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Agricultural and Mechanical College,

EXPERIMENT STATION,

AUBURN, ALABAMA.

Co-operative Soil Tests of Corn

—BY—

A. J. BONDURANT.

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CO-OPERATIVE SOIL TEST EXPERIMENTS FOR 1894.

Fertilizers, mixed at the Experiment Station, were sent to twenty-seven farmers living in different sections of the State, for Co-operative Soil Test Experiment on Corn.

The ferilizers sent out consisted of 250 pounds of cotton seed meal, and 250 pounds of acid phosphate.

The land to be used for this experiment was two plots of one-half acre each.

Plot No. 1 was to receive all of the fertilizer. Plot No. 2, no manure.

The object of this experiment was to ascertain the greatest quantity of corn that could be produced on a half acre of land, with a given quantity of fertilizer, as compared with a half acre unmanured.

The following instructions were sent to each one of the Co-operative Soil Test Experimenters:

Break the land broad-cast. When ready to plant, lay-off rows with a shovel plow. Each sack of fertilizer sent contains 125 pounds. Scatter two sacks in the furrow and follow with a scooter plow in order to mix thoroughly with the soil. Drop the corn in the furrow and cover with a scooter. When the corn is up, thin to one stalk in the hill. If the land is not already in excellent condition, plow *deep* at first plowing. All subsequent plowing should be done shallow and with a heel scrape if possible.

Some time in May scatter the other two sacks of fertilizers broad-cast, and at this time plant a row of peas in each *corn middle*. The planting of the peas and plowing in the fertilizer will be done at the same plowing.

Keep a record of the time of planting, of the method of cultivation and of the difference between the manured and

unmanured plots or half-acres, and note whether the fodder ripens at the same time, or not, on both plots.

Weigh corn in the *shuck*, and report as soon as convenient after gathering.

The following tabulated reports show the results of the experiments:

Corn Experiment by Mr. E. J. Beasley,

Red Level, Covington County, Alabama.

Soil—Red, with Red Clay sub-soil.

Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers, use Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. per bush., weighed in shuck.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1243.....	2486.....	31⅓
2	½ "	Nothing.....	755.....	1510.....	18⅞

Mr. Beasley says that he prepared his land according to instructions from the Station.

Corn was planted March 10th, on the 25th killed by freeze. On the 14th of April planted the second time, securing a good stand. First plowing was done with a scooter, and succeeding culture with scrape and scooter. Just as corn was bunching for tassel, a drought began, which lasted three weeks. A good rain fell at the close of this drought, and another three weeks drought came on which cut off the fertilized half acre, fully one half. The unfertilized plot did not seem to suffer much for rain. Mr. Beasley thinks that the first application of fertilizer was lost on account of the heavy rains in April and May.

Corn Experiment by Mr. M. A. Bishop,

Madison, Madison County, Alabama.

Soil—Dark Loam with Red Clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1262.....	2524.....	31½
2	½ "	No Manure	878.....	1756.....	21 9–10

The land on which this experiment was made, Mr. Bishop writes, was planted in cotton for four years in succession previous to the corn, was high upland, and well adapted for corn with favorable seasons. Planted corn March 22d, in the face of inauspicious seasons, varying from cold to dry. From April 6th to June 27th, three months lacking one week, no rain fell; and although the crop was much injured from this drought, the fertilized plot started off in advance and maintained a difference, and a good color, although the growth was slow for want of rain. After the rains set in, the fertilized plot developed a large, vigorous growth, but the ears were not in proportion to size of stalk. Plot 2, or the unmanured half acre, was the reverse as to results, the stalks being medium in size and the ears well developed. The quality of corn good from both plots.

The variety of corn used was a cross of Hickory King and Tennessee Gourd-seed.

The crop of peas on No. 1 was very fine, and will pay the rent of land, while No. 2 scarcely made the seed planted.

The variety of peas planted was the "Unknown," and was furnished by the Agricultural Department at Washington, at the suggestion of your Station.

Peas were late in ripening, which prevented the gathering of the corn until September 25th.

Corn Experiment by Mr. F. W. Bradley.

Walker Springs, Clarke Co., Ala.

Soil—Sandy with red clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Acre.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bushels, allowing 80 lbs. in the shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	896.....	1792.....	22 2-5
2	½ "	No Manure.....	435.....	870.....	10⅞

Mr. Bradley says that the land on which the experiment was made was old sandy soil never before fertilized. Broke the land deep broad cast, laid off rows as directed and applied 250 lbs. fertilizers at time of planting which was Mar. 27th. Failed to get a stand and planted again April 14th, and failing again, replanted the second time April 26th, when a good stand was secured. Thinned to one stalk to the hill. First plowing was done with shovel and sweep. Used the other 250 lbs. fertilizer at second plowing. Plowed corn every two weeks. Injured very much from drought.

Corn Experiment by Mr. G. W. Compton.

Wayne, Marengo Co., Ala.

Soil—Dark sandy with clay subsoil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	538.....	1076.....	13 3-7
2	½ "	No Manure.....	196.....	392.....	4 9-10

Mr. Compton writes: "I planted corn Mar. 16th, at which time I put in one-half the fertilizers. Corn came up and looked well until the last of April. Rains were plentiful until the 19th of April. On May the 12th a light shower fell, at which time I applied the other half of fertilizers, and there was no more rain until the 19th of July, which made 67 days without rain. The fertilized corn burned up to the ear. The crop is about one-half what it would have been with seasons.

Corn Experiment by Mr. R. H. Cross.

Letohatchie, Lowndes Co. Ala.

Soil—Dark sandy with clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers, use Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal 250 lbs. Acid Phos.	1820...	3640...	45½
2	½ Acre.....	No Manure.....	980...	1960 ..	24½

The results of Mr. Cross's experiment are more satisfactory than some others, which may be attributed to the favorable seasons. He says this acre was in cotton last year (1893) from which he gathered a good crop. In February, the land was broken with a Double Avery plow, turning under the cotton stalks. On March 1st laid off rows 5½ feet wide with a long scooter, distributed fertilizer and bedded on it, with a Pony Avery plow. Next day opened furrows and planted the usual way, and in a few days had a perfect stand.

Cultivated the crop very shallow after the first plowing.

The seasons were all that could be desired for a perfect development of stalk and ears.

A magnificent crop of peas is made which were planted at the last plowing of corn.

Corn Experiment by Prof. H. Benton.

Uniontown, Perry Co., Ala.

Soil—

Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	626....	1252....	15 6-10
2	½ Acre.....	No Manure.	468....	936....	11 7-10

Mr. Benton accompanies his report with the following remarks: "The land used for this experiment was a rich bottom. The small yield was due to the long drought from April 11th to July 16th. All corn in this immediate vicinity suffered likewise.

One noteworthy fact is that the experiment shows that fer-

tilizers will increase the yield on canebrake lands, a fact which is denied by most farmers of this section."

Corn Experiment by Mr. John F. Deer.

Monroeville, Monroe Co., Ala.

Gray sandy soil with clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	800....	1600....	20
2	½ Acre.....	No Manure.....	483....	966....	12 1-16

This experiment was planted March 13th, instructions being followed as to preparation, putting in fertilizer, &c. Corn was killed and replanted March 30th, resulting in a good stand. Mr. Deer says on the 14th of April, run around corn with a "half-twister" barring it off, in which condition it remained until the 26th, when the dirt was thrown back to it. Hoed it May 1st and on the 3d plowed out middles. Run around corn May 15th with Dixon sweep, planted the "Unknown" pea in this furrow three days afterwards and covered with the same sweep. On the 31st plowed out the middles.

Second application of fertilizes made at time of planting peas, May 18th.

Good rains, in fact there was too much rain up to the 24th, and none from that time to the 17th of June. For four days previous to this rain corn failed rapidly and a fair estimate is, that it was cut off one-third.

Fertilized plat grew rapidly from the beginning and appeared to be about 10 days earlier than the unmanured.

Much of plot 2 was destroyed by worms. While plot 1 averaged 90 hills to the row, plot 2 averaged 60 hills.

Corn Experiment by Mr. R. M. Dick.

Albertville, Etowah Co., Ala.

Red loam soil—red clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield in bush. per acre, allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre	250 lbs. C. S. Meal 250 lbs. Acid Phos.	978...	1956...	24½
2	½ Acre	No Manure	485...	970...	12⅛

Mr. Dick says that on the 19th and 20th of May a cold spell injured the corn very much, at which time plot 1 was twelve inches high, vigorous and green, and plot 2 was four inches high, yellow and not vigorous. Plot 2 was not damaged so much as the other plot, it being less forward. Mr. Dick remarks that one thing developed, "that Sand Mountain soil will stand as heavy fertilizing as river or creek bottoms, so far as moisture is concerned."

Corn Experiment by Maj. E. M. Davis.

Prattville, Autauga County, Alabama.

Plot Number.	Size of Plot.	Fertilizers used per plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre	250 lbs. C. S. Meal 250 lbs. Acid Phos.	593	1186	14 4-5
2	½ Acre	No manure	389	778	9 7-10

Mr. Davis says: "This has been a bad year for fertilizers in this country, the extremely dry spring and early summer seem to have caused the plant to lose the benefit of the 250 lbs. applied at planting time."

Corn Experiment by Mr. R. T. Ewing.

Round Mountain, Cherokee County, Alabama.

Soil—Gray sandy (piney woods) yellow clay sub-soil. Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1165	2330	29⅛
2	½ Acre	No Manure	793	1586	19 4-5

Mr. Ewing reports that he planted corn on April 7th, and owing to the late cold Spring, had to replant three times before securing a stand. Preparation of land, putting in fertilizers, &c., were according to instructions. On 2nd of May run around corn with scooter and scrape, and on the 5th plowed out middles. On the 12th run around with scooter and scrape and followed with hoe. Did the same on the 22d. On May 31st run a furrow in the middle of each row, dropped peas in this furrow, scattered the other 250 lbs. fertilizer broadcast and plowed out with scooter and 20 inch scrape.

All of May and the early part of June was dry and the fertilized portion of experiment stood drought better than the other.

Corn Experiment by Prof. J. B. Espy.

Southeast Alabama Agricultural School, Abbeville, Henry County, Alabama.

Soil—Sandy. Sub-soil, sand and clay mixed.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn in the ear.		Estimated yield per acre in bush., allowing 70 lbs. in the ear to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	726.....	1452.....	20 5-7
2	½ Acre.....	No Manure..	403.....	806.....	11½

The report of this experiment, as will be seen from the above table, was made in the *ear* instead of in the shuck. The estimate is made at the rate of 70 lbs. of ear corn to a bushel of shelled, that being the custom. Prof. Espy says that the corn was planted Mar. 12th, but owing to a freeze killing it, was replanted April 14th.

Fertilizer on plot 1 was put on at time of planting, that is the first application and the other 250 lbs at last plowing. First plowing May 8th, second May 23d, and third and last plowing, June 9th. Seasons very unfavorable, no rain for two months after the first plowing.

Prof. Espy thinks the last application of fertilizer did very little good.

Plot 1 yielded 165 lbs. fodder and plot No. 2, 98 lbs.

Corn Experiment by Dr. John Gordon.

Healing Springs, Washington County, Alabama.

Soil—Sandy loam. Sub-soil about the same.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs C. S. Meal. 250 lbs. Acid Phos.	750....	1500....	18¾
2	½ Acre.....	No Manure.....	288 ...	576 ...	7 1-5

Dr. Gordon makes the following statement about his experiment: "The experiment was almost a complete failure in consequence of the dry weather in May and June, and the excessive rains in July and August. I followed instructions in preparing land and cultivating crop. Planted corn Apr 6th in 5 feet rows. Plowed May the 7th, thinned to a stand and sided up on the 17th. Plowed with heel scrape June 12th, planted peas and put down the other 250 lbs fertilizer at this time."

Corn Experiment by Mr. J. A. Logan.

Clanton, Chilton County, Alabama.

Soil—Mulatto and sandy. Sub-soil, red clay.

Plot. Number.	Size of Plot.	Fertilizers used per Plot	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds corn in shuck to bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1103....	2206....	27 3-5
2	½ Acre.....	No Manure.....	570 ...	1140....	14¼

Mr. Logan, in selecting his ground for experiment, says that he got an acre as level as possible, plowed it broad-cast from 4 to 6 inches deep on Mar. 1st, and on the 24th run off rows 5 feet apart, using mold board, put in 250 lbs. of fertilizer and run a small plow through it in order to mix it with the soil. In this furrow he dropped the corn and covered with one furrow. On April the 2nd put another furrow on opposite side.

The experiment was cultivated according to directions and did not lack for work. On May 22nd the other 250 lbs. fertilizer was scattered broad-cast, corn plowed, hoed and put to a stand. Bud worms were very injurious and with difficulty succeeded in getting a stand. From the 14th to the 22nd of May, light showers and some little rain in June, but the corn was in a wilted condition half the time. Mr. Logan thinks on account of the dry weather, that the last 250 lbs. of fertilizer did but little good.

Corn Experiment by Mr. J. P. Oliver.

Dadeville, Tallapoosa Co., Ala.

Soil—Gray sandy—sub-soil, clay.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs corn in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1110....	2220....	27¾
2	½ Acre.....	No Manure.....	960....	1920 ..	24

Corn was planted April 1st. Preparation of land, applying fertilizers and culture of crop according to instructions. Mr. Oliver says that the long and very severe drought at the time the corn was tasseling and silking, reduced the yield

considerably. No fodder was saved—all burnt up and peas failed to come up, the ground being so hot and dry.

Corn Experiment by Mr. J. C. Ott.

Florence, Lauderdale Co., Ala.

Soil—Gray and gravelly—sub-soil, clay.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bushels, allowing 80 lbs. in the shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1622	3644	40½
2	½ Acre	No Manure	1390	2780	34¾

While this experiment was considerably damaged by cold in the spring according to Mr. Ott's opinion, yet the yield is quite satisfactory. He says it was planted on clover land which was broken flush last fall, and this in connection with favorable seasons after the crop started off, is the reason why there is so little difference between the manured and unmanured plots.

Corn Experiment by Mr. T. M. J. Porter.

Georgiana, Butler Co., Ala.

Soil—Light sandy—sub-soil, red and yellow sand.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre	250 lbs. C. S Meal. 250 lbs. Acid Phos.	1617	3234	40 3-7
2	½ Acre	No Manure	945	1890	23⅝

Mr. Porter says he carried out instructions according to the letter. The plot was selected in a field planted in oats last year (1893), but a portion of the plot had peas on it the year before, and the difference in the corn where the peas had been grown was so marked as to attract the attention of every visitor who saw it.

May 16th plowed corn the last time, and at this time put down the last fertilizer and planted peas. From the 2nd of May until the 17th of June, had no rain. Mr. Porter says he thinks the crop would have doubled in yield, had the seasons been favorable. His opinion is that the "*intensive system*" is the best, as better crops are insured and the land vastly improved by it.

Corn Experiment by Mr. M. H. Sellers.

Geneva, Geneva Co., Ala.

Soil—Sandy, with sub-soil of clay and sand mixed.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	550	1100	13¾
2	½ Acre	No Manure	200	400	5

Mr. Sellers reports that he planted corn on March 15th, was killed by freeze on the 28th, and replanted April 10th. Thinned to a stand April 18th, and cultivated with scrape and sweep.

Corn Experiment by Mr. Wm. Martin.

Greensboro, Hale Co., Ala.

Soil—Sandy loam—sub-soil, clay.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bushels, allowing 80 lbs. to the bushel in the shuck.
			Per Plot	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1400.....	2800.....	35
2	½ Acre	No Manure.	940.....	1880.....	23½

Mr. Martin in rendering his report simply says that the experiment suffered some for want of rain. The inference is that preparation of land, planting, culture, &c., were all according to instructions.

Corn Experiment by Mr. T. A. Snuggs.

Holly Pond, Cullman Co., Ala.

Soil—Sandy and gravelly—sub-soil, yellow sand.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bushels, allowing 80 lbs. in the shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1195.....	2390.....	29⅞
2	½ Acre.....	No Manure.....	715.....	1430.....	17⅞

Mr. Snuggs says he planted corn April 21th. Secured a good stand. No rain from date of planting until June 21st,

being two months without rain. On June 21st, a severe wind and rain storm came which damaged the experiment, particularly the fertilized portion.

Corn Experiment by Mr. J. H. Radney.

Roanoke, Randolph County, Alabama.

oil—Light sandy, clay sub-soil.
Rows 70 yards long, 5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1960	3920	49
2	½ Acre	No Manure	1312	2634	32¾

Mr. Radney reports that the corn was closely slip-shucked and that the weight of shucks from 75 lbs. were 4¾ lbs. In this instance, as well as several others, 80 lbs. in the shuck are *too much to allow* to the bushel but an *average* was necessary to all alike. Supposing that 76 lbs. were allowed in this instance, which would be about correct, the yield from plot No. 1 would show nearly 51½ bushels per acre, and plot No. 2, in proportion.

Corn Experiment by Mr. A. C. Walker,

Wheelers Station, Lawrence County, Alabama.

Soil—Sandy, yellow clay foundation.
Rows 70 yards long, 5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds corn in shuck to bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	1176....	2352....	29¼
2	½ Acre.....	No Manure.....	630....	1260...	15¾

Mr. Walker makes the following statement concerning preparation, planting, culture, &c.: March 12th, broke land with single Oliver chilled plow, the soil being too thin to use the double plow as it would have turned up too much clay. Then harrowed over and planted in 5 feet rows. Before planting, drilled the fertilizer in the rows, run a scooter in it to mix it thoroughly with the soil, dropped the corn and covered with a scooter, using two lists. The seasons were all that could be desired up to May 15th. Plowed over with Iron Age 5 tooth Cultivator and planted peas in middles, at the same time sowing the other two sacks of fertilizers. Corn grew off well, was laid-by June 1st, seasons still very favorable. July 13th, manured plot began to tassel and silk, and fully 12 feet high. The unmanured plot still very small and just shooting and beginning to tassel in spots.

The manured half acre ripened fully two weeks before the other. A severe storm blew it down, and the yield was lessened, but the test shows that the acid phosphate and cotton seed meal are a perfect fertilizer for this light soil.

Corn Experiment by Mr. Jno. C. Killebrew.

Newton, Dale County, Alabama.

Soil—Sandy loam, red clay sub-soil.
Rows 70 yards long, 5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 pounds in the shuck to the bushel.
			Per Plot.	Rate per Acre.	
1	½ Acre.....	250 lbs C. S. Meal. 250 lbs. Acid Phos.	753....	1506....	18 4-5
2	½ Acre.....	No Manure.....	280....	560....	7

Mr. Killebrew reports the following: Planted corn March 1st, killed by freeze and planted over. But for spring drought, and with 10 per cent. less of stalks, would have made 20 per cent. more of corn. As it was, crop fired badly. Seasons were extreme, first cold, then dry, and then rain for forty days in succession, and August 2d, a heavy rain and wind storm, levelling much of the corn to the ground and rendering the fodder worthless.

Corn Experiment by Alabama Experiment Station.

Auburn, Lee County, Alabama.

Soil—Light sandy, clay sub-soil.
Rows 70 yards long—5 feet wide.

Plot Number.	Size of Plot.	Fertilizers used Per Plot.	Pounds yield of corn weighed in shuck.		Estimated yield per acre in bush., allowing 80 lbs. in shuck to the bushel.
			Per Plot.	Rate Per Acre.	
1	½ Acre.....	250 lbs. C. S. Meal. 250 lbs. Acid Phos.	690.....	1380.....	17¼
2	½ "	No Manure.....	510.....	1020.....	12¾

SUMMARY.

Reports were received from twenty-three co-operative Soil Test men, including this Station, to whom fertilizers were sent. Five failed to report.

(1) The *rate per acre* cost of fertilizers sent to each experimenter, was $9.62 laid down at Auburn, and we estimate the cost to each one at that price, which would have been the figures if purchased for cash.

(2) To determine whether high fertilization has been a gain or loss the past season, which in many respects has been an unfavorable one, as can be seen from the reports, the following facts are submitted for comparison; and in this connection the *average* yield of the 23 experiments is given, both for the manured and unmanured plots.

Average yield per acre for the *manured* plots is as follows:

26 4-5 bus. corn valued at 55c in farmer's crib		$14 74
330 lbs. fodder, valued 75c per cwt		2 47
276 lbs. shucks valued at 50c per cwt		1 38
Total		$18 59
Cost of fertilizers per acre	$9 62	
Labor expense	5 44	
Total	$15 06	

Deducting the total expenses $15.06 from the proceeds $18.59, we have a *profit* of $3 53

Average yield per acre for unmanured plots, as follows:

16 1-3 bus. corn at 55c. in farmer's crib	$8 98
196 lbs. fodder at 75c. per cwt	1 47
163 lbs. shucks at 50c. per cwt	81
Total	$11 26
Deduct labor expense per acre	5 44
We have profit	$5 82

(3) From the foregoing it would appear that the value of the product from the unmanured acre is.....$5 82
and from the manured..... 3 53

Leaving balance in favor of the unmanured.....$2 29

In making this report, several things however are to be considered, and as peas were planted in this experiment, one prominent consideration is, that a large crop of peas is reported in some instances by some, justifying the following yield; and taking the same proportion, for both manured and unmanured plots, as for corn, we have—

For the manured, 10 bus. peas per acre, at 75c.....$7 50
For the unmanured, 6 " " " 75c..... 4 50

Leaving in favor of the manured, profit..... .$3 00

Now by deducting the $2.29 from $3.00, we have a net gain of 71 cts. in favor of the fertilized plots.

(4) As to the character of the soils on which these experiments were conducted, many of them were among the poorest in the State. In addition to the net gain of 71c per acre in favor of fertilizers, other benefits were secured. The heavy fertilization, owing to the adverse seasons in many cases as can be seen from these reports, was not all available to the growing crop, and much remains in reserve for succeeding crops. Besides there is an improved condition in the soil due to the large amount of organic matter in the pea vines, which we reasonably conclude is much greater in the manured, than in the unmanured plot.

(5) While the profits from these experiments have not proven large in dollars and cents, yet the indirect benefits are considerable. And the writer is persuaded to believe that the results might have been better, and more economically attained, had the fertilizers contained a higher per cent. of potash and a smaller of nitrogen.

Since writing the foregoing, I have been informed that 76 lbs. of corn in the shuck are allowed to the bushel of shelled corn, instead of 80 lbs.

This being the case, the *average* yield of corn from the use of fertilizers would be 28 1-5 bushels, instead of 26 4-5, and without fertilizers 17 1-5, instead of 16 1-3.

This correction is made in justice to the Experimenters, who deserve to have a correct report of their work.

BULLETIN No. 60. JANUARY, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Experiments on Foreign Seeds.

P. H. MELL.

MONTGOMERY, ALA.:
THE BROWN PRINTING CO., STATE PRINTERS AND BINDERS.
1895.

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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.

BULLETINS OF 1895.

59. Co-operative Soil Test Experiment on Corn.
60. Experiments on Foreign Seeds.

EXPERIMENTS ON FOREIGN SEEDS.

During the season of 1894 the foreign plants described in this bulletin were tested on the grounds of the Botanical Garden, and have been found sufficiently valuable to warrant their introduction into Alabama.

There has been much published in recent years in regard to certain field crops and vegetables highly prized by the inhabitants of India, Japan, China, Egypt and the South American countries. In some of the Northern States experiments have been conducted on a somewhat elaborate scale to determine which ones of these foreign plants are best adapted to that climate and will repay cultivation. Comparatively little, however, has been done on this subject in the Southern States. This is to be regretted, since some of these plants are of great value as food for stock and man and can be successfully grown only in a southern climate. The season in the South is so mild and the cool weather is of such short duration, many of the field crops, vegetables and fruits which are so valuable abroad can be as successfully grown here as in their native countries; and we have a means here of greatly increasing the lists of our food producing plants. It is the intention of the Botanical Department to continue the experiments on these foreign plants from year to year until much that is valuable to the Alabama farmer is secured and published for his benefit.

Ragi Millet. (*Eleusine corocana.*)

This grass was imported from the Madras Presidency, India, and a small area was planted in 1894. The growth was quite rapid and luxuriant; and within a few weeks after the seeds were sown the fine growth of culms and leaves were admired by every passer-by. The stalks reached a height of three or four feet and then threw up thick flower heads, and soon began ripening their seeds; other flower

stalks came forth in succession until three crops of seeds were gathered. During the first two periods in which the seeds were being matured, the stems and leaves remained green and succulent and in excellent condition for green feeding. The grass matures remarkably well for hay and supplies a great abundance of forage. It will stand several mowings before the time of blooming and will, no doubt, make excellent pasturage for cows and other stock.

The following is a chemical analysis of this grass, made under the direction of Professor B. B. Ross, in charge of the Chemical Department:

Water	16.09
Ash	6.02
Ether extract	3.00
Crude fiber	20.65
Crude protein	2.40
Nitrogen free extract	51.84

KODO MILLET. (*Paspalum scrobiculatum.*)

This plant was imported at the same time and from the same country as the last. It also yielded good results and produced foliage almost as tall and luxuriant as was secured from the Ragi. Its valuable properties are unmistakable, and I recommend it to the farmers of Alabama for a good hay producing plant. The growth was not quite as rapid as the last, but it is vigorous and makes ample foliage before the season closes.

The following analysis was made by the Chemical Department:

Water	14.75
Ash	3.95
Ether extract	2.10
Crude fiber	30.57
Crude protein	1.92
Nitrogen free extract	46.71

New Japanese Buckwheat.

The grains of this buckwheat are nearly twice the size of those produced by the ordinary American varieties. The yield is very large—one quart produced two bushels of seeds on the poor sandy soils of Auburn. The plant throws out numerous branches on all of which flowers are developed, and the stem is stout and tall. Planted early in the season the crop will mature rapidly, and may be harvested in time to permit the use of the land in the same season for another crop of a different nature. The flour from the kernels is fine flavored and is equal in all respects to that obtained from the best grades of American buckwheats.

Buckwheats are not often seen as far South as Alabama, and I have many times thought experiments should be made to determine whether the crop could be profitably cultivated in the lower belt of the Southern States. The results of the past season's trials are so remarkable and satisfactory it is deemed best to call attention to them and advise the farmers of the State to add this grain to the important crops of Alabama.

Flat-pea, (*Lathyrus Sylvestris.*)

This plant may be truly termed a sub-soiler. The tap roots penetrate deep into the soil, and the droughts, unless very long continued, fail to produce any material effect on the plants. This pea is a perennial, and, on ordinary land will grow to a height of eight to ten inches the first year. Light frosts do not kill the tops and the roots remain alive in the soil throughout the winter months ready to throw forth a strong, vigorous growth in early spring, thus yielding a valuable forage and good grazing for cattle. Cows and horses greatly relish the cropping at any time but especially so before the other plants have put forth their foliage. Grown from the seed it requires some care to secure a stand, but after it takes good hold of the soil the growth becomes vigorous and rank. Experiments conducted on the Botanical grounds of the College indicate that the flat-pea is a

good soil renovater and is fully equal to the field pea in this respect. Its slow growth at first. however, is rather discouraging, and great care is required to prevent weeds from choking the young plants, but proper attention the first year will enable the roots to take good hold of the soil and thereafter it will far more than repay the farmer for all his painstaking. An excellent way to grow this plant is to sow the seeds in a small bed in the garden, properly enriched with phosphate fertilizer and calcareous matter, and then transplant to the field in the same manner adopted for growing potato slips. As soon as the weather becomes mild in early spring the seeds may be sown.

Sugar Beets.

During the season of 1894 some experiments were made on sugar beets to determine if the climate of Alabama would permit the development of sugar in sufficient quantities to warrant the culture of this plant in the State for the manufacture of sugar.

Three varieties of seeds were planted viz: Wohawk, Wanzleben and Vilmorin's Improved. The experiments, however, were greatly damaged by the attacks of Nematodes causing a rapid decay early in the season. The results secured before this decay was too far advanced are of such encouraging nature as to warrant the repeating of experiments another year under more favorable circumstances. The chemical analyses made under the direction of Prof. Ross give the following results:

Wohawk	8.5	per cent.	of	sugar.
Wanzleben	11.4	"	"	"
Vilmorin's Improved	10.4	"	"	"

These results are much more encouraging than we would be led to hope for judging from the reports sent out from the Chemical Bureau of the United States Depatment of Agriculture in which it is stated that beets will not mature the standard per cent. of sugar when grown as far south as

Alabama and Georgia. Now when it is well known that beets producing 12 per cent. of sugar can be worked with profit the above results are at least encouraging in view of the extremely unfavorable conditions under which the plants were raised at Auburn.

Bengal Gram or Chick-pea. (*Cicer Arietinum.*)

The name arietinum is given to this plant because of a fanciful resemblance of its seed to a ram's head. In India and Egypt the peas are parched and sold in the markets to the natives for the best food to carry on long journeys. An excellent use in this country for the seeds would be for stock food, although not quite so valuable as the ordinary cow-peas. It will also serve as good food for fowls.

Green gram or Small Fruited Kidney Bean. (*Phaseolus Mungo.*)

The peas are deep green in color, quite small and are delicate in flavor. The plants come to maturity very early before the ordinary green peas of our gardens are ready to gather.

Sesame, Gingelly, Til seed or Oily-grain. (*Sesamum orientale.*)

The seeds of this plant are used by the natives in India and Africa for expressing an oil not unlike or inferior to the oil of almonds. An attempt has also been made to manufacture salad oil ("olive") from the seeds but without much success. The Jews of Jamaica also use the seeds for making a cake much relished by them. The chief value of the plant, however, is in the oil extracted which has fine keeping qualities. Two varieties were grown in the Botanical Gardens at Auburn the past season, viz: White and Yellow Sesame.

Soja or Soya or Soy Bean. (*Glycine hispida.*)

"The soja bean is much cultivated in tropical Asia on account of the seed, which are used for preparing a well known brown and slightly salt sauce called "Soy," and is used both in Asia and Europe for flaboring certain dishes, especially beef, and supposed to favor digestion. Of late it has been cultivated as an oil plant. It is an erect hairy herb with trifoliate leaves and axillary racemose flowers. The pod contains from two to five compressed seeds. The Japanese call this plant "Sooja," and the seed-like kidney beans in form though smaller are called "Miso." The manner of making the sauce called Sooja or Soy is said to be by boiling the beans with an equal quantity of barley or wheat, and leaving the mixture for three months to ferment, after which salt and water are added and the liquid strained. This sauce is used in many of the dishes and the beans are also used in soups."—(The Treasury of Botany.)

This plant is valuable for man and stock and the results of the experiments conducted at Auburn show that it can be easily grown in Alabama. The forage cured from it is excellent, and stock eat it with relish. Two varieties of the seeds have been tested and both have yielded favorable results.

The soja bean is not a new plant in the United States since it has been grown with marked success in some of the Middle and Western states for several years; it is however new to the South.

The Experiment Station has a small quantity of the following seeds of the plants mentioned in this bulletin for distribution among the farmers of Alabama. Efforts will be made to give the seeds as wide a distribution as possible:

Ragi millet. (*Eleusine corocano.*)
Kodo millet. (*Paspalum scrobiculatum.*)
New Japanese buckwheat.
Soja bean. (*Glycine hispida.*)

P. H. Mell, Botanist.

BULLETIN No. 61. JANUARY, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Insects Injurious to Stored Grain.

J. M. STEDMAN.

MONTGOMERY, ALA.:
THE BROWN PRINTING CO., PRINTERS AND BINDERS.
1895.

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INSECTS INJURIOUS TO STORED GRAIN.

J. M. STEDMAN.

INTRODUCTION.

In the Southern States more particularly, the stored grain and seeds are usually greatly damaged, if not entirely destroyed in one season, by the attack of insects, principally weevils. The amount of damage needs no comment. It has been stated that grain affected with insects is injurious to stock; but whether this be true or not, it is of little consequence compared with the injury done to grain used for seed. When injured grain is planted, there will be a poor "stand," since the essential part of the seed is usually eaten away and germination rendered impossible; or else if the seed germinates, it has been robbed of much of the nourishment placed there by nature to enable it to attain a healthy and vigorous start, and such seeds will yield a small crop. Instances have come under my observation where whole graineries of corn have been entirely ruined; and it is almost impossible to purchase peas that are not badly effected.

Fortunately we have methods by which we can destroy these pests in our graineries, and there is no excuse now for suffering any considerable loss from insects in stored grain. I find, however, that few understand these methods, and how easily and cheaply they may be applied. There are nine different species of insects that may attack stored grain in Alabama, and in all cases the method of combatting them is the same.

In order that one may determine the kind of insects found in stored grain, I have given a figure of all but one, and a short description.

Figures 12, 13, 14 and 15, were kindly loaned by the Mississippi Experiment Station.

The discussion of the life history of the insect is given only in so far as it is important that the farmer should know it.

In view of the fact that the edition of bulletin number 45 on Injurious and Beneficial Insects has long since been exhausted, and that the demand for it still continues, on account of the general remarks, insecticides and machines for applying the same that it contained, I have here repeated, with some additions and omissions, that portion of Bulletin 45.

GENERAL REMARKS.

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

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

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

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

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

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

covering the trunks of trees with a sticky or poisonous wash to prevent the borer from entering. All preventive applications must be made just before the adult insect appears, and must be kept up at frequent intervals as long as the adult is in a condition to lay eggs.

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

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

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

but where the adult deposits its eggs inside the tissue beneath the outer layer, this method is of little value. The application of certain substances like coal tar, tobacco, etc., is sometimes used as a repellant. Methods and contrivances to keep the insect away will be noted under the special insect.

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

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

The mode of applying the different poisons to kill biting insects varies with the kind of plant infested and also with the insect. Some are simply dusted on to the plant as a powder, others sprayed on with a force pump. The methods

of applying each substance will be given under their respective heads. (See Insecticides.)

INSECTICIDES.

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

INTERNAL POISONS.

Paris green is the most important insecticide of its class. It kills by virtue of the arsenic that is here in chemical combination with copper. It comes in the form of a fine powder and can be purchased at about thirty cents per pound. It can be used either as a powder to be dusted, or as a liquid to be sprayed on the plants. As a powder it is to be well mixed with from twenty to forty, and even eighty, times its bulk of flour, Plaster of Paris or air slacked lime; and can then be evenly and thoroughly dusted on to all parts of the plant by means of some kind of bellows or other powder dusting machine. (See machines for applying Insecticides.) One pound of Paris green to the acre is usually sufficient provided the dusting be done evenly and thoroughly. Paris green is sometimes used undiluted, or very slightly so (one part of Paris green to three parts of flour) as is the usual case with cotton, when the poison is placed in two heavy sacks made of some strong cloth, as 8 oz. osnaburg, and fastened to each end of a five foot pole. It is the thoroughness with which this poison is applied and not the strength that secures success. As a liquid Paris green is to be mixed with water in the proportion of one pound poison to from 150 to 200 gallons water. Paris green does not dissolve in water, and since it is very heavy and tends to settle

quickly, it is very essential that the liquid be often and thoroughly stirred. It is to be sprayed on the fruit trees and other plants by means of some kind of force-pump and hose with a spraying nozzle. (See machines for applying Insecticides.) One should be exceedingly careful in spraying peach trees not to get the mixture too strong, since the leaves of this plant are very tender and easily "burned" by Paris green or London purple. A mixture of one pound Paris green to 250 gallons of water should be used on peach trees, and that only when the leaves are young. Apple trees should be sprayed just after the flowers have fallen. Small fruits and vegetables are not easily injured, if at all, by Paris green. Since Paris green is frequently adulterated, it is advisable to test it before making any extensive application. One sample of Paris green analyzed by the chemical department here last year was found to contain not a trace of Paris green, nor even of arsenic or any other poison. Some failures in the application of insecticides are due to poor or adulterated material.

Paris green or London purple may be mixed with Kerosene Emulsion in some cases, and thus an insecticide for both biting and sucking insects is made. The great advantage to be gained by this mixing is the time saved in making one application instead of two. For details see under Kerosene Emulsion.

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

Hellebore (white) is a powder poison made from a plant. It kills both by being eaten and by contact. It can be used as a powder to be dusted on to the plant either full strength or diluted with flower, or as a liquid, one pound Hellebore to 40 gallons of water, to be sprayed on the plant. It costs about twenty-five cents per pound. It is used

less extensively than Paris green or London Purple, but is especially excellent in destroying the currant worm.

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

EXTERNAL POISONS.

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

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

The kerosene emulsion will injure no foliage, and since it

kills insects by contact, it is the most effectual remedy against the chinch bug, plant lice, bark lice, melon bug and other sucking insects, and also for the cabbage worm, and white grub, and will even kill eggs in some cases. It is of the greatest importance that the emulsion be forcibly, thoroughly, and evenly applied, as can be done only by the use of some force pump arrangement.

Kerosene may be used without the trouble of making an emulsion with soap and water, and, so far as my experience goes and from what I can learn of others, with equal results to the soap emulsion. This is rendered possible by using a force pump that will mechanically mix the kerosene with the water at the instant of spraying. One can readily see what an immense saving of time and trouble this will effect. The best machine to use in this connection is the Perfected Galloway Knapsack Spray Pump with kerosene attachment, made by the Deming Company, Salem, O. or the one made by the W. & B. Douglass Company, Middletown, Conn. (See figure under machines for applying poisons.) The water is placed in the usual reservoir and the kerosene in an additional reservoir attached to it. The proportion of kerosene to the water can be regulated by a stop-cock. The kerosene is thoroughly mixed in the pump and spray nozzle only when the pump is in action, otherwise the two fluids remain separate. This attachment does not interfere with the use of the pump for other purposes, since a stop-cock completely shuts off all communication with the attachment, which may also be removed.

Kerosene emulsion may have added to it a small amount of Paris green or preferable London purple and thus be converted into an insecticide for both biting and sucking insects. This method does away with the necessity of making two applications of insecticides. I find it better to first dilute the stock emulsion to the usual extent, and then to add the Paris green or London purple in the proportion of one-fourth pound to the barrel. To use the Paris green or London purple with the kerosene and water spray from the

knapsack sprayer, I thoroughly mix one-fourth pound of the poison in a barrel of water, and fill the knapsack sprayer with this mixture, and the attachment with kerosene.

Carbolic Acid Emulsion is made by adding Carbolic Acid (the crude material, dry to get a good strength) one part to 5 or 7 parts of the soap solution similar to that used in making the Kerosene Emulsion. The liquid is to be churned in the same manner as the Kerosene Emulsion, to form an Emulsion. This Carbolic Acid Emulsion is one of the best preparations to protect plants against lice and fruit trees against borers. It can be sprayed upon the trunks of fruit trees or rubbed on by means of a cloth. Every fruit tree should be treated in this way, especially the young trees, about two weeks after the trees blossom.

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

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

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

E. R. Taylor, Cleveland, Ohio, advertises Bisulphide of Carbon for ten cents per pound in fifty-pound cans.

MECHANICAL ARRANGEMENTS.

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

Machines For Applying Poisons.

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

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

One of the best machines for dusting a powder on plants is Leggett's Powder-gun. It works by turning a crank, and throws the powder in a fine dust constantly and evenly, and the supply can be easily regulated so that one or one-half pound of Paris green or London purple can be evenly distributed over an acre. This instrument has been highly recommended by all who have tried it. The price of this gun delivered complete with four extra tubes, shoulder strap, oil can and all necessary attachments for distributing the powder is $7.50. This machine can be purchased from the makers, Leggett & Bros., 301 Pearl St., New York. See fig. 1, 2, 3.

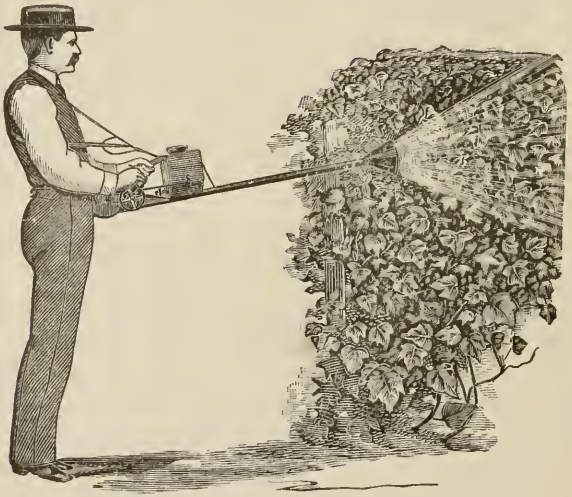

Fig. 1, 2, 3. Leggett Bros. Powder-Gun.

Another very simple and effective machine is Woodason's Liquid and Powder Spraying Bellows, of which four styles are made. The Double Cone Bellows for dusting Paris green, London purple or Pyrethrum, can be purchased for $3.00, and will be found a very simple and economic machine. The liquid spraying bellows can be had for $2.50. These machines will be found very useful, and are highly recommended. They are manufactured by Thomas Woodason, 2900 D. St., Philadelphia, Penn., or they can be purchased of H. A. Kuhus, Atlanta, Ga.

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

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

There are many force pumps with spray nozzles manufactured for spraying liquids on plants; but my experience leads me to believe that for cheapness, durability, simplicity and effectiveness the pumps of The Deming Company, Salem, Ohio, are superior to all others. The "Success" brass spray pump for bucket is shown in fig. 4. I regard this as the best pump made for ordinary use, and it is extremely cheap. The regular catalogue price is $6.00, but it can be had for $4.00. In ordering, one should state that they wish a hole drilled in the suction casting for an agitator.

Where it is necessary to do a large amount of spraying,

the "Ideal" double-acting brass spray pump manufactured by the same company, and shown in fig. 5, should be used. The price of this pump varies according to the attachments from $12.00 to $18.00, exclusive of the barrel. This pump can be placed on any barrel and carried about the field in a wagon.

This company, and also the W. & B. Douglas Co., Middletown, Conn., manufacture a "Knapsack" spray pump with an attachment for kerosene. By means of this attachment one can save much time and trouble in not having to make a regular kerosene emulsion, since the water and kerosene are mixed in the act of spraying. These pumps are a great convenience, but they are rather costly for most farmers. Fig. 6 shows one of these pumps made by The Deming Co. The price with the kerosene attachment is $18.00 in the catalogue, but they can be had for $15.00,

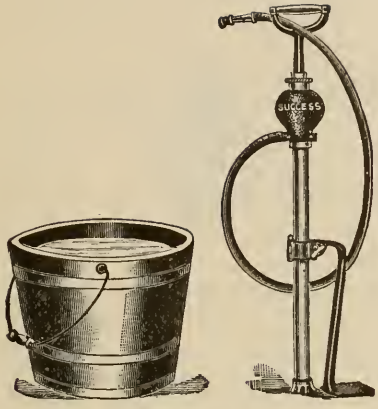

Fig. 4. "Success" brass spray Pump for Bucket.

Fig. 5. "Ideal" double-acting brass spray pump mounted on barrel.

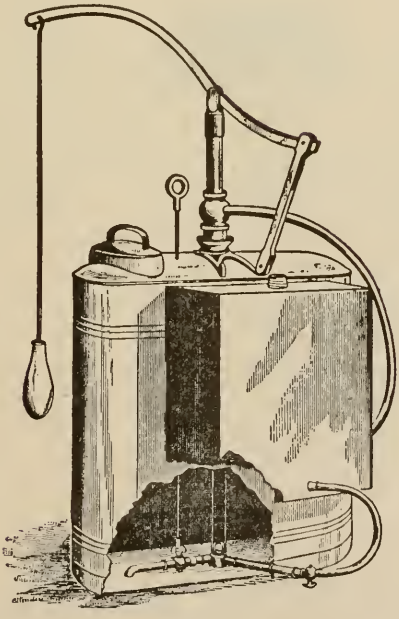

Fig. 6. The Perfected Galloway Knapsack sprayer with kerosene attachment.

INSECTS INJURIOUS TO STORED GRAIN.

The Pea Weevil.

(*Bruchus pisi*, Linn.)

The pea weevil is a small beetle about three-sixteenths of an inch in length. It is of a dull gray color, with a few markings on the back and occasionally a white spot on the thorax. Figure 7 shows this beetle in its different stages enlarged, and with the natural size figures near them. The adult beetle lays her yellow colored eggs singly on the outside of the young pea pod. As soon as the eggs hatch, the small larvæ bore through the pod and enter the peas. Here they feed, avoiding as a rule the germ, until full grown, when they cut a hole nearly through the seed coat, leaving a thin membrane over the burrow. The larvæ then turn to the pupa stage. But one insect can, or at least usually does, develop in a single pea. The adult beetle issues either in the fall or more commonly in the spring.

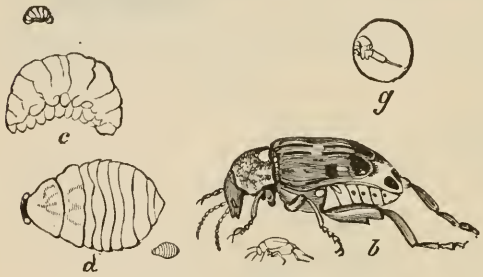

Fig. 7. Pea weevil; b, adult; c, full grown larva; d, pupa; g, pea showing exit hole. Natural size indicated by smaller figures.

The Bean Weevil.

(*Bruchus obtectus*, Say.)

The bean weevil is a small brownish beetle a little over one-eighth of an inch in length. It resembles very much

the pea weevil, and has much the same life history and habits. Figure 8 shows this beetle enlarged at *a* with a natural size figure near it, and an effected bean at *b*. The female beetle deposits her eggs in clusters, either in a slit or hole made with her jaws in the pod, or else in the split caused by the partial drying of the pod. The eggs are most abundantly found in fully developed or partially dried pods, where the seeds are fully matured. The young larvæ enter the beans, and make circular mines in them while feeding upon their substance. Unlike the pea weevil, only one of which is found in a single pea, the bean weevil may occur in considerable numbers in a single bean. When the larvæ are fully grown, they bore a hole to the outer skin of the bean, and then turn to the pupa stage. When the adult beetles emerge, they will deposit their eggs in the stored grain, and thus multiply and damage the beans continually. Hence when these insects once infest stored beans, it is necessary to kill at once all the insects, or they will completely ruin them. The number of generations varies, and thus one finds these insects in all stages in the stored beans. The bean weevil is very troublesome in cow peas also.

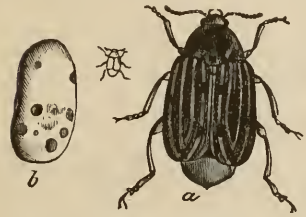

Fig. 8. Bean weevil; a, adult; b, damaged bean. Natural size shown by smaller figure.

The Four-Spotted Bean Weevil.

(*Bruchus 4—Maculata.*)

The four-spotted bean weevil is a little larger than the pea weevil, and can be distinguished from it by the presence of four black spots on the wing covers. The habits and life histories of this insect are similar to the bean weevil, and therefore will not need describing here. The four-spotted bean weevil is extremely troublesome and injurious to our cow pea, perhaps even more so than any other weevil. I

find it next to impossible to purchase cow peas that are not infested with them. I regret that I have no figure of this insect.

The Grain or Corn Weevil.

(*Calandra granaria*, Linn.)

The grain or corn weevil is a dark brown or black beetle about three sixteenths of an inch in length. This weevil can be distinguished from the grain beetle, which also infests corn, by its stouter body and by the presence of a long snout, which is wanting in the grain beetle. Figure 9 shows the grain or corn weevil enlarged at *e* and with a natural size figure just above. The snout can be readily seen by glancing at the figure. The female beetle deposits her eggs singly upon the corn, and also upon wheat in some cases. In a few days the eggs hatch, and the small larvæ enter the corn, and feed upon and burrow through it. The full grown larvæ transform to the pupa stage within the kernel. The adult beetles emerge by cutting a hole through the skin of the kernel of corn or wheat as the case may be. An ear of corn infested with these weevils will be full of holes, showing where the adult beetles have emerged.

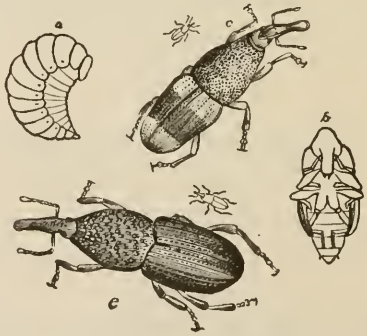

Fig. 9. e, Grain or corn weevil; c, Black or rice weevil. Natural size shown by smaller figures. a, larva; b, pupa.

The Black or Rice Weevil.

(*Calandra oryzae*, Linn.)

The black or rice weevil is a black colored beetle with four reddish brown spots on the wing covers. It is somewhat smaller than the grain or corn weevil, being about one eigth of an inch in length. Figure 9 shows this beetle enlarged at *c* and with a natural size figure just above.

As the name indicates, this beetle is frequently found in rice, but it attacks corn and wheat as well, and does its greatest amount of damage to corn in this state. The adult female makes a hole in the grain with her mouth parts, and deposits an egg in it. Frequently more than one hole and egg is deposited in a single kernel. The larvæ burrow and feed upon the inside of the grain, and when full grown change to the pupa stage within the kernel. The adult beetles soon emerge and deposit eggs for another brood. In infested corn, one can find these weevils in all stages of development. The adult beetles are also very injurious in a direct way, in that they will eat into the kernels of corn for a short distance themselves, and are not content with a single kernel. An ear of corn infested with the black or rice weevil will soon be ruined, nearly every kernel having holes eaten into it, and its interior more or less eaten away.

