Rye, after corn, ears pulled	3440	1080	41
Rye, after chufas, eaten on the land	4560	2200	93
Rye, after Spanish peanuts; dug and only nuts removed	3440	1080	41
Rye, after Spanish peanuts; eaten on the land	6640	4280	181
Rye, after Whippoorwill cowpeas, drilled and picked (diseased)	4960	2600	110
Rye, after velvet beans, entire growth plowed in (av. 2 plots)	5720	3360	142
Rye, after velvet beans, nearly mature pods picked, vines plowed in	4720	2360	100
Rye, after running peanuts, entire growth plowed in (av. 2 plots)	5212	2852	121

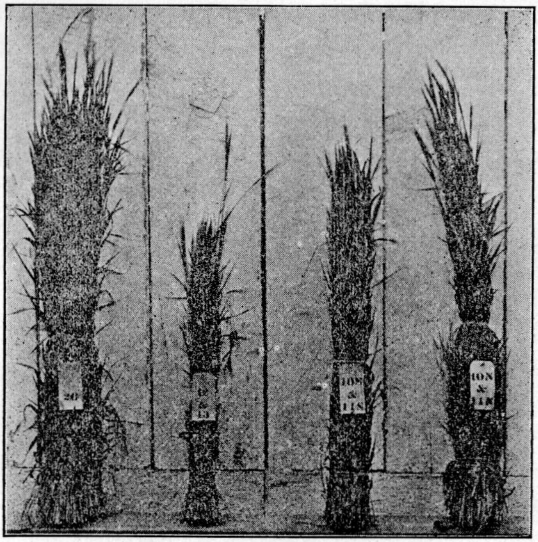

FIGURE 2. Rye from equal areas, following (20 velvet beans: and (12 & 13) sweet potatoes; (10 S & 11 S.) corn; (10 N. & 11 N.) chufas hogged

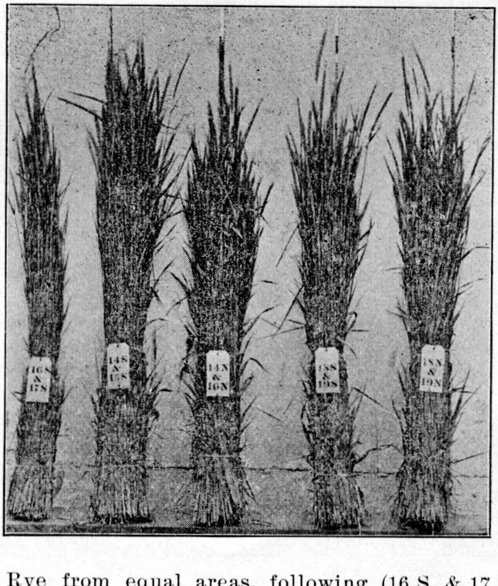

FIGURE 3. Rye from equal areas, following (16 S. & 17 S.) Spanish peanuts, dug; (18 S. & 19 S) cowpeas; 14 N. & 15 N.) running peanuts.

The legumes increased the yield in every case as compared with sweet potatoes, the excess ranging from 41 to 181 per cent. Among the non-leguminous plants sweet potatoes was most exhausting to the soil, and chufas, when consumed on the land, the least. This agrees with common observation. In this case the exhausting effects of the sweet potatoes were not due to leaching of the disturbed soil, for all plots were plowed soon after the potatoes were dug.

Among the legumes the greatest increase, 181 per cent. was obtained on the plot where Spanish peanuts had been consumed on the land by hogs. Since the yield of peanuts here was not excessive, since the growth of tops was only moderate, and since the vines of Spanish peanuts on an adjoining plot did not greatly increase the yield, we can attribute the increase where hogs had grazed, only to an assumed quicker nutrification of the material that had passed through animals. This view finds further support in the fact that chufas consumed by hogs on the land left the soil in better condition than did either corn or sweet potatoes.

Wherever the entire growth of the several legumes was left on the land, with or without being utilized as hog food, the succeeding yield of rye was more than doubled.

Cotton was grown in 1899 on a plot adjacent to the legumes. The rye following cotton yielded 5,560 pounds per acre, but it is not fair to compare this yield with that following the legumes, because the cotton had been very heavily fertilized, and some of this fertilizer probably remained in the soil to be utilized by the rye.

Fertilizing effects of legumes on sorghum grown as the second crop.

To ascertain what differences still existed in the soil as a result of legumes grown in the summer of 1899, sorghum was sown in drills on this same field June 19, 1900, all plots being uniformly fertilized with acid phosphate. So that sorghum thus becomes the second crop after the various legumes, and is intended to reveal the residual or "left over" effects of the summer crops of 1899.

Residual fertilizing effects on sorguhm, of peanuts, cowpeas and velvet beans.

Preceding crops. Summer of 1899.	Winter, 1899, 1900.	Yield sorghum hay per acre.	Increase from legumes as compar'd with sweet potatoes.
		Lbs.	*Lbs.*
Sweet potatoes, dug	Rye	5360	
Corn, ears pulled	Rye	5760	400
Spanish peanuts, dug; nuts removed	Rye	4480	loss.
Spanish peanuts; eaten on land	Rye	4000	loss.
Cowpeas, picked	Rye	5760	400
Velvet beans, all plowed in	Rye	7110	1750
Velvet beans, pods picked	Rye	7600	2240
Running peanuts, all plowed in	Rye	6320	960
Cotton, heavily fertilized	Rye	4000	loss.
Av., potatoes, corn, cotton	Rye	5040	
Av., velvet beans, cowpeas, running peanuts	Rye	6697	1657

Evidently rye had not exhausted all the fertilizing value of the legumes. This second crop was favorably affected by all the legumes except by Spanish peanuts, the benefits of which had disappeared. The average increase on the plots where all the other legumes had grown the preceding summer was 33 per cent. as compared with the yield on the plots where corn, cotton and sweet potatoes had constituted the summer crops in 1899.

Relative Fertilizing Values of the Cowpea and Velvet Bean.

When tested on a number of crops, each grown *immediately after* the legumes, the percentage increase as compared with corresponding plots that had borne no legume was 128 per cent. from peavines, and also 128 per cent. from velvet bean vines. Additional weight is given to these figures since they represent the average of six tests with each plant. Continuing the inquiry as to their comparative value, we find that the second crop after cowpea vines showed an increase of 37 per cent. and the second crop after velvet bean vines an increase of 48 per cent. This is the average result of two comparable tests with each plant.

Comparing these two plants with reference to the fertilizing effect of the stubble on the first crop we find as the average of three tests an increase that is practically the same for the two plants.

Combining the results for the vines of each legume as shown in the first and second succeeding crops with the immediate results from the stubble of each we must conclude that at Auburn the fertilizing values of the cowpea and velvet bean are practically equal. This is true for an acre of each. In the stubble plots the average yield of velvet bean hay has been the greater, that is 4,781 pounds per acre of velvet bean hay against 3,278 pounds of cowpea hay, so that apparently pound for pound the cured tops of cowpeas have been somewhat more effective than the vines of velvet beans. This is in practical accord with the results of chemical analyses made at this station by Dr. Anderson, who analyzed peavine hay and velvet bean hay from plots where the stubble was used as fertilizer. He found 2.29 per cent. nitrogen in velvet bean vines and 2.46 per cent. of nitrogen in the cowpea vines, both samples containing 9 per cent. moisture. The nitrogen in the two stubbles was practically equal, 1 per cent.