The Angoumois Grain Moth.

(*Gelechia cerealella*, Oliv.)

The angoumois grain moth is perhaps the most destructive insect affecting our grain. It was introduced into this country sometime before 1728 by the earlier settlers of Carolina and Virginia, who brought it with them from Europe. The original home of the moth is supposed to be South Europe, although it seems to have attracted popular attention first in Angomoise province, France, where it caused immense damage and nearly resulted in a famine. This insect is more destructive in the Southern States than in the Northern, and attacks corn and wheat not only in the granary, but also in the field. It is also said to attack cow peas, oats, and barley. This grain insect is all the more destructive from the fact that it will breed readily in confinement; and if once introduced into a granary and left to itself, it will entirely destroy it.

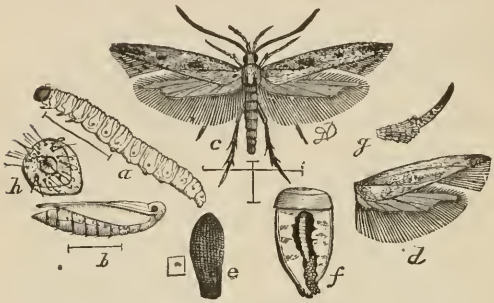

Fig. 10. Angoumois Grain Moth; a, larva; b, pupa; c, adult; d, wings; e, egg; f, kernel of corn showing work of larva; all enlarged except f.

The angoumois grain moth is a small fawn or light gray colored insect, measuring about one-half an inch across its expanded wings; it has a shiney appearance, and the hind wings have a feathery edge. The adult moth is represented somewhat enlarged at *c* figure 10, and natural size by the cross lines just beneath. A greatly enlarged egg is shown at *e;* the larva at *a*, with a line beneath representing the natural size of the fully developed larva; and at *b* the pupa is figured enlarged, with the natural size indicated by the line just beneath.

The female moth deposits her eggs on the grain in the field or in the granary. The eggs may be deposited singley or in clusters just under the thin membranes at the base of the kernel of corn or between the rows. The eggs hatch in a few days into minute active larvæ, that are frequently seen suspended by a delicate silken thread. They soon find a tender place and enter the kernel of corn or wheat. The hole in the grain made by their entrance is so small as not to be readily noticed, or it may be closed up with excrement. The larvæ mine and feed upon the interior of the grain, and in some cases leave only the outer coat entact. When full grown, they cut a circular hole through the skin, but do not disturb the plug. They then spin a delicate cocoon within the kernel, and inside of it turn to the pupa stage. In a few days or weeks, according to the climate, the adult moths appear and lay the eggs for another brood. But one larva is found in a grain of wheat; but two or more may occur in a kernel of corn. The number of broods per year varies from two in the northern states to seven or eight in the southern states. In this state one can find the insect in all stages in infested granaries.

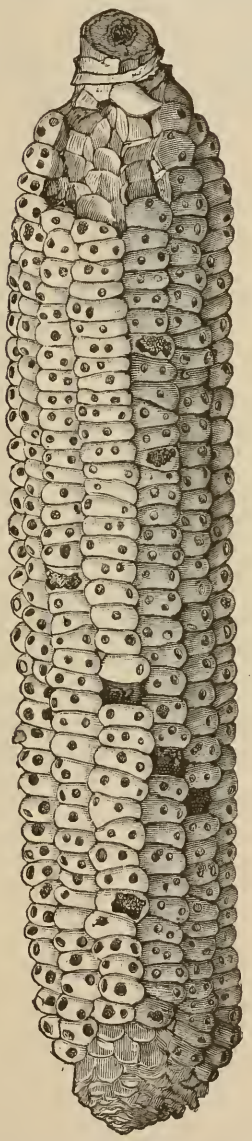

Fig. 11. Ear of corn showing work of the Angoumois Grain Moth.

The appearance of an ear of corn after the moths have emerged is shown in figure 11. Grain

infested with these insects to any considerable extent will not germinate, will loose considerably in weight, and is not wholesome as food, but may even be injurious. When these insects are found in stored grain they should be exterminated at once, since they multiply with such rapidity that they will completely ruin all the grain in a short time.

The Grain Beetle.

(*Silvanus surinamensis*, Linn.)

The grain beetle is a small reddish brown colored insect, a little over one-eighth of an inch in length. It can be distinguished from the other grain beetles by its more cylindrical form, and the presence of saw-like teeth on the margin of the thorax; it also has three longitudinal ridges on the thorax, and several less distinct on the wing covers. See figure 12, which represents this beetle much enlarged.

Fig. 12.
Grain Beetle.

This beetle is found in granaries usually in connection with other grain insects. The adult beetle as well as the larvæ feed upon corn or wheat, and do not confine themselves to a single kernel. The larvæ often pupate in the cracks about the granary.

The Red Grain Beetle.

(*Silvanus cassiæ*, Reiche.)

The red grain beetle is a small flat reddish brown insect, about one-ninth of an inch in length. The adult beetle is represented as enlarged at *c* figure 13; the pupa at *b*; and the larva at *a*. The lines at the side of each shows the natural size.

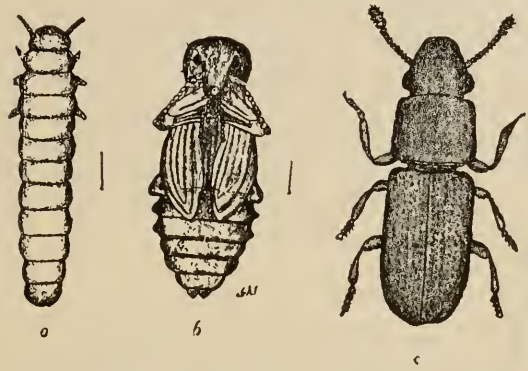

Fig. 13. Red Grain Beetle; a, larva; b, pupa; c, adult. All enlarged.

These beetles infest corn more particularly. The eggs are deposited at the base of the kernels, either in the field or in the bin. The larvæ enter the kernels, and feed as a rule only upon the softer lower portion; and when mature make their pupæ within the corn. More than one larva may develop in a single kernel. There are several broods each year; in some localities as many as nine. The beetles are quite lively, and will seek shelter when disturbed; the larvæ rarely make their presence known, and as a result these insects often remain unobserved until they have accomplished considerable damage.

The Brown Grain Beetle.

(*Tribolium ferrugineum*, Fab.)

The brown grain beetle is, as its name implies, a brown colored beetle about one-eighth or three-sixteenths of an inch long. It is represented enlarged in figure 14. It is usually found in stored grain in connection with other grain insects, but may become quite common in neglected granaries. It also feeds upon dried animal matter, and is sometimes found in museums, and in the kitchen store room.

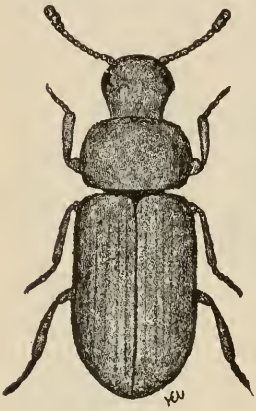

Fig. 14. Brown Grain Beetle. Enlarged.

The Corn-Sap Beetle.

(*Carpophilus fallipennis*, Say.)

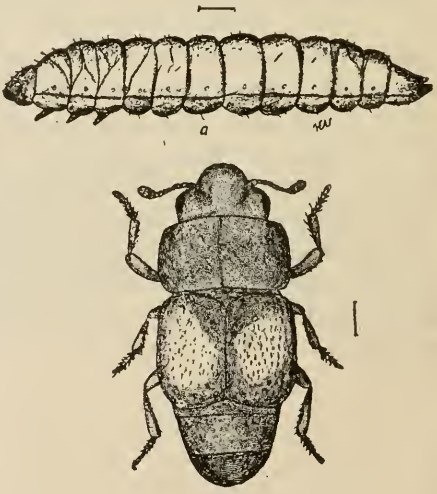

Fig. 15. Corn Sap-Beetle. Larva and adult, enlarged.

The corn-sap beetle is about one-seventh of an inch in length, of a dark brown color, with the wing covers lighter in color and not extending to the end of the abdomen. An enlarged beetle and larva is represented in figure 15, with the natural size indicated by lines at the side.

This beetle, like most of the beetles belonging

to the same family, are not very destructive to healthy vegetable products, but prefer injured or decaying vegetable matter. They are to be found in injured cotton bolls, in heaps of decaying cotton seed, in decaying fruit of all kinds, and sucking the juices from injured fruit and trunks or limbs of trees. I have found them in the ear of corn only when such ears had been previously injured by other cause. It has been stated, however, that they will attack healthy kernels even in the bin; but I am inclined to think this would not occur if they had not been introduced there in the larvæ stage in diseased corn, and after eating that, were forced to eat the healthy kernels.

Remedies.

The best remedy in every respect for killing grain insects is *bisulphide of carbon.* It is cheap, effectual, and easy to apply. Bisulphide of carbon, or the new fuma bisulphide of carbon, can be obtained of the manufacturer, Mr. E. R. Taylor, Cleveland, Ohio, in fifty pound cans for ten cents per pound, or in smaller quantities at a little more per pound.

One pound of the bisulphide of carbon is ample for one hundred bushels of grain, provided it be in a comparatively tight bin or granary, and the grain is not in the husk or pod. If the bin or granary is quite open and contains many holes, it will be necessary to use more bisulphide of carbon, since it will evaporate and escape. The holes should be closed as much as possible. The grain should not be stored in the pod or husk, since it is almost impossible for the fumes of the bisulphide to penetrate through the husk of an ear of corn, and much less through the pod of a bean or pea.

In view of the fact that many grain insects attack the grain while it is in the field, and are thus carried directly into the granary, it is advisable to make one application of the bisulphide of carbon immediately or very soon after the grain is gathered and stored. The grain should then be ex-

amined at least once a month, and if there appear signs of insects, it should receive another application. Then in the spring, before the grain is taken out for planting, it should always receive an application of bisulphide of carbon, to be sure that all insects are destroyed and thus prevented from attacking the grain in the field and multiplying there.

The bisulphide of carbon is best, or at least as well, applied by sprinkling it over the top of the grain. It will soon evaporate, and as the fumes are heavy they will penetrate through the grain. The germinating properties of grain are not injured in the least by any ordinary application. Some may prefer to saturate cotton with the bisulphide and place it in the grain, or to fill shallow dishes and place them about the granary. No harm can result, however, from sprinkling the bisulphide directly on the grain, since it evaporates almost immediately, and if pure, leaves no trace of it on the grain. One can test the bisulphide of carbon to determine whether it is pure or not, by dipping a black feather in it and allowing it to dry; if the bisulphide is pure no residue will be seen.

The only precaution in the use of bisulphide of carbon is not to have the least trace of fire about; the fumes are very explosive and will ignite from a lighted cigar or lantern.

Bisulphide of carbon evaporates so rapidly that it will disappear in a few moments, if some of the grain be removed to the open air.

It is not necessary to mention any other remedy for insects in stored grain as the above is much superior to all others.

J. M. STEDMAN,
Biologist.

BULLETIN No. 62. FEBRUARY, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

CORN AND COTTON.

ALEX. J. BONDURANT.

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1895.

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CORN.

Fertilizer Experiments.

A given quantity of kainit, acid phosphate and cotton seed meal *mixed* thoroughly and applied at time of planting, *compared* with a *compost* of a certain quantity of cotton seed, acid phosphate and stable manure applied at time of planting.

Plot No. 1 was fertilized with kainit, acid phosphate and cotton seed meal, well mixed, at the rate of 1,000 pounds per acre.

Plot No. 2 with cotton seed, acid phosphate and stable manure composted, at the rate of 2,000 pounds per acre.

By referring to the following table of results, it will be noticed that plot No. 1, which was manured with a compound of commercial fertilizers made a larger yield than plot No. 2, which was manured with compost.

By comparing the cost of substances used in this experiment, it was rather more in plot 2 than in plot No. 1.

Kainit, acid phosphate and cotton seed meal in plot No. 1, *compared* with compost of cotton seed, acid phosphate and stable manure in plot No. 2.

Corn planted April 4th, and fertilizers applied in drill at the same time.

Size of plot ½ acre.

PLOT 1.

Name and Quantity of Fertilizers used per ½ Acre.		Quantity per acre.	Pounds yield of corn in shuck per plot.	Pounds yield of corn in shuck per acre.	Bushels yield of ear corn per acre, allowing 76 lbs. in the shuck to the bushel.
Kainit	100 lbs.	200 lbs.	.....	.....	.....
Acid Phosphate	150 lbs.	300 lbs.	.....	.....	.....
Cotton Seed Meal	250 lbs.	500 lbs.	.....	.....	.....
	500 lbs.	1000 lbs.	815	1630	21.11-19

PLOT 2.

Names and Quantity of Fertilizers used in Compost for ½ Acre.	Quantity per acre.	Pounds yield of corn in shuck per plot.	Pounds yield of corn in shuck per acre.	Bushels yield of ear corn per acre, allowing 76 lbs. in the shuck to the bushel.
Cotton Seed..... 333⅓ lbs.	666⅔ lbs	.....	.....	.....
Acid Phosphate. 333⅓ lbs.	666⅔ lbs.	.....	.....	.....
Stable Manure.. 333⅓ lbs.	666⅔ lbs.	.....	.....	.....
1000 lbs.	2000 lbs.	550	1110	14 3–5

CORN.

Variety Experiment.

Object of this experiment was to ascertain the best yielding variety.

Corn was planted on plots 1-14 of an acre in size—rows 5 feet wide and corn dropped 3 feet apart in drill.

Fertilizer, composed of 250 pounds cotton seed meal and 250 pounds acid phosphate, was applied in drill at time of planting, and was mixed with soil by running a scooter in the furrow. Corn came up well and was killed by the severe freeze March 25th. Replanted April 4th and several other times after. The Renfro, Experiment Station Yellow, Cocke's Prolific, Pride of America, and Clayton Bread, gave the best yields in the order named. A perfect stand was never secured upon any of the plots, though it was better on some plots than on others, and hence this fact with some inequality of the soil, prevents reaching any reliable conclusions as to the best variety. Further experiments will be necessary to arrive at correct conclusions.

The following table shows the results of the experiment:

Plots 1-14 acre. Fertilizers applied in drill March 10th, consisting of 250 lbs. cotton seed meal and 250 lbs acid phosphate per acre.

Corn planted March 17th, killed by freeze, and replanted April 4th.

Plot No.	Names of Varieties.	SEEDSMAN.	Pounds yield per plot in shuck.	Pounds yield per acre in shuck.	Bushels yield per acre, ear corn, allowing 76 lbs. in the shuck to the bushel.
1	Expt. Station Yellow	Expt. Station	96.5	1351	17¾
2	Clayton Bread	Jas. Clayton	82.2	1151	15 1–7
3	Renfro	...	99.5	1393	18⅓
4	Pride of America	T. W. Woods & Son. Richmond, Va.	91.0	1274	16¾
5	Gentry's Market	" "	75.0	1050	13 4–5
6	Hickory King	" "	74.0	1036	13¾
7	Blount's Prolific	" "	75.0	1050	13 4–5
8	Giant Broad Grain	" "	61.0	854	11¼
9	Cocke's Prolific	" "	90.0	1260	16 9–10
10	Virginia Gourd Seed	" "	66.0	924	11 7–11
11	Clarke's Mastodon	" "	45.0	630	8 3–10
12	Improved Golden Dent	" "	75.0	1050	13 4–5
13	Improved Leaming	" "	25.0	350	4⅔
14	Dallas Prolific	" "	75.0	1050	13 4–5

COTTON.

Compost applied on February 1st, against compost applied at planting time.

Floats vs. Acid Phosphate.

Numerous enquiries have arisen from time to time, which pays the better, to compost green cotton seed, acid phosphate and stable manure about Feb. 1st and let it remain in bulk to be applied at planting time, or to apply it as soon as made, thereby saving any further expense and trouble.

Also to determine the *comparative* value of acid phosphate with floats, in *compost*, to be applied at time of planting.

Plot 1, applied Feb. 1st.

Plot 3, applied April 17th.

Plot 2, Floats with compost applied April 17.

For this experiment, one and a half acres of land, of uniform fertility, was selected and divided into plots of ½ acre each. The soil was sandy and poor.

On Feb. 1st, a compost of equal parts of green cotton seed, acid phosphate and stable manure was made, and on the same day was put on plot 1. An equal quantity of this same mixture was put in a heap until planting time, when it was put on plot 3.

While the results are seen from the table, one fact is worthy of note, that plot 1 remained greener and maintained its vigor a longer period than plot 3, and did not yield to the effects of rust as badly as plot 3.

In plot No. 2 as will be seen from the table, floats were substituted in place of acid phosphate as in plot 3, the same quantity of green cotton seed and stable manure being used on both.

The following table shows the results:

COTTON.

Compost Applied February 1st.

Plot Number	Name and quantity of fertilizers used on one-half acre.	Rate per acre, ℔	Yield Seed Cotton Per Plot.			Total yield per plot seed cotton.	Total yield per acre seed cotton
			1st picking, Sept. 5th.	2nd picking October 2d.	3rd picking. Nov. 15th.		
	Green cotton seed, 400 lbs.	800					
	Acid Phosphate, " "	800					
	Stable manure, " "	800					
1	1200 lbs.	2400	336	187	28	551	1102

COTTON.

Compost Applied April 17th.

Plot Number.	Name and quantity of fertilizers used on one-half acre.	Rate per acre, ℔	Yield Seed Cotton Per Plot. 1st picking, Sept. 13th.	2nd picking, October 2d.	3rd picking, Nov. 15th.	Total yield per plot seed cotton	Total yield per acre seed cotton
	Green cotton seed, 400 ℔s.	800					
	Acid Phosphate, " "	800					
	Stable manure, " "	800					
3	1200 ℔s.	2400	439	97	9	545	1090

COTTON.

Floats vs. Acid Phosphate in Plot 3.

Plot Number.	Name and quantity of fertilizers used on one-half acre.	Rate per acre. ℔	Yield Seed Cotton Per Plot. 1st picking, Sept. 13th.	2nd picking, October 2d.	3rd picking, Nov. 15th.	Total yield per plot seed cotton	Total yield per acre seed cotton
	Green cotton seed, 400 ℔s.						
	Floats,..... " "						
	Stable manure,... " "						
2	1200 ℔s.	2400	392	138	30	560	1120

COTTON.

Comparison of Fertilizers and Compost.

The object of this experiment was to compare a given quantity of kainit and acid phosphate *mixed* with a certain quantity of cotton seed meal as is shown in plot 1, with a similar quantity of kainit and acid phosphate *composted* with a certain amount of stable manure and cotton seed as in plot 2. That is, the quantity of kainit and acid phosphate in both plots being the same, using the cotton seed meal in plot 1, against the cotton seed and stable manure in plot 2. Fertilizers in plot 1 were thoroughly mixed and applied at

time of planting; on plot 2 composted and applied at same time. The plots being about equal in natural fertility, and both receiving equal quantities of kainit and acid phosphate, the results appear in favor of the cotton seed meal as against the cotton seed and stable manure. Should the improved condition of the land be considered, which thing however was not contemplated in this experiment, the question arises, which has paid the better, plot No. 1, or No. 2? In plot No. 1, the nitrogen in the cotton seed meal was more available than in plot 2, and this being true there is left in plot 2, for future crops, a larger per cent. of fertilizing matter. No conclusions however can be drawn in this particular, as it would require further trials on both plots to ascertain the comparative quantity of fertilizers now in reserve on both plots.

It is a known fact from observation that land fertilized with stable manure and cotton seed shows the effects for several years following.

The following is a statement of results:

A given quantity of acid phosphate, kainit and cotton seed meal mixed to be compared with a given quantity of acid phosphate, kainit, cotton seed and stable manure composted.

Size of plot, ½ acre.

PLOT 1.

Names and Quantity of Fertilizers used on ½ Acre.	Quantity per Acre	Yield per Plot.			Yield per Plot.	Yield per Acre.
		1st Picking, Sept. 13th.	2nd Picking, Oct. 9th.	3rd Picking, Nov. 1st.		
Kainit.....100 lbs.	Kainit .... 200 lbs.	.....	.....	.....	.....	.....
Acid Phos..150 lbs.	Acid Phos 300 lbs.	.....	.....	.....	.....	.....
Cotton S. M.250 lbs.	Cotton S.M. 500 lbs.	.....	.....	.....	.....	.....
500	1000	354	285	86	725	1450

PLOT 2.

Name and Quantity of Fertilizers used on ½ Acre.	Quantity per Acre.	Yield per Plot. 1st Picking, Sept. 13th.	2nd Picking, Oct 13th.	3rd Picking, Nov. 11th.	Yield per Plot.	Yield per Acre.
Kainit..... 100 lbs.	Kainit..... 200 lbs	.....	....	.....	.....	.....
Acid Phos. 150 lbs.	Acid Phos. 300 lbs	.....	.....	....	.....	.....
Cotton Se'd 375 lbs.	Cotton Se'd 750 lbs.	.....	.....	.....	.....	.....
Stable Ma. 375 lbs.	Stable Ma. 750 lbs.	.....	.....	.....	.....	.....
1000	2000	245	305	77	627	1254

COTTON.

Intercultural Experiments with Fertilizers.

The object of this experiment was to ascertain whether or not, it would pay to apply nitrogenous fertilizers interculturally.

For this purpose, a piece of sandy upland of medium fertility was selected, and made into plots of 1-10 of an acre each. Rows were laid off, 210 feet long by 3½ feet wide.

Just before planting, the following mixture of fertilizers was applied to each plot alike, at the rate of 200 pounds per acre: 200 lbs. acid phosphate, 66 lbs. muriate potash and 66 lbs. sulphate ammonia. Soon after the cotton came up, it was chopped, and then sided with heel-scrape. The stalks of cotton were counted in each row and the same number allowed to stand on each plot.

On June 16th, cotton seed meal and nitrate soda, in different quantities, were applied broad-cast, at which time the cotton was plowed with heel-scrape.

From observations made during the latter part of June, the plots fertilized interculturally began to show a little difference, and by the time the second application was made, the difference was quite marked in favor of the fertilizers. Further observations later on showed a still greater and

more decided improvement in the crop, that is, the stalks, were much larger, were taking on fruit more rapidly and presented a richer color than the plots not fertilized after planting. By noticing the difference in the yield of plots having the same quantity of fertilizers, it appears that a *given* amount used interculturally at an *earlier stage of crop* growth, gave better results than the same quantity, one-half applied at *the earlier stage* and the other half several weeks later. For instance, by comparing plot No. 1 with plot No. 7, it is shown that a better yield resulted from the single application to plot 7 in June than from the two applications to plot 1 in June and July.

Also in comparing No. 2 with No. 8, it is seen that a better yield was secured from the June application on No. 8, than from the June and July appiications on No. 2.

By a still further comparison of plots 4 and 9, the same fact is established, that a single application of nitrate soda in June on plot 9, gave a better yield than the same quantity of nitrate soda at different times on plot No. 4. The 100 lbs. applied *at once* to No. 9 acted more efficiently than the *two* applications to No. 4, and the inference is, that the most favorable conditions existed as to No. 9, for a maximum yield.

Taking the average yield of the three unmanured plots, which is 809½ lbs. seed cotton per acre, the difference in favor of fertilizers is plainly seen by reference to the table of results.

The following table shows the results of this experiment:

COTTON—INTERCULTURAL EXPERIMENT.

Plots 1-10 of an Acre.

At time of planting, April 14th, Acid Phosphate 200 pounds, Nitrate Potash 66 pounds, and Sulphate Ammonia 66 pounds, were mixed, and 20 pounds of this mixture applied to each plot. Subsequent fertilization is shown in the following table:

Plot.	No.	Fertilizers used per plot. Applied April 14th.		Name and quantity of fertilizers and when applied. Rate per acre.	Name and quantity of fertilizers. and when applied. Rate per acre.	Yield seed cotton per plot				Total yield per plot.	Total yield per acre.
						1st picking. Sept. 12th.	2nd picking. Sept. 28th.	3rd picking. Oct. 18th.	4th picking. Nov. 1st.		
"	1	Acid Phosphate....	12.05	June 16th.	July 5th.						
		Muriate Potash....	3.97½	100 pounds.	100 pounds.						
		Sul. Ammonia.....	3 97½	Cotton seed meal....	Cotton seed meal.....	48.15	55.50	31.50	13.50	148.65	1486.5
			20 lbs.								
"	2	Acid Phosphate....	12.05	June 16th.	July 5th.						
		Muriate Potash....	3.97½	200 pounds.	200 pounds.						
		Sul. Ammonia.....	3.97½	Cotton seed meal....	Cotton seed meal....	41.25	50.25	43.50	24.75	159.75	1597.5
			20 lbs.								
"	3	Acid Phosphate....	12.05								
		Muriate Potash....	3.97½								
		Sul. Ammonia.....	3.97½	No manure.....	No manure.....	51.15	25 50	6 30	1.50	84.45	844.5
			20 lbs.								
"	4	Acid Phosphate....	12.05	June 16th.	July 5th.						
		Muriate Potash....	3.97½	50 pounds.	50 pounds.						
		Sul. Ammonia.....	3.97½	Nitrate soda.....	Nitrate soda.....	42.60	63.75	39.30	19.50	165.15	1651.5
			20 lbs.								
"	5	Acid Phosphate....	12.05	June 16th.....	July 5th.						
		Muriate Potash....	3.97½	100 pounds.....	100 pounds.						
		Sul. Ammonia.....	3.97½	Nitrate Soda.....	Nitrate soda.....	35.55	57.00	29.55	18.90	141.00	1410.0
			20 lbs.								

COTTON.—INTERCULTURAL EXPERIMENT—CONTINUED.

Plot.	No.	Fertilizers used per plot. Applied April 14th.	Name and quantity of fertilizers, and when applied. Rate per acre.	Name and quantity of fertilizers, and when applied. Rate per acre.	Yield seed cotton per plot: 1st picking, Sept. 12th.	2nd picking, Sept. 28th.	3rd picking, Oct. 13th.	4th picking, Nov. 1st.	Total yield per plot.	Total yield per acre.
"	6	Acid Phosphate....12.05 Muriate Potash.... 3.97½ Sul. Ammonia..... 3.97½ 20 lbs.	No Manure.....	No Manure.....	44.25	22.50	7.50	3.00	77 25	772.5
"	7	Acid Phosphate....12.05 Muriate Potash.... 3.97½ Sul. Ammonia..... 3 97½ 20 lbs.	June 16th. 200 pounds. Cotton Seed Meal....	.....	55.95	78.00	30.00	21.00	184.95	1849.5
"	8	Acid Phosphate ...12.05 Muriate Potash.... 3.97½ Sul. Ammonia..... 3.97½ 20 lbs.	June 16th. 400 pounds. Cotton Seed Meal....	.....	66.75	90.00	25.80	9.00	191.55	1915.5
"	9	Acid Phosphate....12.05 Muriate Potash.... 3 97½ Sul. Ammonia..... 3.97½ 20 lbs.	June 16th. 100 pounds. Nitrate Soda.....	.....	42.45	90.00	23.55	15.75	171.75	1717.5
"	10	Acid Phosphate....12.05 Muriate Potash.... 3 97½ Sul. Ammonia..... 3.97½ 20 lbs.	No Manure.....	No Manure.....	51.75	24 00	3.90	1.50	81.15	811.5

Average yield of unmanured plots, 809.5 pounds per acre.

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ALABAMA

Agricultural Experiment Station

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Fertilizers---Commercial and Domestic.

B. B. ROSS.

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FERTILIZERS—COMMERCIAL AND DOMESTIC.

The extremely low prices of agricultural products almost everywhere prevalent, at present, and particularly the unprecedentedly low figures which the chief Southern staple brings on the market, have, of necessity, attracted attention to the importance of the practice of greater economy in all of the departments connected with the conduct of the farm.

In no single department of the farm economy is there a greater tendency to make retrenchment or to curtail expenditures than in the direction of the reduction of the amounts heretofore paid out for the purchase of commercial manures or other fertilizing materials, and it is to be hoped that this tendency will at least lead to a more thorough utilization of the valuable domestic manurial resources which have been to a great extent, heretofore, either neglected or else disregarded.

These crude supplies of fertilizing materials which are within easy reach of almost every farmer, can, if intelligently and properly utilized, be made to supplement quite advantageously the supplies of artificial fertilizers which are employed as ingredients of the best domestic mixed manures.

The rational system of fertilization of the soil demands that the chief essential fertilizing constituents removed by any crops shall be replaced by returning to the soil an equivalent amount of these constituents for the use of subsequent crops, and it is, in part, to a lack of observance of this important principle, that the exhausted condition of many of our soils is due.

At the same time, it is also true that a very large proportion of our soils have been impoverished in a most marked degree by a washing away of the surface soil with its supplies of plant food and vegetable matter, while many of our

exposed soils lose by oxidation and decomposition a large proportion of their organic constituents.

To make good the losses occasioned under the several conditions above enumerated, there is a constant demand for fresh supplies of fertilizing materials for the purpose of returning to the soil the elements of plant food which have been removed, and these elements may be returned, in part, either in the form of some portion of the crop which has been produced, or by the application of supplies of manures derived from the feeding of the crops in question to farm animals.

It is the design of this bulletin, therefore, to furnish some practical information with regard to the methods of utilizing to the best advantage crude domestic manures, in conjunction with appropriate kinds and quantities of commercial fertilizers.

It is consequently not strictly within the province or scope of this pamphlet to treat of the methods of preventing or avoiding the other forms of soil exhaustion above referred to (viz: by washing and exposure), but the employment of better systems of drainage and the protection of the land by keeping it covered as continuously as possible with some vegetable growth, even if that growth be only grass, will be found to prove valuable aids in the diminution of the losses due to these sources.

Of the dozen or more elements which the soil supplies under ordinary conditions for the development and maintenance of plant life, all except three are commonly present in soils in sufficient quantities to meet the requirements of plant growth. These three important constituents of plant food are nitrogen, potash and phosphoric acid, and it is these three substances which both artificial fertilizers and domestic manures are designed to supply to the soil.

Manures are commonly divided into two classes — viz: *stimulant* and *nutritive* manures.

STIMULANT MANURES.

Stimulant manures are those whose addition to the soil does not supply directly any plant food of value, but whose presence there brings about the decomposition of other forms of plant nutriment not otherwise available for plant use. Among the more important and more commonly employed manures of this class are lime and gypsum (land plaster), and in some countries, salt also finds some employment as an auxiliary stimulant manure.

Lime is, itself, an important mineral ingredient of plant life, and some scientists and investigators (notably Ville) have classed it along with the three essential constituents of complete manures above alluded to. It so happens, however, that lime is present in sufficient quantities in almost all soils to meet the actual requirements of the plant itself for this particular element, and when it or its compounds are supplied to the soil it is almost invariably with a view to the fulfilment of its functions as a stimulant manure. One of the most important offices performed by the lime consists in the decomposition or breaking up of certain mineral forms of potash, whereby the latter becomes readily soluble and available for plant food, while in its original state of combination it was practically of no nutritive value.

Lime also corrects the acidity of so-called "sour soils" and checks in a marked degree the tendency of "running to weed" commonly exhibited by cotton and other crops grown on such soils.

The more important uses and effects of lime upon soils are very appropriately given by Dr. Hilgard in one of the Tenth Census Reports on Cotton Production, and his conclusions are reproduced herewith :

(a.) "A more rapid transformation of the vegetable matter into active humus.

(b.) The retention of such humus against the oxidizing influences of hot climates.

(c.) It renders adequate for more profitable culture per

centages of phosphoric acid and potash so small that in the case of the absence or deficiency of lime, the soil is practically sterile.

(d.) It tends to secure the proper conditions of nitrification whereby the inert nitrogen of the soil is rendered available.

(e.) It exerts a most important influence upon the flocculation and therefore upon the tillability of the soil."

For many purposes, gypsum is employed instead of lime, itself, and many of the functions performed by the latter can be quite effectively accomplished by the substitution of the gypsum (or land plaster), while for certain other purposes, gypsum can be used to better advantage than the lime.

On account of the tendency which gypsum (sulphate of lime) in a moist condition, has to fix certain volatile ammonia compounds, it is highly esteemed for use in covering compost and manure heaps, and effects a saving of considerable proportions of valuable plant food, which would otherwise be lost.

The continuous employment of stimulant manures to the exclusion of nutritive fertilizers, however, is one of the surest and quickest means of impoverishing the soil, since nothing of value is added to the stores of plant food, and the pre-existing supplies of nutritive materials are all the more readily removed by virtue of the presence of the lime or kindred stimulants.

NUTRITIVE MANURES.

The nutritive manures, in contradistinction to the stimulant, contribute directly to the plant valuable supplies of nutriment, and any excess of nutritive ingredients left unconsumed by the plant or crop, adds so much to the stores of plant food available for the use of subsequent crops. The various forms and descriptions of commercial fertilizers upon the market are designed to fulfill the office of nutri-

tive manures, and contain one, two or all three of the essential fertilizing ingredients previously referred to.

The proportions in which these ingredients are supplied, and the forms in which they occur in commercial manures exhibit considerable variations, and are largely dependent upon the manufacturerer's ideas as to the requirements of any particular crop or soil. These commercial manures are commonly divided into two classes, viz: "complete" and "partial manures," the former containing, as the term implies, all three of the chief essential fertilizing constituents of value (phosphoric acid, nitrogen and potash) while the latter contain only one or two of these ingredients.

The former are designed for general use and for direct application to soils and crops, frequently, of widely different characters ; the latter are either to be employed as ingredients of home made mixed manures or composts, or else to supply some particular element, in a concentrated form, to some specific crop.

Partial manures may be advantageously considered under the following subdivisions :

(1.) Phosphoric acid manures.
(2.) Nitrogen manures.
(3.) Potash manures.
(4.) Manures containing phosphoric acid and potash.
(5.) Manures containing phosphoric acid and nitrogen.
(6.) Manures containing potash and nitrogen.

The following matter with reference to the composition, characteristics and sources of commercial manures is reproduced from the fertilizer bulletin published by the Department of Agriculture in August 1894 :

(1) PHOSPHORIC ACID MANURES.

Formerly the chief source of supply of this valuable fertilizing element was bones, either raw or chemically treated, and while "bone meal" and raw bone superphosphates still have a large consumption, by far the largest proportion of phosphoric acid for artificial fertilizers, is derived from phos-

phate rock, from the fossilized remains of extinct animals, or from the soft phosphate deposits of tropical islands, and quite recently large supplies of this element have been furnished by the Thomas slag, a by-product of the Thomas-Gilchrist steel process. In this country, for the past twenty-five years, a large proportion of the phosphoric acid consumed by our agricultural economy has been furnished by the deposits of phosphate rock contiguous to Charleston, S. C., but within more recent years the supplies of South Carolina phosphate have been largely supplemented by the soft phosphates from South Florida.

The mechanical condition of fertilizers of all classes greatly affects the utility and availability of their fertilizing constituents, and in order to more readily meet the needs of the plant the crude phosphate rock is crushed to a state of impalpability, and the resulting powder so finely divided that its particles can "float" in the air, is placed upon the market under the name of "floats."

Phosphates from some of the tropical islands of the Caribbean sea and adjacent waters are also utilized to some extent as a source of phosphoric acid, though the deposits are being rapidly exhausted.

The phosphatic formations of this character owe their origin largely to the deposits of sea birds, and in rainless climates nitrogen in the form of nitrates and ammonia salts is also found, but in localities where the rainfall is at all considerable, the proportion of this element is extremely small, if it be not entirely absent. Large quantities of phosphoric acid are also supplied from the wastes of our large slaughter houses, and the fertilizers obtained from this source contain also considerable proportions of nitrogen.

Refuse bone black from the sugar refineries, after being utilized for the decolorization of sugars, is frequently treated with sulphuric acid and sold as a fertilizer under the name of "dissolved bone-black," or else is used in the preparation of many of our mixed fertilizers.

The phosphoric acid in most of our complete fertilizers is

found in three forms, viz., the soluble, reverted and insoluble forms. The first is soluble in water, the second is soluble in neutral citrate of ammonia, and is termed by the fertilizer law "citrate soluble," while the third form is insoluble both in water and citrate of ammonia, but is soluble in acids, and is therefore designated "acid soluble phosphoric acid."

In nearly all of our fertilizers the phosphoric acid is in combination with lime, and in bones, phosphate rock and the chief mineral phosphates, is in the form of what is termed "bone phosphate" or insoluble phosphate of lime. While this form of phosphoric acid is insoluble in pure water, it dissolves slowly in water containing carbonic acid (carbon dioxide) in solution, and upon many soils, especially in the presence of organic matter, and where the particles of the fertilizer are in a finely divided condition, has been employed to good advantage.

In order to reduce crude phosphates such as bones, phosphate rock, etc., to a state of fine division, and also to convert the phosphoric acid into a form soluble in water, the crude materials are treated with sulphuric acid and a product is obtained which is known as superphosphate of lime or acid phosphate, while gypsum (sulphate of lime) is also produced and remains admixed with the phosphate.

Pure superphosphate of lime is completely soluble in water, and were the precise amount of sulphuric acid required to completely convert the insoluble phosphate into the superphosphate employed, the whole of the phosphoric acid of the acid phosphate would be in a soluble condition.

In actual practice, however, the full theoretical amount of sulphuric acid is seldom employed in the manufacture of superphosphates, and a small amount of insoluble phosphoric acid is left in the product.

This insoluble phosphate, in contact with the soluble phosphate, leads to the formation of a compound intermediate between the two in composition, and this substance is the "reverted" or "reduced" phosphate.

The term "reverted" is so applied because the soluble phosphoric acid of the fertilizer "turns back" toward its original insoluble form, and a similar behavior is noticed in soils containing good proportions of iron and alumina or lime.

The "reverted" phosphate of lime is the form previously referred to as insoluble in pure water, but soluble in a neutral solution of citrate of ammonia, this solution being assumed to approximate in solvent power the soil water with which the fertilizer will be brought in contact.

"Reverted" or "citrate soluble phosphoric acid" together with the water soluble, constitute what is termed" available phosphoric acid," and though usually assigned the same value, there is considerable diversity of opinion among scientific investigators as to the relative values of these two forms of phosphoric acid.

While the soluble phosphoric acid is soluble in water only so long as its free acid remains uncombined with some such base as lime, oxide of iron, alumina, etc., and while it speedily reverts in soils containing any considerable proportions of these substances, nevertheless it is believed to have an initial diffusive property not possessed by the reverted form; that is, it is disseminated more rapidly and fertilizes more soil in a given time than the same amount of reverted would do.

While the soluble phosphoric acid is seldom found in appreciable quantities in natural phosphates, the reverted form is frequently found in small quantities along with the insoluble in phosphate rock, and in still larger quantities in some tropical phosphates, such as orchilla guano, etc.; it is also found in bones to a considerable extent, and the phosphoric acid in many of our organic fertilizers, such as cotton seed meal, is readily soluble in ammonium citrate.

The superphosphates prepared from bones are believed by many to have a higher value than those from phosphate rock; this superiority, however, if it exists, extends only so far as the availability of its insoluble phosphoric acid is

concerned, the insoluble phosphoric acid from animal sources being much more readily appropriated by the plant than the same form when of mineral origin.

The phosphoretic slag obtained by dephosphorizing pig iron in the Thomas-Gilchrist process for steel-making, has recently become an important factor in the world's supply of phosphoric acid, but has been met with but little in southern fertilizer markets.

Should the basic process of steel making be introduced in this State, an additional valuable source of phosphoric acid will be furnished to the farmers of Alabama.

The attention of this office has been called to circulars distributed by manufacturers and dealers in non-acidulated phosphates, in which a claim is advanced in favor of the natural phosphate and against the acid phosphate, to the effect that the free sulphuric acid of the latter is highly detrimental to vegetation, and therefore constitutes a valid objection to its use for fertilizing purposes.

As a matter of fact, however, the proportion of sulphuric acid used in the treatment of phosphate rock is, as stated above, very rarely sufficient to give even a slight excess of free sulphuric acid in the product and farmers need apprehend no trouble from this source.

(2.) NITROGEN MANURES.

Nitrogen is supplied in commercial fertilizers in three forms, these several forms being designated by the sources from which they are derived :

(1) Vegetable nitrogen.
(2) Animal nitrogen.
(3) Mineral nitrogen.

Among the chief forms of vegetable nitrogen may be mentioned cotton seed, cotton seed meal, and the cakes and meal resulting from the extraction of oils from various vegetable sources.

Cotton seed and its product, cotton seed meal, is the best known of any of the vegetable fertilizers to the southern

farmer, and at the same time, it is the cheapest form in which nitrogen can be obtained in the Southern States.

In addition to the seven per cent. of nitrogen which the meal contains, it also furnishes a considerable supply of phosphoric acid and potash—about three per cent. of the former and two per cent. of the latter.

While the nitrogen of cotton seed meal may not act as quickly as that of nitrates and ammonia salts, nevertheless, upon the decomposition of the meal in the soil, there are formed compounds both of nitric acid and ammonia, similar in composition to some of the mineral forms of nitrogen.

In the purchase of cotton seed meal the farmer should always guard against the admixture of hulls with the meal, the presence of the hulls being readily detected by placing the meal upon an ordinary sieve and shaking thoroughly.

The dark colored cotton seed meals, which are sometimes met with upon the market, while greatly damaged so far as their utility as feed stuffs are concerned, are uninjured as regards their fertilizing value, as has been repeatedly shown by analysis. The cotton seed meal, in addition to its direct application to the soil by the farmer, is employed as a source of nitrogen in the preparation of a large proportion of the complete fertilizers manufactured in the South.

Among the chief forms of animal nitrogen met with in the markets, may be enumerated fish scrap, dried blood, tankage and various other by products from the wastes and refuse of slaughter houses.

Several of these, as tankage, fish scrap, etc., contain in addition to the nitrogen, considerable proportions of phosphoric acid, though they are in general utilized chiefly for the nitrogen they furnish.

The dried blood is a product resulting from the evaporation of the blood from slaughter houses and the thorough drying of the residue, frequently by means of superheated steam. The color of the product varies with the temperature at which the drying is effected, and the red blood is generally considered of more value than the black. The

proportion of nitrogen varies from 9 to 15 per cent. and practical field experiments show that this element, in this form, is readily and quickly available for the use of the plant.

The chief mineral forms of nitrogen of importance are sulphate of ammonia and nitrate of soda, though nitrate of potash and muriate of ammonia are also met with occasionally in the fertilizer trade. The supplies of nitrate of soda are obtained chiefly from the nitrate beds of Chili and Peru, and the refined product has of recent years had quite a large consumption in this country. It contains 15 to 16 per cent. nitrogen in a highly available form and is employed in the preparation of high grade fertilizers, and also as a top dressing for grains, grasses, etc.

Sulphate of ammonia is largely prepared from the ammoniacal liquors of gas works, the crude liquor being neutralized with sulphuric acid and evaporated to dryness.

This substance is the most concentrated commercial form of nitrogen which is found, in general, upon the markets, and is used in the manufacture of complete fertilizers rich in nitrogen, or else is employed as a top dressing for certain crops.

For this latter purpose, however, both of the above mineral forms of nitrogen must be applied with great caution, since by virtue of their easy solubility, they are readily leached from the surface soil, especially if the subsoil is at all permeable.

(3.) POTASH MANURES.

The manures of this class which meet with the largest consumption, either for direct application to the soil or as ingredients of mixed goods, are the crude potash salts from the German salt deposits. The chief forms in which the potash is found in the crude commercial salts are the sulphate and muriate (chloride), the latter form containing the higher proportion of potassium. Kainite, another product of the German mines, consists of potassium sulphate, mag-

nesium sulphate and the chlorides of magnesium and sodium. Its average proportion of potash is about 12 per cent. and it is largely employed in the preparation of composts and in compounding mixed fertilizers designed to contain a moderate potash percentage.

The muriate of potash met with in commerce generally has a purity of only 80 to 85 per cent., giving a potash equivalent of about 50 to 53 per cent., while the high grade sulphate contains from 45 to 50 per cent. potash, and the low grade sulphate only about 30 per cent. of this ingredient. These latter goods are used almost exclusively for the preparation of complete fertilizers with a high potash content.

Cotton seed hull ashes is a southern product which is quite a valuable source of potash, though its use is largely confined to the States bordering on the Atlantic.

The hulls removed from the cotton seed, preparatory to the extraction of oil, are largely used as fuel under the boilers of the oil mills, and the ashes obtained are found to contain from 15 to 25 per cent. potash, and 7 to 10 per cent. of phosphoric acid.

In mixing hull ashes with nitrogenous organic materials, great caution is to be observed, since mixtures of this kind, if kept for any length of time, especially if allowed to become moist, are likely to ferment, with consequent loss of a considerable proportion of nitrogen.

Among the chief vegetable sources of potash may be mentioned tobacco stems, which are utilized to a great extent in the tobacco growing States, and many of the complete fertilizers manufactured along the Atlantic seaboard contain potash derived from this waste product.

(4.) MANURES CONTAINING PHOSPHORIC ACID AND NITROGEN.

Bones, whether in the original crude state or treated with sulphuric acid, contain in addition to their phosphoric acid, from 3 to 5 per cent. of nitrogen derived from the gela-

tinous matter of the bone and constitute one of the most common forms of partial manures of this class.

The boiled or de-gelatinized bone, obtained as a by-product of gelatine manufacture, is sometimes found on the market, but this, of course, contains only phosphoric acid.

Tankage, a product of the large slaughter houses, consists chiefly of a mixture of the dessicated residues of meat and bone left from the treatment of the slaughter house wastes for extraction of grease. The proportions of meat and bone in this fertilizer vary considerably, and lead to quite large differences in the nitrogen and phosphoric acid contents of different samples, the phosphoric acid generally being in excess, though its proportion is dependent largely upon the amount of bone in the material.

Fish scrap, which is simply the dry, pulverized residue from the extraction of oil from fish, contains both phosphoric acid and nitrogen, though the latter predominates and the product is chiefly used for the nitrogen which it supplies. The fertilizing value of all the materials of this class is largely enhanced by a finely divided condition of the particles, and a mechanical analysis is frequently resorted to in addition to the chemical examination.

(5.) MANURES CONTAINING PHOSPHORIC ACID AND POTASH.

Many of the acid phosphates upon the southern market have been mixed with a small proportion of kainite or some of the higher grade potash salts, and are thus better adapted for composting than the plain super-phosphates. By the simple mixture of goods of this class with cotton seed meal a complete fertilizer is obtained, and the farmer can frequently prepare advantageously, in this way, mixtures to meet the needs of his different crops.

(6) MANURES CONTAINING NITROGEN AND POTASH.

Nitrate of potash is the only manure of importance of this class, supplying both potash and nitrogen in a very

soluble form. Its cost, however, is quite high, and its consumption is somewhat limited.

COMPLETE FERTILIZERS.

As the name implies, fertilizers of this class contain all three of the chief fertilizing constituents of value, though the proportions of these ingredients are extremely variable.

The basis of the complete fertilizer is the super-phosphate, and with this are mixed some common forms of nitrogen and potash, the proportion of these elements being largely dependent upon the manufacturer's ideas of the needs of the soil or crop. Kainite and cotton seed meal are more commonly employed than any other materials to furnish potash and nitrogen to the mixed fertilizers, and planters will, in many cases, find it a good policy to prepare their own complete manures by purchasing the materials referred to and mixing them to suit the requirements of the crop or soil of their particular section.

With these materials at hand, the farmer can prepare a fertilizer of a certain composition for his cotton and a mixture of a still different composition for his corn, the proportion of nitrogen required in the latter case being in general greater than in the former.

Of course, fertilizers prepared according to any definite formula would not be equally well adapted to all soils and sections of the State, and to those who have written to this office for information with regard to the composition of fertilizers best suited to the needs of their particular locality, the formulas furnished in reply have been largely governed by the characteristics of the soil, both as regards composition and location. For instance, on many of our hill soils which consist very largely of particles derived from micaceous and feldspathic rocks, the addition of potash is of very doubtful necessity, and in some cases, quite recently, it has been recommended that for such soils potash either be omitted entirely, or else used in very small quantities. For the same reasons, the addition of excessive quantities of

phosphates to some of our soils which are already well supplied with phosphoric acid is an extremely ill-advised procedure.

DOMESTIC MANURES.

Among the domestic manurial supplies of importance the manure of the more common farm animals first demands consideration.

Originally they found quite general employment in the manurial economy of the farm, but since commercial fertilizers have gained such extensive use, the supplies of domestic manures have been either partially disregarded or else not intelligently applied.

The value and importance of farm manures can possibly be better appreciated and understood when it is stated that the value of the manure produced by a well fed horse per year will be from $23 to $25, calculated according to our scale of fertilizer valuations, while the value of manure per head from our average full grown cattle will probably vary from $15 to $18 per year.

The value of farm manures is largely dependent upon the kind and condition of the animal and the character and quantity of food supplied, and even under uniform conditions the composition is subject to slight variations.

Young and growing animals excrete from one-half to three-fourths of the total fertilizing ingredients in their feed and this proportion is rarely exceeded for the reason that a considerable percentage of these fertilizing constituents are being constantly utilized in the formation of fresh quantities of bone, muscle, tissues, etc., there being in consequence much smaller amounts of waste materials than is the case with full grown animals.

With milch cows the amount of fertilizing constituents excreted is relatively smaller than with other neat cattle on account of the fact that a large proportion of these valuable elements are important constituents of milk, thereby diminishing the amounts found in the excrement itself.

Full grown animals, whether fattening or working, assimilate only a very small proportion of the three chief fertilizing elements, more than nine-tenths of the total amounts of these substances taken in the food, being found in the excreta.

The manure of the horse (or mule) is weight for weight much richer than that of cattle, though a portion of this difference is due to the extremely large percentage of water contained in the manure of cattle.

Samples of barn yard manure both from the stable and cow stalls at the experiment station were subjected to analysis with the following results:

ANALYSES OF BARN-YARD MANURE.

	Water.	Phosphoric Acid.	Nitrogen.	Potash.
Manure from cow stalls (fresh)*	83.85	0 28	0.29	.....
" " " " (dry)	.....	1.75	1.81	.21
" " mule " (fresh)	76.33	0.46	0 63	0.31
" " " " (dry)	.....	1.94	2.66	1.31

* Solid excrement.

The proportion of water contained in the fresh manures of all animals is extremely high, as the analyses just given indicate, although the water percentages in these samples are below the average. The fertilizing value of such manures are made much more apparent when the percentages of the fertilizing ingredients in the dried material are given, as has been done in the case of each of the above samples, though in actual practice, it is best not to permit the manure to become even approximately dry, since "burning" or "fire-fanging" will almost always take place.

Since farm animals excrete such large proportions of the total fertilizing ingredients contained in their food, it is at once manifest that the character of the feed exerts a most important influence upon the composition and fertilizing value of the manure produced.

Indeed, the value of the manure of any given animal for fertilizing purposes is determined almost wholly by the proportions of phosphoric acid, potash and nitrogen contained in the feed stuffs, and analyses of manures resulting from the use of foods rich in the valuable elements of plant food invaribly show a marked superiority over those produced from a food less rich in those constituents.

For instance, carefully conducted feeding experiments have shown that the manure obtained where cotton seed meal and hulls were used, possessed a value more than 40 per cent. greater than that of manure resulting from the employment of an ordinary mixed feed.

In England and several continental countries, it is frequently the case that large numbers of cattle are fattened on high grade and concentrated feeds, either grown on adjacent land or imported, the manure carefully collected and preserved and in many instances returned to the very soils on which the feed stuffs have been produced, with only a very small net loss of the original fertilizing constituents removed by the crop from the soil.

The careful littering or bedding of the stalls of farm animals is of far greater importance than it is generally considered to be, and a disregard of the necessity of giving proper attention to this matter undoubtedly leads to considerable loss of valuable fertilizing ingredients. The chief function of the litter is to absorb the liquid manures which would otherwise go to waste and which it is very important to preserve and properly utilize.

The liquid manures of most farm animals contain relatively larger proportions of nitrogen and potash than do the solid excrements, and if these are not properly collected, it can be readily seen that there will be a loss of no inconsiderable amounts of the total fertilizing materials which are excreted. Among the materials ordinarily employed for litter or bedding may be mentioned straw of various kinds, leaves, saw dust, peat, muck, etc., though the first named substance is more extensively used than any other.

Experiments have demonstrated that dry straw will absorb frequently more than twice its weight of water, while dry peat and muck are almost perfect absorbents and at the same time add very greatly to the fertilizing value of the manure.

Dry straw contains only from one-half to three quarters of a per cent. of nitrogen and considerably less of potash and phosphoric acid, so that it's presence in a state of admixture with the manure does not add materially to the fertilizing value of the latter.

Straw and similar materials, however, in addition to their utility as absorbents, serve to decrease the compactness of manure, to check and regulate fermentation and in many cases promote chemical action in the manure.

The decomposed and disintegrated straw or litter will also supply humus to the soil, a not unimportant consideration in the case of many of our soils, which are almost destitute of organic matter.

The preservation of stable manures is a subject to which too much importance cannot be attached and their value is frequently much diminished by reason of the careless exposure to which they are subjected. Frequently manure heaps are left in an unprotected condition, under the eaves of barns and stables, and the leaching, which takes place with each rain fall, causes a considerable proportion of the fertilizing constituents to be washed out and lost.

Exposure to wind and variable conditions of weather also causes a loss, by reason of the escape of some of its constituents, particularly ammonia, in a gaseous form.

Carefully conducted experiments at the Cornell Experiment station have demonstrated that the reckless exposure of loose manure heaps to wind and weather may cause a loss of as much as 42 per cent. of its original fertilizing value during a period of only six months.

MUCKS.

In localities contiguous to swamps or low marshy bottoms where a dense vegetable growth has prevailed at some time in the past, mucks form a desirable proportion of the manurial supply of the farm, and in some sections of this country, as well as in Europe, mucks and peat form an article of commerce.

Materials of this character owe their value largely to the quantity of vegetable matter they contain, though the character of the vegetable growth from which they are derived influences very appreciably their composition.

Nitrogen is the most important fertilizing constitnent of mucks, though it is present in quite varying proportions, ranging from one half per cent. in a low grade article to 4 per cent. in mucks of extreme richness.

In addition, there are small proportions of phosphoric acid and potash, but these are of minor importance as compared with the nitrogen contained in the muck, and the large supplies of organic matter, which constitute a ready source of humus.

The thoroughly air dried muck may either be employed in composting, or is used as bedding in stables, it being especially adapted to this latter purpose on account of its great absorbent properties, readily taking up and retaining liquid manures with comparatively small loss of ammonia.

In composting, it can be used along with acid phosphates, either as a substitute for, or in conjunction with, stable manure.

The addition of moderate proportions of lime to muck composts is frequently practiced and in most cases to good advantage.

Two samples of muck from the southern part of the State have been examined in this laboratory quite recently and showed on analysis the following composition:

ANALYSES OF MUCK.

SAMPLE.	Phosphoric Acid.	Nitrogen.	Potash.
No. 1. From Baldwin county, Alabama.....	Trace	0.70	0.04
No. 2. From Escambia county, Alabama.....	0.58%	0.98	0.31

MARLS.

Throughout a very considerable area of the State, particularly in the cretaceous formations, marls are found in comparative abundance and many samples of high quality have been analyzed in this laboratory.

Marls, properly speaking, consist of carbonate of lime admixed with varying quantities of sand, clay or loam.

The carbonate of lime is ordinarily the chief constituent of value in marls, though small proportions of phosphoric acid and potash accompany the lime in many cases.

The carbonate of lime contained performs the functions of a stimulant manure, decomposing and rendering available some of the ordinarily inaccessible mineral forms of potash present in the soil, and also promoting the formation of humus and the nitrification of the otherwise inactive nitrogen of the soil. The chief difficulty in the way of the more extensive utilization of marls lies in the fact that they will not admit of transportation to any considerable distance, and the soils in the immediate vicinity of the marl deposits are in most cases quite well supplied with lime.

Light and sandy soils, however, will in most instances be benefited by the application of good quantities of well pulverized marl and such soils are sometimes found within easy reach of marl deposits.

"Green sand marls," or glauconitic marls, have been found in a number of localities in this State in sufficient quantities to prove of value for local use. They contain potash (in the form of the mineral "glauconite," in quite considerable proportions, and somewhat smaller quantities of phosphoric acid. Materials of this class act quite slowly when employed for fertilizing purposes, but as this action extends

over quite a long period, the application of green sand marls constitutes quite an important contribution to the permanent plant food supplies of the soil.

The following are the analyses of two samples of green sand marl examined in the station laboratory within the past year.

ANALYSES OF GREEN SAND MARLS.

	Phosphoric Acid.	Potash.
Green Sand Marl, No. 1. From Silas, Ala.....	2.24	3.78
" " " " 2. " " "	2.74	3.86

Marls of this high quality can be employed to quite good advantage, locally, either by direct application to the soil, or in conjunction with cotton seed and stable manure in the form of composts.

MISCELLANEOUS MANURIAL SUPPLIES.

In addition to the above described manurial supplies, there are other crude natural fertilizing materials which are incidental to certain localities in the State. Especially is this the case in North Alabama where valuable deposits of bat manure have been found in a number of caves. These deposits of bat excrement show considerable proportions of nitrogen and fairly good proportions of phosphoric acid and potash.

The following results of analysis of several samples of this material will serve to illustrate its composition and value as a fertilizer.

ANALYSES OF BAT MANURE.

SAMPLE.	Phosphoric Acid.	Nitrogen.	Potash.
Bat Manure, No. 1. From North Alabama, exact locality not known	2.79	3.20	0.85
Bat Manure, No. 2. From North Alabama, exact locality not known	5.56	8.26	2.02
Bat Manure, No. 3. From Lauderdale county	2.27	5.40	0.85

Samples No. 1 contained 65 per cent. moisture, while sample No. 2 had been air dried.

Deposits of cave earth, when employed locally, are of no small manurial value by virtue of the phosphoric acid and nitrogen contained, as the following analyses will show:

SAMPLE.	Phosphoric Acid.	Nitrogen.
Cave Earth, No. 3. From North Alabama, exact locality unknown	0.86	0.36
Cave Earth, No. 4. From North Alabama, exact locality unknown	1.63	0.29
Cave Earth, No. 5. From North Alabama, exact locality unknown	2.20	0.53
Cave Earth, No. 6. From North Alabama, exact locality unknown	3.31	0.20
Cave Earth, No. 7. From Lauderdale county, Alabama	6.84	0.94
" " " 8. " " " "	Trace	0.41
" " " 9. " " " "	3.65	

The bat manure, in a moderately dry condition, is of sufficient fertilizing value to admit of its transportation and it can be employed in mixed fertilizers as a source of nitrogen.

As a top dressing for grains, grasses, clover, etc., it can also be used to considerable advantage.

COMPOSTS.

The most advantageous form in which the crude manurial materials of the farm can be utilized, is, in general, in the compost heap.

Among the advantages offered by composting may be mentioned the better proportioning of the fertilizing ingredients designed for use on some specific soil or crop, which the proper preparation of the compost heap permits; the rapid disintegration and decomposition of the organic materials which may be employed as litter or else as ingredients of the compost; the promotion of nitrification, which is generally believed to be facilitated by the employment of carbonate of lime or marl in the compost; the retention and preservation of ammonia, which is possible in properly managed composts, the loss of which element constitutes one of the most objectionable features of the exposure of loose heaps of stable manure.

In addition, the stable manure by admixture with the other materials in composts, ordinarily becomes less compact, the material is more easily handled, and when applied to the soil, the fertilizing constituents contained are in a condition of more ready availability for the use of the plant. The most common ingredients of composts in the South are acid phosphate, cotton seed and stable manure, though in some cases mucks, marls, ashes, lime, etc., are employed.

For cotton the following compost formula is recommended for use on the average soil:

Acid Phosphate (14 per cent. available Phosphoric Acid)	500 lbs.
Cotton seed	700 "
Stable manure	800 "
Total	2,000 lbs.

In the preparation of composts, a layer of stable manure is spread out evenly in a level place to a depth of several inches; upon this a corresponding quantity of acid phos-

phate is placed, next a layer of cotton seed, this alternation being continued until the materials are exhausted.

The cotton seed employed in the compost should be moistened thoroughly, and the heap after its completion, should be saturated with water containing 100 pounds of Kainite in solution. The heap should be covered with a layer of rich earth or vegetable mould, or better still with a thin layer of gypsum; any liquid drainings from the stable which may be at hand, can be used to advantage in moistening the heap from time to time. The bed should be protected from rains by a shelter, and the heap should be left undisturbed for a period of from three to six weeks. When ready for use, the heap is broken up and the materials are thoroughly mixed and incorporated with each other. The quantities of this compost applied to the soil should be just about double the quantities of the average complete fertilizer ordinarily used on the soil or crop in question, i. e.—from 300 to 600 pounds of the compost per acre.

The composition of such a compost would be approximately as follows :

	Available Phosphate Acid.	Potash.	Nitrogen.
500 ℔ Acid Phosphate	70 ℔	.....	.....
700 " Cotton Seed	7 "	8 ℔	21 ℔
800 " Stable Manure	2.4 "	4.8 "	4.81 "
Total	79.4 ℔	12.8 ℔	25.81 ℔

The percentage composition would be :

Available phosphoric acid 3.97%.

Nitrogen 1.29%.

Potash .64%.

The addition of the kainite will increase the potash percentage to about 1.2, and the fertilizing value of the complete mixture, calculated on a fertilizer basis, will be about $9.70.

Instead of stable manure, muck can be employed, if deposits of this material of a good quality are at hand, and straw and decaying leaves in moderate quantities, may also be used if the heap is to be allowed to stand for some time.

A compost for corn will require relatively larger proporportions of nitrogen and smaller quantities of phosphoric acid, and the following formula will furnish the desired elements in fairly satisfactory proportions :

Acid Phosphate (High Grade)	300 lbs.
Cotton Seed	900 lbs.
Stable Manure	800 lbs.
Total	2,000 lbs.

Kainite to be added as before.

Mixtures adapted to corn can be used to some advantage also with sugar cane, especially where the latter is grown on light sandy lands.

FRAUDULENT FORMULAS FOR COMPOSTS.

Several times during the present season there have been forwarded to this office, formulas for the preparation of composts and home mixed fertilizers, these formulas having been sold for as much as $5 by the parties who have adopted this fraudulent means of earning a livelihood.

The character of the materials recommended, and the forms and proportions in which the several ingredients are to be supplied, show upon the face of the formulas, evidence of the fraudulent and deceptive character of the latter.

Two of these formulas are given below, in order that the sham and deception involved in the sale of such recipes may be exposed.

FORMULA NO. 1.

Ammonia	5 lbs.
Phosphoric Acid	2 "
Nitrate of Potassium	5 "
Saltpeter	10 "
Sulphur	5 "
Potash	10 "
Lime	50 "
Ashes	100 "
Dirt or lot scrapings	1800 "

FORMULA NO. 2.

Nitrate of Ammonia	4 lbs.
Soda Ash	4 "
Saltpeter	2 "
Potash	4 "
Bluestone	2 "
Lime	50 "
Salt	25 "

Mix in 10 gallons of water and add to green vegetable mold or barn yard scrapings.

It will be observed that in the first formula, commercial ammonia is recommended, although it is one of the costliest forms of ammonia and a form in which its complete loss is best assured. The amount per ton of actual ammonia thus supplied is insignificant, and were the ammonia not already in a free condition, it would soon be liberated by virtue of the presence of caustic alkalies in the mixture.

Potassium nitrate and saltpeter are one and the same substance, although they are mentioned separately in this formula.

This salt is one of the costliest and most concentrated forms of nitrogen and potash obtainable, and its use in a compost would be entirely inadvisable, when so much cheaper forms of nitrogen can be easily secured. The sul-

phur in this formula, as well as the bluestone and other substances (soda, etc.) in the other formula, is entirely superfluous and unnecessary, and supplies but another evidence of the untrustworthiness of such recipes.

The presence of caustic alkalies in the second formula, along with ammonia salts would of course lead to an almost total loss of this last ingredient, while the proportions in which it is recommended that these mixtures should be applied, would furnish extremely small quantities of the important fertilizing ingredients to the soil.

For instance, the commercial value of the materials in formula No. 1, would be only about $1, though one of these ingredients, phosphoric acid, is not on the market in a free state, as the formula might lead one to suppose.

The commercial value of the fertilizing constituents in formula No. 2, is even less than that in No. 1, and the mixture is as equally untrustworthy.

It is to be hoped that the sellers of these formulas have met with but little success, and that the farmers will prepare their composts or home mixed manures out of the crude materials which they have at hand, used in conjunction with acid phosphate, kainite, etc.

GREEN MANURES.

The practice of green manuring, or the plowing under of certain green crops grown especially for this purpose, is one of the oldest systems of fertilization at present in use, and has been followed in the South with advantage for many years, though only one or two particular crops have been utilized for this purpose. While it has been long known that the cow pea and many other leguminous plants possessed in a most marked degree the capacity of collecting and assimilating large quantities of the chief fertilizing constituents, and particularly, nitrogen, nothing has been definitely known as to the causes underlying their remarkable properties as nitrogen collectors until within quite recent years.

So readily does the cow pea grow upon many soils which fail to respond to the requirements of other crops, that when it is desired to convey the idea of an almost total lack of fertility in a soil, we often hear the expression—"the land is too poor to grow cow peas."

It was formerly supposed that this capacity of collecting plant food so successfully, even on very poor soils, was due to the long and deep reaching roots which were presumed to readily take up supplies of plant food beyond the reach of many other crops. The amounts of nitrogen assimilated by the pea and similar plants on rather unfertile soils were frequently so out of proportion to the available supplies of nitrogen in these soils, that investigators have for years sought to determine whether or not these plants possessed the power of assimilating the free nitrogen of the atmosphere. The researches and experiments of a number of German investigators, extending over a long period of years, have at last shown that leguminous plants are capable of taking up and assimilating the nitrogen of the atmosphere, and this property is known to be dependent upon the presence of bacteria or minute microscopic forms of life, which are found in the tubercles or excrescences which occur quite profusely upon the roots of thrifty and vigorous plants of this character.

Certain particular bacteria are found to be peculiar to certain specific plants, and plants grown in a soil destitute of the organism peculiar to them, are observed to have few if any root tubercles.

By adding to the soil in question small amounts of soil from land on which similar plants are observed to develop root tubercles, it will be found that the plants grown on the former soil will also soon have tubercles formed upon their roots, and at the same time, the growth of the plants becomes vigorous and rapid. The presence of these bacteria in the tubercles of the roots of leguminous plants, in connection with the functions which the bacteria perform, constitutes an example of what is termed by scientists "*symbiosis*" (*life together*), the plant, itself, and these micro-organ-

isms being mutually dependent upon each other. Since nitrogen is the costliest form of plant food obtainable, and since many of the commercial forms of nitrogen are either inaccessible to, or beyond the means of, many of the farmers, it will be readily seen that this system of green manuring, which provides a means for the collection of this valuable element from the atmosphere and a medium through which it can be stored up for the use of subsequent crops, is of the highest importance and utility to the farmer. Experiments conducted at this station several years since, showed that a crop of pea vines, grown on a sandy loam, of only moderate fertility, contained the following amounts of phosphoric acid, potash and nitrogen (calculated from actual analyses) per acre.

	In vines.	In roots.	Total.	Value.
Phosphoric Acid	39.05 lb	6 90	45.95	$ 2 30
Potash	88.79 "	13.12	101.91	1 02
Nitrogen	115.54 "	7.70	123.24	21 56

The values are calculated according to our scale of fertilizer valuations, and it will be seen that the value of the nitrogen alone, exceeds that of a ton of ordinary complete fertilizer, while the nitrogen is equivalent in amount to that contained in 1750 pounds of cotton seed meal, though this crop was considerably above the average yield.

In addition to the advantages derived from turning under a crop which has a peculiar adaptability to securing plant food from the air, and from the soil and soil water, such a crop supplies an immense mass of organic matter to the soil.

This vegetable matter on oxidation and decomposition, gives off large amounts of gaseous matter of which carbonic acid forms the chief proportion, and this last substance is highly instrumental, especially when in a state of solution, in the breaking up and dissolving the chief constituents of the soil.

The organic matter is also the source of supply for large amounts of humus which is so essential to soils in promoting the absorption and retention of moisture, and in the improvement of the mechanical condition and physical characteristics of the soil.

Humus is a material of somewhat complex composition and is the result of the partial decomposition of organic matter (whether vegetable or animal) in the soil.

Its color varies from brown to black, owing to the stage of decomposition it has reached, and the dark color of our most fertile soils is due to the presence of considerable proportions of this substance.

Very light, quickly drained soils, to which the term "thirsty" is often applied, are especially benefited by the addition of large quantities of humus forming material, which enable the soil by its increased absorptive and retentive capacity to withstand drought much more readily.

It also improves to a marked degree the texture of stiff, difficulty tillable soils, enabling them to be worked more easily, at the same time that it permits of more thorough aeration by virtue of their increased porosity.

Gases, such as carbonic acid, are more readily retained, and in conjunction with the water with which they are brought in contact, render the solution of certain forms of plant food comparatively easy.

It is also a most important agent in effecting the decomposition and disintegration of the mineral constituents of the soil, and in supplying some of the conditions most essential to nitrification.

In addition to the cow pea, which is the favorite crop for plowing under in the South, the clovers and alfalfa (or lucerne) rank very high as crops adapted to green manuring.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

TOBACCO.

ALEX. J. BONDURANT.

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PART I.

TOBACCO EXPERIMENTS.

Experiments in tobacco were continued the past year with Plug and Cigar varieties. These experiments were undertaken to ascertain the best method of raising tobacco plants in Alabama, to find out the best kinds of tobacco for this climate and soil, the most suitable fertilizers for the tobacco crop, and for investigating some of the different methods of curing tobacco.

Methods of raising the plants.—The first bed for raising the plants was made at the Horticultural Grounds Jan. 31st. A frame was made of boards, 8x16 feet, such as is used for hot-beds, and into this frame rich woods mould was placed, well fertilized with equal portions of cotton seed meal and acid phosphate. The seeds were sown in drills a few inches apart, and the different varieties labelled. The bed was then covered with cheese cloth sewn together to make a close covering to keep in as much heat as possible and fastened to the planks with tacks. In three weeks from time of seeding, the plants came up. In this bed the plants made a good growth and would have been large enough for setting-out early in April, but for a freezing spell which occurred March 25th, destroying corn that was up and gardens generally. This unusually cold weather so late in the Spring in this climate, continued for three days, and owing to this bed being in a cold, exposed position, most of the plants were killed. In this connection, I found that the thin cheese cloth used for covering, in this instance, was not sufficient to protect the young plants from freezing. A thicker and better covering for the beds upon which oil is used in its make, and which will last more than a year, is prepared by T. W. Woods & Son, Richmond, Va.

The Woods bed.—This bed was prepared in a moist bottom in the woods, well protected by being surrounded with pines, and was seeded about a week later than the first bed. The bed was well burnt, the heavy coals taken off and the ground gotten in a finely pulverized condition with hoes and rakes. It was fertilized after the same method as before mentioned, seed sown and labelled, and covered in the same way as the first bed.

Boards about one foot broad were placed around this bed for the laths to rest on to which the canvass was tacked. In addition to this purpose, when a plant bed is inclosed with boards in the manner described, there is not much danger of its being attacked by the hopping flea beetle.

The plants came up well in this bed and were not so large as those in the first bed, when the dreadful March freeze came. Comparatively few of these plants were killed, which is accounted for, by the bed being so well protected from the cold winds by the dense pine forest.

After recovering from the effects of the cold, the plants grew off rapidly and many were ready for setting out in the month of April. These plants were not attacked at all by the flea beetle, which fact is explained by the beds being surrounded with boards and covered with cheese cloth.

From experiments made in raising plants in open beds, we find that they are liable to be destroyed by the flea beetle and other insects. Hence, we can reasonably infer that the best results will be obtained by having the plant bed in a well sheltered moist place in the woods, by surrounding the bed with boards, covering it with cloth and placing a light dressing of short pine straw on the bed after burning and before putting on the cloth.

Again, it is better to use cloth of a heavier thickness than the ordinary cheese cloth. It can be safely stated, that in the experiments conducted for three years in raising tobacco plants on the station, that fertilizing the plant beds with equal parts of cotton seed meal and acid phosphate have given better results than any other method of fertilization.

Preparing for Planting.—The land used for the Variety Experiment was poor, sandy up-land. It was cultivated in tobacco the year previous and after the crop came off, the land was plowed, fertilized and seeded with rye for winter soiling. After the rye was used for feeding purposes, the stubble was plowed-under the 23d of April and this plot of ground prepared for the tobacco Variety Experiment.

The rows were laid-off with a shovel plow, and the amount of fertilizers, as is shown in the table, was applied to each plot, mixed with the soil with a shovel furrow and then bedded-on with a Dixie plow. On May 1st, afternoon, planting commenced on the Variety Experiment by hauling water, and a few rows were set out. In the afternoon of May 2d and morning of the 3d, sufficient rain fell and all the plots of this Experiment were planted.

May 14th. Gentle rain commenced at 12.30 this day and continued until night.

The next day this Experiment was replanted—that is, plants were put in all missing hills. Most of the plants used at this time were overgrown and spindling, and were taken from the burnt bed in the woods. The few plants that were not killed in the bed at the Horticultural Grounds were overgrown even before the time of planting and on that account were not used in any of the experiments.

May 23d. The missing hills in this Experiment were again re-planted. More of the Cigar varieties were missing than the plug varieties.

June 18th. Slight rain in the evening, the first rain sufficient to moisten the ground since the 23d of May.

June 19.—Another light rain and this with the rain of the 18th made a fair season for putting out plants. All the plots in this experiment were gone over and every missing hill replanted. There was no further replanting done on this Variety Experiment as a fair stand was secured. The experiment was worked mostly with plow, receiving one or two workings with the hoe. Notwithstanding the season was dry, some of the first plants set out grew rapidly, and on

June 18th a few plants of the Havana tobacco were putting out fruit buds and were topped.

July 3d.—The dry weather has continued, but the plants have made a good growth and a general topping was done on the cigar varieties. The plug varieties were not so forward in their growth and at that time, very few of these varieties required any topping.

About July 5th it commenced raining, and for several weeks there were occasional showers and heavy rains. Soon after that time, both the plug and cigar varieties in this experiment attained their growth.

HARVESTING AND CURING.

The gathering of the leaves for curing was begun August 20th, by first taking off the ground leaves of the plug varieties, placing them in baskets used for this purpose as fast as gathered and then taking them to the curing barn. The gathering continued through the 21st and the barn was filled on the morning of the 22nd.

August 24th 6 a. m.—Started fires for curing. Tobacco had yellowed fairly well in the house. Temperature outside and inside of barn 75° before starting fires.

After starting the fires, the temperature in the barn for 24 hours ranged from 80° to 86°

August	25.—	Temperature	ranged	from	90°	to 95°
"	26	"	"	"	95	to 100
"	27	"	"	"	100	to 110
"	28	"	"	"	120	
"	29	"	"	"	125	to 130

and fires stopped at sun-set.

Tobacco seemed to be thoroughly cured with a fair proportion of bright yellow tobacco.

Sept. 1st.—Sprinkled floor of tobacco barn about 4 p. m. preparatory to taking it down.

Sept. 3rd, Monday.—Took tobacco out of barn and bulked it down in another building, so as to have the barn ready for another curing.

The tobacco remained in bulk until about Nov. 1st, when it was opened, assorted and put into hands. At this time samples were selected for the Montgomery Exposition.

The tobacco having been taken down out of the curing house in good, safe keeping order, that is, without the leaves being *too moist* or in *too high case*, and the *stems being thoroughly cured* by fire in the barn, the bulk after standing more than *two months* was found to be perfectly sound and with a good flavor.

Just here it may be well to note, that in this case, flue cured tobacco underwent *but little*, if *any fermentation*, when *placed in bulk*, which condition is favorable for chewing tobacco, but not suitable for cigar and smoking.

August 22nd the cigar leaf of this experiment was gathered.

The method of harvesting and curing was different from the one followed with the plug varieties. The stalk was cut off close to the ground, after first splitting it half way down from the top. The tobacco was then placed in a well ventilated house, with doors at each end and windows in the sides—for air curing. In a few weeks the leaves were air-cured. When it was taken down, which was about the same time that the plug kinds were taken down, all of the main stems were pretty well cured, though some parts of the stalks were not fully cured.

The cigar types were managed, after being taken down, the same as the plug kinds, samples of which were on exhibition at the Montgomery Exposition in Nov. 1894.

The following facts from investigations concerning the cigar varieties are of some importance.

(1) *Comstock Spanish*—Large, broad, thin leaf good cinnamon color. Size sufficient to make cigar wrappers.

(2) *Connecticut Seed Leaf*—Fine, large size, rather lighter color than No. 1, and not so large a leaf. Leaf large enough for cigar wrapper.

(3) *Havana*—Rather small for wrappers—makes good fillers and binders.

(4) *Havana Seed Leaf*—Larger than Havana. Not so

large as Nos. 1 and 2. Makes good fillers and binders and some leaves large enough for wrappers. The flavor of all these is decidedly cigar, and having been cured by the *air process* will ferment well, and after undergoing fermentation, should make cigars of fine quality.

(5) *Brazil Gold Leaf*—This variety was from seed sent by Mr. R. D. Martin, Florence, Ala. When cured, it was of a brighter color than any of the other cigar varieties. Leaf thin and silky, but not so decided a cigar flavor as the others mentioned. Yield much less. Mr. Martin has been growing this variety for several years and informed me that he had sold last year's crop for thirty cents a pound.

The yield of the plug and cigar varieties in this experiment is shown by table No. 1, which is hereto appended.

TOBACCO. TABLE NO. 1.

Variety Experiment.

Plot ½ Acre. 11 Plots 1–22 Acre each.

Plot No.	Name and Quantity of Fertilizers per Plot.	Names of Varieties.	How cured and when.	Yield per Plot Dry.	Yield per Acre Dry.
1	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Comstock Spanish.....	Air Oct. 31.	39.6	871.2
2	Cotton S. Meal 27.3–11 Acid Phos.....13.7–11. Kainit..... 9 1–11	Connecticut Seed Leaf.....	"	34.1	750.2
13	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Pure Havana....	"	39.1	860 2
4	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Havana Seed Leaf.	"	59.3	1304.6
3	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Conqueror.....	Snow Barn Sept. 3d.	32.4	712.8
6	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Hyco	"	41.7	917.4
7	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Long Leaf Gooch.	"	39.7	873.4
9	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Yellow Oronoco..	"	34.3	754.6
14	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Yellow Pryor....	"	39.2	862.4
10	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11 Kainit..... 9.1–11.	White Stem Oronoco	"	35 6	783.2
16	Cotton S. Meal 27.3–11. Acid Phos.....13.7–11. Kainit..... 9.1–11.	Brazil Gold Leaf.	"	23.8	523.6

SPECIAL NITROGEN EXPERIMENT.

As the cultivation of tobacco in the State of Alabama is a new industry, it is important to find out the best method of fertilizing on this soil.

The experiment which follows was undertaken with this in view—to ascertain how the tobacco plant responds to the use of nitrogen in different forms and qualities when added to a *basal mixture* of phosphoric acid and potash. By a *basal mixture*, is meant a specific amount of fertilizer, in this case, phosphoric acid and potash being used as a basis for comparison in studying the effect of some fertilizing constituent, nitrogen being used in different forms and amounts, in the experiment to show the increased yield in the produce due to its action.

Phosphoric acid and potash are supplied in the proportions that are thought sufficient for a good yield, and nitrogen is supplied in one-third, two-thirds and full quantities. Nitrogen is used as nitric acid in nitrate of soda, as ammonia in sulphate of ammonia and as organic nitrogen in dried blood.

Twenty plots are provided for in the *field plain*—eighteen of which received the experimental manures while two plots received none.

Figure 1 shows the appearance of some of the plug varieties while growing.

NOTES ON FERTILIZER TEST, AUGUST 20.

No. 1.—No manure. Tobacco only medium in size. Ripened unevenly and seems to belong to the cigar variety.

No. 2.—About one-third larger than No. 1. and at this date (Aug. 20) about one half of the plot is ready for cutting. Seems to be the same variety as No. 1, and from general appearance would call it Havana. Inclined to ripen with a yellow color.

No. 3.—Evidently a cigar variety. The entire plot has ripened quite yellow and it is very evident that this fertilizer will cause tobacco to ripen yellow.

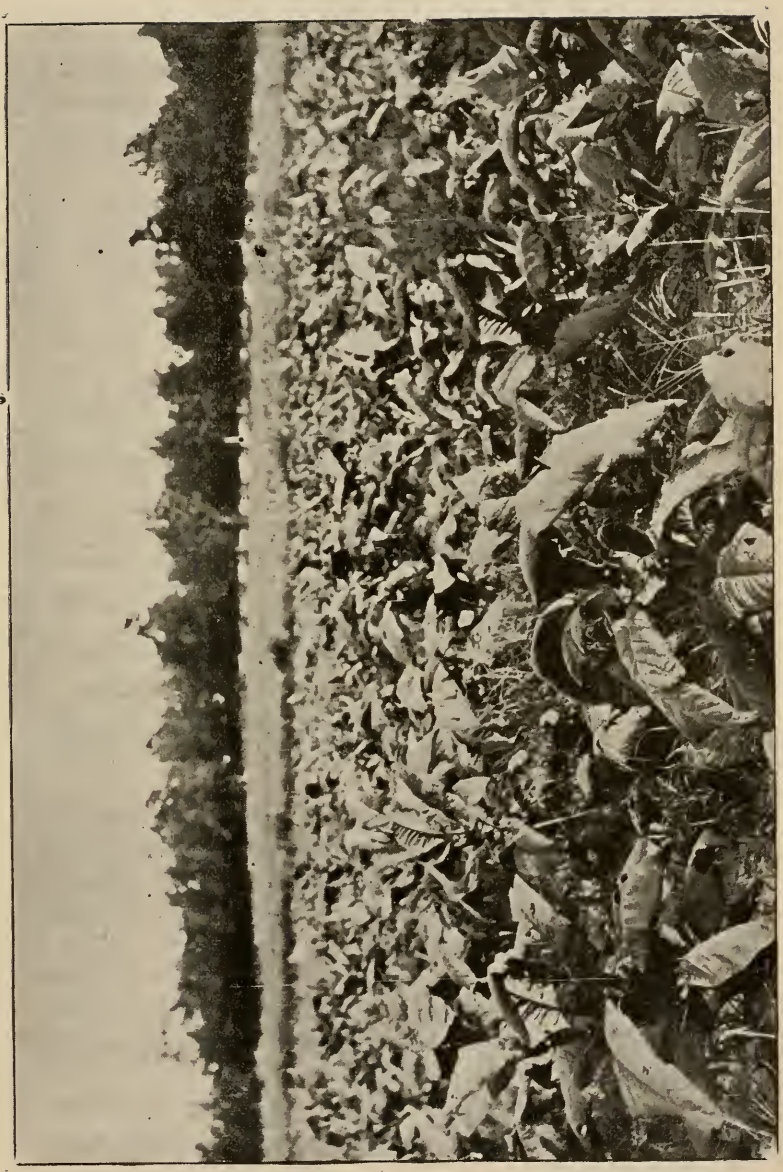


FIGURE 1

No. 4.—Cigar variety. Smaller than No. 3. Ripens quite yellow on stalk.

No. 5.—Plug variety. Greenish appearance, seems to fire badly at bottom of stalk. I am inclined to the opinion that the fertilizer used on this plot is too caustic, or it may be due to too much rain for this soil.

No. 6.—Evidently a plug variety. The fertilizer on this plot seems to have acted fairly well for this kind, good size growth, light tea green color and at this date but little ripe.

No. 7.—This plot though not yet ripe, the indications are that it will ripen yellow, and that the fertilizer used will make yellow tobacco.

No. 8.—Evidently a plug variety. At this date it is decidedly larger, and greener in appearance than any of the preceding plots. The fertilizer used is for extra large stemming which this seems to be.

No. 9.—Plug variety. Larger than No. 8; very large stemming; dark green, and from the appearance the indications are that the fertilizer, in quantity and quality used, is a complete fertilizer for large stemming tobacco.

No. 10.—This plot quite large, dark green and shows that the fertilizer used is suitable for a large dark tobacco.

No. 11.—Plug variety. Medium size, beautiful yellow color, and indicates that the fertilizer seems to be the kind for making yellow tobacco.

No. 12.—Tobacco good size; light green, but little burnt at bottom. Fertilizer seems to suit a dark tobacco.

No. 13.—Very large; ripening pale green, and the indications are that this application of fertilizer is very fine for making a large tobacco suitable for stemming.

No. 14.—Compares favorably with No. 13, and does not seem to be superior to it.

No. 15.—Medium size and compares favorably with No. 7, with the exception of not being so bright.

No 16.—Medium in size; shows yellow tint in ripening.

No. 17.—Large; green color, and shows color and size for stemming.

No. 18.—Decided stemming type. Resembles No. 17 in color, but leaf much larger than 17.

No. 19.—Quite small and indifferent, slight yellowish tint.

No. 20.—No manure. Very small and indifferent, and shows plainly that tobacco can not be raised on soil like this without fertilizers.

By reference to the following table, and by comparing these plots in groups of threes, it appears that the nitrogen in the form of nitric acid, contained in nitrate of soda, in plots 8, 9 and 10, of group 1, gave the best results. Dried blood, in the form of organic nitrogen in plots 16, 17 and 18, of group 2, gave the next best, and ammonia, in sulphate ammonia in plots 12, 13 and 14, group 3, gave the poorest results.

Group 1.	Plot No. 8.	Nitrate Soda, yield per acre.....	964 lbs.
	" " 9.	" " " " "	1020 "
	" " 10.	" " " " "	972 "
			2956
Group 2.	Plot No. 16.	Dried Blood, yield per acre.....	800 lbs.
	" " 17.	" " " " "	996 "
	" " 18.	" " " " "	1072 "
			2868
Group 3.	Plot No. 12.	Sulphate Ammonia, yield per acre.....	508 lbs.
	" " 13.	" " " " "	1000 "
	" " 14.	" " " " "	952 "
			2460

CONTINUATION OF NITROGEN EXPERIMEMT.

This test was made on plots contiguous to one another and as nearly alike as possible in physical conditions and fertility.

The soil upon which it was made was poor sandy upland. Every application contained the same amounts of potash and phosphoric acid, and practically the same amount of nitrogen, but in different forms, thus giving at the same time all the fertilizing constituents required and full effect to the nitrogen employed.

The plots upon which the sulphate of ammonia was used suffered more from *field-fire* or *blister* than any of the others. To sum up the results of this experiment, it appears that the unmanured plots gave the poorest returns, that nitrogen was most effective in the form of nitric acid in nitrate of soda and in the form of organic nitrogen in dried blood, and was least effective in the form of ammonia in sulphate of ammonia.

Owing to circumstances, it was impossible to have all the plots of the same variety of tobacco.

Table No. 2, attached, gives the experiment in full. Figure No. 2, which follows this table, shows the appearance of several kinds of tobacco before harvesting.

TOBACCO. TABLE NO. 2.

Special Nitrogen Experiment, to ascertain how the *plant responds* to the use of Nitrogen in different forms and quantities, when added to a *basil mixture* of Phosphoric Acid and Potash, one.half acre, plots 1–40 acre.

Pot No.	Names and Quantity of Fertilizers used per Plot.	Names of Varieties.	How Cured.	When Cured.	Yield per Plot Dry.	Yield per Acre Dry.
1	No manure.....	Brazil Gold Leaf..	Air..	Oct. 31.	...	.....
2	Nitrate Soda ... 8 lbs.	" " " ..	" ..	"	...	.....
3	Diss. Bone Black.16 "	" " " ..	" ..	"	...	.....
4	Sul. Potash.....12½"	" " " ..	" ..	"	...	.....
5	Nitrate Soda.... 8 " Diss. Bone Black.16 "	Yellow Pryor....	Snow Barn.	Sept. 3.	15.1	604.
6	Nitrate Soda ... 8 " Sul. Potash.....12½"	" "	" ..	"	31.3	1252.
7	Diss. Bone Black.16 " Sul. Potash.....12½"	" "	" ..	"	6.6	264.
8	Diss. Bone Black.16 " Sul. Potash.....12½" Nitrate Soda.... 8½"	Yellow Oronoco..	" ..	"	24.1	964.
9	Diss. Bone Black.16 " Nitrate Soda... 16 " Sul. Potash .....12½"	" " ..	" ..	"	25.5	1020.
10	Diss. Bone Black.16 " Nitrate Soda....24 " Sul. Potash.....12½"		" ..	"	24.3	972.
11	Diss. Bone Black 16 " Sul. Potash.....12½"	White Stem Oronoco. .	" ..	"	22.2	888.
12	Diss. Bone Black.16 " Sul. Potash.....12½" Sul. Ammonia.6.1–10"	" "	" ..	"	12 7	508.
13	Diss. Bone Black.16 " Sul. Potash.... .12½" Sul. Ammo.12.2-10 "	" "	" ..	"	25.0	1000.
14	Diss. Bone Black.16 " Sul. Potash.....12½" Sul, Ammo.18.3–10 "	Conqueror	" ..	"	23.8	952.
15	Diss. Bone Black 16 " Sul. Potash .... 12½"	"	" ..	"	16.3	652.
16	Diss. Bone Black.16 " Sul. Potash .....12½" Dried Blood..16 6-10"	"	" ..	"	20.0	800.
17	Diss. Bone Black.16 " Sul. Potash.....12½" Dried Blood..23.2–10"	Hyco.....	" ..	"	24.9	996.
18	Diss. Bone Black.16 " Sul. Potash.....12½" Dried Blood..34.9-10"	"	" ..	"	26.8	1072.
19	Diss. Bone Black.16 " Sul. Potash.....12½"	"	" ..	"	10.9	436.
20	No manure.....	"	" ..	"	.....	.....

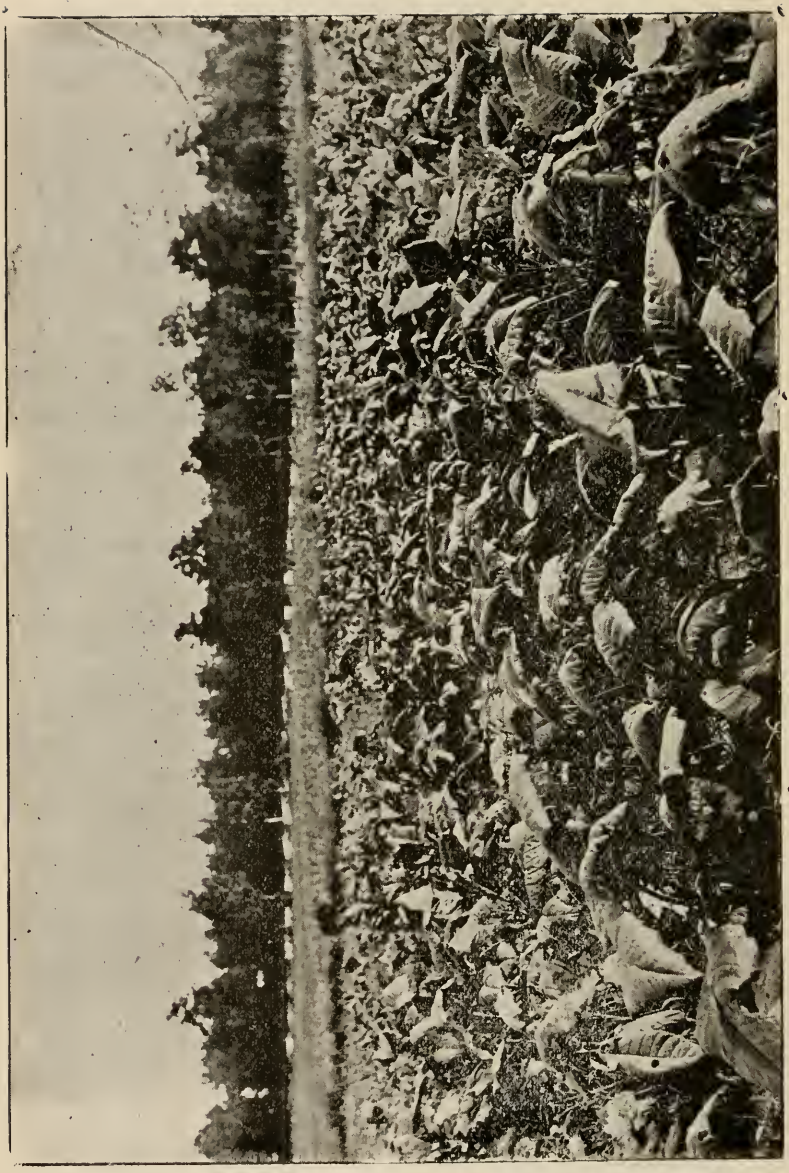


FIGURE 2.

Tobacco—Table No. 3.

EXPERIMENTS WITH FERTILIZERS WITH THREE POPULAR CIGAR VARIETIES.

This was the last experiment, planted May 14th. Fertilized with 225 lbs. sulphate of potash, 150 lbs. sulphate ammonia and 150 lbs. acid phosphate, for ½ acre. One plot was unmanured in addition to the ½ acre.

The land upon which this experiment was made was very poor, was planted in peas the year previous which yielded a very poor crop on account of the extreme poverty of the soil.

The yield of these three cigar types can be seen from table No. 3 which follows.

Plot No.	Size of Plot.	Name of Varieties.	Pounds yield per Acre.
1	1-6 Acre. ...	Connecticut Seed Leaf.....	519.4
2	" "	Havana Seed Leaf.....	827.8
3	" "	Pure Havana	387.5
4	.....	Unmanured.....	made nothing.

Figure 3 shows the appearance of the plots while growing and before cutting. Also shows the unmanured plot on the left side of picture, which was a total failure on account of the extreme poorness of the soil.

MANUFACTURING INTO PLUG AND CIGARS.

The tobacco raised on the station in 1893, was manufactured into chewing tobacco and cigars by a firm in Richmond, Va.

The cost of manufacturing for chewing was twenty-six cents a pound. After the flavoring necessary for its manufacture into plug had been put on, the tobacco weighed as much as it did before it was stemmed for manufacture. In

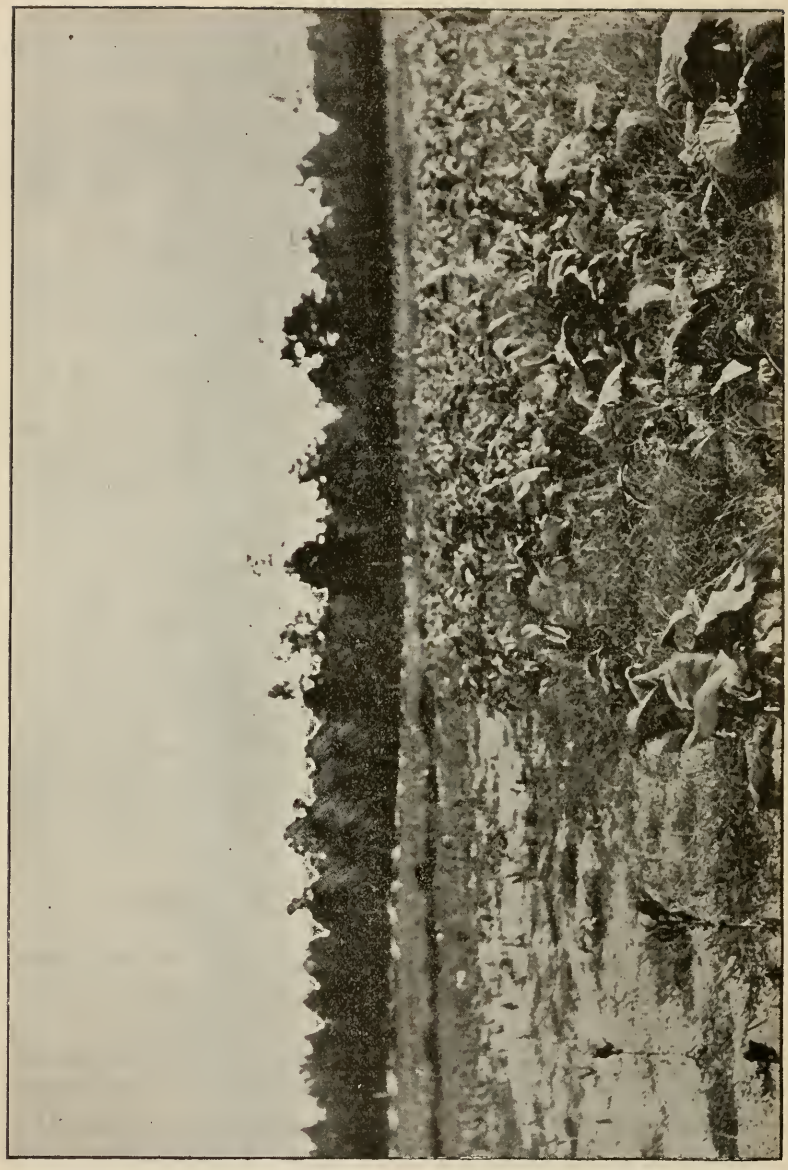


FIGURE 3.

other words, in this case, 100 pounds of unmanufactured tobacco made 100 pounds ready for chewing. The leaf sent from the station was of good quality, and the manufactured article was pronounced excellent by competent judges. In order to test the merits of this tobacco it was placed in the hands of merchants for sale in different localities, and the prices realized at retail were 40, 50 and 55 cents per pound.

Several boxes were sold by a merchant in Montgomery, Ala., at 30 cents a pound wholesale. These are better prices than are obtained for much of the Virginia and North Carolina plug tobacco sold in this State.

The manufacturer of this tobacco used the best quality and a high priced flavoring material, which made the cost more than the common grades. A fair chewing tobacco, with less costly seasoning, can be manufactured for about 14 or 15 cents a pound.

Notwithstanding the cost of manufacture in this particular case, it left a reasonable profit for the tobacco.

This tobacco was on exhibition at the late Montgomery Exposition, and much of it was distributed to the lovers of the weed and to those who are interested in this new industry in Alabama.

MAKING CIGARS.

The tobacco sent to be made into cigars had to go through several months fermentation before being manufactured. A few boxes were received in November and some sent to the Montgomery Exposition and distributed. None have been sold as the supply made up was limited. Judges of cigars value them at $25 to $50 per thousand. It requires about twenty pounds of tobacco to make a thousand cigars such as we had made. The cost of making was $20 per thousand.