Let us now consider the results as a whole, combining those for the two plants and assuming that the fertilizing value of cowpea vines and of velvet bean vines are equal, and that the stubble of the one plant is as effective as that of the other. In what follows the figures express the average results for cowpeas and velvet beans considered together under the name of summer legumes.

Increase in the First Crop After Plowing in the Vines of Summer Legumes.

With cotton as the first crop the increase in seed cotton per acre at Auburn was respectively 367, 546, 696, and 660 pounds of seed cotton per acre. This is an average increase of 567 pounds, worth at 2½ cents (equal to 6¾ cents for lint, $7.50 per ton for seed) $14.17.

The yield of *seed cotton* following the vines of the summer legumes exceeded that on plots where the preceding crop had been cotton to the extent of 32, 64, 83, and 72 per cent. *The average increase in the yield of seed cotton attributable to the vines of the legumes was* 63 *per cent.*

With *corn* as the first crop, the increase per acre attributable to plowing in the entire growth of velvet beans was 81 per cent. or 12.3 bushels, worth, at 50 cents per bushel, $6.15.

With *oats* as the first crop, the effect of the vines of the summer legumes is seen in an increase per acre of 10.4, 20.2, and 20.4 bushels respectively. The average increase per acre was 17 bushels, worth at 40 cents per bushel, $6.80. *The increase in the first crop of oats after summer legumes was* 84, 240 and 242 per cent., *an average of 189 per cent.*

With *wheat* the increase was 5.4 and 5.9 bushels, an average of 5.65 bushels per acre, worth at 80 cents per bushel, $4.53. *The increment was* 174 and 190 per cent. respectively, an average gain of *182 per cent.*

With *sorghum* grown as the first crop after the plowing under of the vines of cowpeas and velvet beans, the increase in hay per acre was 1.6, 1.6, 2.07, and 3.11 tons, an average gain per acre of 2.1 tons of hay, worth, at $6.67 per ton, $14.02. The percentage gains were 85, 86, 57, and 86, respectively, *an average of 78 per cent.*

Increase in the First Crop After Plowing in the Stubble of Cowpeas and Velvet Beans.

With *cotton* the yield was greater after velvet bean stubble than after cotton to the extent of 18 per cent., or 208 pounds of seed cotton per acre, worth, at 2½ cents per pound, $5.20.

With *corn*, the stubble of velvet beans afforded a gain of 32 per cent. or 4.3 bushels, worth $2.15.

With *oats* grown after the plowing in of the stubble of these summer legumes the increase was 30.3 and 26 bushels, or an average of 28.1 bushels per acre, worth $11.24. This is an average gain of 334 per cent.

With *wheat* following the stubble of cowpeas and velvet beans the increase was 4.7 and 8.7, *an average of 6.7 bushels per acre, worth* $5.36. The gain amounted to 151 and 280 per cent. respectively, an average of 215 per cent.

With *sorghum* the yield of hay was increased by the stubble of the legumes to the extent of 2.01 and 2.15 tons, an average of 2.08 tons of hay per acre, valued at $13.87. *The average increase was* 57 *per cent.*

What Crops Were Most Favorably Affected by the Vines or Stubble of Cowpeas and Velvet Beans.

The data in the following table answer this question.

Increase in first crop attributable to vines or stubble of cowpeas and velvet beans.

Test Crop.	After Legume Vines.			After Legume Stubble.		
	No. of Tests.	% Increase	Value of Increase	No. of Tests.	% Increase.	Value of Increase.
Cotton	4	63	$14.17	1	49	$11.30
Corn..	1	81	6.15	1	32	2.14
Oats..	3	189	6.80	2	334	11.24
Wheat	2	182	4.53	2	215	5.36
Sorghum..	4	78	14.02	2	57	13.87

The percentage increase attributable to either the vines or stubble of cowpeas and velvet beans was greater with fall oats and wheat than with cotton, corn or sorghum. In other words, the *crop that was best able to utilize the nitrogen of the legumes was that one which left the land unoccupied for the shortest time between the maturing of the legume and the beginning of the new growth.* Unpublished parallel experiments with hairy vetch employed as fertilizers confirm this latter conclusion. All the facts before us indicate that after the vines or stubble of a legume are plowed under in a sandy soil the seed of the succeeding crop should be planted before the lapse of many weeks. The early occupation of the soil by roots of the young plants will serve to retain much nitrogen, which would be leached out and carried away in the drainage water if the ground should remain unoccupied for several months.

From what has just been said it should not be inferred that we are advocating the sowing of the small grains or of any small seed immediately after plowing in a large mass of vines. Instead, sufficient time should be given for the soil to become somewhat settled by the action of the rain or of harrow, drag, or roller. Small grain and still smaller seed can usually be sown after a shorter interval where the vines of the legume are utilized for hay or pasturage, leaving only the roots and stubble to be incorporated, than where the entire growth of the legume is turned under in the fall for fertilizer.

If plowing under of cowpea vines takes place after Christmas the mass of vegetable matter will have become so diminished and the stems so weak that the delay in sowing to permit of the compacting of the earth around the vegetable matter will be less necessary, or perhaps unadvisable. But this interval may be quite necessary with velvet bean vines at whatever time they are plowed under, for the mass of matter will be considerable and the material is apt to be buried in large wads.

Referring again to the last table, we see that while the small grains gave the largest percentage increase from the use of a preceding summer legume as fertilizer, the value of the increase was greatest with cotton and sorghum hay. In other words, *cotton made more profitable use of either the vines or stubble of the summer legumes on sandy land than did either corn, oats, or wheat.*

Sorghum responded freely to the abundant supply of nitrogen in the legumes, and it may be accepted as a thoroughly tested proposition that on poor or medium soil any hay plant of the grass family will return a large profit for a judicious application of nitrogen, whether this be in the form of a preceding crop of cowpeas, velvet beans, melilotus, hairy vetch, or crimson clover, or in an application of stable manure, cotton seed, cotton seed meal, or nitrate of soda.

Rotation of Crops the First Step in Soil Improvement.

The general statement may be safely made that any ordinary crop (except peanuts, cowpeas and most other legumes) can usually be produced with far greater profit when it follows some leguminous plant than when its predecessor is some non-leguminous plant, as cotton, corn, the small grains, etc. It may also be added that many, if not most, poor tracts of land can be cultivated in the usual farm crops at a profit only when a legume is occasionally grown to supply the necessary nitrogen, vegetable matter, and improvement in texture and resistance to drought.

A more general use is urged of some rotation that requires all the cultivated upland of the farm to bear cowpeas or other soil-improving plant every second, third or fourth year or oftener. The growing of legumes constitutes the cheapest means of obtaining nitrogenous fertilizers, and on farms where a large proportion of the land is devoted to legumes, the fertilizer bills can be reduced by the discontinuance of purchases of cotton seed meal and by the substitution of high grade acid phosphate for the higher priced ammoniated guanos.

A highly satisfactory rotation for cotton plantations, which has been widely tested, consists of the alternation in the order named of cotton, corn, and any one of the small grains, with cowpeas between the corn rows and also immediately following the small grains. This three-year rotation gives one-third of the land each year in cotton, the cotton immediately following cowpeas sown after small grain. One-half the total area can be devoted to cotton by a four-year rotation on this plan, as follows: Corn with cowpeas, small grain followed by cowpeas, cotton, and cotton.

THE AVERAGE IMMEDIATE FERTILIZING EFFECTS OF VINES AS COMPARED WITH STUBBLE OF COWPEAS AND VELVET BEANS.

Although in the last table a comparison of the percentage increase after vines with that after stubble is not strictly legitimate since the number of tests was unequal, yet that table throws some light on the matter.

A strictly accurate comparison of the fertilizing effects of vines and stubble as measured by the crop immediately following is shown below; in this table only those experiments are recorded where corresponding vine and stubble plots were under identical conditions of soil, date of planting, etc.

Increased percentage of vine plots over stubble plots.

	No. of tests.	%
With cotton as first crop	1	40
With corn do	4	49
With oats do	2	[31]*
With wheat do	2	[20]*
With sorghum do	2	9

*Yield after legume stubble 31 and 20 per cent. respectively greater than after vines, the latter leaving the land too loose, a condition that could probably have been avoided by better preparation.

In the crop immediately following the legumes the vines afforded the larger yield except when accidental circumstances reversed this result with wheat and oats. This excess in the first crop due to plowing under the vines was here considerable, but was it sufficient to make this method of disposing of the vines more profitable than to use them for hay?

Of the several factors on which the answer depends, we will first consider the value per acre of the increase in the first crop immediately succeeding the legume, using the values for a unit of each crop heretofore assumed (see p. . . .) and omitting results with small grains, for reasons given in the footnote.

Average superiority of vines over stubble of legumes as shown in first crop.

	No. of tests.	Increase per acre.	Value of increase	% increase
With cotton as first crop.	1	452 lbs. seed cotton	$11.30	40
With corn as first crop	4	6.6 lbs. corn.....	3.30	49
With sorghum as first crop...	2	.5 ton hay......	3.34	9
Average in favor of vines over stubble	......	....	**$5.98**	

The average increase of $5.98 in the value of an acre of the first crop in favor of plowing in the vines as compared with utilizing only the stubble for fertilizer is evidently so low as to be much less than the value of the 4,030 pounds of legume hay per acre obtained from the stubble plots, which should be priced at not less than $10 per ton. As a partial offset we must bear in mind that in four of the experiments in plowing under cowpea vines the peas were first picked, the average yield in these tests being 11.1 bushels per acre. There is no such corresponding offset with velvet beans, for the seed usually do not mature in the latitude of Auburn.

If we value cowpeas at 50 cents per bushel, plus the cost of hand-picking, we have a second credit for the vines, the sum being $5.55. Adding this to $5.98, the extra value of the first crop after vines, as compared with stubble, we have a total credit for the vines when used as fertilizer of $11.53 per acre in comparison with the value of the cowpea and velvet bean hay when utilized as stock food. The average yield of cowpea hay from the stubble plots was 3,278 pounds per acre, and of velvet bean hay 4,781 pounds, or a collective average of 4,030 pounds of legume hay per acre. At $10 per ton, this would be worth $20.15 per acre. Subtracting from this, $9.50 as above, we have $8.47 as the difference in the *first year's profits* in favor of utilizing the vines as hay. However, other factors must be considered before we have satisfactorily determined whether it was most profitable to use the vines after picking the peas or to utilize the tops of both cowpeas and velvet beans for hay; chief among these factors are the relative residual fertilizing values of vines and stubble as shown by differences in the yield of the second and subsequent crops after legumes.

WHAT IS THE FERTILIZING EFFECT OF VINES AND STUBBLE OF COWPEAS ON THE SECOND CROP AFTER THE LEGUME?

The answer is found in the following table:

	Average increase in second crop after legumes.					
	After vines.			After stubble.		
	No. of tests.	Amt. increase.	% increase.	No. of tests.	Amt. increase.	% Increase.
With corn	5	3.36 bus.	24	5	1.34 bus.	12
With oats	1	7.75 bus.	54			
With sorghum	4	2.15 tons	41			

In the second crop after the legumes there was in every case a considerable increase attributable to the use of the vines as fertilizer.

The fertilizing effect of the stubble as shown by the second crop of corn is much less than the increment due to the vines plowed under many months before.

There is a sixth test with corn not belonging in the preceding table, that gives additional data for a comparison of the second-year effects of vines with stubble. Combining the results of the six tests, we find that the corn grown as the second crop after legumes afforded a larger yield on the vine plots than on the stubble plots to the average extent of 2.1 bushels per acre, or 14 per cent.

The Duration of the Fertilizing Effects of Stubble and Vines of Cowpeas and Velvet Beans.

The stubble of these legumes repeatedly exerted so slight an effect on corn grown as the second crop, (an average of only one and one-third bushels per acre), that we may reasonably conclude that two crops mark the limit to which the benefits of legume stubble extends in cases where the soil is sandy and permeable, as at Auburn. It is quite possible that the advantages from using stubble as fertilizer might have been slightly more enduring in a stiffer soil, but in no case can such a relatively small amount of vegetable matter and nitrogen afforded by the roots and stubble influence the succeeding crops more than a few years.

It is quite a different matter when the vines, representing the entire growth of the legume (except in some cases the pods) are plowed under. We have learned from the data in previous tables that the yield where the vines were used as fertilizer was in the first crop, 63 to 189 per cent. greater than the yield of the corresponding crop immediately preceded by a non-legumenous plant; and that in the second crop the increase ranged from 24 to 54 per cent. The effect exerted by the vines of the legumes on the third succeeding crop was tested in only one field, the increase in oats as the third crop after cowpea vines being 3.2 bushels per acre, or 14 per cent. With sorghum planted in 1901 as the fourth crop immediately after the oats were cut, there was a perceptible increase on the plots where the vines of cowpeas and velvet beans grown in 1898 had been plowed under; extremely unfavorable conditions and partial failure of late sorghum detract from the reliability of the percentage figures for this, the fourth crop. For three years or four crops the large mass of vines continued to exert some influence. This experiment was conducted on a soil of the stiffest type found on the station farm, which, however, is fairly permeable to water, and which might be described as a reddish loam containing an abundance of large flint stones.

We should expect an equal mass of leguminous vegetation employed as fertilizer on clay or prairie soils to exercise a favorable influence for at least three years, or probably for as long a period as do heavy applications of coarse stable manure. Local experiments to determine the permanency of the action of the legumes are greatly needed, and correspondence is invited from parties wishing to make such tests.