MARKETING THE CROP.

Much trouble is found in marketing the tobacco raised here on account of the high rates of freight to the Eastern and Western markets, and to remedy this tobacco *should be manufactured at home.*

Since this industry was started on the station, parties who have gotten instructions from us as to the growth and management of the tobacco plant, are growing their own tobacco and making cigars.

The cost of an out-fit for manufacturing plug is small, and if enterprising farmers would grow tobacco in sufficient quantities and co-operate in establishing manufacturing plants in different parts of the State the undertaking should prove profitable. The culture of tobacco will add materially to the prosperity of the farmers when they learn to give it proper and careful attention.

This industry has become quite a prominent feature in South Carolina agriculture and has proven one of the best paying crops introduced. It has been demonstrated beyond question to be a success in certain parts of the State. In the Pee Dee section it has succeeded well, but it has had its most satisfactory development in Darlington county. Ten years ago tobacco was not grown for market in South Carolina. Last year 1,000,000 pounds were raised and marketed in Darlington county. The acreage devoted to the cultivation of tobacco was not 5 per cent. of what was devoted to cotton, yet the value of the tobacco product was 16 per cent. of all the cotton raised in the county. The money value of the tobacco crop of Darlington county was $120,000.

This station has sent out this winter, on application of farmers, a large quantity of tobacco seed raised here. There is yet a limited quantity on hand which will be furnished to those asking for them.

PART II.

Inasmuch as the interest in tobacco culture has increased in the State during the last two years, the demand for the Tobacco Bulletins has exceeded the number published by the station; and owing to this fact, it becomes necessary to reproduce in this issue some inportant information contained in previous Bulletins, especially in the illustrated number, 44, issued May, 1893.

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

Some service may be done to the farmers generally, and especially in the Cotton States, by stating some important facts that are accurately and certainly known, and the experience of intelligent farmers and scientific men on the subject of tobacco culture and by presenting these in compact form.

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

The investigation of this subject was commenced in 1892, and methods of cultivation and management of this crop were given in Bulletins No. 37, March 1892, No. 44, May 1893, and No. 54, February 1894.

I.

RAISING THE PLANTS.

It has been demonstrated from experiments made in the raising of tobacco plants that the young plants were easily affected by cold and quickly killed by freezing weather, in this climate, in fact, they seemed to be affected sooner in this

respect than in many localities in the old tobacco raising States. To avoid this difficulty, it is advisable to raise the plants under covered beds, in preference to open air beds. Another important discovery has been made in raising plants on the station, viz: That the flea beetle, commonly called tobacco fly in the old tobacco States, seems to be abundant in this section, attacking the plants soon after they come up, and in uncovered beds destroying them, unless insecticides be promptly applied.

As a remedy for the flea beetle and other insects I would advise spraying the bed with the following solution: One ounce of Paris Green well mixed with fifteen or twenty gallons weak soap suds. This same application can also be used after the plants reach the surface.

Pyrethum, commonly called insect powder, can be used in place of Paris Green, either dry or mixed with water, but it is not considered so effective as Paris Green, and besides it is costlier and more difficult to procure unadulterated.

It has been ascertained from these experiments that the plants raised under canvass made a more rapid growth and presented a healthier appearance and were ready for transplanting much earlier than those from open air beds.

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

A more recent plan of raising the plants is under a covering of cheese cloth in a hot bed. Plate No. 4 is an illustration of the modern method of covering the plants during their growth, both in the open air and hot beds. The area of the seed-bed will of course depend upon the extent of the proposed cultivation and as usually about one square inch in space is allowed to each young plant in the seed-bed, it will require a seed-bed of thirty-six square feet, say nine by four feet, to supply plants for an acre planted at equal distances of three feet apart.

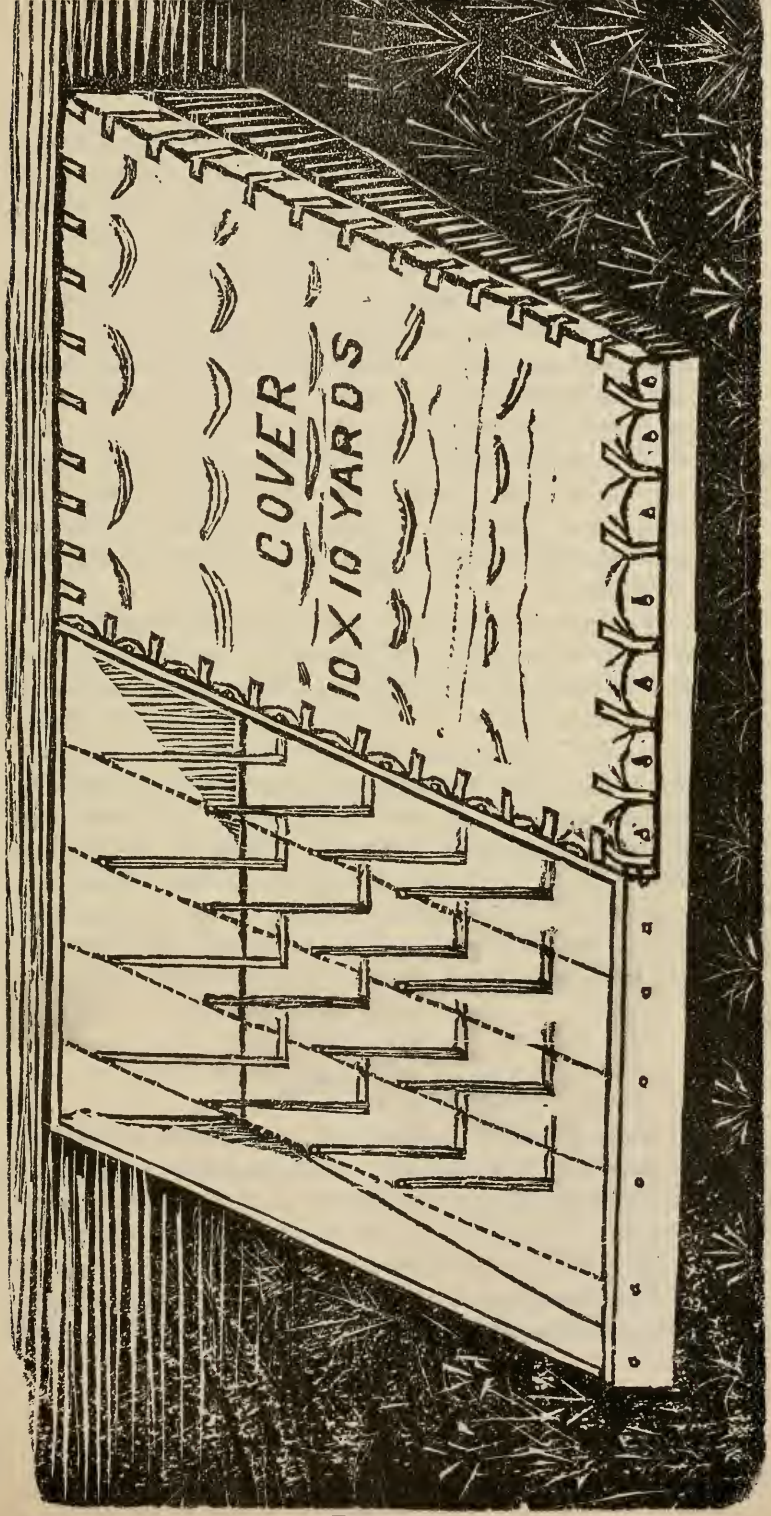


FIGURE 4.

An ounce contains enough seed to plant from six to seven acres, but as the seed do not possess a high percentage of vitality, it is usual to sow at the rate of half an ounce for an acre. The bed ought to be covered with a covering of cheese cloth, or fine brush or short-leaf pine straw. A bettter cloth, however, than cheese-cloth for this purpose, is prepared by T. W. Woods & Son, Richmond, Va., which will last more than one season. This not only protects the plants from the cold, sudden freezes, which are common in the early spring in this latitude about the time germination commences, but checks too rapid evaporation from the earth, keeping the surface moist. When the young plants first appear above the surface, they are very tender and require frequent watering of weak liquid manure and top dressing with fertilizers.

All weeds must be carefully removed, and the flea beetles, which often destroy the young plants in a few days, must be watched for and the insect remedies before mentioned applied. In from five to six weeks from the time the plants appear on the surface, they will be ready for transplanting.

The bed for producing the plants should be well fertilized. A complete fertilizer has given good results. We have also raised excellent plants by fertilizing with equal portions of cotton seed meal and acid phosphate. When these too, however cannot be supplied, stable or hog manure, free from seeds, well chopped into the soil at the time of preparing bed for planting, will answer a good purpose.

II.

CLIMATIC CONDITIONS.

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

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

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

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

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

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

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

The tobacco of the tropics, as to the uses to which it is put, is limited, while the tobacco of the more temperate re-

gions can be used for all the purposes for which the plant is needed.

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

III.

FIELD CULTURE.

Land on which it is intended to grow tobacco should be well ploughed; on compact soils the ploughing should be deep. An intelligent rotation of crops carried out with an intelligent knowledge of the needs of the tobacco crop will be the aim of the practical farmer. Before transplanting the young plants from the seed-bed the land should be ridged, the distance between the ridges depending on the kind of tobacco to be planted—the larger kinds requiring more room than the smaller-leaved and tall sorts. Generally from three to three and a half feet apart between the rows, and the same between the plants will be sufficient. Where the surface is level the plough may be run lightly over the field at right angles, thus forming small hills on which the plants are planted.

Choice of Soil.—The growers of the plant are very particular in the selection of suitable soil for tobacco growing. The selection of soil will depend upon the color of leaf in demand, as the soil as well as the fertilizers determine to some extent the color and texture of the leaf.

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

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

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

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

IV.

TRANSPLANTING.

Figure 5 shows the plan of placing and setting the plants.

FIGURE 5.

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

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

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

When the plants are from six to nine inches high they

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

V.

FERTILIZING.

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

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

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

Previous Culture of Land for Tobacco.—The quality of the soil and the manuring are largely responsible for the

early and late ripening and the regular and irregular ripening of tobacco.

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

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

Formulas for Fertilizing for Tobacco.—The following formulas for fertilizing tobacco are recommended:

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

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

Magnesium carbonate, a new product of the Stassfurt industry, of Prussia, Germany, containing 18.5 per cent. of potash, is said to possess good properties in improving the quality of tobacco. In the Connecticut valley, where fine

cigar leaf is raised, nearly all kinds of domestic, commercial, and special fertilizers are used. Of domestic fertilizers, horse manure is considered the best, as it produces the finest and lightest colored leaf of any known fertilizer. Cotton seed meal, when used with domestic manure, is an excellent and strong manure.

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

VI.

THE PLANT.

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

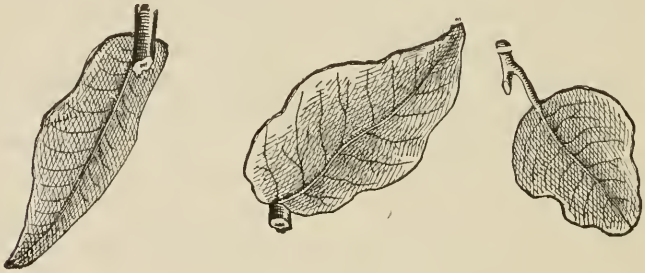


FIGURE 6.

They have, as represented in figure 6, various forms; ovate, lanceolate, and pointed. Leaves of a lanceolate form are the largest, and the shape found on most varieties of the American plant.

The color of the leaves when growing, as well as after curing and sweating, varies, and is frequently caused by the condition of the soil. The color, while growing, may be either a light or dark green, which usually changes to a yellowish cast as the plant ripens. The ground leaves generally ripen first, turning yellow and during wet weather will rot and drop from the stalk if not gathered. The color of the leaf, after curing, may be determined by the color of the leaf while growing; if dark green while maturing in the field, the

color will be dark after curing and sweating, and the reverse if of a lighter shade of green. If the soil be dark, the color of the leaf will be darker than if grown upon light soil. The kind of fertilizers applied to the soil, as well as the soil itself, has much to do with the texture of the leaf, and should be duly considered by all growers of the plant.

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

FIGURE 7.

Uusually these are not seen until after the plant has been topped, when they come forward rapidly and if not plucked off in a short time develop into strong, vigorous shoots. The growth of the suckers is injurious to the leaf, retarding their size and maturity, and affect the quality as well as the maturity of the plant. When the plants are fully ripe and ready to harvest, the suckers will be found to be growing around the root of the plant.

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

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

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

FIGURE 8.

to prevent the plant running up to flower and seed.

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

There are various methods of topping, as well as different periods. Some planters top as soon as the capsules appear, while others wait until the plants are in full blossom. If topped before the plants have come into blossom, it should be done as soon as possible, as a longer time will be required for the leaves to grow and ripen than when topping is delayed until the plants are in bloom. Top the plants at a regular height, leaving from nine to twelve leaves, so that the field will look even and also make the number of leaves to a plant uniform. The above method of topping refers more especially to cigar rather than cutting leaf. Those varieties of tobacco suited for cutting leaf should be topped as soon as the flower bud appears; top low, thereby throwing the strength of the stalk into a few leaves, making them

large and heavy. Let it grow from five to six weeks after it is topped, so as to have it thoroughly ripe, thereby giving it the bright, rich, golden color, entirely different from cigar leaf, but desirable for chewing leaf. The custom in the old tobacco States is to top for English shipping from eight to ten leaves; for coal and flue curing, from ten to twelve. In some sections of the United States the plants are not topped at all; the leaves are left upon the stalk until they are fully ripe, when they are taken off.

VII.

INSECT PESTS.

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

FIGURE 9.

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

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

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

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

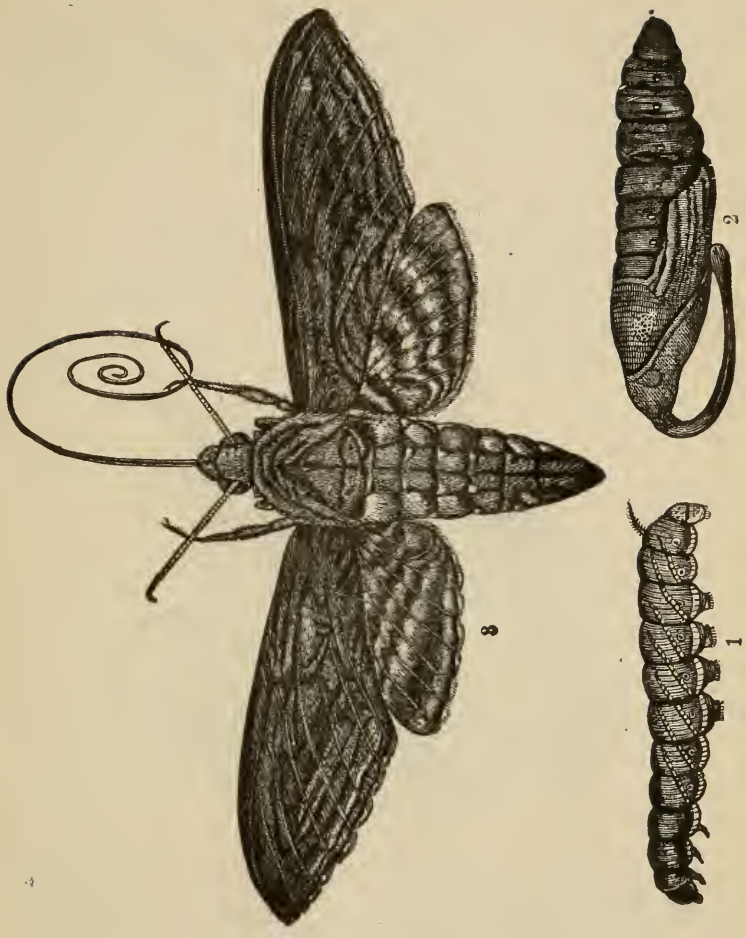


FIGURE 10.

The horn worm feeds upon the finest and largest leaves; eats the leaves in the finest parts of them. They leave large holes which render the leaf worthless for a cigar or chewing wrapper, leaving it fit only for fillers. As the Sphinx, that lays the eggs usually deposits two crops of eggs on the tobacco plant during its growth, it will require much time and labor to destroy the eggs and worms. If this is neg-

lected, the crop will be much injured and will not be sought after by good judges of tobacco. An insecticide for destroying the worms has been advertised by a firm in Virginia and when applied does not injure the tobacco for chewing and smoking.

VIII.

VARIETIES OF TOBACCO AND HARVESTING.

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

FIGURE 11.

The varieties cultivated in the United States and known as "seed leaf" tobaccos, are grown mostly in Connecticut, Massachusetts, Vermont, and eastern and western States.

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

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

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

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

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

FIGURE 12.

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

The plant grows to the height of from three to five feet; the leaves are long and broad, and when cured are of various colors, from a rich brown mahogany, cinnamon, to a fine golden yellow.

The finest quality of Virginia tobacco comes from the

southside counties, but the amount is small compared to the quanitties of dark raised on the lowlands of the Dan and James rivers and their tributaries. The tobacco grown in the southside and southwestern counties of Virginia is much lighter in color, and of much softer and finer texture than the ordinary Virginia tobacco.

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

FIGURE 13.

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

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

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

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

FIGURE 14.

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

Both these plans of gathering have their advantages, the first is the easier, and permits of quicker handling.

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

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

IX.

CURING.

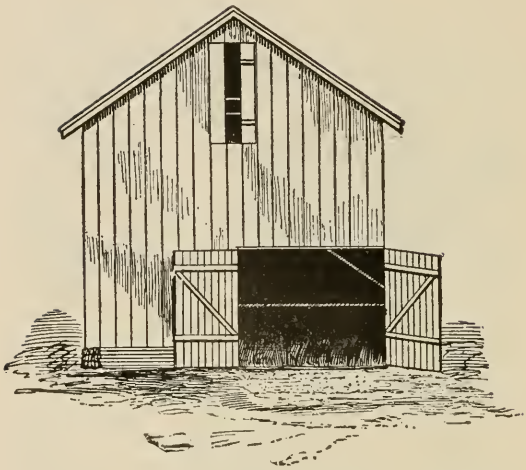


FIGURE 15.

The process of curing now commences, and on the success of this operation depends in a great measure the ultimate value of the crop. No matter how fine the plants may be, or how large the production, an error in curing is sufficient to destroy, in a great degree, the work of the season. The tobacco barn should be built with windows and doors sufficient to insure a free current of air. The barn should be high enough to permit three rows of plants being hung one above the other, say 16 to 18 feet from floor to roof. Figure 15 represents an inexpensive framed barn used for curing where heat is applied with open fire or with furnaces.

There are several methods of curing, viz: With open fires, as shown in figure 15; curing by flues, air curing and sun curing.

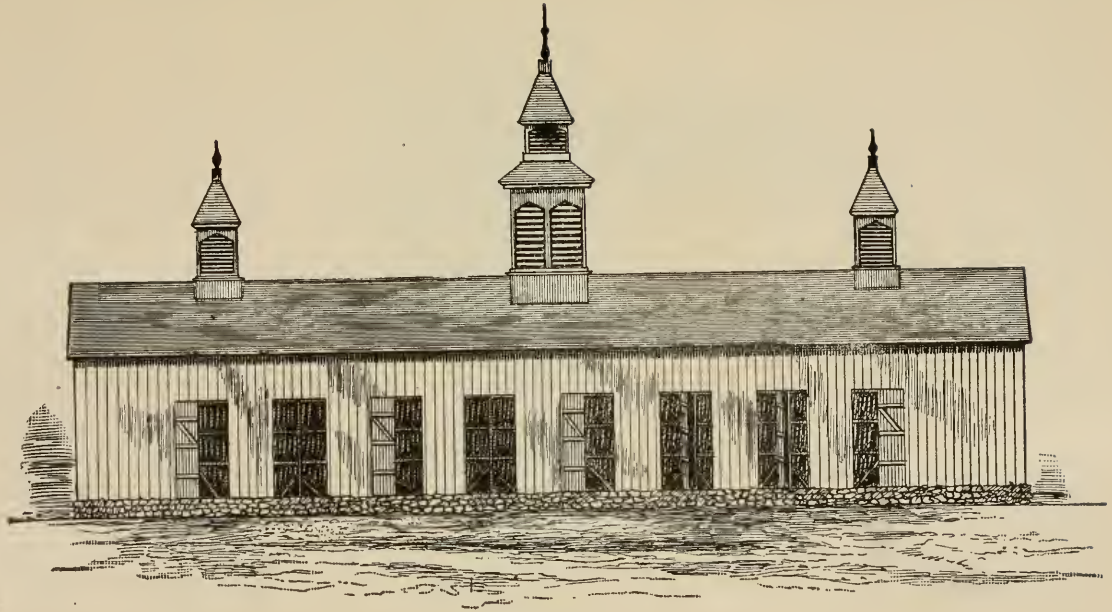


FIGURE 16.

Air curing is the process of curing the plant in the barn, as seen in figure 16. This cut illustrates a barn 32 feet wide, 60 feet long and 27 feet high, with ventilators in the sides and ends, so constructed that they may be opened or closed to admit or exclude air as the condition of the tobacco and weather demands. A barn thus constructed should be closed in very dry or windy weather, closely or partially to give plenty of air during the curing stage, closing the ventilators during the day and opening them at night so that the tobacco may receive moisture to give it a uniform good color, or closing day and night during warm wet weather to prevent mould.

This illustrates a principal of curing cigar tobacco which should never be cured with fire, especially with flues, as the burning qualities will be impaired thereby.

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

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

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

SNOW'S MODERN TOBACCO BARN.

This new process of harvesting and cutting tobacco was introduced by W. H. Snow of High Point, North Carolina.

Figure 17 shows the view of this modern barn, which is in operation on this Station.

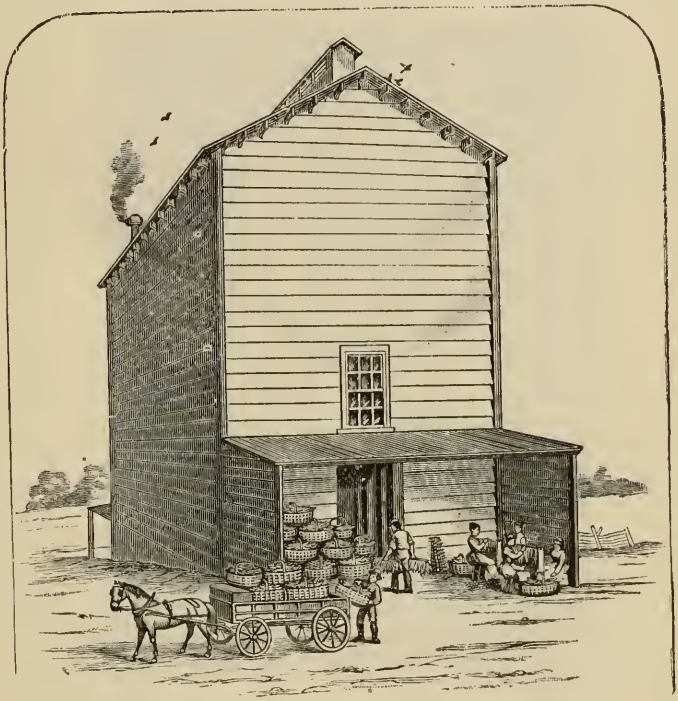


FIGURE 17.

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

Plan of Housing.—The plan of housing in this barn is illustrated by figure 18.

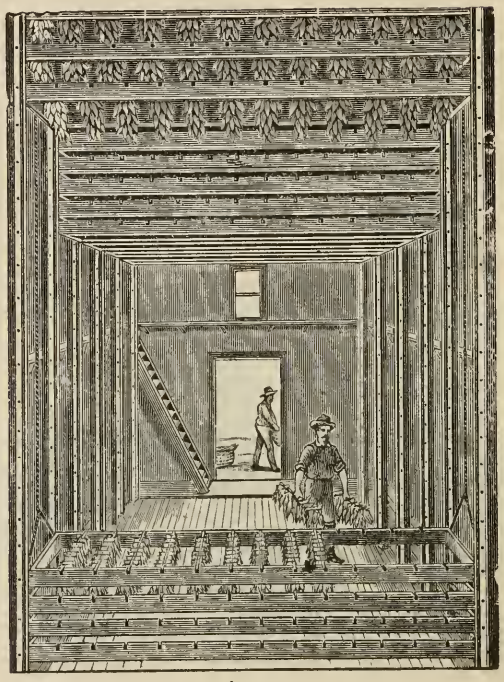


FIGURE 18.

Advantages of the Method.—The following are some of the important advantages in favor of the Snow process over the old:

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

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

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

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

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

Flues and Flue Curing.—Flues are extensively used instead of open fires for curing yellow tobacco for chewing purposes, and is a better method. The heat is more readily controlled by the use of flues, and tobacco cured by this process is cleaner, brighter and sweeter. The flue is the best mode for applying heat in the curing process for any type of tobacco requiring the application of heat.

X.

STRIPPING.

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

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

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

The assorting of the plant previous to putting in hands or bundles is an operation that requires judgment and a practiced eye. This mode of assorting colors in stripping is similar to that of shading cigars, in which the utmost care is taken to keep the various colors and shades to them-

selves. Assorting the plant does not imply that it is carried to its fullest extent in point of color, as in shading cigars, but simply keeping those general colors by themselves, like light and dark brown leaves. Figure 19 shows the bundle after it has been stripped, assorted and tied.

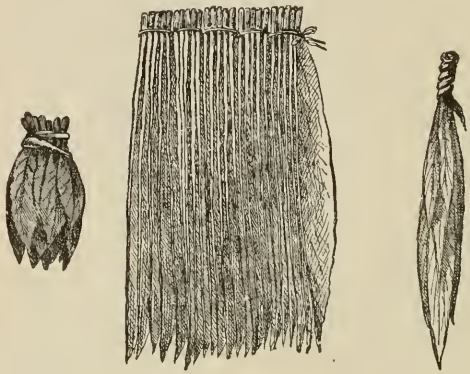


FIGURE 19.

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

It is important to have tobacco in right case for packing. If too dry, it is broken and damaged to a great extent; if too moist, fermentation is so rapid and extensive as to destroy the vitality of the tobacco, and induce mould or rot and spoil its flavor. The right condition for packing is, when the large stems are dry enough to break on pressure several inches down from the butt ends, while the lower part of the leaves should be just soft and pliant enough to not break in handling.

The process of sweating or fermenting perfects it in color, improves the flavor, corrects the acid or pungent taste and increases its burning qualities.

Where tobacco is fermented for cigar purposes, it takes from three to four months to get it ready for working into cigars. In fact, it is believed, that the best cigars can not be made unless the tobacco undergoes a second fermentation the ensuing year, which adds much to its quality.

Prizing Casing and Baling.—This is shown by figure 20.

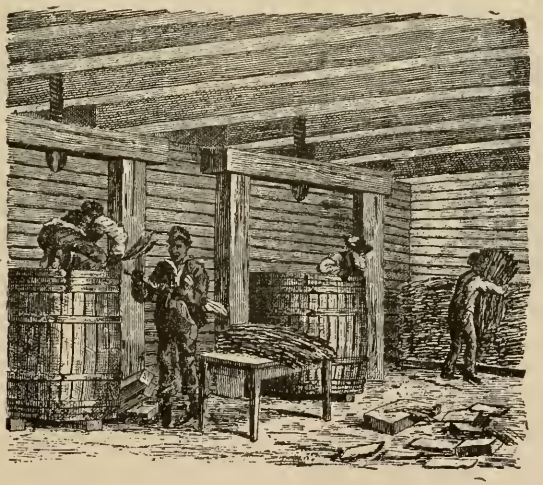


FIGURE 20.

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

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

The hands or bundles are packed in the hogshead, or the case in two tiers—when nearly filled, it is subjected to a strong pressure as is shown in figure 21.

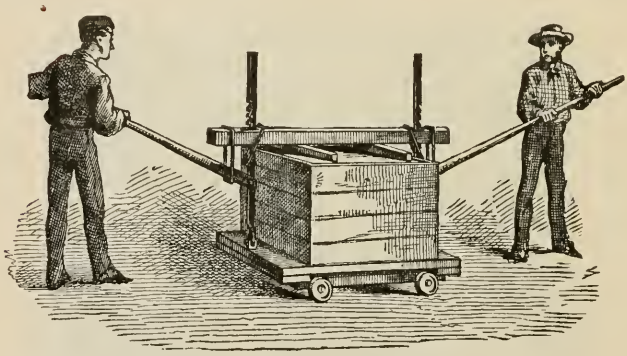


Figure 21.

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

BULLETIN No. 65 JUNE, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

CO-OPERATIVE SEED TESTS.

ALEX. J. BONDURANT.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1895.

☞ 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 SEED TESTS.

The Department of Agriculture at Washington, directed that the names of farmers in different sections of the State should be furnished by the Agricultural Department of this Station to conduct co-operative experiments with seed. The names of fifty farmers living in different parts of the State, in accordance with this request, were sent to the Department at Washington, the seed were sent direct from Washington, the reports were forwarded to the Station on blanks furnished to the experimenters, and this Bulletin is a report of these experiments.

REPORT OF Mr. L. C. ADAY,

NEWBURGH, FRANKLIN COUNTY.

Cotton—Egyptian Afifi.—Level red loam soil with red clay sub-soil, manured heavily; culture thorough. Planted April 10th. First open August 25th. Yield 732 lbs. per acre. Quality good; growth vigorous, but the yield poor as the bolls are too small.

Cotton—Bamia Egyptian.—Soil, same as above, manured same as above, and same culture. Planted April 10th. First open August 30th. Yield about 600 lbs. per acre. Quality good; growth vigorous and large, but the bolls are too small for it to be a desirable cotton.

White Millo Maize.—Soil as above, no manure. Land ridged, seed planted and plowed four times. Planted April 25th; harvested September 13th. Quality good; yield very good, and growth good.

Yellow Millo Maize.—Conditions same as for the white, but the yield was less and the quality of product not so good.

Red Kaffir Corn.—Level loam soil, no manure. Land

ridged and plowed four times after seeding. Planted April 25th; harvested September 13th. Quality good; growth vigorous and yield good.

Sweet Clover.—Planted March 13th, and was killed by freeze on March 25th while in the sprout.

Alfalfa.—Planted March 13th, and was killed by freeze on the 25th while the seed were in the sprout.

Awnless Brome Grass..—Planted March 13th, and killed on the 25th in sprout.

Spurry.—Same result as with the Awnless Brome.

Crimson Clover.—Same result as with Sweet Clover.

REPORT OF Prof. H. BENTON,

UNIONTOWN, PERRY COUNTY.

Tobacco, Hester.—Black soil, well drained, fertilized with compost. Shallow culture with sweep. Planted May 15th; harvested September 29th. Yield good; growth large; quality of product coarse. Insect enemies, *Macrosila Carolina.* (Linn.)

Tobacco, Havana Seed Leaf.—Soil same as above, fertilized, planted and gathered same as above. Yield fair; growth good; quality of product good. Insect enemies, *Macrosila Carolina.* (Linn.)

Tobacco, Connecticut Seed Leaf.—Conditions of planting, culture and harvest same as the foregoing. Yield good; growth good, and quality fairly good. Insect enemies, same as above.

Red Kaffir Corn.—Decomposed lime rock soil on hillside. Manured with stable manure. Culture, shallow with sweep. Planted April 3rd. Gathered August 30th to October 16. Yield not quite so large as sorghum; quality good; growth good.

Cauliflower.—Soil, well-drained red prairie, heavily manured with compost. Planted seed in beds, set out plants in April; growth poor, quality poor, and yield about nothing. Not suited for this climate; insect enemies, *Pieris rapæ* (Schran.)

Onion—Prize Taker.—Soil same as above, manured with kainit, cotton-seed meal and stable manure composted. Cultivated with hoe and plow. Planted March 16, harvested September 29. Quality good; average yield. Growth and yield would have been better but for drought.

Sugar Beet.—Soil as above, manured with compost; cultivated with hoe and plow. Quality good; average growth, and yield good.

Turnip—Golden Ball.—Soil as above, manured same as onions. Cultivated around plants with hoe and rake. Planted March 19. Quality of product excellent; growth good and yield good; turnips large.

Lathyrus Sylvestris.—Seed did not germinate.

Spurry.—Seed did not germinate.

Yellow Millo Maize.—Soil, decomposed lime rock, hill side; fertilized with stable manure. Culture shallow, with Hartselle sweep. Planted April 3d; harvested from August 30th, to October 16th. Quality fairly good; growth good; yield poor on account of poor stand.

White Millo Maize.—Same report as for the yellow.

Bromus Indicus.—Seed did not germinate.

Cotton; Kuppan, India Cotton.—No. 1. Soil, black cotton land; culture, shallow with sweep. Planted April 9th; harvested last of November. Quality poor; growth, large stalks; yield very poor; staple short, and is inferior to any of our native varieties. Insect enemies, boll worm; plant diseases, rust. Professor Benton says the yield was too poor to take the trouble to record.

Cotton; India No. 2.—Soil same as the foregoing, and culture the same. Quality poor; growth of stalk very large; yield too little to record; staple very short. Insect enemies, boll worm; plant diseases, rust.

Cotton; India No. 3; Bourbon.—Same as Nos. 1 and 2 in all respects.

Cotton; India, Nagpur Jari, No. 4.—Quality of product poor; yield almost nothing.

Cotton; Painaa, White India Cotton, No. 5.—Poor. See Nos. 1 and 2 for report.

Cotton; India No. 6.—Poor. See Nos. 1 and 2 for report.

Cotton; Desila Koposh, India No. 7.—Poor. See Nos. 1 and 2 for report.

Cotton; Desila Bango, India No. 8.—Poor. See Nos. 1 and 2 for report.

Cotton; Niurari Bani L. S. Kopas, India.—Poor. Nos. 1 and 2 report.

Cotton; Huigumbot Bani, L. S. Kopas; India.—Poor. See Nos. 1 and 2 for report.

Cotton; Chuidwan Jari, India.—Poor. See 1 and 2 for report.

Cotton; Karunganni, India.—Poor. See Nos. 1 and 2 for report.

Tomato; Matchless.—Soil black and well drained; fertilized with compost. Plants set April 4th. Quality good; growth large; yield large. Insect enemies, *Macrosila Carolina.* (Linn.)

Tomato No. 175.—Soil same as above, and fertilized same way. Plants set April 4th. Quality fairly good; growth good, and average yield with other varieties. Insect enemies, *Macrosila Carolina.* (Linn.)

REPORT OF Mr. M. A. BISHOP,

MADISON, MADISON CO.

Cotton; Egyptian Bamaia.—Soil, dark brown stiff land; red clay sub-soil.

Manured with	200 lbs.	acid phosphate,
	800 "	stable manure, composted.
Per acre, -	1000 "	

Planted April 17. First open August 25th, last, November 1st. Gathered in November. Quality of product—staple about ¾ inch, very fine and silky and of medium strength. Growth rather slow, but stood the drought well. Height from 3 to 5 feet.

Mr. B. will plant again, and although hard to gin, owing

to the length and strength of staple, thinks it wlli do well when it becomes acclimated.

No enemies except the beetle, which disappeared after the nights got cooler.

Yield per acre about 500 pounds.

Cotton; Affifi-Egyptian.—Soil, and fertilized about same as above. Planted April 17th. First open September 1st, last November 10th. Gathered in November. Quality of product—lint cream colored, medium length and very fine and silky. Appears to be hardy as to cold; was not injured by spring frosts when other varieties were damaged. Grows from 6 to 10 feet high. Yield about 300 pounds per acre. Small insect, resembling a beetle, did damage to the squares by puncturing them just before the bloom appeared. Mr. B. thinks that this insect was imported with the seed, as it was not found in any other variety.

Unknown Pea.—Soil dark loam, high upland, manured with 200 lbs. acid phosphate and cotton-seed meal per acre, in drill between the corn at second plowing. Cultivated twice with walking cultivator. Planted in corn-field May 21st. First ripe September 22nd. Gathered October 10th. Yield, about 12 bushels per acre. Quality, perfect. A large, late stocky growth, producing peas in bunches around the base of vine. Should be planted earlier, as this crop was caught by frost November 2nd and many killed.

Mr. Bishop says that this pea will take the place of clover to improve worn-out soils, and regards it as a very fine pea. Dealers sold it at $12.00 per bushel in his town last spring. No diseases.

Red Kaffir Corn.—Soil, chocolate loam, red clay sub-soil. Good natural corn land, no manure. Culture, same as corn or sorghum crop. Planted April 16. First ripe August 5th. Began to gather August 10th, last ripe October 10th. Quality of product, perfect. Yield, about equal to common corn. The injury by English sparrows was such as to lessen the yield. It made three crops.

Spanish Pea Nuts.—Soil, almost exhausted of vegetable matter, manured with 125 lbs. acid phosphate per acre, in drill at time of planting. Planted May 5. First ripe August 15. Gathered September 8th. One quart in the hull made two bushels. Quality perfect. An exceedingly early variety, would mature on ground following a wheat or oat crop. Farmers in Mr. Bishop's vicinity are beginning to raise them for fattening hogs, and Mr. B. says it is one of the best things that they have tried. No insect diseases.

Awnless Brome Grass.—Soil, loam and clay. Land plowed just before planting. Planted March 22. Imperfect stand owing to dry, cold spring. Stood drought and heat well, revived with first fall rains and bids fair to afford a good yield of hay next spring. It is regarded as a success, and many farmers are anxious to procure seed.

Sweet Clover.—Thin upland, gravelly loam, manured lightly, broad-cast. Planted broad-cast, March 22nd. Stand perfect, stood the drought better than Japan Clover. Made a growth of ten inches by July 1st, at which time stock was turned on. At this time, Nov. 24th, it is green and bids fair to stand the winter. Stock exceedingly fond of it.

Alfalfa or Lucern.—Dark loam moist soil, good land for corn and clover, no manure. Sowed broadcast. Planted March 22nd. Came up well and grew well until June 14th, when it died out. Will plant again in the spring and cultivate in the drill, and if it can be made to stand one season will be a success.

Crimson Clover.—Dry ridge land, dark loam, red clay sub-soil, and highly manured by turning under green vegetable matter and pasturing. Land thoroughly prepared by plowing and harrowing before seeding.

Planted March 22nd. Owing to extremely dry spring, the growth was stunned and did not grow large enough to mow. Crimson Clover is being extensively grown in this country in the last two years. Seed sown in August makes fine grazing in November. It is fast taking the place

of Red Clover, as the yield is equal and comes off in time to plant corn and get two crops.

Rape—Dwarf Essex.—Dark loam soil, 10 inches deep, very rich in plant-food. No manure applied. Ground thoroughly prepared as for turnips, and seed sown broad-cast. Planted April 14th. Ready for use in six weeks. Yield per acre at least 3½ tons. Quality of product good and good for hogs and cattle. The growth was enormous. By repeated sowings it will, and did carry more hogs through our dry, hot summers than four times the amount of land planted in any thing else ever grown here. Forty-nine head of hogs lived on it six weeks and did well. I would recommend it to all southern farmers.

Spurry.—Dark loam, very rich soil. Planted April 14th. Prepared land as for turnips, sowed broad-cast, but supposed on account of the dry season the seed did not germinate. Consider it a failure.

Jerusalem Corn.—Light, gray sandy soil, rather thin, had rested two years previous, no manure. Bedded ground in February. Planted one foot apart in drill, May 5th. Not properly cultivated. First ripe August 10th. Gathered August 27th. Yield about 20 bushels per acre. Quality of product light and chaffy; had to gather too early on account of devastation by English sparrows. Did not tiller out like Kaffir Corn or Yellow Millo Maize.

Yellow Millo Maize.—Dark gray soil, mixed with sand, clay sub-soil, no manure. Land prepared as for common field corn. Planted May 14th. First ripe September 1st, harvested September 10th. Yield about 33 bushels per acre. Quality of product perfect. Much the best non-saccharine sorghum for this country ever tried. One peculiarity was, while the English sparrow destroyed all other grains, this was left untouched. With good seasons, can make as high as 50 or 60 bushels per acre, and the fodder is relished by all stock. A successful crop.

REPORT OF Mr. J. M. BRANNON,

SEALE, RUSSELL COUNTY.

Millo Maize.—Fresh soil, home mixture fertilizer used. Planted April 10th, harvested July 25th. Yield was satisfactory, and quality of product good. Thinks it unnecessary to put aside sorghum as a stock feed.

Red Kaffir Corn.—Stiff, sandy hill-side. Quality good. Yield good. Fed to stock while green. Gave a larger yield of forage than sorghum.

Spanish Pea-nut.—Poor sandy soil unfit for anything else, no manure. Planted April 20th, harvested October 2d. Quality good. Is common in this section and fruits better than any other kind.

Jerusalem Corn.—Sandy loam, clay sub-soil. Stable manure, phosphate and cotton-seed meal composted. Planted May 25th. Plant grew well and large enough and headed out properly, but contained no seed. Considers it a poor crop in that locality.

REPORT OF Mr. T. W. BRADLEY,

WALKER SPRINGS, CLARKE COUNTY.

Alfalfa—Planted June 20. Light sandy soil. Acid phos. and cotton seed meal 100 lbs per acre. Died out on account of the hot summer sun. Replanted Oct. 10th, and at the time this report was made, the prospect flattering for a crop.

Rape.--Planted June 20th. Black sandy soil—stable manure. Quality of product good. Fed cows, sheep, goats and hogs on it and expected to save a good quantity of seed.

Red Kaffir Corn.—Planted May 10. Hill side; 100 lbs. cotton seed meal and 50 lbs. acid phos. per acre, harvested Sept. 1st. Product only fair. Came up and grew off well, but the drought came on it about the time of heading and cut off the crop.

Yellow Millo Maize.—Black bottom soil, no manure. Planted June 15, harvested Oct. 12. Quality of product very fine. No diseases.

Unknown Cow Pea.—Level gravelly land, stable manure broadcast. Planted April 15, harvested Aug. 25th. Product very fine. 1 quart was planted and the yield 3 bushels.

Jerusalem Corn.—Hill side, black soil, 100 lbs. cotton seed meal and 50 lbs. acid phos. per acre. Planted May 10, harvested Aug. 20. Product good; yield per acre 20 bushels.

Spanish Peanut.—Level sandy land, lot manure broadcast. Planted June 1st, harvested Oct. 27th. Product very fine.

REPORT OF Mr. D. L. BROWN,

RANDOLPH, BIBB COUNTY.

Unknown Pea.—High, dry sandy soil, no manure. Cultivated with heel-scrape, two plowings. Planted June 3rd, first ripe Sept. 15th, harvested Oct. 15; quality very fine; rapid growth.

Mr. B. says "it is a very fine pea and I can not say too much in its favor."

Clover—Red and White.—All killed by extreme drought.

Egyptian Cotton.—Sandy soil, oak and hickory flat, manured with compost of phosphate and barnyard manure about 250 lbs. per acre. Cultivation thorough, with scrape and hoe. Planted April 14th; first open boll August 15th, and continued opening until frost. Yield per acre very poor; quality inferior; lint short and yellow.

Mr. Brown considers this cotton a "flat failure" for this country.

REPORT OF Mr. G. W. COMPTON,

WAYNE, MARENGO COUNTY.

Alfalfa.—Soil sand, clay sub-soil, no manure, fresh land. Land broken, seed sowed broad-cast and brushed in. Planted April 20th, grew to a height of 4 to 6 inches about August 1st,

and then died. Melilotus had been tried on the same soil, but would never prove successful.

Spurry.—Soil same as for Alfalfa, no manure. Planted April 22nd, like the Alfalfa, grew to a height of 4 to 5 inches and died out about July 1st.

Red Kaffir Corn.—Soil same as above, no manure. Land prepared like that for cotton crop and cultivated same as cotton. Planted April 28th, harvested Oct. 1st. Quality of product poor. Growth not very good and the yield was poor, grains being very scattering in the heads.

White Millo Maize.—Soil same as above, no manure. Culture same as cotton. Planted April 28th, harvested Oct. 1st. Quality of product good; growth good; yield good. Gathered a wagon body, that holds 15 bushels corn, full from 4 rows 70 yards long.

Awnless Brome Grass.—Seed did not germinate.

REPORT OF Mr. W. D. CRENSHAW,

HACKNEYVILLE, TALLAPOOSA COUNTY.

Jerusalem Corn.—Soil, red clay; hillside, manured with compost in drill. Cultivated as other corn. Planted April 10th. Did not mature; results perhaps would have been better on good land.

Spanish Peanuts.—Soil, clay. no manure. Cultivated same as cotton. Planted May 1st, first ripe Aug. 10th; harvested Oct. 1st, large yield. Quality good. Vines grew upright, very prolific and excellent for hogs.

Red Kaffir Corn.—Soil red, thin hillside, manured in drill with compost. Cultivation not good. Planted April 1st, first ripe Aug. 15; harvested Sept. 10th. Yield about 5 bushels per acre. Quality of product not good—not equal to sorghum for any purpose.

Alfalfa. Sowed broad-cast and choked out with weeds and grass. No report.

Unknown Pea.—Dark sandy soil, no manure. Cultivated every ten days. Planted May 5th, first fruit ripe Sept. 1st; harvested Sept. 20. Yield per acre about 15 bushels.

Quality of product good. Foliage dense, grows upright and better than the ordinary pea. An excellent pea for hogs.

Egyptian Cotton.—Soil, black upland loam, manured broadcast with lot manure and some guano in drill. Planted April 12th, first open Oct. 1st. Gathered during October and until frost. Yield about 600 lbs. per acre. Lint very long and strong.

Another variety of Egyptian cotton, Mr. Crenshaw says, is worthless on account of the smallness of bolls and being so few on the stalk.

REPORT OF Prof. C. C. L. DILL,

DILLBURG, PICKENS COUNTY.

Jerusalem Corn.—Land sandy, manured 10 bushels cotton seed per acre. Planted June 1st, harvested Sept. 15th. Yield about 15 bushels seed per acre. Quality of product fair, not equal to sorghum as a forage.

White Millo Maize.—Land sandy, manured with cotton seed. Planted June 1st, harvested Sept. 15th. Yield about 15 bushels seed per acre. Quality of product fair.

Egyptian Cotton.—Sandy loam, manured with compost from cow pen. Planted June 8th, harvested October and November, first open October 1st. Yield per acre about 200 lbs. Quality of product, fine strong fibre, dingy color. Stalk large, bolls small, does not pay for cultivating.

Awnless Brome Grass.—Planted June 5th. Seed did not germinate on account of drought.

REPORT OF Mr. D. B. EDWARDS,

POLK, DALLAS COUNTY.

Spanish Ground Pea.—Soil red and sandy, no manure. Cultivated same as for cotton. Planted March 1st, first ripe July 15th, gathered July 25th. Quality generally good. Yield good and well matured. Unless dug as soon as matured, will sprout in the field if the seasons be wet.

Kaffir Corn.—Sandy soil, no manure. Cultivated as other

corn. Planted March 15th, first ripe July 1st, last ripe July 15th. Yield fair, product ordinary, injured by the early six weeks drought.

Lucern (*Alfalfa.*)—Soil same as above, manured with cow pen fertilizer. Planted March 1st, in drills. Has not made much headway, but hope to have a fine patch next year as it is very tenacious of life and requires time.

Jerusalem Corn.—Soil as above. Planted 1st of March. Ruined by early long drought.

Unknown Cow Pea.—Soil, gray bottom and sandy, no manure. Planted May 15, on beds between corn rows. First ripe September 1st. Began to gather as they ripened. Yield very large, large pods and 20 peas to the pod. Quality very fine; growth very luxuriant, and surpasses all other varieties ever before tested. Vines continued green up to frost.

Mr. Edwards says he is thankful that he got it and will continue its culture.

Cotton—Foreign Fijii.—Soil, sandy loam, manured with 200 lbs acid phos. and cotton seed meal per acre. Planted April 28th, first open August 15th. Yield about 700 lbs. per acre. Generally 5 locks to the boll. It rained 23 days during July, causing it to shed many blooms. Insect enemies, boll worm. No rust, though other varieties suffered from the rust. The lint is very fine, has a stained color resembling wool and Mr. E. says when it is dyed it is a difficult matter to tell it from wool. This may prove a very valuable variety as a wool substitute or rather for mixing with wool.

REPORT OF Mr. R. T. EWING,

CENTRE, CHEROKEE COUNTY.

Rape—Brassica Riapus.—Good loam soil. Complete failure.

Sweet Clover.—Good loam soil. All died during the drought.

Alfalfa or Lucerne.—Good loam soil. Seed did not come up.

Crimson Clover.—Black loam soil. All died within a month after coming up.

Awnless Brome Grass.—Soil sandy. Seed did not germinate.

Yellow Millo Maize.—Good sandy soil, no manure. Cultivated same as field corn. Planted May 10th, first ripe Aug. 15th, gathered Sept. 15th. Yield very good, quality good, growth vigorous.

White Millo Maize.—Good sandy soil, no manure. Planted in rows April 10th. Quality good, yield good considering the poor stand. A heavy rain just after planting packed the land and prevented its coming up better.

Red Kaffir Corn.—Soil sandy and low, no manure. Planted April 10th. Sowed broad-cast. Failure.

Jerusalem Corn.—Good sandy soil with red clay sub-soil, no manure. Planted May 5th, poor stand. What was made was of good quality and the growth was good.

Spurry.—Light sandy soil, no manure. Prepared the land, which was fertile, in good condition and sowed broad-cast. Planted May 15th. All died out from drought.

Spanish Peanuts.—Gray sandy soil. Planted May 5th, first ripe Aug. 1st, gathered Oct. 15th. Quality very fine. Growth and yield fine.

REPORT OF Prof. J. B. ESPY,

ABBEVILLE, HENRY COUNTY.

Japan Cotton.—Sandy soil, clay sub-soil, manured with 250 lbs. guano per acre. Cultivated with heel-scrape and shovel. Planted April 10th, first open boll Sept. 8th. Yield 344 lbs. per acre seed cotton, 112 lbs. lint. Quality of staple excellent. Grows about 4½ feet high, hardy and thrifty, long limbed, fruits poorly, bolls small and contain only three locks.

REPORT OF Mr. URIAH JOHNSON,

TRINITY, MORGAN COUNTY.

Jerusalem Corn.—Sandy soil. Planted June 15th, harvested Sept. 15th. No manure. Seed crop good, forage short and hard.

Yellow Millo Maize.—Sandy soil, no manure. Quality of product not good. Poor yield. Bottom blades fired before seeds commenced to mature. Stalk large and light. Not so good as sorghum. Small insects injured it very much.

Spurry.—Sandy land, no manure.

Egyptian Cotton.—Sandy land, red clay sub-soil, no manure. Planted April 15th. Yield about 200 lbs. per acre. Lint very fine and weak. Stalks from 3 to 6 feet high, very few limbs and bolls.

Spanish Peanut.—Land same as above. Planted May 1st, harvested Oct. 1st. Quality good.

Rape.—Land same as above. Planted on land that had been used for cow pen, and it was rich. Planted June 15. Eaten up by a beetle unlike any insect he ever saw. Only eats the *Rape.*

Unknown Cow Pea.—Land same as above, no manure. Product good.

Melilotus.—Land same as above. Planted April 1st, no manure. Good product. Growth slow in Spring, but in August and September the roots grew large and deep into the ground.

REPORT OF Mr. J. A. LOGAN,

CLANTON, CHILTON COUNTY.

Turnip—Purple Top, White Flat Dutch, Snow Ball and Golden Ball.—Light soil, fertilized with guano and Ala. Fertilizer. Planted in rows in September. Yield about 100 bushels per acre. Quality of product as fine as can be grown.

Cotton—Hawkin's Improved.—Light soil, manured with compost. Cultivated as other cotton. Planted April 15th, first open Oct. 31st. Yield one-half bale per acre. Growth tall, very full of bolls, rather small, but a good cotton. Some rust.

Egyptian Cotton.—Soil mixture of red and gray pine land, manured with compost. Cultivated as other cotton. Planted April 25th, harvested September and October. Yield about

one-third bale to the acre. Lint short, bolls scattering, very large growth.

Spanish Peanut.—Ordinary fresh soil, manured with compost. Planted in April. Quality good. Yield 50 bushels per acre. Very fine variety.

Jerusalem Corn.—Failed to germinate.

Spurry.—Fresh land, manured with compost. Planted in March. Came up and grew about 10 inches high and died. Considered worthless.

Unknown Cow-pea.—Soil red; had been in cultivation several years, manured with phosphate. Culture same as cotton. Planted in May. First ripe in August. Yield good, and growth fast and vigorous.

Awnless Brome Grass.—Light gravelly land, manured with compost of lime and phosphate. Sown broadcast in March. Came up, but was choked out by crab grass.

Alfalfa.—Soil as above. Planted in March. Came up a fine stand, but after reaching 12 inches high, died out from dry weather.

Red Kaffir Corn.—Soil as above. Planted in May. Manured with stable manure and phosphate. Yield about 25 bush. per acre. Quality good, and grew well although the weather was extremely dry.

REPORT OF J. H. LOVEJOY.

ETOWAH COUNTY.

Alfalfa.—Sandy upland, no manure. Planted March 10. Badly killed by March freeze, and the few stalks remaining did not do well for want of culture.

Unknown Cow-pea.—Sandy upland, no manure. Planted July 10th; gathered October 1st. Products *very fine indeed.* Consider them the best pea I have ever grown, and shall discard all others for them.

Yellow Millo Maize.—Sandy upland, broadcast five wagon loads stable manure per acre. Planted May 9th; harvested September 10th. Quality of product seemingly as fine as it could be. Rapid growth; made a large quantity of foliage, and the seed a most excellent feed, especially for chickens.

Spanish Peanuts.—Sandy, no manure. Planted May 20; harvested August 30. Quality good; about 50 bu. per acre. A desirable variety, as the vines grow in a bunch straight up and the nuts grow close to the vine and adhere in gathering, which makes them easy to gather.

Kaffir Corn.—Sandy upland, five wagon loads stable manure per acre, broadcast. Planted May 10th; harvested September 10th. Crop would have been very fine, had it not been injured by English sparrows at the time the seed began to form.

Sweet Clover.—Sandy upland, no manure. Planted Mar. 10. Did fairly well; cut twice, fair crop each time. Horses very fond of it.

Crimson Clover.—Sandy upland, no manure. Planted March 31. Killed out by summer drought.

Spurry (Spergula Arensis.)—Sandy soil, dressing of stable manure. Planted March 31. Quick growth, but very low; not high enough to cut. Made a good crop of seed.

Awnless Brome Grass.—Sandy upland, no manure. Planted March 31. Got a good stand, but died out on account of the summer drought. "Not the grass for my soil."

Egyptian Cotton.—Complete failure.

Tobacco.—Sandy upland, manured with a small quantity in the drill. Plants set about May 1st; harvested September 10th, quality pronounced by judges to be excellent. Yield about 800 pounds per acre. Think tobacco a paying crop for this section, and am convinced that it is more profitable than cotton. Only wormed it two or three times.

REPORT OF Mr. S. PERCY JONES,

JOSEPHINE, BALDWIN CO.

Spanish Peanut.—Soil sandy, manured with cotton-seed meal, at rate of 500 pounds per acre. Plowed twice; hoed once. Planted April 1st; harvested August 1st. Yield per acre, 32 bush. Does well in this soil and climate.

Spurry.—Soil sandy; no manure. Planted April 15th; harvested June 5th. Grows about 15 inches high. Not so good as Giant Spurry.

Alfalfa.—Low land; manured with 500 pounds cotton seed meal per acre. Planted March 5th. Killed out by drought. No yield.

REPORT OF Mr. R. D. MARTIN,

FLORENCE, LAUDERDALE COUNTY.

Yellow Millo Maize.—Soil, gray red clay sub-soil, on south hill-side, no manure. Culture same as for corn and sorghum. Planted May 1st. Gathered August 1st. Yield not measured, but was large. Growth vigorous, about eight feet high. It is a valuable addition to the forage crop; can be cut several times, and comes out very rapidly. Seasons were the dryest ever known.

Kaffir Corn.—Soil as above, no manure. Culture, same as corn. Planted May 1st; harvested September 1st. First ripe August 1st. Owing to extreme drought, did not estimate the yield. Heads measured from eight to eighteen inches in length, and one solid mass of large grains. Stock fond of it. Have saved nearly all for seed.

Jerusalem Corn.—Soil on edge of basin, no manure. Planted May 1st; harvested September 15th. Not so tall a growth as Millo Maize; will grow it another year. Stock like it very much.

Unknown Cow Pea.—Light thin soil, well drained, no manure. Cultivated as directed on package. Planted May 29th. Gathered in September. Yield 15 to 20 bushels per acre. Quality very fine. Pods extra long, and on account of the extremely dry weather, many were lost from shattering out. Had the seasons been better, the crop would have been larger.

Crimson Clover.—Soil in a low place, no manure Planted in March. The extremely dry spring caused it to die-out some, and on account of dry weather did not grow tall enough to cut.

Lucerne.—Soil as for clover, no manure. Planted in March. Owing to drought, grew about 12 inches high and seeded. Stood the drought remarkably well.

Brome Grass.—Soil as for Lucerne, no manure. Planted in March. Did not develop sufficiently to authorize a report. May do better the next experiment.

Egyptian Cotton.—"No good" for this climate, will not mature.

Spanish Pea-nut.—Soil, light sandy, no manure. Planted May 1st, harvested in October. Yield per acre, *large; quality good.*

Tobacco, Brazil variety.—Cured bulk of crop by pulling off the leaves as they would ripen and hanging them on sticks in a log house. Sold most of it at 30 cents per pound. Took premium at the county fair.

REPORT OF Mr. WM. MARTIN,

GREENSBORO, HALE COUNTY.

Egyptian Cotton.—Soil, level, sandy upland, no manure. Cultivated by first barring-off, and afterwards by plowing with sweep, and hoeing. Planted April 10th. First open August 1st. Last open October 1st. Gathered in September and October. Yield per acre, 1,200 lbs. Quality good. No insect enemies; no plant diseases.

REPORT OF Mr. J. W. MIZE,

REMLAP, BLOUNT COUNTY.

Spanish Pea-nut.—Light sandy soil, clay sub-soil, manured light with stable manure. Cultivated with hoe and small shovel. Quality of product very good, and the crop good.

Egyptian Cotton.—Flat branch land, manured with dry pulverized stable manure. Cultivated with small scooter, heel-scrape and hoes. Planted April 20th. Yield, about 400 lbs seed cotton per acre. The quality of lint was very fine and yellow. The growth tall, limbs long, bolls very small and scattering. Same ground in common cotton would make 1,600 lbs.

Jerusalem Corn.—Soil dark, red sandy, manured with small quantity of stable manure. Planted May 7th, harvested September 20th. Nothing good but the heads or tops, which grew compact and is relished by stock. Stalks low and pithy.

Red Kaffir Corn.—Gray, sandy soil, no manure. Planted April 26th, harvested September 17th. Nothing good but the *heads.* Quick growth.

Tobacco.—Branch, sandy loam, no manure. Planted in May; harvested in September. Hester variety after cureing was strong and had a rich color and fine flavor. Comstock Spanish, cured yellow, with a fine flavor.

REPORT OF Mr. S. H. PRUITT,

SHADY GROVE, PIKE COUNTY.

Egyptian Cotton.—Soil sandy, manured with 150 pounds guano per acre. Planted last of May. Gathered first December. Yield about 300 lbs. to the acre. Growth rapid, stalks from 6 to 10 feet high.

Brome Grass.—Soil sandy, Cow-pen manure. Planted March 1st. Matured first seed June 11th. Yield good. Product very good. Rapid growth.

Spurry.—Land and manure as above. Planted March 1st. First ripe seed May 10th. Quality very fine and yield good.

Alfalfa.—Level sandy soil, Cow-pen manure broad-cast. Quality good. Growth fine and rapid, and is recommended in that section.

REPORT OF Mr. T. A. SNUGGS,

HOLLY POND, CULLMAN COUNTY.

Kaffir Corn.—Soil gray, manured with 100 lbs. guano per acre. Cultivated same as cotton. Planted May 15th; harvested October 1st. Yield about 30 bushels per acre. Quality a little better than sorghum. Mr. Snuggs considers

this a fine food for stock, but it should be threshed and the grains crushed as stock fail to masticate it.

Spurry.—Gray sandy soil, no manure. Planted March 20th. Dry spring season; grew to be about three inches high. Failure.

Jerusalem Corn.—Seed did not germinate.

Unknown Cow Pea.—Soil, gray sandy, manured with mixture of acid phosphate and cotton-seed meal. Planted June 15th, between corn rows. First ripe September 15th; harvested October 10th. Quality of product good and well adapted to this soil and climate.

Rape.—Soil gray, manured with stable manure. Cultivation same as rutabaga turnips. Planted July 20th. The drought was too prolonged to determine its merits.

Millo Maize.—Soil, gray hill-side, manured with 100 lbs. guano per acre. Cultivated in three feet rows, same as cotton. Planted May 1st; harvested October 15th. First ripe October 15th. Last ripe November 1st. Did not mature well. Not adapted to this soil and climate.

Spanish Ground-pea.—Soil, gray, south hill-side, manured with compost of cotton-seed and stable manure. Cultivated in 2½ feet rows. Planted May 15th; harvested October 1st. Quality good, and is a very fine ground-pea for this climate and soil.

Crimson Clover.—Soil sandy and trod. Planted April 1st. The spring drought was fatal to this crop.

Egyptian Cotton.—Soil gray, east hill-side, manured with 150 lbs. guano per acre. Cultivated like ordinary cotton. Planted April 26th. First open September 1st. Yield about 200 lbs per acre. Quality of product not good. Not adapted to this country, bolls too small and scattering and too slow in maturing.

Hawkins Improved Cotton.—Soil, sandy, south hill-side, manured with compost of stable manure and cotton-seed. Cultivated as other cotton. Planted April 26th. First open boll September 1st. Yield per acre about 700 pounds. Quality of product good. This cotton is very prolific, but the bolls are too small.

REPORT OF Mr. ROMEO TAGLEABUE,

DAPHNE, BALDWIN COUNTY.

Unknown Cow Pea.—Soil, high gray, red clay sub-soil, manured, kainit 280 lbs. bone dust 100 lbs. per acre. Not cultivated. Sown broad-cast. Planted May 18th. Harvested from last of June until the last of October. Yield very large. Product very good. Insect enemies, common pea beetle.

Crimson Clover.—Plateau on an elevation, gray soil, manured with 100 lbs. lime, 200 lbs. kainit, and 40 lbs. bone dust, per acre. Not cultivated. Failure.

Yellow Millo Maize.—Soil same as above, manured with 330 pounds kainit, and 130 pounds bone dust per acre. Culture, one hoeing and one plowing. Planted May 24th; harvested October 25th. First ripe 15th September. Yield about 40 bushels per acre. Quality good. Growth of grains and stalk enormous, some stalks 14 feet high and some heads weighed $2\frac{1}{4}$ pounds. This plant is highly recommended. Insect enemies, yellow winged beetle, same as attack cow-peas.

Brome Grass.—High, gray soil, manured with 200 lbs. kainit, 40 lbs. bone dust per acre. Planted May 28th. Did not germinate.

Spurry.—High elevation, gray soil, manured with 160 lbs. lime, 330 kainit, 100 lbs. bone dust per acre. Planted May 28th. A few seed sprouted, but soon all signs of the plant disappeared.

Spanish Peanut.—Soil same as above, manured with 600 lbs. kainit, 350 lbs. bone dust, 130 lbs. cotton seed meal per acre. Cultivated with two hoeings soon after the plants came up, and nothing more. Planted May 26th; harvested October 15th. Yield per acre about 70 bushels. Quality small, but good. Growth good, but suppose the results would have been as large with less manuring. The vines are good for horses and cattle.

Red Kaffir Corn.—Plateau upon a high elevation, sandy

gray soil, manured with 200 lbs. kainit, 140 lbs. bone dust, 60 lbs. cotton seed meal per acre. Cultivation, hoed one time, and then hilled. Planted May 21st; harvested August 25th. First ripe July 31st. Yield about 35 bush. per acre. Quality good. Growth and yield satisfactory, though there were some missing hills.

Mr. T. thinks the growth and yield could have been increased by better culture and by cutting the stalks earlier than this was cut.

Jerusalem Corn.—Soil same as above, manured with 330 lbs. kainit, 130 lbs. bone dust per acre. Culture same as the *Kaffir*. Planted May 23d; harvested August 25th. First ripe last of July. Yield about 30 bush. per acre. Quality good. A good many seeds did not come up. The growth and yield very satisfactory; at the same time better culture would have given better results. Well pleased with it.

Rape.—High elevation, gray soil, manured with 330 lbs. kainit, 160 lbs. bone dust, 100 lbs. cotton seed meal per acre. Cultivation, several hoeings. Planted May 26th. Quality of product good. Only a few seeds sprouted, and they made enormous bunches of leaves that were as good as cabbage. Will try it again with a heavier manuring. Insect enemies, the common cabbage worm.

Alfalfa.—Soil same as the foregoing, manuring—100 lbs. lime, 200 lbs. kainit, 40 lbs. bone dust per acre. Planted May 26th. Sprouted June 2d, and up to Nov. 26th, rootlets had grown about a foot long. Prospects good for its doing well after it becomes firmly rooted. Growth continues from year to year.

Sweet Clover.—Soil as above, manured with 100 lbs. lime, 200 lbs. kainit, 100 lbs. bone dust, 40 lbs. cotton seed meal per acre. Planted May 20th. Complete failure.

REPORT OF Hon. J. C. OTT,

FLORENCE, LAUDERDALE COUNTY.

Egyptian Cotton.—Soil level, on Cox's Creek, fertilized with acid phosphate, and cotton seed meal. Cultivated like

ordinary cotton. Planted April 17th, first open boll Sept. 21st; harvested Nov. 1st. Yield about 250 lbs per acre. Quality of product good. Growth vigorous, 3 to 5 feet high. Yield poor on account of maturing so late. Peerless cotton on the same land produced 1,100 lbs. per acre.

Egyptian Cotton (Afifi).—Soil same as above, manuring same as above. Cultivated same as ordinary cotton. Planted April 17th, first open Oct. 1st. Yield practically nothing. Growth extremely vigorous, from 6 to 10 feet high. All labor and fertilizer and use of land lost.

Spanish Peanut.—Soil level, on creek, manured with cotton seed meal. Cultivated about the same as cotton. Planted April 27th; harvested Sept. 18th. Yield per acre about 63 bushels. Quality very good. Growth vigorous.

Yellow Millo Maize.—Soil about the same as above, manured with cotton seed meal. Cultivation: Broke land in Nov. and again in April, just before planting. Planted May 1st; harvested at intervals. First ripe middle of August. Last ripe Oct. 1st. Quality of product, very best. Vigorous growth, abundant yield of green feed, the use of which I mostly made of it.

Mr. Ott says it is very valuable as a green feed and for fodder, producing two or three crops from the same planting.

Jerusalem Corn.—Soil similar to that on which the foregoing were planted, manured with cotton seed meal. Cultivation: Broke land in Nov. and again in April and plowed with double shovel. Planted May 1st, first ripe last of July, last ripe Aug. 20th; harvested Aug. 28th. Yield and quality not good, on account of excessive rains, causing the seeds to mould before maturing. Growth very vigorous.

Red Kaffir Corn.—Soil same as preceding experiments, manured with cotton seed meal. Land was broken in November and re-broke in April, cultivated with a double shovel. Planted May 1st, first ripe Sept. 1st, last Oct. 15th; harvested at intervals. Quality of product very good Growth vigorous, yield heavy as a forage plant. Foliage heavy.

BULLETIN No. 66. OCTOBER, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

CANE SYRUP.

B. B. ROSS, Chemist.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1895.

☞ 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 MANUFACTURE OF SYRUP FROM CANE.

The manufacture of syrup for home use or local consumption has been carried on upon a small scale in southern and middle Alabama for many years, and in many of the villages and towns of this section, home made cane or sorghum syrup is found upon the market during the fall and early winter months.

Even during the period of the year referred to, however, the home made product only partially supplies the demand for this article, while during the spring and summer months the syrup of home manufacture is not to be obtained at all, and the demand is supplied by syrup from the outside markets.

These imported syrups are frequently adulterated with corn glucose or else have been obtained by reboiling syrups and molasses which have undergone partial fermentation, while in still other cases the syrups consist of low grade and originally dark colored products which have been bleached or brightened by chemical processes.

That a portion of the local demand for syrups throughout such a large section of the State can be successfully supplied during a small portion of the year, is already an established fact, and with an increased cultivation of cane and an improvement in the present crude methods of manufacture, it is not too much to say that within a comparatively short period, the demand for syrup for the greater portion of the State, throughout the entire year, can be satisfactorily filled with a product of high quality, manufactured within the borders of the State. The composition of cane produced on hill lands in this State, as indicated by analyses made during a number of seasons, exhibits a marked superiority as regards saccharine content when compared with the cane grown upon the alluvial lands in

Louisiana, the proportion of sugar contained in the former being from 2% to 4% in excess of that found in the latter.

Experiments with regard to the adaptability of cane to soils of varying quality and character have almost invariably shown that light, easily drained soils produce a cane of higher sugar content than rich alluvial or bottom lands, though the latter soils give the larger yield in almost all cases. While the lands throughout such a large portion of this State are capable of producing cane with such a high sugar content, there has been made, as yet, very little progress in the employment of intelligent and improved methods in the manufacture of syrup from sugar cane, and the processes at present in use are extremely crude and in most cases quite uneconomic.

The process of manufacture, as carried out at present, makes little if any provision for the clarification or purification of the juice prior to evaporation, the only impurities removed being those which come to the surface as froth or scum during the process of evaporation, the skimmings being removed by means of a small perforated ladle.

As the cooking of the juice to syrup is commonly effected in the ordinary shallow copper evaporator, the evaporation is of course quite rapid, and in many cases considerable proportions of the impurities escape the skimming ladle and are boiled down along with the syrup, contaminating the product and giving a darker color to the syrup.

In ordinary practice, no appliance of value is employed to ascertain when the syrup has reached the proper density, and in most cases the evaporation is carried too far, a product being obtained which permits the deposition or crystallization of it's sugar within a comparatively short time.

Owing to this tendency on the part of the thicker syrups to crystallize, it is quite difficult to obtain the home-made article for more than a few months after the period of manufacture, while syrups that may have partially escaped this defect will be likely to ferment somewhat later in the season.

The presence of organic impurities has the effect of increasing the tendency of syrups to ferment, so that a failure to properly clarify or defecate (remove impurities from) the syrups during the process of manufacture will almost invariably lead to the fermentation of the syrup, after the lapse of a few months, at least.

A lack of care in regulating the heat during the cooking process frequently results in the scorching of a portion of the syrup and a consequent darkening of the liquid, owing to the formation of caramel or similar substances.

While a dark syrup may equal a syrup of lighter and brighter shade as regards sweetness and flavor, the lighter and brighter syrups almost invariably command a higher price on the market, so that it is advantageous to make as clear and bright an article as possible, if the syrup is being manufactured for sale.

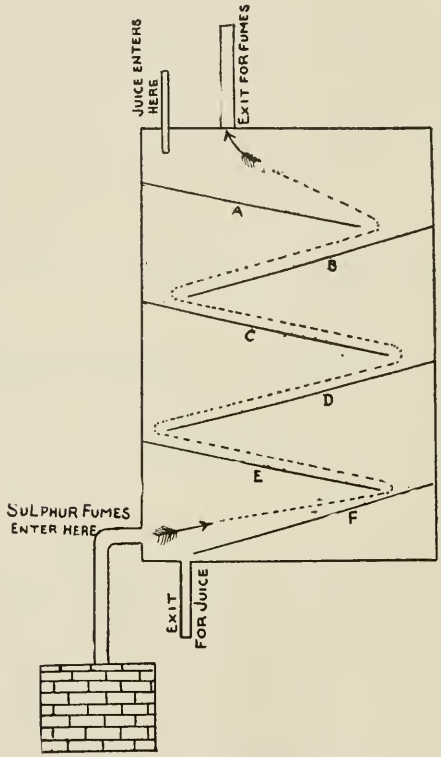
The materials and appliances for the proper clarification or purification of syrups are quite simple in character, and in order to show that they could be successfully employed in syrup making on a small scale in this section, a series of experiments were conducted by the writer during last November.

As it was found difficult to secure a portable furnace or mill for use at the Experiment Station, it was found advisable to conduct the experiments at the adjacent place of Mr. M. Floyd, where both furnace and mill were in operation.

For effecting the clarification or defecation of the juice, both sulphur and lime were employed as raw materials, the former being converted into sulphur di-oxide or sulphur fumes by burning in a small furnace, while the latter was employed in the form of milk of lime.

Both of these agents are successfully employed in Louisiana and in other sugar producing sections upon a large scale, but the manner of applcation with the small outfits at our disposal was necessarily somewhat different.

The apparatus for sulphuring the juice was constructed of an ordinary box about 1 x 2½ x 4 feet and in order to more fully illustrate its construction the following cut is inserted, which gives a vertical cross section of the box, showing interior arrangement of shelves and also the sulphur furnace and pipe connections.



As indicated by the diagram, the shelves *a*, *b*, *c*, *d*, *e*, *f*, are arranged in a gently sloping position in order to permit of the easy, but not too rapid, flow of the juice through the apparatus, the sides and joints of the box being made as nearly air and water tight as possible, in order to provide against waste of either the juice or sulphur fumes.

The raw juice as it comes from the mill is placed in a ves-

sel above the sulphur apparatus, and is allowed to enter the box through the pipe shown at the top of the diagram.

As soon as the stream of liquid encounters the first shelf it spreads out over the whole of the surface exposed to it, and flows in a thin layer down shelf after shelf until it reaches the exit tube at the bottom of the apparatus.

The sulphur furnace can be constructed of a few bricks laid either in moist clay or mortar, while the pipe connecting the furnace with the box can be constructed of sheet iron, or else a piece of 1½ or 2 inch gas pipe can be employed.

An opening is left in one side of the furnace to assist the draught, while the sulphur is burned in a small iron pot or pan, ordinary roll sulphur or brimstone being the form best adapted to this purpose.

The fumes enter the apparatus near the bottom as shown in the cut and, in passing through the box, follow the course indicated by the arrows and dotted lines, the juice as it flows downward being continually met by a stream of sulphur fumes passing upward.

The employment of this form of apparatus insures the ready absorption of the sulphurous acid gas by the juice, and a very marked change is observed in the character and color of the juice as it flows from the box, as compared with the juice fresh from the mill.

The juice, after sulphuring, is allowed to flow into the first compartment, of the evaporator, and when it has almost reached the boiling point, a small amount of a thin milk of lime is added, the juice, however, being left distinctly acid as indicated by litmus test paper.

As soon as boiling commences, and frequently before the boiling point is reached, it will be observed that large quantities of froth and scum have accumulated on the surface, and can be removed in the usual manner as fast as they are formed, a very clear bright juice being obtained in a very short time.

The evaporation is now conducted, in the usual manner,

avoiding sudden or excessive heating of the pan, the syrup being drawn off when it has attained the proper density or thickness.

To ascertain when a sufficient degree of concentration has been reached, it will be found convenient to employ what is known as the Baume hydrometer or saccharometer, which consists of a hollow glass spindle, with graduations on the stem for indicating the density of liquids in which it may be immersed.

In reading the instrument, the point to which the spindle sinks in the syrup is noted, the boiling being continued, if a sample, tested in an ordinary pickle jar with the spindle, is found to be of too thin a consistency.

Ordinarily, it will be found best to boil the syrup to a density of about 32 degrees, as indicated by the Baume spindle, immersed in the hot liquid, since with syrups of greater density, the crystallization of a portion of their sugar will take place in a short time.

(A hydrometer or spindle of the above description can be purchased of I. L. Lyons & Co. of New Orleans for about 75 cents.)

In the experiments conducted last fall, a portion of the syrup was clarified with the use of sulphur fumes alone, while another portion was defecated by means of sulphur fumes, followed by treatment with milk of lime in the evaporator.

The latter treatment gave more satisfactory results in almost every test, the syrup obtained being clear, bright and of excellent flavor.

The advantages resulting from the use of sulphur fumes are as follows :

1st. It bleaches the juice thoroughly and yields a clear, bright product.

2nd. It aids in the defecation or removal of impurities from the juice, the impurities removed consisting largely of easily fermentible organic substances, which interfere with the preservation of the syrup.

3rd. The sulphurous acid remaining in the syrup is of value in tending to prevent or check fermentation, since this substance possesses marked anti-fermentive properties.

The milk of lime is of advantage in partially neutralizing the excess of sulphurous acid and in precipitating albuminous matters and other organic impurities, which would otherwise be difficult of separation.

As previously stated, a great objection to the methods of syrup making in common use is that no attempt is made to thoroughly clarify or defecate the juice, and further that the syrup is boiled too thick a consistency, thus facilitating the crystallization of the sugar contained. Where sulphur fumes have been employed, any excess of free sulphurous acid remaining in the juice will aid in the conversion of the cane sugar into uncrystallizable sugars, and the same result can be attained by the employment of other acids such as acetic and muriatic, though their use for this purpose is not to be strongly recommended.

If, instead of removing the upper green joints of cane preparatory to grinding, the whole stalk is passed through the mill, it will be found that the syrup obtained will have much less tendency to deposit sugar, than where the former plan is adopted, although the product is more susceptible to fermentation and quite likely to be darker in color.

The experiments conducted during the season of 1894, were performed with the aid of an ordinary shallow copper evaporator, together with the sulphuring apparatus previously described, and the results secured were quite satisfactory in almost every particular.

The syrup obtained was much brighter and clearer than the syrups made during the same season without the use of clarifying agents, and portions of this syrup, preserved for almost six months in open vessels, gave no perceptible sign of fermentation at the end of that period, and there was only a partial deposition of the sugar contained.

THE PRESERVATION OF SYRUP.

As before stated, the two chief difficulties in the way of the satisfactory preservation of syrups are—first—the deposition of sugar, and second—fermentation, which frequently takes place at a somewhat later period.

While some of the syrup manufactured in the experiments referred to was kept quite satisfactorily in open vessels for a period of about six months, it is almost invariably difficult to preserve syrups in bulk from fermentation during the summer months.

To show that cane syrup could be successfully preserved, even through the long heated term, without undergoing any material changes, several large glass bottles were filled with the hot syrup and immediately sealed tightly, after which they were set aside in a secure place and were left undisturbed until the first of October, nearly eleven months after the date of making the syrup.

The bottles were about two-thirds of a gallon capacity each, and were rinsed with hot water before being filled with the hot syrup to the full capacity of the bottle.

On opening the bottles there was not the slightest indication of fermentation, nor had any deposition of sugar, whatever, taken place, while at the same time the flavor and taste of the article could not be distinguished from that of a syrup fresh from the evaporating pan.

At the time of filling the large bottles, a small bottle was filled with the same syrup, in order to make comparative analyses of the two samples, the small bottle being labeled "Sample 1" and the large bottles "Sample 2."

The following is the analysis of sample 2, made immediately after unsealing one of the large bottles.

Total solids, - - -	71.2 per cent.
Cane sugar, - - -	46.4 " "
Glucose, - - - -	22.9 " "
Solids not sugur, - -	1.9 " "

On comparing these figures with the analysis of Sample 1, it will be seen that the syrup has undergone scarcely an appreciable change in composition when preserved in bulk sealed vessels, and the preservation in still larger vessels can be effected with fully as satisfactory results.

ANALYSIS OF SAMPLE 1.

Total solids,	71.2	per	cent.
Cane sugar,	46.7	"	"
Glucose,	22.4	"	"
Solids not sugar,	2.1	"	"

Instead of employing large bottles, one gallon jugs can be utilized to good advantage, provided that a thoroughly glazed ware is used and that care is observed in sealing the vessels.

In conclusion, it is scarcely necessary to add that by employing intelligent methods both for the clarification and preservation of cane syrup, the greatly enhanced quality of the product will obtain for it better prices upon the market, while the local demand for syrup can be supplied throughout the entire year, instead of for only a few months as at present.

Experiments in syrup making will be continued at the Station this fall, and it is expected that small steam evapoators will be tried as a substitute for the common form of evaporator heretofore employed.

BULLETIN No. 67. NOVEMBER, 1895.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

BOVINE TUBERCULOSIS.

C. A. CARY, Veterinarian.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1895.

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

BOVINE TUBERCULOSIS, [1]

BY

C. A. CARY.

The history of medicine informs us that Hippocrates (400 B. C.) described many of the characteristic symptoms and lesions of tuberculosis in man and animals. During the middle ages tuberculosis in animals was considered contagious and the flesh of infected carcasses was condemned by law as unfit for human food. Many of those old laws are still in force in Italy and Spain (Law).

During the first eight decades of this century the common and accepted theory was that tuberculosis was hereditary and this was its chief, and possibly only, method of transmission.

In fact, the history of tuberculosis has been checkered by numerous and various theories, because the exciting or essential cause remained unknown until 1882, when Robert Koch discovered the *bacillus tuberculosis.*

No other disease is so widely distributed geographically; it is found in all climates and in all lands. It attacks man and nearly all the domestic animals. It accompanies the progress of civilization and seems to be most active during the transitional stage from savagery or barbarism to civilization. Artificial modes of living, without intelligent and scrupulous sanitation, fosters and increases its virulency and frequency.

Tuberculosis annually claims more victims than smallpox, cholera and yellow fever. An average of 14 per cent.

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(1) The term Tuberculosis embraces all forms of disease caused by the *bacillus tuberculosis*, namely: consumption (tuberculosis of the lungs), tubercular meningitis, tubercular peritonitis (pearl disease), scrofula, consumption of the bowels, lupus (tuberculosis of the skin) and, in fact, tuberculosis of any part of the body.

(one out of every seven) of all the deaths in the human family is due to tuberculosis [1]. In some of the largest cities and in some of the older and most densely populated countries the average per cent. is 25 (1 death in every 4 a result of tuberculosis).

It is said that the civilizing (?) influences, as applied to the American Indian, have increased the mortality to 50 per cent.—one-half of all the deaths result from some form of tuberculosis (Law).

In Alabama during the years 1889–90–91–92–93, the annual average number of deaths from tuberculosis was 1009; or 11.44 per cent. (1 in every 9) was due to tuberculosis (2).

The annual average among the white people is 373, or 4.23 per cent. of all the deaths; the yearly average among the blacks is 636, or 7.21 per cent. of all the deaths. This indicates that the superior intelligence of the white people with their better observance of the laws of health tends toward decreasing the ravages of this disease. The ignorance of the negro with his disregard of the laws of hygiene

(1) One authority claims that 20 per cent. of all the deaths in the United States (1 out of every five deaths) is due to tuberculosis.

2. Total No. of deaths in Alabama in 1889–90–91–92–93, was 44,096
The No. of deaths from tuberculosis during the same time, was:

Total.	Annual Average.	White.	Black.	Male.	Female.
5048	1009	1867	3181	2106	2942

These records were derived from Dr. Cochran's annual reports to the State Board of Health. Dr. Cochran informs me that these reports are accurate for the cities, but they are more or less incomplete from country districts.

It is very probable that the reports of deaths among the white people are more complete and accurate than those from the black race. It is also very probable that the number of deaths from tuberculosis among the negroes is greater than the reports show; because many deaths are not reported, that occur in localities where the inhabitants are nearly all black.

propogates tuberculosis at a frightful rate. During slavery times the negro was as free from tuberculosis as were the white people at that time.

The constant and uniform appearance of deaths from tuberculosis are accepted by the people as inevitable. This constant contact breeds a tolerance which merges into an indifferent fatalism that is more becoming to the ignorance and superstition of the heathen than the intelligent and highly civilized American or European. We legislate, quarantine and use all the methods known to expert medical men, when cholera, yellow fever or small-pox enters or threatens to enter, our country or State. Yet only a few States legally recognize tuberculosis as an infectious disease that annually destroys more lives than all of the three frightful diseases just mentioned.

"If we take the whole civilized world and compare with the tuberculous mortality all the accumulated deaths from war, famine, plague, cholera, yellow fever and small-pox, we find that the latter are comparatively insignificant. Yet tuberculosis like every other germ disease is absolutely preventable and is allowed to continue its career of death because of reprehensible ignorance and criminal indifference" (Law).

THE EXCITING OR ORIGINATING CAUSE OF TUBERCULOSIS.

Since Koch's discovery of the bacillus tuberculosis, the study of this disease has been thorough and systematic. It is now a well established fact that tuberculosis can not exist without the presence of the living tubercle bacillus. This microbe or germ is a one-celled plant, having the shape of a very delicate rod, about 1-2500 of an inch long and about 1-10 as broad as long. This rod is usually almost straight but may be slightly curved. It may appear alone, in pairs, or in irregular groups or masses. It absorbs coloring matters (stains) very slowly; but when once stained it holds the stain with great tenacity. It will hold certain stains when all or nearly all other germs become discolorized.

This enables the pathologist to distinguish it amid myriads of other germs. The bacillus tuberculosis is a plant parasite that lives in the animal body, but it may be cultivated on artificial culture media, such as: agar agar or bouillon containing 5 per cent. of glycerine, and blood serum. It develops best at 100 to 102 degrees Fah. This germ may also live and retain its vitality outside of the animal body for an indefinite time; its length of life out of the body will depend upon heat, light, moisture and the material in which it exists. Koch and other observers have found that in many instances the tubercle bacillus has retained its vitality for nine or ten months in the sputa or expectorations of tuberculous persons. However, it is very probable that this germ does not grow or multiply outside of the animal body.

Many authorities (Baumgarten, etc.,) claim that the gastric juice will not destroy the tubercle bacillus. If infected sputa be kept at a temperature of 158° Fah. for ten minutes the tubercle bacilli are destroyed. The germ in the same material is destroyed in 20 hours if 3 per cent. of carbolic acid is added; the germ perishes in five minutes in iodoform-ether; it dies in ten minutes in a mercuric chloride solution (1 to 1,000). According to Koch the tubercle bacillus perishes in a few hours in direct sunlight, and in five to seven days in diffuse daylight. This germ may remain virulent in ordinary living rooms from two to ten months, varying with the light, heat and the frequency of disinfection or cleansing of the room. An absolute heat of 158 degrees Fah. for fifteen minutes in meat and other tuberculous masses, will kill the germs. Boiling for one-half hour is always fatal to the tubercle bacilli. In springs, wells and all forms of surface water, at ordinary temperature, the tubercle bacilli may maintain their virulency indefinitely. Non-sterilized water from rivers and surface wells may be contaminated; likewise public drinking troughs. Freezing will not destroy the tubercle bacillus. Fermentation and decomposition of organic materials, in which tubercle ba-

cilli are present, will not always destroy them. Common salt liberally applied to meats is fatal to the germ in one month; but in large masses of meat, the salt may not permeate the mass evenly and many bacilli may thus escape the destructive action of the salt.

In truth, there are probably many conditions outside of the animal body in which the tubercle bacillus may live and retain its virulency that are yet unknown to pathologists. However, it is certain that poorly ventilated and dark living rooms, public halls, school rooms and churches are places where the infected sputa may be slowly dried, thus preserving its infective power indefinitely. Hence, the dust from such rooms may carry the virulent germs into the air passages, and into the alimentary canal with the food. In fact the greatest number of cases of tuberculosis in the human family are contracted by breathing tuberculous dust in living rooms, churches, school rooms and public places. The next greatest number of cases of tuberculosis are contracted by eating tuberculous food.

ACCESSORY OR PREDISPOSING CAUSES OF TUBERCULOSIS.

Predisposing causes consist of influences or factors that reduce the animal vigor and the resisting power of the leucocytes and tissues of the animal body, and of conditions which favor the introduction of the germs into the body.

(1). Heredity produces a tendency in the cell structure of the body favorable to the development of the germ and depressing more or less the body vitality or vigor. The offspring of tuberculous parents readily contracts tuberculosis, because the protecting liquids and cells of the body can not prevent the invasion of the tubercle bacilli. In rare instances the bacilli pass into the embryo or unborn fœtus. Some authorities claim that the germ may pass from a tuberculous sire in the semen, or it may be in the ovum from the dam, or pass from the mother to the fœtus by way of the fœtal membranes.

Evidently the continued breeding of tuberculous animals

produces a weak family; and weakness of body, whether of tuberculosis origin or not, predisposes the offspring to tuberculosis.

(2). The modern method of breeding the cow as a milk-producing machine is developing a constitutional weakness in many individuals of the milk-producing families. Furthermore, experience has proven that a cow which is kept in a small stall without exercise will give more milk with a given quantity of food, than one which is given plenty of exercise in a lot or field, with the same quantity of food. Of course, such close confinement reduces the vigor of the cow and predisposes her to tuberculosis. This doctrine of close, warm, continual confinement is occasionally preached and practiced by dairymen and sometimes it is taught by instructors in agricultural colleges. Dairy cows as well as beef cattle should have exercise in open air. Exercise and fresh air will not prevent all cases of tuberculosis, but they certainly help to prevent the contraction or spreading of tuberculosis.

(3). *Ventilation and Light.*—Poorly ventilated and dark stalls are, in many respects, worse than continual out-door exposure. Light is one of nature's best disinfectants, and moving air carries away foul gases and brings fresh, pure air. The drainage of stalls should be so arranged that they may be kept dry and clean.

(4). Climate, in a degree, influences the propagation and development of tuberculosis. A moist and variable climate favors the development and transmission of tuberculosis. Dry and rarified air with a uniform temperature tends to decrease its ravages.

(5). *Food and Feeding*—Too heavy or forced feeding may weaken the animal as well as a deficiency in the quantity of food. The proper quantity and the best quality of food should be given. Food should not only be nutritious and digestible, but should also be given at regular intervals in proper quantities. Too much food overtaxes the digestive

organs and decreases the vitality of the animal, and eventually produces acute or chronic indigestion.

(6). *Faulty Breeding*—In-and-in breeding or the mating of closely related individuals is always to be regarded as unsafe. It may bring out the weak or the bad points which may predominate over those that were strong and good in the sire and dam. Breeders who have developed distinct breeds recognize the fact that continued in-and-in breeding is very liable to produce an outcrop of tuberculosis.

Early and frequent breeding produce a decrease in bodily vigor and should be avoided.

Intensive breeding, or the pairing of animals from two great milking strains, may result in an offspring that is weak, poorly developed and predisposed to tuberculosis.

Animals with thin flat chests and long legs are predisposed to tuberculosis by conformation and should not be used for breeding purposes.

Animals having tuberculosis should never be bred.

(7). Disease, exposure to cold and rain and any influence which depresses the vitality or physical vigor of an animal, predisposes it to tuberculosis.

It should not be understood that any or all of these predisposing or preparing causes will produce tuberculosis without the presence of the bacillus tuberculosis. Neither should it be taken as self-evident that the absence of any or all of these predisposing causes will always prevent the spread of tuberculosis or the contraction of it. Dr. Niles of Iowa reports the appearance of tuberculosis in a herd that had been kept in the best out-door conditions.

TUBERCULOSIS AMONG THE VARIOUS SPECIES OF DOMESTIC ANIMALS AND IN MAN.

There appears to be a constant relation between the prevalence of this disease in man and in domestic animals. In a state or locality where tuberculosis is very common in the human family, it is also very frequently observed among the more susceptible of domestic animals. Cattle and swine

are more susceptible to the disease than the other domestic animals; however, sheep, horses, dogs and cats occasionally become infected. Many of the wild animals when caged succumb to this disease. Caged monkeys, lions, tigers, deer, elk, kangaroos, antelope and birds have been known to die of tuberculosis. Rats and mice are susceptible and instances have been recorded where they have contracted tuberculosis in houses that were inhabited by tuberlous persons. Guinea pigs and rabbits are very susceptible.

ITS PREVALENCE IN CATTLE.

In Europe.—According to Arloing 0.5 per cent. of the cattle of France are tuberculous; in Paris, 6 per cent.; in Baden, Germany, 0.2 per cent.; in the province of Bavaria, 0.225 per cent.; in Belgium, 0.4 per cent.; in Holland, 20 per cent.; in Leipsic 20 per cent.; in Edinburgh 26 per cent.

The above per centages (from Law's bulletin) shows how tuberculosis in cattle varies in the thickly populated cities and countries of Europe. It will be observed that the cattle of the cities are more frequently tuberculous than the cattle of the country(1). In some local herds of Europe 75 per cent. have been found to be tuberculous. According to the records in the slaughter houses of Germany cows are more frequently tuberculous than oxen or calves. In fact,

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1. It is interesting to note in this connection the following valuable table prepared by Dr. Lagnaeu, showing the gradual increase of tuberculosis when the smaller cities are compared with the larger. These tables were made from the records of 662 cities in France:

95	cities with less than	5,000	inhabitants		1.81
332	cities of between	5,000 and	10,000	inhabitants	2.16
127	" "	10,000 and	20,000	"	2.71
50	" "	20,000 and	30,000	"	2.88
46	" "	30,000 and	100,000	"	3.05
11	" "	100,000 and	430,000	"	3.65
Paris with 2,224,704 inhabitants					4.91

The above table shows the number of persons who die annually from tuberculosis of the lungs (consumption) to every 1,000 inhabitants in cities of different population. The table does not take into comparison any of the other forms of tuberculosis.

almost, one-half of the cases of tuberculosis in cattle are found in cows. This is due to the fact that the cow comes in closer contact with man and has less freedom, less pure air and receives more infected food than calves or oxen.

In the Copenhagen slaughter houses from 1891 to 1893 inclusive, the following records were made:

Inspected	132,294 oxen and cows,	23,305 or 17.7 %	were	tuberculous.
"	8,292 swine,	1,272 or 15.3 %	"	"
"	185,765 calves,	369 or 0.2 %	"	"
"	337,014 sheep,	1 or 1.0003 %	"	"

At the Berlin public slaughter house during 1892, the following records were made:

Inspected	142,874 oxen and cows,	21,603 or 15.1 %	were	tuberculous.
"	518,073 swine,	7,055 or 1.55 %	"	"
"	108,348 calves,	125 or 0.11 %	"	"
"	355,949 sheep,	15 or 0.004 %	"	"

In America.—The extent of tuberculosis in the United States is not definitely known. So far only one State has commenced a systematic attempt at eradicating bovine tuberculosis. Massachusetts is now working upon a large scale and during the present year has tested over 25,000 cattle for tuberculosis. In this work the diagnostic agent has been Tuberculin.

Outside of Massachusetts the tests for tuberculosis have been confined to local herds. In New York State, Law has found some herds with 98 per cent. of the animals tuberculous; while in other herds he found only 5 per cent. tuberculous. To be sure some dairy herds in country districts were found entirely free from tubuculosis.

Reports of tests in Minnesota, Wisconsin, Illinois and Iowa show that many of the herds in the favored country regions of the north-west are infected. In fact, so far as tuberculin tests have been made in every part of the United States no state has been found entirely free of this bovine pest. However, there is no doubt that the older and more densely populated states and cities are more extensively and seriously infected. A few tests have been made

in Virginia, Texas, North Carolina and Alabama, and these are sufficient to determine the fact that we have tuberculosis among our cattle.

The following reply to a letter of inquiry sent out by the department explains itself:

MOBILE, ALA., JUNE 28, 1895.

DR. C. A. CARY, Auburn, Ala.,

MY DEAR SIR:—In reply to your favor of the 25th inst., I beg to inform you that tuberculosis is prevalent among cattle here. I consider the extent alarming enough although I have no idea what the per centage is. Human tuberculosis is also quite prevalent, which is not to be wondered at, since prominent dairy herds are infected. * * * * Yours fraternally,

L. VAN ES, V. S.

The following letter from the Board of Health of the city of Mobile gives their views and present position:

MOBILE, ALA., JULY 16, 1895.

DR. C. A. CARY, Auburn, Ala.,

DEAR SIR—In reply to your favor of the 5th inst., I beg to say: No officer of this board inspects the dairy herds supplying this city with milk. If tuberculosis exists among these herds, knowledge of it is not possessed by this board. No power is possessed to make the tuberculin test, to determine the presence or absence of tuberculosis. At present we could not use the tuberculin if furnished free. It is the intention of the Board of Health to try to have the requisite laws enacted as insure a thorough inspection of milk, and if successful we may have occasion to correspond with you on the subject of tuberculosis.

Yours truly,

JAS. A. ABRAHAMS, M. D., H. O.

Dr. French, of Birmingham, Alabama, has found, by physical and post mortem examinations, tuberculosis in four different dairy herds in and around Birmingham.

By physical and post mortem examination the writer has found tuberculosis in three dairy herds in Alabama.

It is hoped that within another year the writer may have many records of tests, made with tuberculin, that will give more definite and extensive knowledge concerning the prevalence of bovine tuberculosis in Alabama.

HUMAN AND BOVINE TUBERCULOSIS CAUSED BY THE SAME GERM.

The tubercle bacilli found in man are identical in all respects with those that are found in cattle and all other animals with one possible exception—the chicken. At present it is questionable whether tuberculosis in man is identical with tuberculosis in chickens. Koch has found considerable variation in the bacilli from the two different sources. Any of the domestic animals except fowls, when inoculated with living tubercle bacilli from man contract tuberculosis Dogs and cats have become tuberculous by eating the sputa from tuberculous persons. Guinea pigs when forced to inhale air ladened with fine particles of dried tuberculous sputa, or when inoculated with the same material become tuberculous.

Numerous instances are recorded where tuberculous material from cattle has infected other animals.

Pearson, Bollinger, Ernst, Peters, Schroeder and others have produced tuberculosis in guinea pigs, by feeding them milk from tuberculous cows.

At the Experiment Station in Vermont a number of the dairy cows were found by the tuberculin test to have tuberculosis. A litter of five pigs, from healthy parents, had been fed milk from this dairy herd. The five pigs at the time of slaughter were found tuberculous. In every instance where pigs have been fed, any length of time, upon milk containing tubercle bacilli, they have contracted tuberculosis.

Since the discovery of the bacillus tuberculosis, the transmissibility or the contagious and infectious character

of tuberculosis has been proven by numerous accidental or natural and artificial cases of transmission. A few typical cases will be given illustrating the transmissibility from man to animal, from animals to man, from man to man and from animal to animal.

(1) The writer knew a family, of which nearly every member died of tuberculosis. This family's herd of milch cows nearly all died of tuberculosis. The disease first appeared in the family; later in the herd of cattle.