It is our expectation to continue work along the lines indicated in this bulletin, and it is highly desirable that these investigations should be extended to include soils of a character different from that at Auburn, though the means of doing this in a thoroughly satisfactory manner are not now in sight.

In conclusion the writer would reaffirm his previous statement, made in Bulletin No. 107 of this station, as follows:

A Rational System of Fertilization.

Considering permanency of effect, as well as influence on the crop immediately following, the cowpea and other leguminous plants must be ranked as a cheaper source of nitrogen than is any nitrogenous material which may be bought as commercial fertilizers. The aim of the cotton farmer should be to grow such areas of legumes as will enable him to dispense with the purchase of nitrogenous fertilizers for cotton, using the funds thus saved to purchase increased amounts of phosphates or other necessary non-nitrogenous fertilizers. The money that would have been necessary to purchase one pound of nitrogen will buy about three pounds of phosphoric acid, or of potash, which larger purchases of phosphate and potash will enable the farmer to grow heavier crops of legumes. And heavier crops of legumes trap larger amounts of otherwise unavailable atmospheric nitrogen and result in further soil enrichment.

In the writer's opinion *the most promising method of increasing the yield of cotton per acre and the profits of cotton culture is by a more general use of leguminous plants as fertilizers.* These invaluable allies are by some farmers utilized and appreciated, but their use might be increased twentyfold with advantage to the current crop, to the permanent upbuilding of the soil, and to the filling of the farmer's pocket. It is putting the case very mildly to say that the average yield of cotton per acre in Alabama might be increased by at least fifty per cent. through the general use of legumes as fertilizers.

APPENDIX. Condensed statement of effects of using cowpea and velvet bean vines or stubble as fertilizers at Auburn.

Legumes.	Vines or stubble.	Test crop. Plant.	Test crop. 1st or 2nd after legumes	Test crop. Year grown	Amt. per acre, increase. From vines.	Amt. per acre, increase. From stubble.	Per cent increase. From vines.	Per cent increase. From stubble.	Superiority of vines over stubble. Am't per acre.	Superiority of vines over stubble. Per cent.	Yield of legumes per acre. Lbs. hay.	Yield of legumes per acre. Bus. cowpeas.	Field.
Cowpea	V. & S.	Corn	1st	'01					8 88	78	1648		D
Cowpea	V. & S.	Corn	1st	'01					.60	2	3920		M
Cowpea	V.	Cotton	1st	'99	367		32					11.8	D
Cowpea	V.	Oats	2nd	'00	5 8*		29*						D
Cowpea	V.	Oats	2nd	'00	9.7		79						D
Cowpea	V.	Sorghum	1st	'97	1.6		86						F
Velvet bean	V.	Sorghum	1st	'97	1.6		85						F
Velvet bean	V.	Corn	1st	'01	12 3		81		5.0	28			D
Velvet bean	S.	Corn	1st	'01		4.3		32			3632		D
Velvet bean	V. & S.	Corn	1st	'00					11 9	76	2800		D
Velvet bean	V. & S.	Corn	2nd	'01					3.9	33			D
Cowpea	V.	Sorghum	1st	'99	2.1		57		0.1	1		13.6	T
Cowpea	S.	Sorghum	1st	'99		2 0		55			6400		T
Velvet bean	V.	Sorghum	1st	'99	3.1		86						T
Velvet bean	S.	Sorghum	1st	'99		2.2		59			5360		T
Cowpea	V.	Corn	2nd	'00	3.6		15		2.0	8			T
Cowpea	S.	Corn	2nd	'00		1 6		6					T
Velvet bean	V.	Corn	2nd	'00	2.6		11		2 4	10			T
Velvet bean	S.	Corn	2nd	'00		.2		1					T
Velvet bean	V.	Cotton	1st	'99	546		64						T
Cowpea	V.	Cotton	1st	'99	696		83						T
Velvet bean	V.	Sorghum	2nd	'00	3.1		61						T
Cowpea	V.	Sorghum	2nd	'00	3.0		59						T
Velvet bean	V.	Oats	3rd	'01	3 2**		14						T
Cowpea	V.	Oats	3rd	'01	3 2		14						T

Velvet bean....	V.	Sorghum.	4th	'01	0.5		60						T.
Cowpeas........	V.	Sorghum.	4th	'01	0.5		50						T.
Velvet bean....	V.	Cotton..	1st	'99	660		72						T.C.
Velvet bean....	S.	Cotton...	1st	'99		208		18	452	40			T.C.
Velvet bean....	V.	Corn.....	2nd	'00	7.5		42		2.6	10			T.C.
Velvet bean....	S.	Corn.....	2nd	'00		2 6		14					T.C.
Cowpea.........	V.	Oats.....	1st	'97	10.4		84						M.
Velvet bean	V.	Oats.....	1st	'98	20.2		240						F.
Velvet bean....	S.	Oats......	1st	'98		30.3		360	¶7 6	¶27	3872		F.
Cowpea.........	V.	Oats......	1st	'98	20 4		242					11.	F.
Cowpea.	S.	Oats......	1st	'98		26.0		309	¶10.1	¶35	2420		F.
Velvet bean....	V.	Corn, late	2nd	'98	2 1		36		0 7	9			F.
Velvet bean....	S.	Corn. late	2nd	'98		1 9		33					F,
Cowpea.........	V.	Corn. late	2nd	'98	0 9		16						F.
Cowpea.........	V.	Corn, late	2nd	'98		0.4		7	¶1.0	¶6			F.
Velvet bean....	V.	Wheat....	1st	'00	5.4		174						F.
Velvet bean....	S.	Wheat....	1st	'00		4.7		151					F.
Cowpea,........	S.	Wheat....	1st	'98	5.9		190					7 9	F.
Cowpea.........	V.	Wheat....	1st	'00		8.7		280	¶2 8	¶31	2004		F.
Sp. Peanuts	††	Rye......	1st	'00.	4280		181						F.
do. nuts remv'd		Rye......	1st	'00	1080		41						F.
Run'g Peanuts..	All.	Rye......	1st	'00	2852		121						F.
Cowpea.........	V.	Rye......	1st	'00	2600		110						F.
Velvet bean....	V.	Rye......	1st	'00	2360		100						F.
Velvet bean....	All.	Rye......	1st	'00	3360		142						F.
Sp. Peanuts....	V.	Sorghum.	2nd	'01	Loss.		Loss.						F.
Run'g Peanuts.	All.	Sorghum.	2nd	'01	960		16						F.
Cowpeas........	V.	Sorghum.	2nd	'01	400		7						F.
Vel. beans (av.)	V.	Sorghum.	2nd	'01	1995		----37						F.

* Nitrate of soda used both on non-legume and legume plot.
** Reducing the increase to that on corresponding cowpea plot.
¶ Stubble afforded the larger yield.
†† Peanuts eaten by hogs on land where grown.

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ALABAMA.

Agricultural Experiment Station

OF THE

Agricultural and Mechanical College,

AUBURN.

DAIRY HERD RECORD AND CREAMERY NOTES.

By R. W. CLARK.

MONTGOMERY, ALA.,
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DAIRY HERD RECORD AND CREAMERY NOTES

BY R. W. CLARK.