(2) Three Grecian physicians injected tuberculous sputa into the thigh of a fisherman whose death from another disease was inevitable. His lungs previous to the inoculation were sound and his family was free from any taint of tuberculosis. In three weeks his lungs exhibited symptons of disease and at death (38 days after the inoculation) seventeen tubercles were found in his right lung, two in his left and two in his liver.

(3) Tappiener was trying to produce tuberculosis in dogs by forcing them to breathe air, artificially infected with tubercle bacilli. His servant, disbelieving in the danger, persisted in going into the infected inhalation rooms. In fourteen weeks he died from acute tuberculosis; and at the post mortem exhibited the same pathological lesions as those found in the dogs.

(4) A servant, in removing a glass sputum cup broke it and punctured her finger with a splinter of glass. In the course of time it became necessary to amputate that finger, when it was found to be filled with small tubercles.

(5) Dr. Stang, of Amorbach, reports a case, in his practice, of a five year old boy, after an illness of a few weeks, dying of acute miliary tuberculosis. Previous to his sickness he was healthy and well developed, and entirely free from any hereditary tendency to tuberculosis. A short time previous to his death the family cow was killed and found to have a severe case of pulmonary tuberculosis.

(6) Dr. Demme, of Berne, reports that four infants, in the Child's Hospital, died of intestinal and mesenteric tuberculosis. They were free from tuberculous taint, but had been fed on unsterilized milk from tuberculous cows.

(7) Hills and Rich state that a grandson of Henry Ward Beecher died from tuberculous meningitis. The child had no hereditary predisposition. The physician suspected the cows, from which the boy was supplied with milk. The tuberculin test and the post mortem examination showed that the two cows were tuberculous.

(8) Dr. Gage, city physician of Lowell, Mass., reports the case of an infant dying of tubercular meningitis. It had no tuberculous ancestry and had never been fed on anything but unsterilized milk from one cow. This cow's milk was examined microscopically and found to contain tubercle bacilli. Guinea pigs inoculated with the milk died of tuberculosis. A second child of the same family, fed on the same cow's milk was also developing tuberculosis. At that time (1890) the cow could not be condemned and destroyed. Hence, a year later Dr. Gage found this cow furnishing infected milk to the public.

(9) Dr. Treon states that the indians of the northwest eat the uncooked livers, entrails, tallow and other parts of the poor cattle furnished them by the agents of the government. These carcasses are eaten fresh or dried and are rarely, if ever cooked. In many tribes the mortality from tuberculosis is 50 per cent. of all the deaths. At Crow Creek agency 50 out of 1200 indians die annually from tuberculosis. Another authority states that the food of the indians is the primary cause of disease among them, and when the supply of fresh beef is most abundant the death rate from consumption is the greatest.

(10) Dr. E. O. Shakespeare, of Philadelphia, a noted specialist in bacteriology and pathology, says: "It has been found that in infants and young children in some large cities the mortality from some form of tuberculosis is far greater than is generally believed, amounting, in some localities to one-fifth of the deaths in the young. The significant fact in this connection is that it is most frequently some part of the digestive tract that first become affected."

(11) From the report of the English Royal Commission of 1895, the following extract is taken: "There is reason to believe that tuberculous matter, when present in meat sold to the public, is more commonly due to the contamination of the surface of the meat with material derived from other diseased parts than the meat itself. The same matter is found in the milk of course when the udder has become invaded by tuberculous disease, and seldom or never when the udder is not diseased. Tuberculous matter in milk is exceptionally active in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of tuberculosis which man obtains through his food is by means of milk containing tuberculous matter."

(12) The statement is frequently made by medical men and others that since the freedom of the negroes there has been a remarkable increase in the amount of tuberculosis among them. This is said to be due to the bad sanitary condition of their homes; their crowding together in filthy, unclean beds and rooms; the indiscriminate mix-

ing of the tuberculous with the healthy; eating infectious meats and milk; the great degree of looseness in social intercourse; and last, but not least, the constant "giving" and "re-giving" of tuberculous individuals in marriage.

HOW TUBERCLE BACILLI ENTER TISSUES AND ORGANS.

(1). Infection by way of the air passages and the lungs.—This is the most common method of infection. The dried sputa and dried infectious materials that float in the air are liable to be carried into the air passages and lungs. Living rooms, churches, school rooms and public halls where persons expectorate indiscriminately are not infrequently filled with air infected with tubercle bacilli. The dust-ladened air of dairy barns, where infected cattle are kept, is also infected with tubercle bacilli. The dust from handkerchiefs, clothing, beds, bed-clothing of tuberculous persons is nearly always very infectious. The reason that all animals and all men do not become infected is because the germ is a very slow growing organism, and in most instances dies before it gains admission into the tissues of a new host. Furthermore, all animals or all men are not susceptible at all times. Full vigor, great bodily vitality and good health are the strongest fortifications against the entrance of any disease-producing germ into the body.

(2). Infection by way of the Digestive Apparatus.—This mode of infection is a result of carrying the tubercle bacilli into the alimentary canal along with the food, and from there into other parts of the body by way of the lymphatics, blood vessels and possibly by the tissues. This method has been demonstrated experimentally by feeding tuberculous material to pigs, calves, cats, dogs and guinea pigs. Moreover, there have been numerous clinical observations recorded where infants, children and even grown persons have become tuberculous by consuming tuberculous milk or other infected food. Infants, children and young animals (calves and pigs) are more frequently infected by drinking tuberculous milk than in any other way. Whenever the intestines, the mesentery or any of the abdominal organs are the first and

chief seats of tuberculosis, it is evident that infection occurred by way of the alimentary canal. Occasionally the family milch cow becomes tuberculous by eating the waste slops and other materials which come from the house or rooms where tuberculous persons live. The alimentary canal may become the secondary seat of the disease by the animal or person coughing up the infectious material from the lungs to the pharynx or mouth and then swallowing it.

(3). Infection by direct inoculation.—If a terbuculous animal drops infected sputa or saliva upon a freshly abraded surface of a healthy animal infection might occur. Or a diseased animal might lick the freshly abraded surface of another and thus infection could take place. However, infection by this method is extremely rare.

(4). Intra-Ulterine Infection.—The bacilli may pass by way of the uterus and fœtal membranes, or by way of the blood vessels, from the mother to the fœtus. The fœtus or unborn embryo, by tuberculous semen from the sire, or a tuberculous ovum from the dam, may become infected. Recorded cases of infection by this method are extremely rare.

(5). It is also asserted that when the genital organs of either sire or dam are infected, the tuberculous one may transmit the bacilli to the other during copulation.

THE ACTION OF TUBERCLE BACILLI IN THE TISSUES.

After the bacilli gain admission (by any method of infection) to the tissues, they multiply at the point of lodgement and there produce the tubercle. A young tubercle is composed of a collection of cells forming a small grayish nodule and the fresh state presenting the appearance of mother of pearl. Two or more tubercles lying near one another in the lungs, liver, spleen or kidney may unite or become confluent as they continue to develop. Later in the development of the tubercle the central mass becomes "cheesy"—forming a large, soft, yellow, pus-like mass that is sometimes called a yellow tubercle. The growth of the tubercle advances by

the multiplying tubercle bacilli invading the tissues around the tubercle. As a rule extension of the disease from the primary focus takes place by way of the lymphatic vessels and glands—the lymph carrying the germs. In old and severe cases, where a large amount of tissue has been destroyed by the invading germs, the tubercle bacilli may be carried from the primary tubercle to other parts of the body by the current of blood in the blood vessels.

LOCATION OF THE TUBERCLES AS DETERMINED BY POST-MORTEM EXAMINATIONS.

No tissue or part of the body is exempt from the ravages of this disease. Some tissues and organs, by virtue of their structure, use and location, are more exposed to the action of tubercle bacilli, and consequently are more frequently the place of lodgement and growth of these germs than other parts of the body. Other organs appear to possess, by location and function, a comparative immunity and are rarely the seat of tubercles. The most frequently attacked tissues and organs will be given in regular order.

(a) The lungs are most frequently the location of tubercles. When the individual has tuberculosis of the lungs he is said to have consumption or pulmonary tuberculosis. When the lung tissue is first invaded it may be filled with small, hard nodules, which are called miliary tubercles. In exceptional cases these miliary tubercles do not increase in size. As a rule, they increase in size until those near one another unite and form large, soft, yellow, cheesy masses. Unusually a fibrous capsule develops around this mass to protect surrounding tissue and prevent its eruption into the bronchial tubes. Occasionally this yellow tuberculous mass erupts into the bronchial tubes; is coughed up and discharged into the outer world by expectoration. No one part of the lungs is more liable to be involved than the others, and the various stages in the development of tubercles may be seen in one tuberculous lung. The Bureau of Animal industry states that their records show that the large caudal lobes of the lungs were most frequently tuberculous. The

bronchial lymphatic glands that lie along the bronchi, and the mediastinal lymphatics that lie along the surface of the thoracic portion of the œsophagus are usually involved when the lungs are tuberculous.

(b). The pleura or serous membrane, lining the chest or lung cavity and reflected over the lungs, is involved next in frequency to the lungs. This membrane, when tuberculous, is covered or filled with numerous, small pearly tubercles, called by the butchers "grapes." The tubercle bacilli, as a rule, reach the pleura from the lungs, and occasionally the germs come from the abdominal organs by way of the diaphragm.

(c). The mesenteric glands or small lymph glands of the mesentery are nearly always infected when infection takes place by way of the digestive tract. When tuberculous, these glands are enlarged and they may contain cheesy masses if the disease is of long standing. Or there may be minute miliary tubercles in the mesentary. Tubercles may appear in the peritoneum, the membrane lining the abdominal cavity. Sometimes Peyers patches in the small intestines may become tuberculous and occasionally tuberculous ulcers or tubercles may develop in the stomach, and other parts of the alimentary canal.

(d). The liver is not as frequently involved as the mesentery. It is very probable that the bacilli gain admission to the liver by way of the portal circulation from the intestinal tract. In the liver the tubercles may be small grayish bodies or large, yellow cheesy masses.

(e). The spleen and kidneys are rarely involved. As a rule, they are tuberculous when the disease becomes generalized or involves many organs and is widely distributed in the body.

(f). The uterus or womb is very rarely tuberculous. When involved its walls are greatly thickened and the mucous membrane is covered with ulcers and tubercles are numerous in tisues of its walls.

(g). The udder may be tuberculous in comparatively rare instances. When tuberculous, the udder becomes

swollen, hard and knotty. The tubercles are located in the mucous membrane which lines the milk cavities and canals. Abscesses of the udder are rarely tuberculous.

It is possible to have a tuberculous abscess in the udder when the lesions are very severe and extensive. Occasionally the lymphatic glands in front and back of the udder may become enlarged and tuberculous.

(h). The bones are more frequently the seat of tuberculosis in swine than in cattle. The spongy centres of the bodies of the vertebræ of swine may exhibit yellow tubercles after the carcass has been cut into right and left halves. The articulations and bones of the limbs in cattle are sometimes involved in tuberculous alteration. The articulations are quite frequently involved in tuberculous calves.

(i). The pharyngeal (throat) glands are more frequently tuberculous than the udder or bones. These glands lie just back of the pharynix (throat); and when enlarged may sometimes be observed before the death of the animal. At first these glands are slightly enlarged and hard but later, as the disease advances, they become large and soft, owing to the extensive breaking down of tissue and the formation of large cheesy masses. In some cases the post pharyngeal glands are the only ones that are sufficiently involved by tuberculous changes as to be visible to the naked eye upon post mortem examination.

(j). The lymphatic glands at the base of the ear, the lymphatic glands on the inside of the lower jaw, the inguinal lymphatics on either side of the scrotum in the male, and on either side of the udder in the female, the lymphatic glands above and in front of the stifle and those in front of the shoulder blade may be the seat of tuberculous nodules or tubercles.

(k). The brain and spinal cord and the covering membranes of each occasionally become tuberculous.

(l). In extremely rare instances tubercles develop between the muscles. The muscle tissue proper does not present favorable canditions for the development of tubercles.

SYMPTOMS OR SIGNS OF TUBERCULOSIS AS OBSERVED IN LIVING CATTLE.

Tuberculosis may be acute or chronic; the former is rare; the latter is common and lasts for months or years. The physical signs or symptoms in the living animal are extremely variable—depending upon the location, extent and severity of the disease.

If the lungs and air passages are involved there may be, in the early stages, a harsh, dry, rough cough. Violent exertion, excitement, eating dry food or drinking cold water may cause the animal to cough. Sometimes the animal coughs at the beginning of exercise or upon rising after having lain down for some time. Striking the animal over the ribs a sharp rap with the knuckles may arouse the cough. Striking the chest with the knuckles may reveal regions or spots where the sound is muffled or dull instead of being resonant as in health. If the ear be applied to the chest, it may detect a weak, highly pitched whistling sound, made by the air rushing through some partially obstructed bronchial tube. Or, the ear may hear a sound that resembles bubbles of air passing through a thick liquid; this would indicate the presence of a liquid in the bronchial tubes. These last two tests are difficult and the trained expert is often mistaken; because there is such a limited area on the sides of the chest that can be thus inspected and because, in many instances, the area of lung tissue involved may be very small and deeply seated. A physical examination of the lungs in the living animal is satisfactory only in the advanced stages of the disease where the tuberculous animal is poor and the diseased part of the lung is very large. As the disease advances the cough may become more and more aggravated; a discharge from the nose may appear; the hair becomes rough and dry, and is not shed regularly; the skin becomes scurfy and clings closely to underlying tissues. In aggravated cases the animal may become greatly emaciated; yet, in some cases, the animal will remain in good flesh when the lungs are extensively tuberculous.

Respirations may be labored or accelerated according to the advancement and intensity of the disease. The pulse and temperature at times will rise above the normal; but will remain normal most of the time.

If the pleura is involved, the ear applied to the chest may detect friction sounds which are most distinct near the end of inspiration.

In tuberculosis of the stomach, intestines or mesentery, digestion is deranged and irregular. Young animals whose chief food is milk may have tuberculosis of the bowels or mesentery; this is manifest by indigestion, bloating and persistent diarrhœa; it may lead to general tuberculosis, involving the lungs and many other parts of the body. In older animals the appetite is capricious, digestion is impaired; the animal may bloat slightly after meals; have attacks of indigestion, and finally persistent and uncontrolable diarrhœa will appear. In some cases constipation will alternate with periods of diarrhœa or "scouring."

Tuberculosis of the peritoneum is difficult to determine in the living animal.

Tuberculosis of the uterus and ovaries is usually accompanied by sterility and long and frequent periods of heat (nymphomania).

When the udder is tuberculous it is confined usually to one quarter; yet it may involve each quarter. The diseased quarter is hard, insensitive to pressure and does not yield much milk. In rare instances the tuberculous udder may contain an abscess. Sometimes the cheesy or yellow tubercles erupt into the milk cavities and canals; thus the bacilli become mixed with the milk. Infrequently the submaxillary glands enlarge, soften, erupt and discharge a cheesy yellowish matter. This might be mistaken for actinomycosis.

The surface lymphatic glands at the base of the ear, in front of the shoulder, in front and behind the udder, in the groins, in front of, and above, the stifle, may be detected at first as hard nodular swellings; in the later stages as large soft swellings.

Bones and articulations are at first swollen and hard. Bones may later become soft, and if close to the skin, may be opened for an abscess.

When the brain, the spinal cord and their coverings are tuberculous the animal shows more or less signs of paralysis or mental derangement. In a brief time general stupidity, paralysis or convulsions may occur.

DIAGNOSIS.

How to Recognize Tuberculosis.

The physical signs or symptoms peviously mentioned may enable the veterinarian to recognize tuberculosis in well marked cases, but there are many dangerous and badly infected cases that can not be recognized by the veterinarian if he bases his diagnosis upon physical signs alone. The United States Veterinary Medical Association at their last meeting declared that tuberculosis in cattle could not, in many cases, be determined by physical examination alone. Besides the symptoms given we have the following aids to assist in making a more accurate diagnosis:

(1). Microscopical examination of the nasal discharge, of the saliva, of the milk and of the tubercles that erupt on the surface or that may be surgically removed from the skin or superficial tissues of the body.

(2). Inoculating susceptible animals with any of the liquids or materials mentioned in (1).

(3). The Tuberculin Test.

The first two of these methods are very tedious and difficult, and in many instances entirely without definite results.

The tubercle bacilli are rarely found in the milk in sufficient numbers to admit of their detection by the use of the microscope. It is only in very severe cases that the tubercle bacilli can readily be detected in the milk. Some claim that the udder or milk glands must be tuberculous before bacilli are in quantities sufficient for easy and accurate microscopic detection. Inoculating susceptible animals (guinea pigs,

rabbits, etc.,) with the milk would require twenty to thirty days for the disease to develop, and the small quantity of milk used for the inoculation might not contain tubercle bacilli. The nasal discharge and the saliva of cattle do not contain tubercle bacilli unless there be erupting tubercles in the lungs or somewhere along the air passages; furthermore, the tuberculous material, coughed up from the lungs, may be swallowed when it reaches the pharynx (throat). In all cases where the lungs and air passages are not tuberculous the nasal discharge and saliva contain no tubercle bacilli. Hence, microscopical examinations, or inoculations with these materials will be of value only in a limited number of cases.

Feeding the milk of a tuberculous cow to a pig or calf may develop tuberculosis in the latter in three to six months.

Tuberculin Test.

The Tuberculin Test comes the nearest being a perfect diagnostic agent for determining the presence or absence of tuberculosis among cattle. Tuberculin is a material that was discovered by Dr. Koch; it is a condensed filtrate that is made from sterilized bouillon cultures of tubercle bacilli. In 1890, Koch gave tuberculin to the medical world as a prospective remedy for tuberculosis. For two or three years it was extensively used as a curative agent, but it gradually grew into disuse because it did not meet with the success that was anticipated. During this extensive use of tuberculin in the human family, physicians observed that it uniformly produced a fever or an elevation of the temperature in a certain number of hours after its administration to tuberculous persons. This fact led veterinarians to try it as a diagnostic agent in detecting tuberculosis in cattle.

If a sufficient quantity of tuberculin be injected beneath the skin of a tuberculous animal, its temperature will rise one and one-half to four or more degrees Fah. above the normal in eight to eighteen hours after the injection. This rise of temperature is known as the "reaction" in the tuberculin test. Before injecting an animal its nor-

mal temperature must be determined. To obtain the normal take the temperature of the animals to be tested every two hours beginning at 6 a. m. and continuing until 6, 8 or 10 p. m. When time is important and many cases are to be tested, the temperature may be taken every three hours during the day. In no case where the temperature runs to or above 102 degrees Fah. from morning till evening should the animal be injected; since it already has fever and the characteristic reaction will not always appear. It should be remembered that the normal temperature, as a rule, reaches its maximum in the evening and only in very rare instances in the morning.

After getting the temperatures during the day, at 6, 8 or 10 p. m. the animals may be injected with tuberculin. If the tuberculin, made by the Bureau of Animal Industry, is used, 2 c. c. (one-half fluid drachm) is hypodermically injected into each animal weighing 1,000 lbs.; for bulls and animals weighing over 1,000 lbs. 3 c. c. is injected into each; for yearlings and small two-year olds use one and one-half c. c.; for calves 1 c. c. may be used. If Koch's or Pasteur's tuberculin is used, .25 c. c. is injected into each animal weighing 1,000 lbs.; this must first be diluted with a one per cent. solution of carbolic acid to a strength of ten per cent. This may be conveniently done by pouring 5 c. c. of Koch's or Pastuer's tuberculin into a perfectly clean glass vessel and adding thereto 19 drachms of a one per cent. solution of carbolic acid. (In making the one per cent. carbolic acid solution always use boiled distilled or filtered water.) Each drachm of this solution will then contain a dose for an animal weighing 1,000 lbs.; 1½ drachms for a bull or larger animal; ¾ of a drachm for 1 and 2 year olds and ½ drachm for calves.

The hypodermic syringe should be thoroughly disinfected and have a capacity of one to two drachms. Inject the tuberculin under the skin on the side of the neck or over the shoulder.

The morning following the injection begin to take the

temperatures at 6 o'clock and continue at regular periods of every two or three hours until six or eight in the evening.

It is important that a good thermometer be used and that it be held in the rectum, at least five minutes. The six inch Hicks'thermometer is very well adapted to this test. An eight inch thermometer would be better.

If within eight to eighteen hours after the injection of the tuberculin, the temperature rises 1½ or more degrees, Fah., above the normal, for two or more successive readings the reaction is characteristic and the animal is tuberculous. But if the temperature rises at one reading, drops to the normal at the next two readings, then rises at the next reading, this reaction ("double curve") is not characteristic—not positive that the animal is tuberculous. Such an animal should be re-tested in three to six months.

The animals should be kept in their stalls under the same conditions each day during the test; the same quantity of water and food should be given at the same time each day; abrubt changes of temperature in the barn should be avoided. The temperature of cows in heat or in the advanced stages of pregnancy are usually above the normal and they should not be tested at such times. Animals that have been greatly exhausted by excitement or by shipment on cars or boats should be kept isolated in a quiet place for, at least, one week before they are tested.

All animals that give slight or indefinite reactions should be isolated for three to six months and then retested. Sometimes the reaction is accompanied by an acceleration of pulse and respirations and may be followed by a brief attack of diarrhœa and a slight decrease in the flow of milk. But as a rule there are no bad results following the reaction.

THE ACCURACY OF THE TUBERCULIN TEST.

Out of 4,068 animals tested in various parts of the United States by different persons and by the various kinds or forms of tuberculin, 1,137 reacted and 1,118 exhibitted undoubted tuberculous lesions upon post mortem examination; in 19 of these that reacted, the naked eye failed to find any visi-

ble tubercular lesions; the microscope was not used and possibly the post mortem examinations were not as thorough and complete as they might have been. Admitting that the 19 cases were not tuberculous this would be less than one error in 500 tests. In Massachusetts, the cattle commissioners have tested over 25,000 cattle and they have found the tuberculin test to fail in one out of every 400 cases tested. No diagnostic method can show a better record, and no other method can detect 75 per cent. of the cases of tuberculosis in 25,000 cattle.

Last year the Inter-National Congress of Veterinarians adopted the following committee report:

"The committee are agreed that tuberculin is a very valuable assistant in the discovery of tuberculosis. The occasional failures for which it is responsible are without practical significance." (Nocard, Bang and Hess.)

The Massachusetts Board of Cattle Commissioners have tested more animals than the United States government and all the other States. They testify as follows:

"First. That tuberculin is a reliable agent for determining tuberculosis in cattle.

"Second. That tuberclin, properly prepared and carefully handled, can have no injurious effects upon healthy cattle.

"Third. That it is the only known means whereby a positive diagnosis can be made in the early stages of the disease."

PREVENTATIVE MEASURES THAT MAY BE ADOPTED BY THE STOCK-OWNER.

The following is taken from Dr. Law's Bulletin:

"If he will the stockowner can extirpate this disease from his herd and thereafter keep the herd from such contamination. The following are the main precautions necessary to this end:

1st. Board up the partitions of the stalls at the front so that no two cows can feed from the same manger nor lick each other.

2d. Keep each animal strictly by its own stall and manger.

3d. When any animal is suspected do not let it use a drinking trough or bucket in common with other animals.

4th. Avoid old milch cows and unthrifty ones or keep them secluded from the rest of the herd.

5th. The following conformation usually indicates a weakness of constitution and a susceptibility to tuberculosis: Head narrow between the horns, sunken eyes, thin and narrow ewe neck, chest small and lacking in both depth and breadth, hollow flanks and tendency to pot belly, a general lack of muscle so that the limbs seem loosely attached to the body, in breeds that show a variety of colors, animals of the lighter shades of brown and yellow. If, however, such animals are of high value for the dairy and can be kept free from infection, they need not be rejected. The finest conformations of short horns, Devons, Holsteins, black or red polled furnish no protection in the presence of the germ.

6th. Don't purchase from a herd in which tuberculosis has appeared, or in which cattle have died or been killed within a year or two. Resort first to tuberculin.

7th. Don't take a cow with a husky or rattling cough; wheezing, hurried breathing; discharge from the nose; fœtid breath; hard bunches under the skin; diseased udder; swollen bones or joints; unthrifty or a tendency to scour or bloat.

8th. Don't purchase from city suburban or swill stables.

9th. Don't add newly purchased cattle to your herd until you have tested them with tuberculin, especially if they are the product of in breeding.

10th. Don't admit strange cattle to house, field or yard with your own; keep them apart until tested with tuberculin.

11th. In case of disease or unthriftiness in your herd put the animal apart and have it examined by a skillful veterinarian.

12th. In case one animal in the herd shows tuberculosis, test the whole herd with tuberculin.

13th. Test in the same manner all animals on the farm

(swine, goats, sheep, horses, rabbits, cats, dogs, fowls), that co-habit with the cattle.

14th. Kill all tuberculous animals and boil, burn, dissolve with acids, or bury deeply in a place to which no animals have access.

15th. Disinfect premises thoroughly, also all products of diseased animals and all articles used by them.

16th. Let no consumptive person attend on cattle or other live stock or prepare their food.

17th. Vermin (rats, mice, sparrows) in a building, where tuberculous animals have been, should be exterminated."

HOW TO DISINFECT.

(1). Remove all loose materials from the mangers and stalls and burn such as are of no value.

(2). Thoroughly cleanse the stalls. If the floor be dirt remove at least three inches of it and replace it with fresh dirt after the disinfection.

(3). When the walls, floors, ceilings, etc., become dry, spray them with a corrosive sublimate solution (1 to 1,000), a two per cent. carbolic acid solution, or a two per cent. creolin solution. A fruit tree spray is best for this purpose.

(4). Close the windows and doors and fumigate the barn by burning two or three pounds of sulphur in kettles containing hot coals.

(5). After fumigation open the windows and doors and flood the barn with sunlight and air. It is the dry air and sunlight that disinfects pastures and other outdoor places.

DUTIES OF THE CITIES AND THE STATE.

What should our larger cities and the State do toward exterminating tuberculosis among domestic animals and prevent its extension in the human family?

The cities should pass ordinances requiring all the dairy herds that supply dairy products to the inhabitants of their respective cities to be tested with tuberculin twice annually, and forbid the use of tuberculous cows in such herds. All tuberculous animals should be destroyed and deeply buried or cremated.

The cities should also require that all animals killed for local consumption be tested with tuberculin. Furthermore, each city should have a city meat and milk inspector, whose duty shall be to test the dairy herds and all beef cattle with tuberculin and inspect all carcasses at the slaughter houses and market places.

The inspector should be a graduate veterinarian who has had special instruction in milk and meat inspection. This work could be done under the supervision of the City Board of Health.

The State laws necessary for the control and eradication of tuberculosis among domestic animals and to decrease human mortaliy from tuberculosis, are briefly suggested as follows:

1st. Alabama should provide for a State Veterinarian and several local assistant State Veterinarians. Said veterinarians should investigate all contagious and infectious diseases among domestic animals; inspect or superintend the inspection of all dairy herds and all animals slaughtered for human food not inspected by city or government inspectors. The State Veterinarian could be an *ex officio* member of the State Board of Health, or work under the supervision of that Board. Said veterinarians should receive pay for time spent in actual service for the State.

2d. Public Slaughter Houses should be established and all animals should be slaughtered at these places.

3d. The State should provide means for carrying on this work, and, also, to pay a small indemnity for animals condemned by the State.

This could be done by levying a small special tax upon all the domestic animals of the State. The protection given to both animals and man and the increase in value of the animals would more than compensate the owner of stock for the small tax.

The following are some of the suggestions made by City and State Boards of Health in various parts of the United States for the prevention and eradication of tuberculosis in the human family:

(1) Sterilize all milk, especially that given to infants and children. (See Bulletin 53).

(2) Thoroughly cook all meats before eating them.

(3) Completely sterilize all drinking water.

(4) Never employ consumptive (tuberculous) persons as cooks, house servants, or to milk or care for dairy cattle or to clerk in stores or handle eatables of any kind. Such persons better work in the open fields.

(5) Never visit improperly kept quarters or living rooms of consumptives, and in no case allow children to play with consumptives or visit their rooms.

(6) Consumptive persons should not teach school.

(7) Children or any one having consumption should not attend public schools or public gatherings in closed rooms.

(8) Consumptives should not marry.

(9) A person having consumption should occupy a room by himself; keep it as clean as possible; never use carpets or rugs; never expectorate upon the floor; always expectorate into cuspidors containing a solution of corrosive sublimate, 7 grains to one pint of water, or upon cloths that can be immediately burned.

(10) Consumptives should never kiss any one—especially children or babies. In fact, many physicians regard mouth to mouth kissing as filthy and as occasionally dangerous, because many diseases are thus communicated from the diseased to the healthy.

(11) Buildings, rooms, sleeping cars, berths and beds occupied by consumptives should be completely disinfected before being occupied by healthy persons.

(12) "Do not fail to wash thoroughly the eating utensils of a person who has consumption as soon after eating as possible, using boiling water for the purpose."

(13) A consumptive's unwashed clothing should never be kept, or washed with similar clothing of other persons. Such clothing should be boiled for at least one hour, or otherwise disinfected before being washed or during the process of washing.

(14) "The bowel discharges of consumptive persons with diarrhœa should be caught in a vessel containing corrosive sublimate seven grains to water one pint."

(15) "Do not fail to consult the family physician regarding the social relations of persons suspected of having consumption."

(16) Tuberculous parents can not be too careful lest they transmit the tubercle bacilli to their children. It is best to give sterilized cow's milk to infants having tuberculous mothers.

(17) Physicians and dentists having consumption should not practice or follow their respective professions.

(18.) Dogs and cats should not be permitted in rooms where consumptives live. If so kept, they should not be allowed to play with children or pass into other rooms or houses. Pets suspected of having consumption should be destroyed.

(19.) The State, counties or cities should provide houses for indigent tuberculous persons or public hospitals where consumptives could be isolated and treated.

The above preventative suggestions may seem to be extreme, but some of them are enforced in some of the largest cities in the United States. As soon as the people become aware of the necessity of State, city and government control of tuberculosis in all forms and conditions it is probable that many of these measures and others more severe will be enforced.

It is to be hoped that opportunity will be given this department to test dairy herds in various parts of this State. In fact, we will test a limited number of herds of cattle and attempt to furnish tuberculin free to those who will secure the services of a graduate veterinarian to make the test. Any one desiring further information upon this subject will please address the Station Veterinarian.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

BOVINE TUBERCULOSIS.

C. A. CARY, Veterinarian.

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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.

BOVINE TUBERCULOSIS, [1]

BY

C. A. CARY.

The history of medicine informs us that Hippocrates (400 B. C.) described many of the characteristic symptoms and lesions of tuberculosis in man and animals. During the middle ages tuberculosis in animals was considered contagious and the flesh of infected carcasses was condemned by law as unfit for human food. Many of those old laws are still in force in Italy and Spain (Law).

During the first eight decades of this century the common and accepted theory was that tuberculosis was hereditary and this was its chief, and possibly only, method of transmission.

In fact, the history of tuberculosis has been checkered by numerous and various theories, because the exciting or essential cause remained unknown until 1882, when Robert Koch discovered the *bacillus tuberculosis.*

No other disease is so widely distributed geographically; it is found in all climates and in all lands. It attacks man and nearly all the domestic animals. It accompanies the progress of civilization and seems to be most active during the transitional stage from savagery or barbarism to civilization. Artificial modes of living, without intelligent and scrupulous sanitation, fosters and increases its virulency and frequency.

Tuberculosis annually claims more victims than smallpox, cholera and yellow fever. An average of 14 per cent.

(1) The term Tuberculosis embraces all forms of disease caused by the *bacillus tuberculosis,* namely: consumption (tuberculosis of the lungs), tubercular meningitis, tubercular peritonitis (pearl disease), scrofula, consumption of the bowels, lupus (tuberculosis of the skin) and, in fact, tuberculosis of any part of the body.

(one out of every seven) of all the deaths in the human family is due to tuberculosis [1]. In some of the largest cities and in some of the older and most densely populated countries the average per cent. is 25 (1 death in every 4 a result of tuberculosis).

It is said that the civilizing (?) influences, as applied to the American Indian, have increased the mortality to 50 per cent.—one-half of all the deaths result from some form of tuberculosis (Law).

In Alabama during the years 1889–90–91–92–93, the annual average number of deaths from tuberculosis was 1009; or 11.44 per cent. (1 in every 9) was due to tuberculosis (2).

The annual average among the white people is 373, or 4.23 per cent. of all the deaths; the yearly average among the blacks is 636, or 7.21 per cent. of all the deaths. This indicates that the superior intelligence of the white people with their better observance of the laws of health tends toward decreasing the ravages of this disease. The ignorance of the negro with his disregard of the laws of hygiene

(1) One authority claims that 20 per cent. of all the deaths in the United States (1 out of every five deaths) is due to tuberculosis.

2. Total No. of deaths in Alabama in 1889–90–91–92–93, was 44,096 The No. of deaths from tuberculosis during the same time, was:

Total.	Annual Average.	White.	Black.	Male.	Female.
5048	1009	1867	3181	2106	2942

These records were derived from Dr. Cochran's annual reports to the State Board of Health. Dr. Cochran informs me that these reports are accurate for the cities, but they are more or less incomplete from country districts.

It is very probable that the reports of deaths among the white people are more complete and accurate than those from the black race. It is also very probable that the number of deaths from tuberculosis among the negroes is greater than the reports show; because many deaths are not reported, that occur in localities where the inhabitants are nearly all black.

propogates tuberculosis at a frightful rate. During slavery times the negro was as free from tuberculosis as were the white people at that time.

The constant and uniform appearance of deaths from tuberculosis are accepted by the people as inevitable. This constant contact breeds a tolerance which merges into an indifferent fatalism that is more becoming to the ignorance and superstition of the heathen than the intelligent and highly civilized American or European. We legislate, quarantine and use all the methods known to expert medical men, when cholera, yellow fever or small-pox enters or threatens to enter, our country or State. Yet only a few States legally recognize tuberculosis as an infectious disease that annually destroys more lives than all of the three frightful diseases just mentioned.

"If we take the whole civilized world and compare with the tuberculous mortality all the accumulated deaths from war, famine, plague, cholera, yellow fever and small-pox, we find that the latter are comparatively insignificant. Yet tuberculosis like every other germ disease is absolutely preventable and is allowed to continue its career of death because of reprehensible ignorance and criminal indifference" (Law).

THE EXCITING OR ORIGINATING CAUSE OF TUBERCULOSIS.

Since Koch's discovery of the bacillus tuberculosis, the study of this disease has been thorough and systematic. It is now a well established fact that tuberculosis can not exist without the presence of the living tubercle bacillus. This microbe or germ is a one-celled plant, having the shape of a very delicate rod, about 1-2500 of an inch long and about 1-10 as broad as long. This rod is usually almost straight but may be slightly curved. It may appear alone, in pairs, or in irregular groups or masses. It absorbs coloring matters (stains) very slowly; but when once stained it holds the stain with great tenacity. It will hold certain stains when all or nearly all other germs become discolorized.

This enables the pathologist to distinguish it amid myriads of other germs. The bacillus tuberculosis is a plant parasite that lives in the animal body, but it may be cultivated on artificial culture media, such as: agar agar or bouillon containing 5 per cent. of glycerine, and blood serum. It develops best at 100 to 102 degrees Fah. This germ may also live and retain its vitality outside of the animal body for an indefinite time; its length of life out of the body will depend upon heat, light, moisture and the material in which it exists. Koch and other observers have found that in many instances the tubercle bacillus has retained its vitality for nine or ten months in the sputa or expectorations of tuberculous persons. However, it is very probable that this germ does not grow or multiply outside of the animal body.

Many authorities (Baumgarten, etc.,) claim that the gastric juice will not destroy the tubercle bacillus. If infected sputa be kept at a temperature of 158° Fah. for ten minutes the tubercle bacilli are destroyed. The germ in the same material is destroyed in 20 hours if 3 per cent. of carbolic acid is added; the germ perishes in five minutes in iodoform-ether; it dies in ten minutes in a mercuric chloride solution (1 to 1,000). According to Koch the tubercle bacillus perishes in a few hours in direct sunlight, and in five to seven days in diffuse daylight. This germ may remain virulent in ordinary living rooms from two to ten months, varying with the light, heat and the frequency of disinfection or cleansing of the room. An absolute heat of 158 degrees Fah. for fifteen minutes in meat and other tuberculous masses, will kill the germs. Boiling for one-half hour is always fatal to the tubercle bacilli. In springs, wells and all forms of surface water, at ordinary temperature, the tubercle bacilli may maintain their virulency indefinitely. Non-sterilized water from rivers and surface wells may be contaminated; likewise public drinking troughs. Freezing will not destroy the tubercle bacillus. Fermentation and decomposition of organic materials, in which tubercle ba-

cilli are present, will not always destroy them. Common salt liberally applied to meats is fatal to the germ in one month; but in large masses of meat, the salt may not permeate the mass evenly and many bacilli may thus escape the destructive action of the salt.

In truth, there are probably many conditions outside of the animal body in which the tubercle bacillus may live and retain its virulency that are yet unknown to pathologists. However, it is certain that poorly ventilated and dark living rooms, public halls, school rooms and churches are places where the infected sputa may be slowly dried, thus preserving its infective power indefinitely. Hence, the dust from such rooms may carry the virulent germs into the air passages, and into the alimentary canal with the food. In fact the greatest number of cases of tuberculosis in the human family are contracted by breathing tuberculous dust in living rooms, churches, school rooms and public places. The next greatest number of cases of tuberculosis are contracted by eating tuberculous food.

ACCESSORY OR PREDISPOSING CAUSES OF TUBERCULOSIS.

Predisposing causes consist of influences or factors that reduce the animal vigor and the resisting power of the leucocytes and tissues of the animal body, and of conditions which favor the introduction of the germs into the body.

(1). Heredity produces a tendency in the cell structure of the body favorable to the development of the germ and depressing more or less the body vitality or vigor. The offspring of tuberculous parents readily contracts tuberculosis, because the protecting liquids and cells of the body can not prevent the invasion of the tubercle bacilli. In rare instances the bacilli pass into the embryo or unborn fœtus. Some authorities claim that the germ may pass from a tuberculous sire in the semen, or it may be in the ovum from the dam, or pass from the mother to the fœtus by way of the fœtal membranes.

Evidently the continued breeding of tuberculous animals

produces a weak family; and weakness of body, whether of tuberculosis origin or not, predisposes the offspring to tuberculosis.

(2). The modern method of breeding the cow as a milk-producing machine is developing a constitutional weakness in many individuals of the milk-producing families. Furthermore, experience has proven that a cow which is kept in a small stall without exercise will give more milk with a given quantity of food, than one which is given plenty of exercise in a lot or field, with the same quantity of food. Of course, such close confinement reduces the vigor of the cow and predisposes her to tuberculosis. This doctrine of close, warm, continual confinement is occasionally preached and practiced by dairymen and sometimes it is taught by instructors in agricultural colleges. Dairy cows as well as beef cattle should have exercise in open air. Exercise and fresh air will not prevent all cases of tuberculosis, but they certainly help to prevent the contraction or spreading of tuberculosis.

(3). *Ventilation and Light.*—Poorly ventilated and dark stalls are, in many respects, worse than continual out-door exposure. Light is one of nature's best disinfectants, and moving air carries away foul gases and brings fresh, pure air. The drainage of stalls should be so arranged that they may be kept dry and clean.

(4). Climate, in a degree, influences the propagation and development of tuberculosis. A moist and variable climate favors the development and transmission of tuberculosis. Dry and rarified air with a uniform temperature tends to decrease its ravages.

(5). *Food and Feeding*—Too heavy or forced feeding may weaken the animal as well as a deficiency in the quantity of food. The proper quantity and the best quality of food should be given. Food should not only be nutritious and digestible, but should also be given at regular intervals in proper quantities. Too much food overtaxes the digestive

organs and decreases the vitality of the animal, and eventually produces acute or chronic indigestion.

(6). *Faulty Breeding*—In-and-in breeding or the mating of closely related individuals is always to be regarded as unsafe. It may bring out the weak or the bad points which may predominate over those that were strong and good in the sire and dam. Breeders who have developed distinct breeds recognize the fact that continued in-and-in breeding is very liable to produce an outcrop of tuberculosis.

Early and frequent breeding produce a decrease in bodily vigor and should be avoided.

Intensive breeding, or the pairing of animals from two great milking strains, may result in an offspring that is weak, poorly developed and predisposed to tuberculosis.

Animals with thin flat chests and long legs are predisposed to tuberculosis by conformation and should not be used for breeding purposes.

Animals having tuberculosis should never be bred.

(7). Disease, exposure to cold and rain and any influence which depresses the vitality or physical vigor of an animal, predisposes it to tuberculosis.

It should not be understood that any or all of these predisposing or preparing causes will produce tuberculosis without the presence of the bacillus tuberculosis. Neither should it be taken as self-evident that the absence of any or all of these predisposing causes will always prevent the spread of tuberculosis or the contraction of it. Dr. Niles of Iowa reports the appearance of tuberculosis in a herd that had been kept in the best out-door conditions.

TUBERCULOSIS AMONG THE VARIOUS SPECIES OF DOMESTIC ANIMALS AND IN MAN.

There appears to be a constant relation between the prevalence of this disease in man and in domestic animals. In a state or locality where tuberculosis is very common in the human family, it is also very frequently observed among the more susceptible of domestic animals. Cattle and swine

are more susceptible to the disease than the other domestic animals; however, sheep, horses, dogs and cats occasionally become infected. Many of the wild animals when caged succumb to this disease. Caged monkeys, lions, tigers, deer, elk, kangaroos, antelope and birds have been known to die of tuberculosis. Rats and mice are susceptible and instances have been recorded where they have contracted tuberculosis in houses that were inhabited by tuberlous persons. Guinea pigs and rabbits are very susceptible.

ITS PREVALENCE IN CATTLE.

In Europe.—According to Arloing 0.5 per cent. of the cattle of France are tuberculous; in Paris, 6 per cent.; in Baden, Germany, 0.2 per cent.; in the province of Bavaria, 0.225 per cent.; in Belgium, 0.4 per cent.; in Holland, 20 per cent.; in Leipsic 20 per cent.; in Edinburgh 26 per cent.

The above per centages (from Law's bulletin) shows how tuberculosis in cattle varies in the thickly populated cities and countries of Europe. It will be observed that the cattle of the cities are more frequently tuberculous than the cattle of the country(1). In some local herds of Europe 75 per cent. have been found to be tuberculous. According to the records in the slaughter houses of Germany cows are more frequently tuberculous than oxen or calves. In fact,

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1. It is interesting to note in this connection the following valuable table prepared by Dr. Lagnaeu, showing the gradual increase of tuberculosis when the smaller cities are compared with the larger. These tables were made from the records of 662 cities in France:

95	cities with less than	5,000	inhabitants		1.81
332	cities of between	5,000 and	10,000	inhabitants	2.16
127	" "	10,000 and	20,000	"	2.71
50	" "	20,000 and	30,000	"	2.88
46	" "	30,000 and	100,000	"	3.05
11	" "	100,000 and	430,000	"	3.65
Paris with 2,224,704 inhabitants					4.91

The above table shows the number of persons who die annually from tuberculosis of the lungs (consumption) to every 1,000 inhabitants in cities of different population. The table does not take into comparison any of the other forms of tuberculosis.

almost, one-half of the cases of tuberculosis in cattle are found in cows. This is due to the fact that the cow comes in closer contact with man and has less freedom, less pure air and receives more infected food than calves or oxen.

In the Copenhagen slaughter houses from 1891 to 1893 inclusive, the following records were made:

Inspected	132,294 oxen and cows,	23,305 or 17.7 %	were	tuberculous.
"	8,292 swine,	1,272 or 15.3 %	"	"
"	185,765 calves,	369 or 0.2 %	"	"
"	337,014 sheep,	1 or 1.0003 %	"	"

At the Berlin public slaughter house during 1892, the following records were made:

Inspected	142,874 oxen and cows,	21,603 or 15.1 %	were	tuberculous.
"	518,073 swine,	7,055 or 1.55 %	"	"
"	108,348 calves,	125 or 0.11 %	"	"
"	355,949 sheep,	15 or 0.004 %	"	"

In America.—The extent of tuberculosis in the United States is not definitely known. So far only one State has commenced a systematic attempt at eradicating bovine tuberculosis. Massachusetts is now working upon a large scale and during the present year has tested over 25,000 cattle for tuberculosis. In this work the diagnostic agent has been Tuberculin.

Outside of Massachusetts the tests for tuberculosis have been confined to local herds. In New York State, Law has found some herds with 98 per cent. of the animals tuberculous; while in other herds he found only 5 per cent. tuberculous. To be sure some dairy herds in country districts were found entirely free from tubuculosis.

Reports of tests in Minnesota, Wisconsin, Illinois and Iowa show that many of the herds in the favored country regions of the north-west are infected. In fact, so far as tuberculin tests have been made in every part of the United States no state has been found entirely free of this bovine pest. However, there is no doubt that the older and more densely populated states and cities are more extensively and seriously infected. A few tests have been made

in Virginia, Texas, North Carolina and Alabama, and these are sufficient to determine the fact that we have tuberculosis among our cattle.

The following reply to a letter of inquiry sent out by the department explains itself:

MOBILE, ALA., JUNE 28, 1895.

DR. C. A. CARY, Auburn, Ala.,

MY DEAR SIR:—In reply to your favor of the 25th inst., I beg to inform you that tuberculosis is prevalent among cattle here. I consider the extent alarming enough although I have no idea what the per centage is. Human tuberculosis is also quite prevalent, which is not to be wondered at, since prominent dairy herds are infected. * * * *

Yours fraternally,

L. VAN ES, V. S.

The following letter from the Board of Health of the city of Mobile gives their views and present position:

MOBILE, ALA., JULY 16, 1895.

DR. C. A. CARY, Auburn, Ala.,

DEAR SIR—In reply to your favor of the 5th inst., I beg to say: No officer of this board inspects the dairy herds supplying this city with milk. If tuberculosis exists among these herds, knowledge of it is not possessed by this board. No power is possessed to make the tuberculin test, to determine the presence or absence of tuberculosis. At present we could not use the tuberculin if furnished free. It is the intention of the Board of Health to try to have the requisite laws enacted as insure a thorough inspection of milk, and if successful we may have occasion to correspond with you on the subject of tuberculosis.

Yours truly,

JAS. A. ABRAHAMS, M. D., H. O.

Dr. French, of Birmingham, Alabama, has found, by physical and post mortem examinations, tuberculosis in four different dairy herds in and around Birmingham.

By physical and post mortem examination the writer has found tuberculosis in three dairy herds in Alabama.

It is hoped that within another year the writer may have many records of tests, made with tuberculin, that will give more definite and extensive knowledge concerning the prevalence of bovine tuberculosis in Alabama.

HUMAN AND BOVINE TUBERCULOSIS CAUSED BY THE SAME GERM.

The tubercle bacilli found in man are identical in all respects with those that are found in cattle and all other animals with one possible exception—the chicken. At present it is questionable whether tuberculosis in man is identical with tuberculosis in chickens. Koch has found considerable variation in the bacilli from the two different sources. Any of the domestic animals except fowls, when inoculated with living tubercle bacilli from man contract tuberculosis Dogs and cats have become tuberculous by eating the sputa from tuberculous persons. Guinea pigs when forced to inhale air ladened with fine particles of dried tuberculous sputa, or when inoculated with the same material become tuberculous.

Numerous instances are recorded where tuberculous material from cattle has infected other animals.

Pearson, Bollinger, Ernst, Peters, Schroeder and others have produced tuberculosis in guinea pigs, by feeding them milk from tuberculous cows.

At the Experiment Station in Vermont a number of the dairy cows were found by the tuberculin test to have tuberculosis. A litter of five pigs, from healthy parents, had been fed milk from this dairy herd. The five pigs at the time of slaughter were found tuberculous. In every instance where pigs have been fed, any length of time, upon milk containing tubercle bacilli, they have contracted tuberculosis.

Since the discovery of the bacillus tuberculosis, the transmissibility or the contagious and infectious character

of tuberculosis has been proven by numerous accidental or natural and artificial cases of transmission. A few typical cases will be given illustrating the transmissibility from man to animal, from animals to man, from man to man and from animal to animal.

(1) The writer knew a family, of which nearly every member died of tuberculosis. This family's herd of milch cows nearly all died of tuberculosis. The disease first appeared in the family; later in the herd of cattle.

(2) Three Grecian physicians injected tuberculous sputa into the thigh of a fisherman whose death from another disease was inevitable. His lungs previous to the inoculation were sound and his family was free from any taint of tuberculosis. In three weeks his lungs exhibited symptons of disease and at death (38 days after the inoculation) seventeen tubercles were found in his right lung, two in his left and two in his liver.

(3) Tappiener was trying to produce tuberculosis in dogs by forcing them to breathe air, artificially infected with tubercle bacilli. His servant, disbelieving in the danger, persisted in going into the infected inhalation rooms. In fourteen weeks he died from acute tuberculosis; and at the post mortem exhibited the same pathological lesions as those found in the dogs.

(4) A servant, in removing a glass sputum cup broke it and punctured her finger with a splinter of glass. In the course of time it became necessary to amputate that finger, when it was found to be filled with small tubercles.

(5) Dr. Stang, of Amorbach, reports a case, in his practice, of a five year old boy, after an illness of a few weeks, dying of acute miliary tuberculosis. Previous to his sickness he was healthy and well developed, and entirely free from any hereditary tendency to tuberculosis. A short time previous to his death the family cow was killed and found to have a severe case of pulmonary tuberculosis.