Can dairying be made profitable in Alabama is a question often asked.

Short, mild winters, long pasture seasons, and a great variety of soiling crops, along with the output of the oil and rice mills, afford a large field from which to select food stuffs. The State is badly in need of such profits as accrue from dairying and live stock growing in general. The appearance of our rural communities, the impoverished condition of our soils, the tremendous growth of the commercial fertilizer trade, and the vast amount of money (the proceeds of our only money crop, cotton) spent every year for hays, grains, meat and dairy products, are convincing arguments against the exclusive growing of corn and cotton and a strong one in favor of diversified farming.

Dairying builds up the soil. From 75 to 90 per cent. of the fertilizing constituents of the food consumed is returned in the manure. Dairying makes the farmer independent by giving him, daily, a salable product. Food consumed one day is turned into cash the next, and much of the risk incident to making a crop of corn or cotton is avoided. No line of farming in the South is so certain of returns as dairying when intelligently pursued. The long growing season makes the dairyman quite independent of drought, a great menace at times in some sections, especially where the summers are short. Our climate is most salubrious. Many of the cattle diseases common in other sections, caused by close housing are almost unknown. Cattle can be turned out every day so far as temperature is concerned, but they should be housed at night during the winter.

The demand in the South for good dairy products is always strong and especially so at the present time and it is likely to continue so for many years. Cheese sells for 12 to 20 cents per pound, butter 20 to 35 cents per pound, and whole milk for 20 to 40 cents per gallon re-retail.

In calculating the cost of food for each animal in the station herd the value of home-grown stuff was estimated. Bought stuff is figured at its market price.

	Price per ton for the year 1900-01.	Price per ton for the year 1901-02.
Hay	$10 00	$10 00
Ensilage	2 00	2 00
Oat straw	5 00	5 00
Cotton seed hulls	4 00	6 00
Soiling crops (fed green)	2 00	2 00
Wheat bran	20 00	25 00
Cotton seed	9 00	12 00
Cotton seed meal	20 00	22 00
Rice polish	.....	20 00
Skim milk	25c per cwt.	30c per cwt.

The value placed on oat straw in the above table is too low. Pasturage is estimated at fifty cents per month for cows and grown animals and thirty cents per month for young animals.

The following record shows what the station herd did for the two years ending September 1, 1902:

SEPTEMBER 1, 1900, TO SEPTEMBER 1, 1901.

Name of Cow.	Breed.	Age at beginning of milking year. Yr Mo	Average weight—Pounds.	Milk—Founds.	Butter—Pounds.	Cost of keep, including pasture.	Cost of butter per pound. Cents	Cost of milk per gallon. Cents	Profit on butter at 25c. per poond.
Ada	Jersey..	7	828	3,492.8	168.4	$24.29	14.4	5.7	$17.85
Annie	Jersey..	10- 2	804	3,740.4	205.4	21.09	10.2	4.6	30.39
Ida	Jersey..	6	810	4,665.7	232.7	24.90	10.7	4.4	33.27
Houron ...	Jersey..	2	649	3,095.6	216.5	20.69	9.5	5.3	33.55
Susan	Jersey..	2- 6	614	5,065.8	331.7	24.28	7.3	3.8	58.71
Queen	Holstein	9- 4	1003	4,676.3	215.3	28.15	13.0	4.9	25.83
Hypatia ...	Jersey..	5- 1	767	4,218.6	246.0	23.56	9.5	4.6	38.13
Average ..	....	.....	782	4,136.4	230.8	$23.85	10.6	4.7	......

Average per cent. of fat, 4.7.

SEPTEMBER 1, 1901, TO SEPTEMBER 1, 1902.

Name of Cow.	Breed.	Age at beginning of milking year. Yr Mo	Average weight—Pounds.	Milk—Founds.	Butter—Pounds.	Cost of keep, including pasture.	Cost of butter per pound. Cents	Cost of milk per gallon. Cents	Profit on butter at 25c. per poond.
Ada	Jersey..	7-10	805	4,581.3	234.7	$30.97	13.2	5.5	$27.69
Annie	Jersey..	11	880	4,806.6	264.8	30.21	11.4	5.1	35.99
Ida	Jersey..	7- 1	847	3,519.9	193.5	22.74	11.7	5.3	25.73
Houron ...	Jersey..	3	786	2,271.2	159.1	15.43	9.6	5.5	24.50
Susan	Jersey..	3- 8	676	4,316.0	297.9	26.31	8.8	4.9	48.25
Hypatia ..	Jersey..	6	814	4,290.9	225.0	24.93	11.0	4.7	31.50
Hazena ...	Jersey..	2	662	3,321.5	217.7	22.49	10.3	5.5	32.00
Lukie	Jersey..	3- 2	692	4,586.5	286.0	24.75	8.6	4.9	47.01
Clementina.	Red Poll	2-11	1131	2,262.2	113.1	20.90	18.4	7.5	7.46
Average ..	....	....	810.3	3,772.9	221.3	$24.30	11.4	5.4	......

Average per cent. of fat, 5.00.

The greater profit for the year 1900 and 1901 is due to lower prices of foodstuffs, more copious feeding of ensilage during the winter and a better summer pasture. The amount of grain in the ration usually depended upon the character of the grain, the character of the fodder and the condition of the animals. All things being the same, a well developed cow several months along in lactation received less grain per 1000 pounds live weight than a cow not so well developed and not so far along in lactation. With cow pea hay and ensilage the grain part of the ration rarely exceeded 6 and 7 lbs. per day, and often dropped to 2 and 3 lbs. per day. Indiscriminate feeding of grain and poor cows are usually the cause of losses and of small profits to the dairyman. Liberal, judicious feeding and kind treatment go hand in hand.

Ada, although possessing good dairy type, carries considerable flesh, and during the year 1900 and 1901 gave a small profit, it being an off year with her. Clementina is the poorest cow. She is of the beef type and is well covered with heavy flesh. The food cost of Houron for the year 1901 and 1902 is light. She milked heavily when fresh, but began to dry off early and then cow pea hay was partially substituted for grain. Her cost of keep ($15.43) for the year 1901 and 1902 is low because she calved in the summer, did her best on grass and was far along in lactation by winter. This allowed light feeding of grain during the winter (2 lbs. per day), cow pea hay, sorgum hay and oat straw forming the greater part of her ration. The advisability of so light a grain ration is questioned. A long pasture season means cheap production.

Young cattle are usually turned to pasture the latter part of March and are not taken up until about the middle of December. Cows are turned to pasture the middle of April, and then receive grain only while in milk. They are soiled in late fall but depend more or less on pasture until the first of December.

On the whole the yearly productions are smaller than they ought to be. A cow should give from 5000 to 7000 lbs. of milk per year and make not less than 300 lbs. of butter.

COST OF RAISING HEIFER CALVES.

Hazena, a registered Jersey was dropped October 22, 1899, and weighed 56 lbs. The first year she consumed 159 lbs. whole milk, 2738 lbs. of skim milk, 66 lbs. bran, 224 lbs. of hay and was on pasture 161 days. When one year old she had cost $12.86 and weighed 435 pounds. The second year she received sorghum hay, ensilage, oat straw, cornstover and a little cotton seed and bran, and was on pasture 224 days. The cost of keep the second year was $9.09 and she weighed 665 lbs. She dropped her first calf when lacking seven days of being two years old. Total cost of keep up to the time of calving was $21.95.

Ella, a registered Jersey, was dropped August 12, 1900, and weighed 50 lbs. The first year she consumed 259.5 pounds of whole milk, 1195 pounds skim milk, 180 pounds bran, 63 pounds of corn meal, 405 pounds hay and was on pasture 112 days. She cost, including pasture, during her first year, $11.65, and weighed when 12 months old 340 pounds.

The second year, aside from pasture, she received cotton seed, cornstover, oat straw and ensilage. She dropped her first calf when 22 months old. The cost of keep the second year up to time of calving was $7.61, making a total cost of $19.26.

Peggy, another Jersey, was dropped July 23, 1900, and weighed 36 pounds. The first year she consumed 287.5 pounds whole milk, 1097 pounds skim milk, 191.6 pounds bran, 67.8 pounds corn meal, 399 pounds hay and was on pasture 91 days. She cost $11.49 and weighed 350 pounds when one year old. The second year she received the same kind of feed as Ella. She dropped her first calf when just two year old. The cost of keep the second year was $7.99, and the total cost of keep was $19.48.

Jenny, a registered Jersey, was dropped November 24, 1900, and weighed 38 pounds. The first year she consumed 52 pounds whole milk, 1740 pounds skim milk, 45.5 pounds bran, 175 pounds hay and was on pasture 217 days. She cost $9.60 and weighed 295 pounds at one year old.

The second year she received the same kind of food as Ella and Peggy. By reason of an accidental service she dropped her first calf June 24, 1902, at nineteen months of age, and then weighed 445 pounds. The cost of keep for the second year was $7.61, and the total cost of keep for nineteen months was $17.21.

Alamarzena, another registered Jersey, was dropped April 16, 1901, and weighed 50 pounds. She received the same kind of food as the others mentioned above. When one year old she weighed 350 pounds and cost $13.66.

Mabel, Hazena's first calf, was dropped October 15, 1901, and weighed 43 pounds. She consumed 92 pounds whole milk, 1191.2 pounds skim milk, 322.7 pounds hay, 204.2 pounds bran, and was on pasture 165 days. The total cost of keep at one year old was $11.40.

Summary of Cost of Raising Heifer Calves.

NAME.	Cost of keep the first year.	Cost of keep the second year.	Total cost of keep to time of calving.
Hazena	$12 86	$9 09	$21 95
Jenny	9 60	7 61	17 21
Peggy	11 49	7 99	19 48
Ella	11 65	7 61	19 26
Alamarzena	13 66	....	....
Mable	11 40	....	....
Average	$11 77	$8 07	$19 47

Ella, Peggy and Jenny are undersize and would not have been bred so early as they were had not a neighbor's bull, in an enjoining pasture, broken into the Station herd. They are very small, due mainly to early breeding and to a small consumption of skim milk when very young calves.

There can be no set age at which young dairy heifers should be bred. If they are well developed, strong and thrifty they should drop their first calf when 24 to 30 months old.

Heifers should be kept growing from the time they are born until they reach maturity. A shortage of a few dollars worth of feed on the calf will mean a loss of many dollars at the pail when the calf becomes a cow. If material advancement is to be made in animal breeding the pregnant mother must be well fed. The fœtus should be well nourished from the time the dam conceives until it is dropped and has reached the goal to which it is destined.

REMOVING BITTER WEED TASTE FROM CREAM.

During the last three years considerable effort has been made to find a means by which the odor and taste of wild onion and bitter weed may be removed from milk and cream. In the spring of 1901 the writer was requested to try a patent compound claimed to remove all kinds of weedy taste from milk. It was fed to the Station herd according to the directions of the manufacturer for four weeks, in which time it proved to be an absolute failure. Cooking soda (saleratus) was also given a like trial but failed of the purpose claimed for it by some people. Having failed so far to find anything that when fed to the cows would remove weedy taste in the milk, the next step was treating the milk and cream.

The following are creamery notes taken in the carrying out of this work:

Treatment of cream before running through the separator.	*Notes on treated cream after coming from the separator; the untreated cream being very bitter*
One gallon of cream was thoroughly mixed with 2 gallons of water, at a temperature of 150° F., in which one ounce of saltpeter had been thoroughly dissolved.	Bitterness removed, but flavor of cream not good, rather soapy.
Same as above, but no saltpeter used.	Not a trace of bitterness in the washed cream.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Not a trace of bitterness in the cream, and of a fine flavor.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F., and containing 1 oz. of saltpeter.	Bitterness removed, but cream not very good.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Excellent cream, not a trace of bitterness.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 68° F.	A slight trace of bitterness in the cream, but this would not ordinarily be detected.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 69° F.	Slight trace of bitterness in the cream.

Bitter weed taste was removed entirely from cream by thoroughly mixing it with two or more parts of water at any temperature above 70 deg. Fahrenheit, and then running the whole through the separator.

Saltpeter dissolved in water was tried as an aid in removing the bitterness, but as good results were secured without it as with it.

Rapidly and slowly heating milk and cream to various high temperatures did not remove bitterness but often imparted a cooked taste.

Butter made from washed cream (as above) was pronounced free of all bitterness by the Station customers. Butter made from unwashed cream was decidedly bad and was often rejected by the customers. No means were found to remove the bitter weed taste from whole milk

In the spring of 1902 milk and cream were treated for the wild onion flavor the same as in the previous year for the bitter weed taste.

The following are the creamery notes taken in the course of this work:

Treatment of cream before running it through the separator.	*Notes on the treated cream after coming from the separator.*
One gallon of cream was thoroughly mixed with three gallons of water at a temperature of 90° F.	Flavor not removed; cream still bad.
One gallon of cream was mixed with two gallons of water, at a temperature of 90° F., in which was dissolved one ounce of saltpeter.	Flavor bad, and made more so by the use of saltpeter.
Same as preceding treatment.	Flavor still bad.
Same as preceding treatment, except temperature of water 100° F.	Flavor still bad.
Same as preceding treatment.	Flavor bad.
One gallon of cream was mixed with two gallons of water at a temperature of 212° F., in which was dissolved one ounce of saltpeter.	Flavor still bad.
Same as preceding treatment.	Flavor very bad, and butter from this cream was rejected by the station customers.
Same as preceding treatment.	Same result as above.
One gallon of cream was mixed with two gallons of water, at a temperature of 95° F.	Cream bad.

The odor and taste of wild onion was not removed from the milk and cream by any method of treatment employed. Cream was washed as above with and without saltpeter, and at different temperatures, but the onion taste and flavor were not removed. Butter made from the treated cream was rejected by the Station customers, Rapidly and slowly heating milk and cream to various high temperatures did not remove the objectionable qualities imparted by the onion.