(6) Dr. Demme, of Berne, reports that four infants, in the Child's Hospital, died of intestinal and mesenteric tuberculosis. They were free from tuberculous taint, but had been fed on unsterilized milk from tuberculous cows.

(7) Hills and Rich state that a grandson of Henry Ward Beecher died from tuberculous meningitis. The child had no hereditary predisposition. The physician suspected the cows, from which the boy was supplied with milk. The tuberculin test and the post mortem examination showed that the two cows were tuberculous.

(8) Dr. Gage, city physician of Lowell, Mass., reports the case of an infant dying of tubercular meningitis. It had no tuberculous ancestry and had never been fed on anything but unsterilized milk from one cow. This cow's milk was examined microscopically and found to contain tubercle bacilli. Guinea pigs inoculated with the milk died of tuberculosis. A second child of the same family, fed on the same cow's milk was also developing tuberculosis. At that time (1890) the cow could not be condemned and destroyed. Hence, a year later Dr. Gage found this cow furnishing infected milk to the public.

(9) Dr. Treon states that the indians of the northwest eat the uncooked livers, entrails, tallow and other parts of the poor cattle furnished them by the agents of the government. These carcasses are eaten fresh or dried and are rarely, if ever cooked. In many tribes the mortality from tuberculosis is 50 per cent. of all the deaths. At Crow Creek agency 50 out of 1200 indians die annually from tuberculosis. Another authority states that the food of the indians is the primary cause of disease among them, and when the supply of fresh beef is most abundant the death rate from consumption is the greatest.

(10) Dr. E. O. Shakespeare, of Philadelphia, a noted specialist in bacteriology and pathology, says: "It has been found that in infants and young children in some large cities the mortality from some form of tuberculosis is far greater than is generally believed, amounting, in some localities to one-fifth of the deaths in the young. The significant fact in this connection is that it is most frequently some part of the digestive tract that first become affected."

(11) From the report of the English Royal Commission of 1895, the following extract is taken: "There is reason to believe that tuberculous matter, when present in meat sold to the public, is more commonly due to the contamination of the surface of the meat with material derived from other diseased parts than the meat itself. The same matter is found in the milk of course when the udder has become invaded by tuberculous disease, and seldom or never when the udder is not diseased. Tuberculous matter in milk is exceptionally active in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of tuberculosis which man obtains through his food is by means of milk containing tuberculous matter."

(12) The statement is frequently made by medical men and others that since the freedom of the negroes there has been a remarkable increase in the amount of tuberculosis among them. This is said to be due to the bad sanitary condition of their homes; their crowding together in filthy, unclean beds and rooms; the indiscriminate mix-

ing of the tuberculous with the healthy; eating infectious meats and milk; the great degree of looseness in social intercourse; and last, but not least, the constant "giving" and "re-giving" of tuberculous individuals in marriage.

HOW TUBERCLE BACILLI ENTER TISSUES AND ORGANS.

(1). Infection by way of the air passages and the lungs.—This is the most common method of infection. The dried sputa and dried infectious materials that float in the air are liable to be carried into the air passages and lungs. Living rooms, churches, school rooms and public halls where persons expectorate indiscriminately are not infrequently filled with air infected with tubercle bacilli. The dust-ladened air of dairy barns, where infected cattle are kept, is also infected with tubercle bacilli. The dust from handkerchiefs, clothing, beds, bed-clothing of tuberculous persons is nearly always very infectious. The reason that all animals and all men do not become infected is because the germ is a very slow growing organism, and in most instances dies before it gains admission into the tissues of a new host. Furthermore, all animals or all men are not susceptible at all times. Full vigor, great bodily vitality and good health are the strongest fortifications against the entrance of any disease-producing germ into the body.

(2). Infection by way of the Digestive Apparatus.—This mode of infection is a result of carrying the tubercle bacilli into the alimentary canal along with the food, and from there into other parts of the body by way of the lymphatics, blood vessels and possibly by the tissues. This method has been demonstrated experimentally by feeding tuberculous material to pigs, calves, cats, dogs and guinea pigs. Moreover, there have been numerous clinical observations recorded where infants, children and even grown persons have become tuberculous by consuming tuberculous milk or other infected food. Infants, children and young animals (calves and pigs) are more frequently infected by drinking tuberculous milk than in any other way. Whenever the intestines, the mesentery or any of the abdominal organs are the first and

chief seats of tuberculosis, it is evident that infection occurred by way of the alimentary canal. Occasionally the family milch cow becomes tuberculous by eating the waste slops and other materials which come from the house or rooms where tuberculous persons live. The alimentary canal may become the secondary seat of the disease by the animal or person coughing up the infectious material from the lungs to the pharynx or mouth and then swallowing it.

(3). Infection by direct inoculation.—If a terbuculous animal drops infected sputa or saliva upon a freshly abraded surface of a healthy animal infection might occur. Or a diseased animal might lick the freshly abraded surface of another and thus infection could take place. However, infection by this method is extremely rare.

(4). Intra-Ulterine Infection.—The bacilli may pass by way of the uterus and fœtal membranes, or by way of the blood vessels, from the mother to the fœtus. The fœtus or unborn embryo, by tuberculous semen from the sire, or a tuberculous ovum from the dam, may become infected. Recorded cases of infection by this method are extremely rare.

(5). It is also asserted that when the genital organs of either sire or dam are infected, the tuberculous one may transmit the bacilli to the other during copulation.

THE ACTION OF TUBERCLE BACILLI IN THE TISSUES.

After the bacilli gain admission (by any method of infection) to the tissues, they multiply at the point of lodgement and there produce the tubercle. A young tubercle is composed of a collection of cells forming a small grayish nodule and the fresh state presenting the appearance of mother of pearl. Two or more tubercles lying near one another in the lungs, liver, spleen or kidney may unite or become confluent as they continue to develop. Later in the development of the tubercle the central mass becomes "cheesy"—forming a large, soft, yellow, pus-like mass that is sometimes called a yellow tubercle. The growth of the tubercle advances by

the multiplying tubercle bacilli invading the tissues around the tubercle. As a rule extension of the disease from the primary focus takes place by way of the lymphatic vessels and glands—the lymph carrying the germs. In old and severe cases, where a large amount of tissue has been destroyed by the invading germs, the tubercle bacilli may be carried from the primary tubercle to other parts of the body by the current of blood in the blood vessels.

LOCATION OF THE TUBERCLES AS DETERMINED BY POST-MORTEM EXAMINATIONS.

No tissue or part of the body is exempt from the ravages of this disease. Some tissues and organs, by virtue of their structure, use and location, are more exposed to the action of tubercle bacilli, and consequently are more frequently the place of lodgement and growth of these germs than other parts of the body. Other organs appear to possess, by location and function, a comparative immunity and are rarely the seat of tubercles. The most frequently attacked tissues and organs will be given in regular order.

(a) The lungs are most frequently the location of tubercles. When the individual has tuberculosis of the lungs he is said to have consumption or pulmonary tuberculosis. When the lung tissue is first invaded it may be filled with small, hard nodules, which are called miliary tubercles. In exceptional cases these miliary tubercles do not increase in size. As a rule, they increase in size until those near one another unite and form large, soft, yellow, cheesy masses. Unusually a fibrous capsule develops around this mass to protect surrounding tissue and prevent its eruption into the bronchial tubes. Occasionally this yellow tuberculous mass erupts into the bronchial tubes; is coughed up and discharged into the outer world by expectoration. No one part of the lungs is more liable to be involved than the others, and the various stages in the development of tubercles may be seen in one tuberculous lung. The Bureau of Animal industry states that their records show that the large caudal lobes of the lungs were most frequently tuberculous. The

bronchial lymphatic glands that lie along the bronchi, and the mediastinal lymphatics that lie along the surface of the thoracic portion of the œsophagus are usually involved when the lungs are tuberculous.

(b). The pleura or serous membrane, lining the chest or lung cavity and reflected over the lungs, is involved next in frequency to the lungs. This membrane, when tuberculous, is covered or filled with numerous, small pearly tubercles, called by the butchers "grapes." The tubercle bacilli, as a rule, reach the pleura from the lungs, and occasionally the germs come from the abdominal organs by way of the diaphragm.

(c). The mesenteric glands or small lymph glands of the mesentery are nearly always infected when infection takes place by way of the digestive tract. When tuberculous, these glands are enlarged and they may contain cheesy masses if the disease is of long standing. Or there may be minute miliary tubercles in the mesentary. Tubercles may appear in the peritoneum, the membrane lining the abdominal cavity. Sometimes Peyers patches in the small intestines may become tuberculous and occasionally tuberculous ulcers or tubercles may develop in the stomach, and other parts of the alimentary canal.

(d). The liver is not as frequently involved as the mesentery. It is very probable that the bacilli gain admission to the liver by way of the portal circulation from the intestinal tract. In the liver the tubercles may be small grayish bodies or large, yellow cheesy masses.

(e). The spleen and kidneys are rarely involved. As a rule, they are tuberculous when the disease becomes generalized or involves many organs and is widely distributed in the body.

(f). The uterus or womb is very rarely tuberculous. When involved its walls are greatly thickened and the mucous membrane is covered with ulcers and tubercles are numerous in tisues of its walls.

(g). The udder may be tuberculous in comparatively rare instances. When tuberculous, the udder becomes

swollen, hard and knotty. The tubercles are located in the mucous membrane which lines the milk cavities and canals. Abscesses of the udder are rarely tuberculous.

It is possible to have a tuberculous abscess in the udder when the lesions are very severe and extensive. Occasionally the lymphatic glands in front and back of the udder may become enlarged and tuberculous.

(h). The bones are more frequently the seat of tuberculosis in swine than in cattle. The spongy centres of the bodies of the vertebræ of swine may exhibit yellow tubercles after the carcass has been cut into right and left halves. The articulations and bones of the limbs in cattle are sometimes involved in tuberculous alteration. The articulations are quite frequently involved in tuberculous calves.

(i). The pharyngeal (throat) glands are more frequently tuberculous than the udder or bones. These glands lie just back of the pharynix (throat); and when enlarged may sometimes be observed before the death of the animal. At first these glands are slightly enlarged and hard but later, as the disease advances, they become large and soft, owing to the extensive breaking down of tissue and the formation of large cheesy masses. In some cases the post pharyngeal glands are the only ones that are sufficiently involved by tuberculous changes as to be visible to the naked eye upon post mortem examination.

(j). The lymphatic glands at the base of the ear, the lymphatic glands on the inside of the lower jaw, the inguinal lymphatics on either side of the scrotum in the male, and on either side of the udder in the female, the lymphatic glands above and in front of the stifle and those in front of the shoulder blade may be the seat of tuberculous nodules or tubercles.

(k). The brain and spinal cord and the covering membranes of each occasionally become tuberculous.

(l). In extremely rare instances tubercles develop between the muscles. The muscle tissue proper does not present favorable canditions for the development of tubercles.

SYMPTOMS OR SIGNS OF TUBERCULOSIS AS OBSERVED IN LIVING CATTLE.

Tuberculosis may be acute or chronic; the former is rare; the latter is common and lasts for months or years. The physical signs or symptoms in the living animal are extremely variable—depending upon the location, extent and severity of the disease.

If the lungs and air passages are involved there may be, in the early stages, a harsh, dry, rough cough. Violent exertion, excitement, eating dry food or drinking cold water may cause the animal to cough. Sometimes the animal coughs at the beginning of exercise or upon rising after having lain down for some time. Striking the animal over the ribs a sharp rap with the knuckles may arouse the cough. Striking the chest with the knuckles may reveal regions or spots where the sound is muffled or dull instead of being resonant as in health. If the ear be applied to the chest, it may detect a weak, highly pitched whistling sound, made by the air rushing through some partially obstructed bronchial tube. Or, the ear may hear a sound that resembles bubbles of air passing through a thick liquid; this would indicate the presence of a liquid in the bronchial tubes. These last two tests are difficult and the trained expert is often mistaken; because there is such a limited area on the sides of the chest that can be thus inspected and because, in many instances, the area of lung tissue involved may be very small and deeply seated. A physical examination of the lungs in the living animal is satisfactory only in the advanced stages of the disease where the tuberculous animal is poor and the diseased part of the lung is very large. As the disease advances the cough may become more and more aggravated; a discharge from the nose may appear; the hair becomes rough and dry, and is not shed regularly; the skin becomes scurfy and clings closely to underlying tissues. In aggravated cases the animal may become greatly emaciated; yet, in some cases, the animal will remain in good flesh when the lungs are extensively tuberculous.

Respirations may be labored or accelerated according to the advancement and intensity of the disease. The pulse and temperature at times will rise above the normal; but will remain normal most of the time.

If the pleura is involved, the ear applied to the chest may detect friction sounds which are most distinct near the end of inspiration.

In tuberculosis of the stomach, intestines or mesentery, digestion is deranged and irregular. Young animals whose chief food is milk may have tuberculosis of the bowels or mesentery; this is manifest by indigestion, bloating and persistent diarrhœa; it may lead to general tuberculosis, involving the lungs and many other parts of the body. In older animals the appetite is capricious, digestion is impaired; the animal may bloat slightly after meals; have attacks of indigestion, and finally persistent and uncontrolable diarrhœa will appear. In some cases constipation will alternate with periods of diarrhœa or "scouring."

Tuberculosis of the peritoneum is difficult to determine in the living animal.

Tuberculosis of the uterus and ovaries is usually accompanied by sterility and long and frequent periods of heat (nymphomania).

When the udder is tuberculous it is confined usually to one quarter; yet it may involve each quarter. The diseased quarter is hard, insensitive to pressure and does not yield much milk. In rare instances the tuberculous udder may contain an abscess. Sometimes the cheesy or yellow tubercles erupt into the milk cavities and canals; thus the bacilli become mixed with the milk. Infrequently the submaxillary glands enlarge, soften, erupt and discharge a cheesy yellowish matter. This might be mistaken for actinomycosis.

The surface lymphatic glands at the base of the ear, in front of the shoulder, in front and behind the udder, in the groins, in front of, and above, the stifle, may be detected at first as hard nodular swellings; in the later stages as large soft swellings.

Bones and articulations are at first swollen and hard. Bones may later become soft, and if close to the skin, may be opened for an abscess.

When the brain, the spinal cord and their coverings are tuberculous the animal shows more or less signs of paralysis or mental derangement. In a brief time general stupidity, paralysis or convulsions may occur.

DIAGNOSIS.

How to Recognize Tuberculosis.

The physical signs or symptoms peviously mentioned may enable the veterinarian to recognize tuberculosis in well marked cases, but there are many dangerous and badly infected cases that can not be recognized by the veterinarian if he bases his diagnosis upon physical signs alone. The United States Veterinary Medical Association at their last meeting declared that tuberculosis in cattle could not, in many cases, be determined by physical examination alone. Besides the symptoms given we have the following aids to assist in making a more accurate diagnosis:

(1). Microscopical examination of the nasal discharge, of the saliva, of the milk and of the tubercles that erupt on the surface or that may be surgically removed from the skin or superficial tissues of the body.

(2). Inoculating susceptible animals with any of the liquids or materials mentioned in (1).

(3). The Tuberculin Test.

The first two of these methods are very tedious and difficult, and in many instances entirely without definite results.

The tubercle bacilli are rarely found in the milk in sufficient numbers to admit of their detection by the use of the microscope. It is only in very severe cases that the tubercle bacilli can readily be detected in the milk. Some claim that the udder or milk glands must be tuberculous before bacilli are in quantities sufficient for easy and accurate microscopic detection. Inoculating susceptible animals (guinea pigs,

rabbits, etc.,) with the milk would require twenty to thirty days for the disease to develop, and the small quantity of milk used for the inoculation might not contain tubercle bacilli. The nasal discharge and the saliva of cattle do not contain tubercle bacilli unless there be erupting tubercles in the lungs or somewhere along the air passages; furthermore, the tuberculous material, coughed up from the lungs, may be swallowed when it reaches the pharynx (throat). In all cases where the lungs and air passages are not tuberculous the nasal discharge and saliva contain no tubercle bacilli. Hence, microscopical examinations, or inoculations with these materials will be of value only in a limited number of cases.

Feeding the milk of a tuberculous cow to a pig or calf may develop tuberculosis in the latter in three to six months.

Tuberculin Test.

The Tuberculin Test comes the nearest being a perfect diagnostic agent for determining the presence or absence of tuberculosis among cattle. Tuberculin is a material that was discovered by Dr. Koch; it is a condensed filtrate that is made from sterilized bouillon cultures of tubercle bacilli. In 1890, Koch gave tuberculin to the medical world as a prospective remedy for tuberculosis. For two or three years it was extensively used as a curative agent, but it gradually grew into disuse because it did not meet with the success that was anticipated. During this extensive use of tuberculin in the human family, physicians observed that it uniformly produced a fever or an elevation of the temperature in a certain number of hours after its administration to tuberculous persons. This fact led veterinarians to try it as a diagnostic agent in detecting tuberculosis in cattle.

If a sufficient quantity of tuberculin be injected beneath the skin of a tuberculous animal, its temperature will rise one and one-half to four or more degrees Fah. above the normal in eight to eighteen hours after the injection. This rise of temperature is known as the "reaction" in the tuberculin test. Before injecting an animal its nor-

mal temperature must be determined. To obtain the normal take the temperature of the animals to be tested every two hours beginning at 6 a. m. and continuing until 6, 8 or 10 p. m. When time is important and many cases are to be tested, the temperature may be taken every three hours during the day. In no case where the temperature runs to or above 102 degrees Fah. from morning till evening should the animal be injected; since it already has fever and the characteristic reaction will not always appear. It should be remembered that the normal temperature, as a rule, reaches its maximum in the evening and only in very rare instances in the morning.

After getting the temperatures during the day, at 6, 8 or 10 p. m. the animals may be injected with tuberculin. If the tuberculin, made by the Bureau of Animal Industry, is used, 2 c. c. (one-half fluid drachm) is hypodermically injected into each animal weighing 1,000 lbs.; for bulls and animals weighing over 1,000 lbs. 3 c. c. is injected into each; for yearlings and small two-year olds use one and one-half c. c.; for calves 1 c. c. may be used. If Koch's or Pasteur's tuberculin is used, .25 c. c. is injected into each animal weighing 1,000 lbs.; this must first be diluted with a one per cent. solution of carbolic acid to a strength of ten per cent. This may be conveniently done by pouring 5 c. c. of Koch's or Pastuer's tuberculin into a perfectly clean glass vessel and adding thereto 19 drachms of a one per cent. solution of carbolic acid. (In making the one per cent. carbolic acid solution always use boiled distilled or filtered water.) Each drachm of this solution will then contain a dose for an animal weighing 1,000 lbs.; 1½ drachms for a bull or larger animal; ¾ of a drachm for 1 and 2 year olds and ½ drachm for calves.

The hypodermic syringe should be thoroughly disinfected and have a capacity of one to two drachms. Inject the tuberculin under the skin on the side of the neck or over the shoulder.

The morning following the injection begin to take the

temperatures at 6 o'clock and continue at regular periods of every two or three hours until six or eight in the evening.

It is important that a good thermometer be used and that it be held in the rectum, at least five minutes. The six inch Hicks'thermometer is very well adapted to this test. An eight inch thermometer would be better.

If within eight to eighteen hours after the injection of the tuberculin, the temperature rises 1½ or more degrees, Fah., above the normal, for two or more successive readings the reaction is characteristic and the animal is tuberculous. But if the temperature rises at one reading, drops to the normal at the next two readings, then rises at the next reading, this reaction ("double curve") is not characteristic—not positive that the animal is tuberculous. Such an animal should be re-tested in three to six months.

The animals should be kept in their stalls under the same conditions each day during the test; the same quantity of water and food should be given at the same time each day; abrubt changes of temperature in the barn should be avoided. The temperature of cows in heat or in the advanced stages of pregnancy are usually above the normal and they should not be tested at such times. Animals that have been greatly exhausted by excitement or by shipment on cars or boats should be kept isolated in a quiet place for, at least, one week before they are tested.

All animals that give slight or indefinite reactions should be isolated for three to six months and then retested. Sometimes the reaction is accompanied by an acceleration of pulse and respirations and may be followed by a brief attack of diarrhœa and a slight decrease in the flow of milk. But as a rule there are no bad results following the reaction.

THE ACCURACY OF THE TUBERCULIN TEST.

Out of 4,068 animals tested in various parts of the United States by different persons and by the various kinds or forms of tuberculin, 1,137 reacted and 1,118 exhibitted undoubted tuberculous lesions upon post mortem examination; in 19 of these that reacted, the naked eye failed to find any visi-

ble tubercular lesions; the microscope was not used and possibly the post mortem examinations were not as thorough and complete as they might have been. Admitting that the 19 cases were not tuberculous this would be less than one error in 500 tests. In Massachusetts, the cattle commissioners have tested over 25,000 cattle and they have found the tuberculin test to fail in one out of every 400 cases tested. No diagnostic method can show a better record, and no other method can detect 75 per cent. of the cases of tuberculosis in 25,000 cattle.

Last year the Inter-National Congress of Veterinarians adopted the following committee report:

"The committee are agreed that tuberculin is a very valuable assistant in the discovery of tuberculosis. The occasional failures for which it is responsible are without practical significance." (Nocard, Bang and Hess.)

The Massachusetts Board of Cattle Commissioners have tested more animals than the United States government and all the other States. They testify as follows:

"First. That tuberculin is a reliable agent for determining tuberculosis in cattle.

"Second. That tuberclin, properly prepared and carefully handled, can have no injurious effects upon healthy cattle.

"Third. That it is the only known means whereby a positive diagnosis can be made in the early stages of the disease."

PREVENTATIVE MEASURES THAT MAY BE ADOPTED BY THE STOCK-OWNER.

The following is taken from Dr. Law's Bulletin:

"If he will the stockowner can extirpate this disease from his herd and thereafter keep the herd from such contamination. The following are the main precautions necessary to this end:

1st. Board up the partitions of the stalls at the front so that no two cows can feed from the same manger nor lick each other.

2d. Keep each animal strictly by its own stall and manger.

3d. When any animal is suspected do not let it use a drinking trough or bucket in common with other animals.

4th. Avoid old milch cows and unthrifty ones or keep them secluded from the rest of the herd.

5th. The following conformation usually indicates a weakness of constitution and a susceptibility to tuberculosis: Head narrow between the horns, sunken eyes, thin and narrow ewe neck, chest small and lacking in both depth and breadth, hollow flanks and tendency to pot belly, a general lack of muscle so that the limbs seem loosely attached to the body, in breeds that show a variety of colors, animals of the lighter shades of brown and yellow. If, however, such animals are of high value for the dairy and can be kept free from infection, they need not be rejected. The finest conformations of short horns, Devons, Holsteins, black or red polled furnish no protection in the presence of the germ.

6th. Don't purchase from a herd in which tuberculosis has appeared, or in which cattle have died or been killed within a year or two. Resort first to tuberculin.

7th. Don't take a cow with a husky or rattling cough; wheezing, hurried breathing; discharge from the nose; fœtid breath; hard bunches under the skin; diseased udder; swollen bones or joints; unthrifty or a tendency to scour or bloat.

8th. Don't purchase from city suburban or swill stables.

9th. Don't add newly purchased cattle to your herd until you have tested them with tuberculin, especially if they are the product of in breeding.

10th. Don't admit strange cattle to house, field or yard with your own; keep them apart until tested with tuberculin.

11th. In case of disease or unthriftiness in your herd put the animal apart and have it examined by a skillful veterinarian.

12th. In case one animal in the herd shows tuberculosis, test the whole herd with tuberculin.

13th. Test in the same manner all animals on the farm

(swine, goats, sheep, horses, rabbits, cats, dogs, fowls), that co-habit with the cattle.

14th. Kill all tuberculous animals and boil, burn, dissolve with acids, or bury deeply in a place to which no animals have access.

15th. Disinfect premises thoroughly, also all products of diseased animals and all articles used by them.

16th. Let no consumptive person attend on cattle or other live stock or prepare their food.

17th. Vermin (rats, mice, sparrows) in a building, where tuberculous animals have been, should be exterminated."

HOW TO DISINFECT.

(1). Remove all loose materials from the mangers and stalls and burn such as are of no value.

(2). Thoroughly cleanse the stalls. If the floor be dirt remove at least three inches of it and replace it with fresh dirt after the disinfection.

(3). When the walls, floors, ceilings, etc., become dry, spray them with a corrosive sublimate solution (1 to 1,000), a two per cent. carbolic acid solution, or a two per cent. creolin solution. A fruit tree spray is best for this purpose.

(4). Close the windows and doors and fumigate the barn by burning two or three pounds of sulphur in kettles containing hot coals.

(5). After fumigation open the windows and doors and flood the barn with sunlight and air. It is the dry air and sunlight that disinfects pastures and other outdoor places.

DUTIES OF THE CITIES AND THE STATE.

What should our larger cities and the State do toward exterminating tuberculosis among domestic animals and prevent its extension in the human family?

The cities should pass ordinances requiring all the dairy herds that supply dairy products to the inhabitants of their respective cities to be tested with tuberculin twice annually, and forbid the use of tuberculous cows in such herds. All tuberculous animals should be destroyed and deeply buried or cremated.

The cities should also require that all animals killed for local consumption be tested with tuberculin. Furthermore, each city should have a city meat and milk inspector, whose duty shall be to test the dairy herds and all beef cattle with tuberculin and inspect all carcasses at the slaughter houses and market places.

The inspector should be a graduate veterinarian who has had special instruction in milk and meat inspection. This work could be done under the supervision of the City Board of Health.

The State laws necessary for the control and eradication of tuberculosis among domestic animals and to decrease human mortaliy from tuberculosis, are briefly suggested as follows:

1st. Alabama should provide for a State Veterinarian and several local assistant State Veterinarians. Said veterinarians should investigate all contagious and infectious diseases among domestic animals; inspect or superintend the inspection of all dairy herds and all animals slaughtered for human food not inspected by city or government inspectors. The State Veterinarian could be an *ex officio* member of the State Board of Health, or work under the supervision of that Board. Said veterinarians should receive pay for time spent in actual service for the State.

2d. Public Slaughter Houses should be established and all animals should be slaughtered at these places.

3d. The State should provide means for carrying on this work, and, also, to pay a small indemnity for animals condemned by the State.

This could be done by levying a small special tax upon all the domestic animals of the State. The protection given to both animals and man and the increase in value of the animals would more than compensate the owner of stock for the small tax.

The following are some of the suggestions made by City and State Boards of Health in various parts of the United States for the prevention and eradication of tuberculosis in the human family:

(1) Sterilize all milk, especially that given to infants and children. (See Bulletin 53).

(2) Thoroughly cook all meats before eating them.

(3) Completely sterilize all drinking water.

(4) Never employ consumptive (tuberculous) persons as cooks, house servants, or to milk or care for dairy cattle or to clerk in stores or handle eatables of any kind. Such persons better work in the open fields.

(5) Never visit improperly kept quarters or living rooms of consumptives, and in no case allow children to play with consumptives or visit their rooms.

(6) Consumptive persons should not teach school.

(7) Children or any one having consumption should not attend public schools or public gatherings in closed rooms.

(8) Consumptives should not marry.

(9) A person having consumption should occupy a room by himself; keep it as clean as possible; never use carpets or rugs; never expectorate upon the floor; always expectorate into cuspidors containing a solution of corrosive sublimate, 7 grains to one pint of water, or upon cloths that can be immediately burned.

(10) Consumptives should never kiss any one—especially children or babies. In fact, many physicians regard mouth to mouth kissing as filthy and as occasionally dangerous, because many diseases are thus communicated from the diseased to the healthy.

(11) Buildings, rooms, sleeping cars, berths and beds occupied by consumptives should be completely disinfected before being occupied by healthy persons.

(12) "Do not fail to wash thoroughly the eating utensils of a person who has consumption as soon after eating as possible, using boiling water for the purpose."

(13) A consumptive's unwashed clothing should never be kept, or washed with similar clothing of other persons. Such clothing should be boiled for at least one hour, or otherwise disinfected before being washed or during the process of washing.

(14) "The bowel discharges of consumptive persons with diarrhœa should be caught in a vessel containing corrosive sublimate seven grains to water one pint."

(15) "Do not fail to consult the family physician regarding the social relations of persons suspected of having consumption."

(16) Tuberculous parents can not be too careful lest they transmit the tubercle bacilli to their children. It is best to give sterilized cow's milk to infants having tuberculous mothers.

(17) Physicians and dentists having consumption should not practice or follow their respective professions.

(18.) Dogs and cats should not be permitted in rooms where consumptives live. If so kept, they should not be allowed to play with children or pass into other rooms or houses. Pets suspected of having consumption should be destroyed.

(19.) The State, counties or cities should provide houses for indigent tuberculous persons or public hospitals where consumptives could be isolated and treated.

The above preventative suggestions may seem to be extreme, but some of them are enforced in some of the largest cities in the United States. As soon as the people become aware of the necessity of State, city and government control of tuberculosis in all forms and conditions it is probable that many of these measures and others more severe will be enforced.

It is to be hoped that opportunity will be given this department to test dairy herds in various parts of this State. In fact, we will test a limited number of herds of cattle and attempt to furnish tuberculin free to those who will secure the services of a graduate veterinarian to make the test. Any one desiring further information upon this subject will please address the Station Veterinarian.

BULLETIN No. 68. JANUARY, 1896.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

PIG FEEDING EXPERIMENTS.

C. A. CARY, Veterinarian.

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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.

PIG FEEDING EXPERIMENTS.

BY C. A. CARY.

These feeding tests were made for the purpose of securing a ration—of which cotton seed or cotton seed meal should form one of the principal ingredients—that would not kill pigs and yet be a profitable food. At the same time it was our aim to attempt to determine the reason why cotton seed or cotton seed meal kills pigs; this part of the experiment was not fully carried out, because no pigs were killed by the feeding tests.

These tests must be considered as preliminary; because their number and the repetition of the same tests are insufficient to make fixed or definite feeding laws. In order to obtain definite conclusions, repeated and various tests must be made, and in connection therewith chemical analyses of the ration as fed and of the indigestible parts of the ration must be made.

In these tests we were controlled by limited means and difficulties in obtaining the foods desired at the time when needed. However, it was our intention to use such foods as were in season and most available to the farmer.

First Experiment. (See table No. I.)

In calculating the cost of the rations in the tests, made from April 28th to August 11, 1894, the following prices were used: Corn, 60 cents per bushel; cow peas, 60 cents per bushel; sweet potatoes, 50 cents per bushel; green oats, green rye and green sorghum, each at 25 cents per cwt.; wheat bran and cotton seed meal at $20 per ton; cotton seed at 12½ cents per bush. Since I could find no digestible per-

FIRST EXPERIMENT. TABLE NO. I.

No. of Pig.	Daily Ration Fed to each Pig.	Weight April 28.	Weight May 5.	Weight May 12.	Weight May 19.	Weight May 26.	Weight June 2.	Weight June 9.	Weight June 16.	Weight June 23	Weight June 30	Weight July 7.	Weight July 14	Weight July 21.	Weight July 28.	Weight Aug. 4.	Weight Aug. 11.	Total gain.	Cost of each lb. of gain.	Nutritive Ratio.
I.	Ground Corn.....1⅓ lbs. Ground Cow Peas.....1⅔ " Sweet Potatoes.....1.2-10 "	112	128	130	131	134	143	149	154	155½	159	165½	172	169	174	183½	185	73	6.1-6ct	1:4.2
II.	Ground Corn.....1⅓ lbs. Ground Cow Peas.....1⅔ " Sweet Potatoes.....2.1-10 "	49	57	59½	61¼	66	73	79	82	90	95½	99	104½	101½	112	118	120	71	6⅓	1:4.6
III.	Ground Corn.....1.1-5 lbs. Ground Cow Peas.... 1½ " Green Oats..... 1.4-5 "	57¼	62	65	66½	70	75	81½	82	88	92	95¼	95½	97	101	108	109	51¾	7⅓	
IV.	Cow Peas.....1.4-5 lbs. Green Oats.....1.4-5 " Sweet Potatoes.....1.4-5 "	42	47	53	53	52	60	67½	67	71	75½	75½	78	79	83½	88	89	47	8.7-12	
V.	Crushed Cotton Seed 1.1-5 lbs. Ground Cow Peas....1.1-5 " Green Oats.....2.1-10 "	41	51¼	50¾	55	56½	61	66½	67	68½	71½	71½	72	75	77½	80	82	41	6.3-5	
VI.	Crushed Cotton Seed 1.2-5 lbs. Ground Cow Peas....1.2-5 " Sweet Potatoes.....2.1-10 "	52	59	62	61½	65	71½	78	77	82	80	85	87½	86	93	92	91	39	7	1:4.2
VII.	Cotton Seed Meal....3-10 lbs. Wheat Bran ..... 1½ " Green Oats.....3.3-5 "	44	47	49	48	50½	49	53½	55	54	51½	54½	56	57½	59	58	57	13	23⅝	
VIII.	Cotton Seed Meal.....3-5 lbs. Ground Corn.....1.1-5 " Green Oats.....3 "	57½	66¼	69	70	66	73	77½	78	78	80½	78	81	77½	73	68	67	9½	18.11-12	

centages of sweet potatoes I used those of Irish potatoes in calculating the nutritive ratio in all rations where sweet potatoes were used.

Pig No. I., during the entire feeding period of 105 days, received daily, 1 1-3 lbs. of ground corn; 1 2-3 lbs. of ground cow peas, and 2 1-10 lbs. of sweet potatoes. The nutritive ratio based on the pig weighing 125 lbs. is 1:4.2. The pig gained 73 lbs. at a cost of 6 4-5 cents per lb. It required 7 1-3 lbs. of the ration mixture (just as fed) to make 1 lb. of gain. This ration is too small in quantity; 2 lbs. of corn, 2½ lbs. of cow peas and 3 lbs. of sweet potatoes would make a ration in proportion to the size of the pig.

Pig No. II., from April 28th to August 11th (105 days), received daily 1 1-3 lbs. ground corn; 1 2-3 lbs. of ground cow peas and 2 1-10 lbs. of sweet potatoes. With the average weight of the pig at 84 lbs. the nutritive ratio is 1:4.6. The pig gained 71 lbs. in 105 days at a cost of 7 cents per lb. It required 7½ lbs. of the ration mixture (just as fed) to make 1 lb. of gain. This ration is the same as that for pig No. I.; but this pig being smaller makes the ration slightly less in quantity than that which is required.

Pig No. III., from April 28th to June 2d (35 days), received daily 1 1-5 lbs. of ground corn; 1½ lbs. of ground cow peas; 1 4-5 lbs. of green oats. With the average weight of the pig at 65 lbs., the nutritive ratio is 1:4.7. The cost of 1 lb. of gain is 6 cents. It required 8 2-3 lbs. of the ration mixture to make one pound of gain. The pig gained 17¾ lbs. in 35 days.

Pig No. III., from June 2d to Aug. 11th (70 days), was fed daily 1 3-5 lbs. of ground corn; 1 3-5 of ground cow peas, and 2 2-5 lbs. of green sorghum. With the average weight of the pig at 90 lbs. the nutritive ratio is 1:5.1. The pig gained 34 lbs. at a cost of 8 2-3 cents per lb,, or 11 2-3 lbs. of the ration mixture.

Pig No. IV., from April 28th to June 2d (35 days), received daily 1 4-5 lbs. of cow peas; 1 4-5 lbs. of green oats, and 1 4-5 lbs. of green sorghum. The average weight of

the pig at 50 lbs. makes the nutritive ratio 1:3.6. The pig gained 18 lbs. at a cost of 6 1-3 cents per lb., or 10 2-3 pounds of the ration mixture.

Pig No. IV., from June 2 to August 11 (70 days), was fed daily 2 2-5 lbs. of cow peas; 2 4-5 lbs. of green sorghum, and 2 2-5 lbs. of sweet potatoes. The pig gained 29 lbs. at a cost of 10 5-6 cents per lb. or 18 lbs. of the ration mixture. With the average weight of the pig at 75 lbs. the nutritive ratio is 1:3.6.

Pig. No. V., from April 28 to June 2 (35 days), received daily 1 1-5 lbs. of crushed cotton seed; 1 1-5 lbs. of ground cow peas, and 2 1-10 lbs. of green oats. With the pig weighing 50 lbs. the nutritive ratio is 1:3.9. The pig gained 20 lbs. at a cost of 4 1-5 cents per lb. or 7 4-5 lbs. of the ration mixture.

Pig No. V., from June 2 to August 11 (70 days), received daily 2 lbs. of crushed cotton seed; 1 1-5 lbs. of ground cow peas, and 2 1-5 lbs. of green sorghum. The average weight of the pig at 70 lbs. makes the nutritive ratio 1:5. The pig gained 21 lbs. at a cost of 9 cents per lb. or 20 lbs. of the ration mixture.

Pig No. VI., from April 28 to August 11, received daily 1 2-5 lbs. of crushed cotton seed; 1 2-5 lbs. ground cow peas, and 2 1-10 lbs. of sweet potatoes. With the average weight of the pig at 70 lbs. the nutritive ratio is 1:4.2. The pig gained 49 lbs. at a cost of 7 cents per lb. or 10½ lbs. of the ration mixture.

Pig No. VII., from April 28 to June 2, was fed daily 3-10 lbs. of cotton seed meal, 1½ lbs. of wheat bran, and 3 3-5 lbs. of green oats. The average weight of the pig at 46 lbs. makes the nutritive ratio 1:4. The pig gained 5 lbs. at a cost of 21 cents per lb. or 38 lbs. of the ration mixture. On May 30 this pig refused to eat, and was apparently sick.

From June 2 to August 11, Pig No. VII. received daily 3-10 lbs. of cotton seed meal; 1½ lbs. of wheat bran, and 3 3-5 lbs. of green sorghum. The average weight of the pig at 50 lbs. makes the nutritive ratio 1:4.5. The pig gained

8 lbs. at a cost of 26¼ cents per pound or 47¼ lbs. of the ration mixture. On August 4 this pig almost entirely refused to eat and grew worse until August 11, when the test closed and the pig was turned out to pasture and fed corn; upon this ration it made an average fat hog in 4 months.

Pig No. VIII., from April 28 to June 2, received daily 3-5 lb. of cotton seed meal; 1 1-5 lbs. of ground corn and 3 lbs. green oats. The average weight of the pig at 50 lbs. makes the nutritive ratio 1:4.7. In 35 days the pig gained 15½ lbs. at a cost of 6 1-6 cents per lb., or 10 4-5 lbs. of the ration mixture. On May 30 this pig refused to eat, but gradually improved until it manifested no signs of illness.

Pig No. VIII., from June 2 to Aug. 11, received daily 3-5 lb. of cotton seed meal; 1 1-5 lbs. of ground corn and 3 lbs. of green sorghum. The average weight of the pig at 70 lbs. makes the nutritive ratio 1:4.5. In 70 days the pig lost 6 lbs. This ration should have contained 1 lb. of cotton seed meal, 2½ lbs. of corn and 4 lbs. green sorghum. On July 28 and August 4 this pig refused food. It was evidently sick. It gradually grew worse until August 11 when the experiment was closed. Very probably it would have died had it not been turned out and given other food. This pig soon recovered after being turned into a pasture and fed corn. In fact, it became a fine "porker" in 4 months after the close of the experiment.

Second Experiment. (See Table No. II.)

In determining the cost of the food in the rations used in the feeding tests, made from March 30 to June 29, 1895, the same prices were used as for the test in 1894.

The green rye gave out on April 27, and it was our intention to follow the green rye with green oats or green sorghum; but owing to unavoidable conditions those foods could not be secured.

Pig No. I., from March 30 to June 29, was fed daily 3½ lbs. of corn. In 91 days the pig gained 25 lbs. at a cost of 13 3-5

SECOND EXPERIMENT. TABLE NO. II.

No. of Pig.	Daily Ration Fed to each Pig.	Weight March 30.	Weight April 1.	Weight April 6.	Weight April 13.	Weight April 20.	Weight April 27.	Weight May 4.	Weight May 11.	Weight May 18.	Weight May 25.	Weight June 1.	Weight June 8.	Weight June 15.	Weight June 22.	Weight June 29.	Total gain.	Cost of each lb. of gain.	Nutritive Ratio.
I.	Corn.....3½ lbs.	67½	60	60	68	70	71	75	78	79	81	81½	83	87	90	92½	25	13.3–5	1:10.3
II.	Ground Corn.....2½ lbs Crushed Cotton Seed..3½ "	47	46	45½	47	45	46½	50	51	53	53½	53½	54½	56	58	58½	11½	32	1:8
III.	Ground Corn.....2½ lbs. Crushed Cotton Seed..3½ "	60	60	60	60	55	55½	64	63	65	66	67	69	71	81	83	23	16	1:7.8
IV.	Ground Cow Peas.....2½ lbs Crushed Cotton Seed..4 "	78	73	71½	75	79½	86	96	96	97	97	97½	101	103	106	107½	29½	12½	1:4.4
V.	Crushed Cotton Seed..4½ lbs.	71	68½	70½	65	62	60	55	53	51	51	51½	53	55	56½	58	lost 13		1:6.7
VI.	Crushed Cotton Seed..3½ lbs. Green Rye.....3½ "	70	69½	68	63	63	63½	70	69	67	67½	67½	69	71	73	76	6	7¾	
VII.	Crushed Cotton Seed....3 lbs. Ground Cow Peas.....3 " Green Rye.....3½ "	65½	64	70	72	72	73	81	81	82	83½	83	83½	84	87	88½	23	14½	
VIII.	Crushed Cotton Seed....3 lbs. Ground Cow Peas.....3 " Green Rye.....3½ "			47½	53	51	51½	60	61	61	61½	62	63½	65	66		19½	19⅓	
IX.	Crushed Cotton Seed....3 lbs. Ground Corn.....3 " Green Rye.....3½ "	58	55½	61	62	64	65	68	70	70	71	71	73	73½	75	77	19	38⅓	
X.	Wheat Bran.....3 lbs. Green Rye.....4 "	60	66½	71	71	69	70	73	74	73	73½	73	74	76	77	79	19	19.2–5	

cents per lb., or $12\frac{3}{4}$ lbs. of corn. The nutritive ratio is 1:10.3. This pig was of common stock.

Pig II., from March 30 to June 29, received daily $2\frac{1}{2}$ lbs. of ground corn, and and $3\frac{1}{2}$ lbs. of crushed cotton seed. In 91 days it gained $11\frac{1}{2}$ lbs. at a cost of 32 cents per lb. or 47 lbs. of the ration mixture. With the average weight of the pig at 52 lbs., the nutritive ratio is 1:8. This ration contains too much cotton seed. Corn $3\frac{1}{2}$ lbs. and cotton seed $1\frac{1}{2}$ lbs. would make a better ration. This pig was from common stock. It was turned into a pasture at the close of the test and in the fall was fed corn. About Jan. 1, 1896, it weighed 216 lbs.

Pig No. III., from March 30 to June 29, received daily $2\frac{1}{2}$ lbs. of ground corn and $3\frac{1}{2}$ lbs. of crushed cotton seed. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:7.8. The pig gained 23 lbs. at a cost of 11 cents per lb., or $23\frac{2}{3}$ lbs. of the ration mixture. The gain is better than that of pig No. II.; yet there is too much cotton seed in the ration. This pig was turned into a pasture at the close of the test and in the fall it was fed corn. It was of common stock, and weighed about Jan. 1, 1896, 164 lbs.

Pig No. IV., from March 30 to June 29, received daily $2\frac{1}{2}$ lbs, of ground cow-peas and 4 lbs. of crushed cotton seed. The average weight of the pig at 93 lbs. makes the nutritive ratio 1:4.4. In 91 days the pig gained $29\frac{1}{2}$ lbs. at a cost of $12\frac{1}{2}$ cents per lb. or 20 lbs. of the ration mixture. Ground cow-peas 3 lbs. and crushed cotton seed 2 lbs. would be a better ration for a pig of the same weight. This pig was afterwards fed as No. III., and weighed about Jan. 1, 1896, 170 lbs.

Pig No. V., from March 30 to June 29, received daily $4\frac{1}{2}$ lbs. of crushed cotton seed. The nutritive ratio is 1:6.7. In 91 days the pig lost 13 lbs. This pig apparently ate enough to prevent starvation. Yet it grew in frame work (bone, etc.), and when turned out to pasture and given corn, after the close of the test, made a hog that weighed 153 lbs. about January 1st, 1896.

Pig No. VI., from March 30 to April 27, received daily $3\frac{1}{2}$ lbs. of crushed cotton seed and $3\frac{1}{2}$ lbs. of green rye. The average weight of the pig at 67 lbs. makes the nutritive ratio 1 : 6.7. In 28 days the pig lost 6 lbs. Crushed cotton seed 2 lbs. and green rye 5 lbs. would have been a better ration for this pig.

Pig No. VI, from April 27 to June 29, received daily $3\frac{1}{2}$ lbs. of crushed cotton seed. The nutritive ratio is 1:6.7. The pig gained $13\frac{1}{2}$ lbs. at a cost of 5.9 cents per lb., or $13\frac{2}{3}$ lbs. of crushed cotton seed. The pig did not eat all the ration at any time. It ate sufficient to maintain life and increase the size of the frame work of the body. It was not in the best of health all the time, but never exhibited signs of serious illness. After the close of the feeding test this pig was treated as pig No. III. It weighed 220 lbs. January 1, 1896. It was of common stock.

Pig No. VII, from March 30 to April 27, received daily 3 lbs. of crushed cotton seed; 3 lbs. of ground cow peas, and $3\frac{1}{2}$ lbs. of green rye. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:3.8. The pig gained $7\frac{1}{2}$ lbs. at a cost of 18 4-5 cents per lb., or 35 lbs. of the ration mixture. Crushed cotton seed $1\frac{1}{2}$ lbs.; ground cow peas 2 lbs., and green rye 4 lbs. would make a better ration.

Pig No. VII, from April 27 to June 29, received daily 3 lbs. of crushed cotton seed and 3 lbs. of ground cow peas. With the average weight of the pig at 80 lbs., the nutritive ratio is 1:3.7. The pig gained $15\frac{1}{2}$ lbs., at a cost of $14\frac{1}{2}$ cents per lb., or $20\frac{1}{2}$ lbs., of the ration mixture. With the same after treatment as No. III, the pig weighed 170 lbs. January 1, 1896. This was an Essex pig.

Pig No. VIII, from April 6 to April 27, received 3 lbs. of crushed cotton seed; 3 lbs. of ground cow peas, and $3\frac{1}{2}$ lbs. of green rye. With the average weight of the pig at 50 lbs. the nutritive ratio is 1:3.9. In 21 days the pig gained 4 lbs. at a cost of 25 3-5 cents per lb., or 49.9 lbs. of the ration mixture. Cotton seed 1 lb.; cow peas 2 lbs., and green rye 5 lbs. would make a better ration.

Pig No. VIII, from April 27 to June 22, received daily 3 lbs. of crushed cotton seed and 3 lbs. of ground cow peas. With the average weight at 58 lbs., the nutritive ratio is 1:3.6. The pig gained 15½ lbs. at a cost of 13 1-6 cents per lb. or 17¾ lbs. of the ration mixture. Cotton seed 1 lb. and cow peas 2 lbs. would make a better ration. On June 22 this pig accidentally escaped from the pen and was killed by being chased too long in the heat of the day.

Pig No. IX, from March 30 to April 27, received daily 3 lbs. of crushed cotton seed; 3 lbs. of ground corn; 3½ lbs. of green rye. With the average weight of the pig at 60 lbs. the nutritive ratio is 1:7.4. The pig gained 7 lbs. at a cost of 20 2-7 cents per lb. or 38 lbs. of the ration mixture. Crushed cotton seed 1 lb.; ground corn 2 lbs., and green rye 5 lbs. would have been a better ration.

Pig No. IX, from April 27 to June 29, received 3 lbs. of crushed cotton seed and 3 lbs. of ground corn. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:8.3. The pig gained 12 lbs. at a cost of 23 cents per lb., or 31½ lbs. of the ration mixture. Corn 3 lbs. and cotton seed 1 lb.; or corn 3 lbs. and cotton seed 2 lbs. would have been better. This Essex pig was treated afterwards as No. III and weighed 186, January 1, 1896.

Pig No. X, from March 30 to April 27 (28 days), received daily 3 lbs. of wheat bran and 4 lbs. of green rye. With the average weight of the pig at 65 lbs., the nutritive ratio is 1:4.7. The pig gained 10 lbs. at a cost of 11 1-10 cents per lb., or 19 3-5 lbs. of the ration mixture.

Pig No. X, from April 27 to June 29, received daily 3 lbs. of wheat bran which has a nutritive ratio of 1:4.2. The pig gained 9 lbs. at a cost of 21 cents per lb., or 21 lbs. of the ration mixture. Bran and rye are apparently better and less expensive than bran alone. This Essex pig with the same after treatment as No. III, weighed 203, January 14, 1895.

THIRD EXPERIMENT. (See Table III.)

In determining the cost of the rations in these tests, cotton seed was rated at 12½ cents per bushel, separated milk at 5 cents per gallon and whole milk at 20 cents per gallon.

It was our aim to make the entire test with separated milk and cotton seed, but owing to unavoidable circumstances whole milk was substituted for separated milk. It is very evident that whole milk at 20 cents per gallon can not be fed to pigs with profit.