Cream was thoroughly mixed with ether and carbon bisulphide and these were then evaporated. The onion flavor was partly removed in both cases, but the cream retained enough of the ether and carbon bisulphide to render it unfit for use.

The compound in the bitter weed which gives milk a bitter taste is held very largely, if not entirely, in the milk serum. The more completely the serum is separated from the fat the less is the degree of bitterness in the cream. The compound in the wild onion which gives milk a bad flavor is held very largely, if not entirely, by the fat, and the more completely the serum is separated from the fat the more concentrated is the onion flavor in the cream.

Washing cream makes it thick and necessitates adding considerable skim milk, which may be a starter, to bring it to a proper consistency before churning. If a large amount of starter is used to thin with, a shorter length of time is required for ripening, therefore the cream should be watched closely until the proper degree of ripeness is reached.

The term starter as used above means sour milk that is used to sour the cream.

Cream containing bad flavors but not sour enough to be clabbered, can often be improved by washing. The thicker the cream the less likely is it to sour and clabber.

DIFFERENT SYSTEMS OF CREAMING.

The question is often asked, does it pay to run a cream separator for a small amount of milk.

The following table gives the average per cent. of fat left in the skim milk by the different systems of creaming, but at different temperatures. As the use of ice, on the average farm in Alabama, is generally out of the question, it was not used, but conditions were taken as they exist on the average farm, and the results secured are believed to be fairly representative of practical conditions. This work was done in August when the weather was hot, except that one of the deep setting tests was made in April.

SEPARATOR VERSUS DEEP SETTING VERSUS SHALLOW PANS.

System.	Temperature, Degrees F.	Per cent. of fat in skim milk. Average.	Min.	Max.
Separator	81.0	.03	.01	.20
Deep setting	50.0	.54	.30	1.10
Deep setting	83.6	1.30	.80	1.80
Shallow pans	85.7	.60	.35	1.00

There is a heavy loss in creaming milk by the gravity system. During hot weather the loss may be one-fourth to one-third of the total butter fat. Shallow pans give better results than deep cans. With the separator the loss of fat in the skim milk was very slight, hardly worth considering. Where facilities for handling cream and butter can be had, and where the skim milk is practically wasted, it will pay, according to the data in the above table, to have a separator for even as small a number as two good cows. These two cows together ought to produce 12,000 pounds of milk per year. One-eighth of the whole milk being cream, there will be 10,500 pounds of skim milk. As the separator leaves only .03 of one per cent. of fat in the skim milk, there will be a loss during the year of 3.1 pounds of butter fat, the equivalent of 3.6 pounds of butter. With deep setting, at a temperature of 83.6 degrees Fahrenheit (a close approximation to our summer temperature), there will be a loss of 159 pounds of butter in the skim milk, between one-third and one-fourth of the total. With shallow pan setting at a temperature of 85.7 degrees Fahrenheit, the loss will be 73.5 pounds of butter in the skim milk. Along with the saving of butter fat a separator gives better cream, a better butter and better skim milk. The cream separator is indispensable to the dairyman of the Gulf States of the South.

THE EFFECT OF FOOD ON THE MELTING POINT AND VOLATILE ACIDS OF BUTTER.

In the year 1901 feeding experiments were carried on to ascertain the effect of different amounts of cotton seed, cotton seed meal and cotton seed hulls, in combination with bran and sorghum hay, on the composition of butter, and for this purpose six cows were divided into two lots of three each. They were fed in the barn all that they would eat up clean twice a day, and were confined to stalls during the night. One week of preparatory feeding preceded the experiment proper, which lasted for four weeks.

FOOD AND AVERAGE COMPOSITION OF BUTTER FROM EACH KIND OF FOOD.

Group.	Ration.	Melting point of butter degrees centigrade.	C. C. of alkali required to neutralize the volatile acid in 2.5 grains of fat.
I	9 pounds cotton seed 3 pounds bran 10 pounds sorgum hay	41.1	13.2
II	5¼ pounds cotton seed meal 3 pounds bran 10 pounds cotton seed hulls	40.7	13.47

There is practically no difference in the melting point and volatile acids of the butter made from the above rations.

Analysis of a sample of Northern butter, made at the same time, in which no cotton seed products were fed, gave a melting point of 24.5 degrees (centigrade), and required 13.5 c. c. of alkali to neutralize the volatile acids in 2.5 grams of fat.

During April and May nine cows were divided into four lots of two cows each and one lot of one cow. They were fed grain night and morning and confined to the barn only while eating their grain and being milked. Pasture was the only forage received and consequently all received of it alike. The feeding period proper lasted three weeks.

FOOD AND AVERAGE COMPOSITION OF BUTTER FROM EACH KIND OF FOOD.

Group.	Ration.	Melting point of butter degrees centigrade.	C. C. of alkali required to neutralize the volatile acid in 2.5 grams of fat.
I	3 pounds cotton seed 1 pound bran	41.76	10.6
II	3 pounds co.ton seed meal 1 pound bran	41.92	9.6
III	5 pounds cotton seed meal 1 pound bran	39.6	10.37
IV	8 pounds cotton seed meal 1 pound bran	40.84	10.1
V	4 pounds bran	38.6	9.65

Feeding cotton seed and cotton seed meal to cows on pasture, had a slight effect in hardening the butter, increasing the melting point from 1 to 3 degrees centigrade. Three pounds of cotton seed meal and one pound of bran gave as hard a butter as eight pounds of cotton seed meal and one pound of bran.

The volatile acids in the butter were not materially affected by the different rations.

MILK PRESERVATIVES.

A study of milk preservatives for composite testing, was made in order to ascertain the one best suited to our conditions. Potassium bichromate, mercuric chloride and formalin were used. Each cow's milk was sampled as soon as drawn, and the sample taken was put into a glass jar. At the end of the week these composite samples of milk were tested for butter fat and notes taken, which are herewith presented.

Potassium bichromate, grains used for one pint of milk.	Mercuric chloride, grains used for one pint of milk.	Formalin.	Season.	Remarks.
3.08	....	....	Winter...	Test very good.
3.82	....	....	Winter...	Test fairly good.
4.62	....	....	Winter...	Test fairly good.
5.35	....	....	Winter...	Test fairly good.
....	3.85	....	Winter...	Test very poor.
....	4.62	....	Winter...	Test not satisfactory
....	6.16	....	Winter...	Test not satisfactory
....	7.7	....	Winter...	Test not satisfactory
3.08	....	....	Summer..	Test not satisfactory
3.82	....	....	Summer..	Test not satisfactory
4.62	....	....	Summer..	Test not satisfactory
5.35	....	....	Summer..	Test not satisfactory
....	3.85	....	Summer..	Test not satisfactory
....	4.62	....	Summer..	Test not satisfactory
....	6.16	....	Summer..	Test not satisfactory
....	7.7	....	Summer..	Test not satisfactory
....	....	½%mixture	Summer..	Very satisfactory test, clear, no sediment below fat line.

Three to four grains of potassium bichromate in a pint of milk served fairly well as a preservative, this material being best in the winter but requiring too frequent duplication of test in the summer when the weather is hot. It causes a more or less leathery condition of the cream which is difficult to re-emulsify, and in hot weather the milk often undergoes a fermentation which causes a loss of butter fat. The milk should not be over one week old before being tested.

Mercuric chloride proved unsatisfactory in nearly every test with composite samples. The tests were very ashy.

One-half per cent. formalin (40 per cent. formaldehyde) proved the most satisfactory of the three preservatives tried and is now being used entirely at the Station. Half a teaspoonful of formalin to one pint of milk makes a one-half per cent. mixture.

Potassium bichromate, mercuric chloride and formaline are poisonous when taken internally and should be handled with care.

One-half teaspoonful of formalin will keep a pint of milk in good condition for testing for one month in any season.

CHURNING EXPERIMENTS.

During the winter of 1900 and 1901 experiments were carried on to ascertain the degree to which cream should ripen before being churned. It has usually been assumed that a fairly high per cent. of acid and a high temperature are necessary in churning the cream of milk from cows receiving cotton seed or cotton seed meal.

Moderate acidity and high temperature compared with low acidity and low temperature.

No. of trials.	Pounds of cream churned.	Per cent. fat in cream.	Per cent. acid in cream.	Temperture of churning.	Minutes churning.	Per cent. fat in Buttermilk.	Melting point of butter. Degrees centigrade.
14	18	33	.37	70	16.7	.56	37.4
10	18	33	.25	63	33.4	.19	39.6

In the 14 trials with an acidity of .37 per cent. and a temperature of 70 degrees Farenheit, the minimum and maximum per cent. of fat in the buttermilk was .1 and 2.5 per cent. respectively. In the ten trials with an acidity of .25 per cent. and a temperature of 63 deg. Fahrenheit, the minimum and maximum per cent. of fat in buttermilk was .05 and .5 per cent. respectively. The most exhaustive churning was made in 40 minutes at a temperature of 67 deg. Fahrenheit, with an acidity of .49 per cent. A ten gallon churn was used in this work. All of the cream was from cows receiving a heavy ration of uncooked cotton seed. The tests were made during the time when cows were on dry food.

In connection with this work notes were taken on the churnability of cream containing high and low percentages of fat. Cream containing 50 per cent. fat or more stuck to the sides of the churn and usually had to be thinned with water before the churning was complete. The best churnings were made with cream containing 33 per cent. fat. Cream containing less than 25 or 30 per cent. fat did not churn well, it being too thin. The cream containing 50 or 60 per cent. fat had better keeping qualities than the cream containing 25 or 30 per cent. fat, because a large per cent. of the bacteria that cause trouble in the latter was eliminated in the skim milk. In ripening thick cream a large quantity of a weak starter should be used. This will give good consistency to the cream and consequently a better churning will be secured.

Churning whole milk with dash and barrel churns. As nearly all of the butter made in Alabama is made from whole milk by the use of the dash churn a few trials of comparing the dash churn with the barrel churn were considered expedient.

DASH CHURN VS. BARREL CHURN.

Pounds of milk churned.	Temp. of milk when churned, Degrees Fah.	Minutes churning.	Per cent. of fat in Buttermilk.
12-GALLON BARREL CHURN.			
16.2	66	55	.55
14.	85	23	.42
12.	85	13	1.
25.	70	60	1.
27.	75	16	.5
Ave. 18.8	76.2	33.4	.69
3-GALLON DASH CHURN.			
11.	75	16	.5
11.	80	15	.5
8.	85	15	1.
11.	85	40	.4
11.	66	10 1	.55
Ave. 10.4	78.2	37.4	.59

According to the above reported trials, with their wide variations, the dash churn gives practically the same results as the barrel churn, and vise versa. In the tests reported above the milk, when churned, was in good condition, and was well clabbered.

With the barrel churn the buttermilk can be drawn off from the bottom, and the butter washed better and more easily than with the dash churn. This is the only advantage that the author can see of the barrel churn over the dash churn for churning whole milk.

The method of churning whole milk is practicable and advisable in the South during the summer months when the weather is hot and ice can not be had, and when all of the buttermilk is consumed by the family. Fairly good butter for local and immediate consumption can be made if the milk is cooled as much as possible when drawn, and sour milk (starter) of good quality added immediately. When the temperature can not be controlled to any extent the ripening (souring) should begin at once.

Modern dairy methods must be adopted by the South if it receives the full benefit of its natural dairy advantages.

SUMMARY.

1. The average yearly production per cow in the Station herd, for the two years ending September 1, 1902, was 3954.6 pounds of milk and 226 pounds of butter. The average yearly cost of keep per cow was $24.07; the average cost of butter per pound was 11 cents, and the average cost of milk per gallon was 5.5 cents.

2. The average cost of raising a heifer calf the first year was $11.77, the second year $8.07 and the total cost to time of calving was $19.47.

3. Bitter weed taste was removed from cream by mixing it with two or more parts of water at any temperature above 70 deg. Fahrenheit and then running it through a cream separator. No means were found by which bitter weed taste could be removed from milk. The compound in the bitter weed which gives milk a bitter taste is held very largely, if not entirely, in the milk serum. The more completely the serum is separated from the fat the less is the degree of bitterness in the cream.

.4 Wild onion flavor was not removed from cream by mixing it with water and then running it through the cream separator. Saltpeter dissolved in the water thus used was of no value. No method was found by which the onion flavor could be removed from either milk or cream. The compound in the wild onion which gives milk a bad flavor is held very largely, if not entirely, by the fat, and the more completely the serum is separated

from the fat the more concentrated is the onion flavor in the cream.

5. The average percentages of fat left in the skim milk by the separator, deep cans and shallow pans were .03, 1.3 and .6 respectively. Shallow pans gave decidedly better results than deep cans. The separator is indispensable to the dairymen of the South.

6. A ration consisting of 9 lbs. cotton seed. 3 lbs. wheat bran and 10 lbs. sorghum hay gave a butter practically equal in firmness and volatile acids to a butter from a ration consisting of 5¼ lbs. cotton seed meal, 3 lbs. wheat bran, and 10 lbs. of cotton seed hulls. Feeding cotton seed and cotton seed meal to cows on pasture increased the melting point of the butter 1 to 3 degrees centigrade. Three pounds of cotton seed meal and one pound of wheat bran gave as hard a butter as eight pounds of cotton seed meal and one pound of bran. The volatile acids in the butter were not materially affected by the different rations.

7. Potassium bichromate, mercuric chloride and formalin were tried as preservatives for composite sampling. One-half per cent. mixture of formalin (40 per cent. formaldehyde) gave the best results. One-half teaspoonful of formalin will keep a pint of milk in good condition for testing for one month.

8. In churning cream from cows receiving cotton seed and cotton seed meal .25 of 1 per cent. lactic acid in the cream, with a temperature of 63 deg. Fahrenheit, gave a more exhaustive churning than .37 of one per cent. of lactic acid with a temperature of 70 degrees Fahrenheit.

9. In a churning experiment of five trials, the dash churn proved as satisfactory as the barrel churn for churning whole milk.