At two periods during the test these pigs were slightly affected, but at no time were they seriously ill.

Pig No. I, from July 15 to September 2, received daily 6 lbs. of separated milk and 3½ lbs. of crushed cotton seed. With the average weight of the pig at 108 lbs., the nutritive ratio is 1:5.1. The pig gained 11½ lbs. at a cost of 21⅔ cents per lb. On August 15 this pig did not eat cotton seed and was evidently somewhat sick.

Pig No. I, from September 2 to October 21 (49 days), received daily 6 lbs. of whole milk and 3½ lbs. of crushed cotton seed. With the average weight of the pig at 126 lbs., the nutritive ratio is 1:6. The pig gained 19 lbs. at a cost 41 1-3 cents per lb. On September 19 this pig failed to eat the cotton seed and was slightly ill.

Pig No. II, from July 15 to September 2, received daily 6 lbs. of separated milk and 3½ lbs. of crushed cotton seed. With the average weight of the pig at 90 lbs., the nutritive ratio is 1:5.8. The pig gained 12½ lbs. in 49 days at a cost of 20 cents per lb. On August 15 this pig ate very little cotton seed.

Pig No. II, from September 2 to October 21, received daily 6 lbs. of whole milk and 3½ lbs. of crushed cotton seed. With the average weight of the pig at 100 lbs., the nutritive ratio is 1:5.7. The pig gained 8 lbs. in 49 days at a cost of 98 cents per lb. On September 19th, this pig refused to eat cotton seed.

THIRD EXPERIMENT. TABLE NO. III.

No. of Pig.	Daily Ration Fed to each Pig.	Weight July 15.	Weight July 22.	Weight July 29.	Weight Aug. 5.	Weight Aug. 12.	Weight Aug. 19.	Weight Aug. 26.	Weight Sept 2.	Weight Sept. 9.	Weight Sept. 16.	Weight Sept. 23.	Weight Sept. 30.	Weight Oct. 7.	Weight Oct. 14.	Weight Oct. 21.	Total gain.	Cost of 1 lb. of gain.	Nutritive Ratio.
I.	Crushed Cotton Seed..3½ lbs. "Separated" Milk.....6 "	102	104	108	111	114	114½	116	113½	114	117½	123	129	136½	132	132½	30½	31½	
II.	Crushed Cotton Seed..3½ lbs. Separated Milk.....6 lbs.	84	84	87½	91	94	94½	96	96½	95	98	103	102½	105	103	104½	20½	59	

Tests at Other Stations.

According to feeding tests made by Curtis at the Texas Experiment Station, raw cotton seed, roasted cotton seed or boiled cotton seed will kill pigs in about six weeks after beginning to feed them. After two years of duplicate tests Curtis states that cotton seed is an unprofitable hog food, because hogs will not eat it. (See Bulletin No. 21, Texas Station.)

The Kansas Station gives the following results: "Cotton seed meal proved poisonous to pigs even though fed in small quantities. A mixture of one-fourth cotton seed meal was as disastrous as equal parts of these feeds. The pigs died in from three to eight weeks after being put on this feed, the larger ones holding out the longest. *Post mortem* examinations revealed in all cases severe inflammation and congestion of the intestines, lungs and heart. But cotton seed meal produces very rapid gains in both pigs and large hogs, and if the feed is changed before symptons of disease appear, hogs can be fed cotton seed meal for a short time with the best results, and this experiment would indicate without subsequent deleterious effects." (See Bulletin 53, Kansas Station.)

Why cotton seed or *cotton seed meal kills pigs* and *hogs* is not definitely known. At present the opinion most prevalent is that it is a result of the condition of the cotton seed or cotton seed meal. It is certain that cotton seed can undergo decomposition—possibly from various forms of germs. These germs when taken into the alimentary canal for some time, may, invade the tissues and produce the severe inflammation of the intestines and the peritoneum. This process may be explained in another way. The germs by their action on the cotton seed or the tissues may develop a poisonous product (ptomaine) which causes the inflammation and death. In either case it is the condition of the cotton seed or cotton seed meal that causes the death. Some one may ask: How is it with the roasted or boiled cotton seed where the germs are destroyed by the heat? The heat

may not destroy the poisonous product, and in many instances the cotton seed is left in the pen and troughs of the pen long enough to begin to decompose before they are eaten. I am of the opinion that boiled or roasted cotton seed will not kill pigs if the seed are not allowed to begin to decompose in the pen before they are eaten. In other words the pen should be cleaned out as soon as the pig stops eating, after each time of feeding. Some have asserted that the lint on the cotton seed formed concretions or impactions in some part of the alimentary canal. I have never observed this and have only heard it asserted by persons whose ability to judge of such conditions was questionable.

Furthermore, some believe that the pig, when fed on nothing but cotton seed or cotton seed meal, starves to death. This may occur, but it failed to take place in the limited number of tests we have made.

From the tests that have been made here, it is very probable that combining crushed cotton seed with a liberal quantity of green rye, green oats, green sorghum, sweet potatoes or turnips, it can be fed to pigs and hogs without great danger, providing the cotton seed is not mouldy or decomposing or allowed to partially decay in the pen. It is also probable that crushed cotton seed can be combined with skimmed or separated milk.

Furthermore, it is quite evident that, after a pig reaches the weight of 50 lbs. cotton seed or cotton seed meal in combination with corn, or cow-peas, can be made a profitable pig ration up to the time of the premonitory symptoms of disease. As a rule this period varies between three and six weeks. The premonitory signs of disease, are weakness, staggering, fever, loss of appetite and few, if any, movements. When these symptoms appear, the pig should be turned into a pasture or the food should be changed to bran slops and corn or other healthy foods.

The details of these experiments were carried out by Mr. T. U. Culver, Superintendent of the Station Farm. Much credit is due him for the results obtained.

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TREATMENT OF SOME FUNGOUS DISEASES.

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TREATMENT OF SOME FUNGOUS DISEASES

——BY——

L. M. UNDERWOOD AND F. S. EARLE.

Much has been written in recent years on plant diseases and their treatment. A division of the Department of Agriculture at Washington has been created for the special purpose of studying them, and the entire staff of ten or twelve trained botanists devote their whole time to the work. The various State Experiment Stations are nearly all working in the same field, and publications from these various sources are rapidly accumulating. It is the purpose of the following pages to present in compact and convenient form to the farmers and fruit growers of Alabama a statement of our present knowledge concerning some of the more common and destructive diseases of our more important crops. It is in no sense a contribution to scientific literature, but a compilation intended as a ready reference for practical farmers. Bulletin No. 45 issued from this station, serves a somewhat similar purpose for injurious insects, but so far this station has published no general directions for the treatment of plant diseases caused by fungi. Only the more important diseases, and those likely to prove troublesome in this State will be discussed under the crops which they affect. It is first desirable to give a brief discussion of the nature of fungi, and their relations to other plants, since many hold very erroneous ideas regarding them.

The Nature of Fungi.

Among the lower forms of vegetation none that are relatively so conspicuous and common are popularly so little understood as the fungi. This arises from the fact that the

group contains a vast number of kinds that, so far as form and habit are concerned, are utterly diverse from each other. It is not easy for instance to see any striking resemblance between an ordinary mushroom or toadstool, and the rust that grows on our grain, or the smut that disfigures our corn. There is little outward resemblance between the giant puff-ball, and the leaf spot of cotton or strawberry, yet all these forms come under the same designation as fungi.

A second source of popular confusion has arisen from the more or less one-sided way in which the subject has been treated by popular or even scientific writers. Certain forms of fungi injurious to cultivated plants have been written about, and naturally their ravages have been made prominent. In this way the farmer has often been led to believe that all fungi are enemies to be combatted with Bordeaux mixture, and all sorts of spraying machines. A comprehensive view of the group is rarely presented, and it is desirable in this as in every other subject that we form some definite notion of the subject in its general relations in order that our ideas may not be one-sided or distorted.

The group of plants known collectively as fungi—for fungi are just as truly plants as any other form of vegetation—are associated together and distinguished from other low forms of vegetation by a simple physiological character, which can be easily recognized, notwithstanding the fact that it is a negative one. This characteristic is the inability to live on mineral or inorganic matter. Ordinary green plants, high or low, have the power to take the gaseous constituents of the atmosphere, together with water and certain mineral salts found in the soil, and through the agency of sunlight transform them into starch, sugars, and other more highly organized forms of food stuffs. This they are enabled to do by virtue of the possession of a green substance, that which gives the color to ordinary vegetation. This substance is called *chlorophyll*

(literally leaf-green). It is this function possessed by green plants that serves to distinguish them from all other living things. The fungi having no chlorophyll in their composition, are unable to perform this function, and hence must depend for their food supply on some form of matter already organized. Some live on decaying matter, and are known as saprophytes: such are the toadstools and puff-balls that grow about muck piles, or decaying stumps, or buried roots, and the bracket-fungi on dead or fallen tree trunks; such also are the moulds that grow on bread, preserved fruits, and other forms of food; such also is the microscopic yeast plant that causes alcoholic fermentation, and is used alike in the manufacture of bread and beer; such are many of the still more minute bacteria that are the cause of decay and putrefaction. Other fungi secure their food from the living tissues of plants and animals, and are called parasitic fungi; a few even are parasitic on other fungi.

Fungi are unable to organize inorganic food, because they contain no chlorophyll. Whatever may be their color, they may be characterized as not green.* The more ordinary color of fungi is white, but black, brown, blue, yellow and various shades of red are not uncommon.

Since it happens that not all parasitic plants are fungi, we should limit the definition of the group still further by the statement that fungi reproduce their kind by microscopic spores, and never by seeds.

Spores Different from Seeds.

As the distinction between seed and spore is not well understood, it may be well to contrast them. If we cut open the seed of a squash, apple or bean, we will find that the in-

*Certain apparent exceptions to this rule are familiar in the ordinary green mould, the green fungus of decaying wood which stains fallen timber, and a few others. In all these cases the green color is due to other substances than chlorophyll, and in fact the shade of green presented is different from the familiar green of ordinary vegetation.

terior consists of two halves, connected at one point by a short sprout-like body. Between these two halves, especially in seeds that have commenced to swell, we can see even with the unaided eye, the young shoot that is destined to become the new plant. These two halves of the seed contain a rich supply of nourishment, and as the seed sprouts, they become the first leaves of the young plant, and supply its food until it has developed its roots and is able to obtain nourishment from the soil. This structure which forms the entire contents of the hull in the cases mentioned, is called an embryo, as it is really nothing but a young plant. It is the possession of this embryo that distinguishes a seed as such. In other seeds like the morning glory and the persimmon, the embryo instead of filling the entire hull, lies embedded in a mass of nutritive substance. This embryo can be seen beautifully in the seed of a persimmon that has been split flatwise after a little soaking. A seed then is a reproductive body of sufficient size to be easily seen, possessing a complex structure, and containing an embryo which on sprouting becomes a young seedling.

Now how does a spore differ from a seed? In the first place a spore is so small that it cannot usually be seen singly with the unaided eye. If we press a puff-ball, a small cloud of dust-like particles issues from it. Every particle of this dust-like matter is a spore and the mass of them issuing from the ball becomes visible because of the immense numbers. These spores are so small that it would take about 5,000 of them laid side by side to make a line an inch long, and a puff-ball an inch in diameter would contain many millions of them. And yet each of these spores, consisting of a mere skin containing a minute drop of a glairy fluid, is capable, if placed under suitable conditions of heat and moisture, of germinating into a new fungus like the one that produced the spore in the first place. Another instance of spores that are visible in the mass is seen in the ordinary smut of corn or oats. The black smutted heads of oats are made up when mature of a mass of black dust that easily soils the fingers. Each particle of this black smut is a spore

and each one that reaches a suitable place for sprouting is able to smut a head of grain the following year. Still other spores can be seen in the rusty or black lines that appear on the stems of various small grains. These lines are simply the masses of spores of the parasitic fungus breaking through the surface of their host plant in order to spread the rust to other plants or to hold the fungus over the winter to attack the young grain of the following season.

A spore then is a reproductive body that has the same office as a seed, but differs from it in its microscopic size and simple structure. When the spore germinates it pushes out a minute germ tube which becomes what we call a *hypha*. The spores of fungi have a definite form when viewed through a microscope. Some have characteristic shapes so that the particular group to which they belong can be easily recognized. In others the shape is less characteristic, but the form of spore produced by any one species is as constant for that species as the shape of the seed produced by any of the higher plants.

Definition of a Fungus.

A Fungus then is (1) A plant that has as definite a life history and mode of growth as a cotton plant, an oak or any other form of vegetation. (2) Is devoid of chlorophyll or the ordinary green color of vegetation. (3) Possesses a simple structure, and (4) Reproduces itself by means of spores.

In structure, fungi vary as widely as do the higher forms of vegetation. Some of the simplest, like the yeast-plant, consist of a minute drop of semi-fluid substance (*protoplasm*) surrounded by a delicate covering known as the cell wall, the whole not over one three-thousandth of an inch in diameter. More complex forms like the moulds, form delicate thread-like structures (*hyphae*) which frequently interlace into a tangled, matted or more or less felty mass (*mycelium*). Some of the larger forms are gelatinous, some are fleshy, some leathery, corky or even firm and woody, but in each case this structure is developed by some modification of the

simple interlacing mycelium. There are none of the highly developed forms of tissues seen in higher plants, the structure of fungi being always simple.

Not all fungi are injurious, many are harmless, some are beneficial and even a necessity to our existence. Of the larger fleshy forms a considerable number are valuable food plants as nutritious as fish, oysters or beef, and there is no reason why they should not form as common an article of food among us as they do in the countries of Europe. The fact that we import large quantities of mushrooms from Europe which could be easily produced in this country and of a much better quality than the imported article is suggestive of one of the undeveloped resources of industry and cultivation that is lying dormant in our midst. It is, however, the parasitic forms of fungi, that at present concern us most.

Classes of Parasitic Fungi.

Parasitic fungi may be conveniently classified in three groups:

(1) Internal free parasites floating or swimming in the cell sap of plants and absorbing their vitality. Such a parasite is the one that produces pear blight and such are the parasites that assist in producing the various rots of different garden vegetables.

(2) External fixed parasites, forming a cobwebby growth of mycelium on the surface of leaves or fruits and drawing nourishment from the plant by means of suckers. Such are the powdery mildew of the grape and those of a similar nature found on many other plants.

(3) Internal fixed parasites, growing entirely within their host-plant, sapping its nourishment, and only appearing at the surface when ready to reproduce by means of spores. This group includes by far the greater number of species of parasitic fungi that infest cultivated plants and include the rusts, smuts, downy mildew of the grape, black rot, the ripe rot of apples and other fruits, etc., etc.

Other Causes of Plant Diseases.

Not all the diseases of plants are produced by parasitic fungi. Some diseases are physiological, due to drainage, the character of the nutrition or the lack of it, and to many other causes not well understood. Other diseases are caused by insects of various kinds or by the ravages of other and often more minute forms of animal life.

In order to treat a disease succesfully we must know its cause and if it is due to a parasitic organism we must know its life-history, its mode of entrance to its host and its method and time of reproducing itself, in order that we may attack it at its weakest point, prevent its entrance to the host, and prevent its spread by its many methods of reproduction.

Not all diseases that are called by the same general name are produced by the same cause. For instance the term "rust" as applied in the State of Alabama to a disease of cotton has nothing in common with the rust that appears on the cereals. In fact the term "cotton rust" is a loose general term that really means about as much as "cotton disease" for it is indiscriminately applied to several distinct diseases, some of which are physiological and some of which are caused by various parasitic fungi. Again the term *blight* has a very loose popular usage and has been the source of much confusion. There is no such thing as a general blight affecting various plants. The blight of the pear and apple is due to a very definite organism, concerning which much is already known. The blights of other plants, notably various garden vegetables, is due to other entirely different organisms whose character is far from being well known.

Root galls, or swellings on the roots of plants, are due to various causes and must be made a separate study before the cause can be determined in any given case. In the grape they may be due to the work of various insects, or produced by minute thread worms (*nematodes*); in many garden vegetables and field crops they may be due entirely to the latter cause; in the cabbage and other members of the mustard family they are due to an internal plant parasite of a low

order that produces the disease known as "club foot," which externally often resembles the deformities produced by the nematodes. In several leguminous plants root galls are produced by an internal parasite, but in this case instead of forming a disease, the parasite is rather beneficial than otherwise as it serves to assist the host in collecting nitrogen. In still other cases the causes of root galls are entirely unknown.

Sufficient has been said to indicate that too careful a study of the conditions and causes of plant diseases can not be made, and that we should be careful in too much hasty generalization. In order to furnish the farmers of Alabama some information of the most common fungous diseases that are likely to be met with in the State, and to furnish simple directions for treating them as approved by practice here and elsewhere, we give, after a few formulas for preparing fungicides, a classified list of fungous diseases, giving symptoms where not well known and method and time of treatment.

FORMULAS FOR FUNGICIDES.

As a rule fungicides are applied as a preventive rather than a cure. Since it has been found that the spores of fungi will not germinaie in the presence of salts of copper, various preparations have been applied which involve the salts of that metal in solution. The following will be found the most efficient for general use, but modifications will be noted for special cases later:

Sulphate of Copper.

Formed by dissolving two pounds of copper sulphate (bluestone) in fifty gallons of water. In dissolving the bluestone it should be placed in a small piece of gunny sack and suspended near the top of the barrel as it will dissolve too slowly otherwise. This can only be used on vines or trees before the buds have commenced to swell.

Bordeaux Mixture.

As commonly applied, it is formed of six pounds of copper sulphate (bluestone) and four to six pounds of quick lime dissolved in fifty gallons of water. The bluestone should be dissolved as in the preceding formula. The mixture must be thoroughly stirred while using.

Ammoniacal Carbonate of Copper.

This is made by dissolving four ounces of carbonate of copper in two quarts of ammonia and adding the solution to fifty gallons of water.

Copper Acetate.

Dissolve four ounces of copper acetate in fifty gallons of water.

Combination of Insecticides and Fungicides.

Four ounces of Paris green or London purple may be added to fifty gallons of Bordeaux mixture when it is desirable to spray for both fungi and insect pests.

Method of Application.

A large number of forms of spraying apparatus are on the market and the amount of work of this kind to be done and the kind of plants to be sprayed will determine the character of the apparatus to be used. A nozzle that produces a fine mist-like spray is always desirable and in some cases a necessity.

DISEASES OF CULTIVATED PLANTS.

CORN.

Fortunately this great staple suffers from comparatively few fungous diseases. The only one to be mentioned here is the smut (*Ustilago maydis*). The appearance of this dis-

ease is too well known to need description. The unsightly pustular masses filled with black powder are only the fruiting portion of the fungus. They usually occur on the ears but are occasionally seen on the tassels or on the leaves. Under the microscope each particle of the black smutty powder is found to be a minute brown ball-like spore covered with little spines. The mycelium or vegetative portion of the fungus grows entirely within the corn plant. It consists of delicate colorless threads which penetrate the tissues of the corn plant and draw its nourishment from it. They cannot be seen without the use of a microscope.

Corn smut is widely distributed. Probably no field can be found entirely free from it. Farmers are so accustomed to seeing it that but little thought is given to the loss it causes. It is true that in individual cases this is not great; it does not sweep through a field destroying an entire crop as is the case with some diseases, but the aggregate loss it occasions is quite large; cattle are sometimes killed by pasturing in badly smutted stalk fields.

The smuts of the small grains can now be quite successfully controlled by treating the seed. So far no treatment has been found that is of the least use for corn smut. It is sometimes recommended to go through the fields and remove the diseased stalks as soon as they can be detected before the spores ripen. If this should be done persistently by all the farmers in a neighborhood, it would doubtless materially reduce the loss from the disease in subsequent crops. At present no other remedy can be suggested.

OATS.

Oat Smut.—Like corn smut this is a widely occurring disease. It is caused by a similar fungus (*Ustilago avenae*). The spore masses are much smaller than in corn smut, and the single spores are slightly smaller and smoother. The smutted heads of course go through the thresher with the rest, so that the dusty smut spores are well mixed with the grain. When such smutty seed is planted the following

spring, the smut spore germinates just as the oats are sprouting, and its delicate germ tube is able to pierce the soft tissue of the young oat sprout. The mycelium of the fungus now grows with the growing oat plant, and it makes no outward sign until the heads are formed, when instead of oats they are found to contain only the worthless smut spores. Fortunately the fungus cannot damage the oat plant after it has had time to harden. Many careful experiments show that infection only takes place through the freshly sprouting seed. For this reason any treatment that will thoroughly disinfect the seed by killing the smut spores adhering to it, will effectually protect the crop. The importance of treatment will be apparent when we know that the average loss in untreated fields is over ten per cent. of the entire crop. Treating the seed with copper sulphate (blue stone), has long been known as a preventitive of smut. It is still often recommended for wheat, but for oats either of the two following treatments are preferred.*

Potassium sulphide treatment.—Dissolve one and one-half pounds of potassium sulphide (liver of sulphur) in 25 gallons of water in a barrel. Add three bushels of seed oats, stir thoroughly at intervals to insure thorough wetting of all the grain, and allow to stand for twenty-four hours. Strain off the liquid and spread the oats to dry. The solution will answer for three lots of seed. Of course a tank should be used for treating large quantities.

Hot water treatment.—Provide two kettles, tubs or barrels holding at least twenty gallons each. Fill one with hot water at 110 to 120 degrees, the other with scalding water at 132 to 133 degrees. Have plenty of boiling water and cold water at hand with which to maintain these temperatures. Put one-half bushel of oats in a coarse loosely woven gunny sack. Plunge it in the vessel of warm water and lift it up and down several times to

*For a full discussion of this subject, see "The grain smuts; their causes and prevention," by W. T. Swingle, in the Yearbook of the Department of Agriculture for 1894.

thoroughly wet and warm the grain. Allow it to drain a moment, and then transfer it to the hot water. Let it remain in the hot water for ten minutes, agitating freely, then remove and spread the grain to dry. The success of the treatment will depend entirely on keeping the hot water as nearly as possible at 133 degrees. If the temperature rises above 135 degrees, it may injure the seed, and if it falls below 130 degrees, some of the smut spores will not be killed. The wet seed should be spread out two or three inches deep, and be shoveled over frequently until quite dry. This is not necessary if it is to be sown immediately by hand.

An important consideration in favor of these two treatments of seed oats, is that the seed germinates quicker, and the yield is considerably increased aside from the gain in preventing smut. The copper sulphate treatment retards germination and does not increase the yield.

Oat Rust.—This disease is produced by *Puccinia coronata*,* quite a different fungus from those causing smut. The mycelium in this case also consists of colorless threads buried within the oat tissues, but instead of extending throughout the plant as with the smut, they are confined to rather small areas beneath the spots covered by the reddish or rust-colored powder from which the disease takes its name. This reddish powder consists of the spores of the fungus. Under the microscope they are seen to be three or four times as large as the smut spores. They are oval in shape, and of a light yellow color. They germinate quickly under proper conditions of heat and moisture, and their germ tubes are able to penetrate the oat leaves, where they soon develop new spots of rust. The disease is thus enabled to spread very rapidly when weather conditions are favorable. This disease does not attack the grain itself, as does the smut. If only a little is present, the injury is slight, but when abundant, it de-

**Puccinia graminis* and *P. rubigo-vera* also occur on oats, but the above remarks will apply equally well to these species.

stroys so much of the leaf surface, and appropriates so much of the nutriment of the plant, that the grain is light and poor in quality, and often greatly deficient in quantity.

A little later in the season a second kind of spore is developed on the rust mycelium. These form short black lines on the leaves and stems. They are called winter spores, because their office is to carry the fungus through the winter. They are long and narrow, and are divided by a cross partition into two cells. They are darker colored, and the cell wall is thicker than in the red or summer spores. This fungus is a good example of the true rusts (*Uredineae*). They form a large group and include some of our most troublesome diseases. As a rule they do not yield readily to treatment. No practical remedy has been found for the oat rust. Some varieties of oats, however, suffer less from the disease than others. In this State it is usually only the resistant or so called "rust proof" varieties that are planted. Something moreover can be done by methods of planting and fertilizing, to help the oat plant to resist the rust. On some soils oats will rust less when plowed in, thus covering the seed more deeply, and producing a deeper rooting habit than when merely brushed and harrowed in after the land is plowed. Excessive applications of nitrogenous fertilizers like stable manure or cottonseed meal that cause a soft, succulent growth, are more apt to favor rust than where the mineral elements, phosphates and potash, predominate in the fertilizer, and the growth is harder and less rapid.

Other serious diseases of oats occur, but they will not be considered here.

COTTON.

The diseases of cotton have been studied by the officers of this station, and have been discussed in Bulletins 21, 27, 36, 41 and 55. In Bulletin 41, Professor Atkinson described all the cotton diseases that had been observed by him, and the reader is referred to that bulletin for a detailed dis-

cussion of them. The diseases enumerated, are briefly as follows:

1. Yellow leaf blight or mosaic disease. A physiological trouble due to poor nutrition. It can often be prevented by applications of kainite.

2. Frenching. Caused by a fungus (*Fusisporium vasinfectum*).

3. Damping off or sore-shin. Caused by the mycelium of an unknown sterile fungus. This affects the young seedlings.

4. Anthracnose. Caused by *Colletotrichum Gossypii*, usually affecting the bolls.

5. Shedding of bolls. A serious trouble, usually entirely physiological and not due to either insects or fungi.

6. Angular spot of cotton. An obscure disease of the leaves, probably caused by bacteria.

7. Areolate mildew of cotton. Caused by a fungus (*Ramularia areolata*) which produces a white mildew on the leaves.

8. Cotton leaf blight. Caused by the early or Cercospora stage of a fungus (*Sphaerella gossypina*).

9. Root gall of cotton. Caused by the nematode (*Heterodera radicicola*). The same nematode affects many other garden and field crops and orchard trees.

Unfortunately no remedies can be suggested at present for most of these diseases. They are doubtless largely induced or at least aggravated by the common practice of cropping the land year after year in cotton. When cotton shall be made to take its place in a carefully considered rotation of crops great benefit will follow in its comparative freedom from disease as well as in the preservation of soil fertility and the avoidance of over production.

POTATOES.

Potato Blight.—The much dreaded Northern potato rot or blight (*Phytophthora infestans*) probably does not occur in this State. It certainly is not a common disease here.

We have, however, a Southern potato blight that is often very destructive. It manifests itself by the sudden wilting of the tops about the time the young potatoes are forming or perhaps after they are nearly grown. On cutting open the freshly wilted stems a spot will be found near the surface of the ground where the substance of the stalk looks clear and watery much as in the "water core" of certain apples. This watery portion is found to be swarming with bacteria and there is little question but that they are the direct cause of the disease. At first the young potatoes will still be quite sound but the disease soon reaches them through the stem and causes them to rot. When seemingly sound potatoes from a diseased vine are cut open a brown line can often be traced under the skin showing that the disease has already reached them. Such potatoes will not keep but will rot quickly, and if stored with others the rot soon spreads throughout the mass, causing great loss. This disease seems to live in the soil from one crop to the next, so that it is unsafe to plant potatoes the following year on land where the disease has appeared. The same, or at least a very similar disease attacks tomatoes, egg plants and peppers, so that these crops should not follow blighted potatoes.

No remedy is known except to avoid planting on infected land and to practice rotation of crops.

Potato Scab.—The black roughened or sunken patches often seen on potato tubers are caused by an obscure fungus (*Oospora scabies*). The same fungus attacks beets. It seems to be able to live as a saprophyte on the vegetable matter in rich soils, so that when the soil is once infected by planting scabby seed it is unsafe to plant it again in potatoes for some years. No known treatment will prevent the scab on such land. On clean land, treating the seed with corrosive sublimate will entirely prevent the disease even if scabby seed is used. Of course clean seed should always be used when possible. For this treatment dissolve two and one-half ounces of corrosive sublimate in two gallons of hot water in a tub or barrel. After standing until all is dissolved add

thirteen gallons of cold water. Soak the seed potatoes in this solution for an hour and a half, then dry, cut and plant as usual. The treated potatoes should of course all be *planted* and not used for other purposes as they are poisoned by the treatment. When scabby potatoes are fed to stock it is unsafe to use the manure for fertilizing potatoes as the scab fungus propagates in the manure and is thus taken to the field. On this account chemical fertilizers are usually preferred by potato growers.

Leaf-spot of potatoes or Macrosporium disease.—Potato foliage is often observed to be covered by rounded brown or arid spots. At first these spots are marked by concentric rings or zones of a darker color, but at length the dried portion of the leaf often breaks out and falls away. This spotting may begin soon after the plants are up. If there is but little of it no great damage is done, but when abundant it destroys so much of the leaf surface that the nutrition of the plant is deranged and the tubers are few and small. In extreme cases the leaves fall and the plant dies prematurely without forming tubers at all. It is a wide spread disease and frequently occasions much damage. Fortunately it can be quite effectually controlled by careful spraying with Bordeaux mixture. The first spraying should be given soon after the plants are up and should be repeated three or four times, at intervals of ten days or two weeks. It must be remembered that this treatment, like most others, is preventive not curative. The Bordeaux mixture serves to protect the foliage from attack; it does not cure the spots already formed, hence the importance of beginning the treatment early. To be successful we must keep ahead of the disease. Fortunately the labor of spraying will not be lost even if the disease does not appear, for in some way, not understood, the Bordeaux mixture seems to slightly increase the yield besides preventing the disease.

If potato beetles appear, Paris green may be mixed with the Bordeaux mixture as indicated elsewhere, and both enemies can be combatted by the one application.

TOMATOES.

Southern Tomato Blight.—This is similar to the Southern potato blight if not identical with it and like it is of bacterial origin.* It also attacks egg plants and peppers. It first appears about the time the fruit is beginning to form, and is characterized by the sudden wilting and dying of plants that are apparently vigorous. In some localities its ravages have been so great as to cause the abandonment of the tomato as a market crop. The disease will remain in the soil from one year to the next, and will increase rapidly if tomatoes are planted continously on the same land. Some experiments conducted in Mississippi indicate the probable usefulness of heavy applications of lime and kainite to the soil, as well as the spraying of the stems with Bordeaux mixture, but these experiments are not conclusive, and no treatment can be positively recommended, except to avoid planting on infected land. Even then the disease sometimes appears when tomatoes are planted on entirely new land quite remote from other tomatoes. The source of the contagion has not been accounted for in such cases.

Tomato Leaf-spot or Macrosporium disease.—This is the same as the potato disease of the same name, and yields to the same treatment. It frequently occasions heavy losses.

Tomato Leaf Blight.—This is caused by a fungus (*Cladosporium fulvum*) that forms a velvety olive brown coating on the under side of the leaves causing them to fall prematurely. It is a common pest when tomatoes are grown in greenhouses in winter, and is sometimes troublesome in the open air at the South. Spraying for the macrosporium will check this disease also.

Tomato Black-rot or Blossom-end rot.—This widely occurring and destructive disease is not yet well under-

*A blight somewhat similar in its effects occurs in Florida that is caused by the growth of the mycelium of some fungus. It has not so far been detected in this State.

stood. At least two fungi (*Macrosporium Tomato and Fusarium Lycopersici*) are usually associated with it, but in just what connection cannot be positively stated. It is usually first seen as a discolored spot on the blossom end of the tomato fruit, soon after it has formed. This increases rapidly in size, becomes sunken, and is at length covered with the dusty spores of the associated fungi. It is liable to cause very serious damage, not unfrequently destroying over half the crop. The early clusters usually suffer worst, but its attacks are quite erratic, seeming to depend on the weather and on the general condition of the plant. It is invariably bad during seasons of protracted drouth ; at such times a good rain will often check its ravages. Again during very wet weather there may be a destructive outbreak. Excessive manuring sometimes seems to favor the disease, while half starved plants growing in some poor spot may also be badly affected. In fact anything that checks or unduly stimulates the normal healthy growth of the plant, seems to favor the disease.

Spraying with Bordeaux mixture is often recommended for this disease, but the results of experiments so far reported are somewhat contradictory, and it cannot be definitely stated how successful such treatment will prove to be. Much will probably depend on the thoroughness and frequency with which the applications are made. Since the Bordeaux is known to be useful in combatting the Macrosporium disease, and is possibly useful in preventing the blight, it should certainly be applied with the hope that it will be of use in preventing the rot also. For one or two applications while the fruits are small, it is advisable to add one-fourth of a pound of Paris green to each barrel of the Bordeaux, with the hope of killing some of the young boll worms that feed on the surface a few hours after they are hatched, and before they bore into the fruit. The ravages of this insect will cause it to contest with the black rot for first place among the enemies of the tomato grower.

Other destructive rots of the green tomato occur, one probably of bacterial origin, but they have been little studied, and no remedies can be suggested.

WATERMELONS.

Melon Wilt or Melon Blight.—This disease is attracting increasing attention throughout the South. In most melon growing districts it is being found impossible to plant the land to melons year after year, without suffering great loss from it. It usually only appears after the vines have run out so as to nearly cover the ground, when they will suddenly wilt and die. The symptons are so much like those of the potato and tomato blights, that some connection between them has been suggested. This, however, is not the case. The melon blight is not bacterial, but is caused by the growth of an internal fungus that plugs up the ducts of the stems and causes the sudden wilting by shutting off the water supplied by the roots. This has been demonstrated by Dr. Erwin F. Smith of the Department of Agriculture, who is making an exhaustive study of this disease. Where the soil becomes infected, it is necessary to abandon the culture of melons for several years. No remedy has been found. A rotation of crops is suggested as a proper preventive measure. In fact the more we study plant diseases, the more important the question of crop rotation becomes.

Melon Anthracnose or Black-rot.—This disease occurs abundantly throughout the South, and causes considerable loss to melon growers. It is probably identical with the melon anthracnose caused by *Colletotrichum lagenarium*, discussed in the fifth annual report of the Delaware experiment station. It has been little studied, and no remedy can be suggested.

SWEET POTATOES.

This is an important crop for the South but its diseases have not been studied much here. In Bulletin No. 76 of the

New Jersey Experiment Station, Dr. Halsted describes nine fungous diseases of the sweet potato. It is probable that many of them also occur in this state. Some of them only attack the stored potatoes, others attack the foliage, while still others live on the vine through the summer and cause a destructive rot of the stored potatoes in winter. The Black-rot (*Ceratocystis fimbriata*) is of this class and is perhaps the worst of sweet potato diseases. It first appears on the potatoes as dry sunken dark-colored spots. If any such diseased potatoes are bedded in the spring, the fungus will attack the draws or shoots forming black spots on the stems. Such draws are said to have "black-shank" and if planted will certainly produce diseased potatoes in the fall. This may not show much when dug but it will develop later and the the rot will spread to neighboring sound potatoes in the bin. This shows the necessity for bedding none but perfectly sound potatoes. This disease seems to be able to live over for some time in the soil so when it is detected it is unwise to replant the same land to sweet potatoes for a year or two at least.

Much of the loss in the stored sweet potatoes from the other rots can be avoided by greater care in digging and handling. Cut and bruised sweet potatoes never keep well and when freshly dug they are very easily injured. The common practice of picking them up in sacks after digging always bruises them badly. Smooth shallow boxes holding half a bushel to a bushel should be provided for this purpose and they should be emptied carefully so as to avoid letting the potatoes fall any distance. In fact they should be handled as carefully as eggs in order to keep well. If they are stored in bins or cellars it is important to clean these out thoroughly and disinfect by burning sulphur and whitewashing before storing another crop. Some very favorable results are reported from dusting the potatoes as they are stored with a powder prepared by slaking lime with water in which copper sulphate has been dissolved.

PEACHES AND PLUMS.

These important stone fruits may be considered together since they are mostly subject to the same diseases. Peach yellows so destructive to orchards in many other regions does not occur here; nor has the closely related peach rosette been reported from this state though it occurs abundantly in middle Georgia and may be expected here at any time. Fortunately it has not proved as serious a disease as was feared a few years ago.

Peach and Plum Rot.—This is easily the worst disease of stone fruits. Its appearance on the half grown and ripening fruit is well known but the fungus causing it (*Monilia fructigena*) also attacks the blossoms and very young fruits causing them to blast and fall. At other times it attacks the rapidly growing young wood and causes a destructive twig blight. It lives over winter in such diseased wood and also in the dried or mummied fruits so often seen hanging on the tree in the spring.

Some varieties are more subject to the rot than others but none a are exempt. Its growth is largely influenced by the weather, being greatly aggravated by hot damp or showery days, and in seasons where such weather is frequent, total loss of crops sometimes occurs. As the fruit approaches ripeness the trees should be examined frequently and any rotting specimens should be removed. This is important as the disease spreads very rapidly from the rotting to the sound fruit. Thinning the young fruit so that they hang separately on the limbs is of great use in preventing the spread of the rot as it allows them to dry more quickly. This practice adds so much to the size, quality and market value of the fruit that it should certainly be practiced by all. Another important precaution is to remove all mummied fruits from the orchard before blooming time. Fruit rots worse on rich land or where an excessively luxuriant growth has been caused by heavy applications of nitrogenous manures. Such lands and fertilizers should be avoided for stone fruits. They thrive best on high well

drained, rather thin lands but on such soils will be greatly benefited by moderate applications of the phosphates and potash.

The advisability of spraying with fungicides to combat peach and plum rot is perhaps still an open question. Some experimenters, particularly Professor Chester of the Delaware Experiment Station, report very encouraging results, but the foliage especially of the peach, is very liable to injury from such applications and they must be made with great care. The disease is so important that extensive experiments are justified in attempting to control it, but only the best pumps and Vermorel nozzles giving a fine mist-like spray should be used in making the applications. Professor Chester * recommends the following treatment :—

1st. During the winter gather and burn all mummied fruit.

2nd. In winter or early spring (before the buds start) spray with a solution of copper sulphate using one pound to 25 gallons of water.

3rd. When fruit buds begin to swell spray with Bordeaux mixture made with six pounds of copper sulphate and at least six pounds of quick lime to the barrel.

4th. Spray again with Bordeaux mixture just before the blossoms open.

5th. As soon as the blossoms fall, spray again with the Bordeaux mixture, to which is added three ounces of Paris green per barrel. This is on account of the curculio which attacks the young fruit. The Paris green should be rubbed to a smooth paste with a little water before adding to secure an even mixture.

6th. In ten days repeat the Bordeaux and Paris green

7th. When fruit begins to color, spray with copper acetate (four ounces to the barrel of water). This is recommended instead of the Bordeaux at this stage, since it does not adhere to the fruit nor disfigure it, and it is found to be equally effective.

*Delaware Experiment Station, Bulletin 29.

8th. Repeat the copper acetate after a week or ten days.

The total cost of this treatment is estimated by Professor Chester at twelve cents per tree where everything is done economically, and in the experiments reported about three-fourths of the rot was prevented. He admits some dropping of the leaves as a result of the spraying, but thinks this injury more than balanced by the foliage hanging much later in the fall on the treated than on the untreated trees.

Leaf Rust.—This is caused by a fungus (*Puccinia pruni-spinosae*) closely related to the rusts of grain. It often develops abundantly on peach and plum leaves late in summer, causing them to fall prematurely. This and other leaf destroying fungi will probably be effectively controlled by the spraying suggested for the rot.

Gummosis.—This is an obscure diseased condition that manifests itself by the occurrence of blisters or pockets filled with gum under the bark of the trunk and branches. It is not to be confounded with the copious flow of gum occasioned by injuries from borers or other mechanical causes. It is accompanied by a serious constitutional derangement of the tree, and frequently causes its death, but the nature of the disease is not known, and no remedy can be suggested.

APPLES, PEARS AND QUINCES.

These pomaceous fruits are subject to many of the same diseases, the most important of which is the—

Blight.—This is a bacterial disease caused by the growth of a minute germ or microbe in the young, soft tissues of the tree. The diseased parts soon die, and the blackened persistent leaves can be seen hanging as a signal of distress in most Southern orchards. As the wood growth begins to harden, the disease becomes less active and usually dies out of its own accord. In such cases a distinct ring marks the union of the dead and living bark. In a few cases, however, the disease does not stop, but

continues to grow slowly in the soft inner bark, and it is such spots of still living blight that serve to carry the contagion over winter. This is an important point in the life history of the disease that has been pointed out recently by M. B. Waite of the Department of Agriculture, who has devoted much time to the study of this disease. He has shown that from such spots of "hold over blight," the germs are carried to the flowers in the spring by bees and other insects. Here they multiply rapidly in the nectar secreted by the flowers, and are widely disseminated by the same insect agency, causing the sudden outbreak of "blossom blight," so familiar and so disastrous to Southern pear growers. The disease has attracted most attention on the pear, but it frequently occurs on the apple and the quince. The only known remedy has been to cut out and burn the diseased portions as soon as they can be detected. Mr. Waite's discovery of the way in which the disease passes the winter, indicates that it should be supplemented by a very careful examination of the trees during winter and early spring, to remove all spots of the "hold over blight," thus destroying the contagion as far as possible before it is carried to the open flowers, which are by far the most vulnerable part of the tree.

Another important point in combatting pear blight, is to so control the growth of the tree as to prevent a rank, sappy, over vigorous condition. It is in soft, rapidly growing tissues that the blight thrives best, and when it gains entrance to such trees, it is very hard to check its course. In a tree that is making only a moderate growth that matures and hardens early, the disease frequently dies out of itself without doing such serious injury. For this reason especially, as the trees reach bearing age, nitrogeneous fertilizers and excessive cultivation should be carefully avoided. A little seeming neglect is often the best possible treatment for a pear orchard. On good soil the ideal treatment of a pear orchard of bearing age would be to sow down to some low-growing legume like *Lespedeza* or

white clover, and pasture with hogs, giving occasional top-dressings of kainite and acid phosphate.

Apple leaf rust.—A yellow spotting of apple leaves, caused by the growth of a fungus forming cupshaped receptacles filled with yellow spores, often does considerable damage. Some varieties are much more affected than others. It seldom attacks pears or quinces. Another stage of the growth of the same fungus occurs on the red cedars, causing the large gall-like growths known as cedar apples. The advisability of destroying infested cedars in the neighborhood of apple orchards will at once suggest itself as a remedy against this disease.

Pear and Quince leaf blight.—A very different fungus (*Entomosporium maculatum*) causes the dropping of pear and quince leaves in midsummer. It does not attack apples. Minute brown spots, usually with a reddish border, appear on the leaves, and when there are many of these spots the leaf turns yellow and falls. Some varieties of pears are so badly affected as to be as bare of leaves in June and July as they should be in December. Such trees can, of course, mature no fruit and the falling of the leaves prevents the forming of fruit buds for the next season's crop. The fungus also grows on the fruit, causing it to crack. It is often less severe in trees standing in sod than in cultivated ground. Pear seedlings in the nursery often suffer severely from this trouble and it prevents their becoming large enough to bud.

It is found to yield easily to treatment with Bordeaux mixture, and the spraying of nursery stock is now largely practiced with the best results. In the orchard the treatment to be recommended under the next heading will serve to control this disease also.

Apple and Pear scab.—The species of *Fusicladium* causing this well known disease are supposed to be slightly different on apple and pear, but for practical purposes they may be considered as identical. The presence of the fungus prevents the fruit from reaching full size; it injures its keeping qualities, and by its unsightly appearance greatly

reduces its market value. It also develops on the leaves and on the young twigs. An early spring growth of the fungus often causes the blasting of the flowers and the serious dropping of the young fruit.

The following combined treatment is recommended for preventing or materially lessening the amount of scab and leaf blights and of various summer rots, and at the same time to prevent the loss from wormy fruit and leaf eating insects.

1st. In winter or early spring, before the buds swell, spray with solution of copper sulphate.

2d. Just before the blossoms open spray with Bordeaux mixture.

3d. Just after the blossoms fall spray with Bordeaux, to each barrel of which four ounces of Paris green has been added.

4th. In ten days or two weeks repeat the Bordeaux and Paris green. Later sprayings of Bordeaux alone may be useful but are liable to mar the fruit.

The above treatment cannot be too strongly recommended to all apple and pear growers where scab and codling worms are abundant. On the Gulf coast these troubles have not yet appeared so that these sprayings are not required.

GRAPES.

Black rot; Downy mildew; Powdery mildew; Anthracnose.—These four well known grape diseases can all be largely prevented by the following treatment, which is earnestly recommended to all grape-growers:

1st. Before the buds swell spray with copper sulphate solution.

2d. When growth starts, and the largest leaves are perhaps an inch across, spray with Bordeaux mixture.

3d. Just before the flowers open spray again with Bordeaux.

4th. As soon as the flowers fall spray with Bordeaux.

5th. In ten days or two weeks, when the berries are the size of small peas, spray again with Bordeaux, taking care to direct the spray so that all the bunches will be fully covered. If the work has been carefully done this will usually serve to protect the crop quite perfectly. In very wet seasons one or two later sprayings may be advisable, but they should be made with the ammoniacal copper carbonate solution, as late spraying with Bordeaux stains the fruit unpleasantly.

The anthracnose is more difficult to fully control than the others and treatment is not always satisfactory. The black rot is also very persistent and in badly affected vineyards the greatest care and thoroughness in making the applications is required to control it. On a small scale pinning paper bags over the clusters as soon as the fruit is set furnishes very complete protection from the rot and such bagged grapes ripen more evenly and are finer in flavor than those unprotected. If the vineyard is infested with the green saw-fly larva or by any of the leaf-eating beetles, four ounces of Paris green may be added to the barrel of Bordeaux at any of the sprayings.

Bitter Rot.—This disease seems to be largely confined to the South. In some localities here it is far more troublesome than the black rot. It attacks the berries just as they are ripening giving them a blistered or sun-scalded appearance. Later they are covered with the fruiting pustules of the fungus (*Melanconium*) which resemble somewhat closely those of the black rot, but the berry remains plump and turgid and does not shrivel and become hard as in the latter disease. The bitter rot also attacks the stems of the fruit clusters and it is here that it does its greatest damage for the diseased stems instead of "curing" and becoming soft and pliant when picked so as to pack nicely and carry well, becomes hard and brittle. The berries fall off easily and such shattered bunches are quite unsaleable in market.

The early spraying with Bordeaux does not prevent this

disease. Something can be done towards controlling it by training the vines so that the fruit will hang in the shade of the leaves, for such sheltered fruit is less often diseased than that hanging exposed to the sun and dew. On this account some form of horizontal trellis is much to be preferred to the ordinary vertical trellis or to training to stakes.

Root Rot.—This disease can be detected by the presence of a white mould-like growth under the bark on the roots and crown. It is quite prevalent at the South often doing serious harm. A recent examination of the Station vineyard shows that out of 584 vines all but 83 show evident signs of this disease and many died during the late summer and fall. It seems evident that this is the cause of the death of so many of the vines on the station grounds as reported in previous bulletins. This disease has been little studied in this country and no remedy for it can be proposed at present. It seems to be identical with the disease known as *pourridie* in France. This has been shown to be caused by the growth of any one of three or more different fungi and is usually fatal in from two to three years.

Here some varieties are evidently much more resistant that others and some facts go to show that vines may live many years while more or less affected by it. The character of the soil probably has much to do with the prevalence of the disease.

***

Correspondence regarding the appearance and extent of any diseases of plants cultivated in the State of Alabama is requested by this Experiment Station. When writing regarding plant diseases accompany the correspondence with specimens of the affected plants or portions of plants. It is desirable also to give as full data as possible regarding the nature and extent of the disease. Address all correspondence on this head to The Biological Department, Alabama Experiment Station, Auburn, Alabama.

BULLETIN No. 70. MARCH, 1896.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

THE FLORA OF ALABAMA.

PART V.

P. H. MELL.

MONTGOMERY, ALA.:
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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.

LIST OF PUBLICATIONS

—OF THE—

ALABAMA AGRICULTURAL EXPERIMENT STATION.

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1. Bulletins Nos. 1–10, 1883–1885.
2. Bulletins Nos. 1–9, 1885–1887. "Second series."
3. Bulletins Nos. 1–8 for 1887.
4. Bulletins Nos. 1–5 for 1888.

The above Bulletins were issued in the early formative period of the Experiment Station partly in conjunction with the Commissioner of Agriculture, whose office was then located at Auburn.

5. Bulletins Nos. 1–69 of the current series. These represent the regular bulletins of the station since the foundation under the Hatch fund.

6. Annual Reports of the Agricultural Experiment Station, 1–8, 1888–1895.

By recent action of the Station Council the above bulletins have been arranged into volumes as follows:

Vol. I. To include all Bulletins issued in the first four series and before the foundation under the Hatch act.

Vol. II. To include Bulletins 1–21 of the current series, 1888–1890.

Vol. III. To include Bulletins Nos. 22–58 of the current series, 1891–1894.

Vol. IV. Commencing with No. 59 and now current.

Indices of these bulletins are in process of preparation and when completed will be sent to such as desire to bind their series of bulletins.

In addition to the early bulletins grouped under Vol. I, the following bulletins are out of print and cannot be furnished: Nos. 3, 4, 5, 7, 8, 35, 43, 44, 48, 54, 57, 60, 61, 63.

THE FLORA OF ALABAMA.

PART V.

LEGUMINOSÆ AND ROSACEÆ,

—BY—

P. H. MELL.

Introduction.

An authentic list of the plants growing wild in Alabama has long been demanded by botanists. No complete work on the subject has ever been printed. With the exception of Chapman's "Flora of the Southern United States," and Darby's "Botany of the Southern States," both of which are now out of date, there is no guide to the botanical explorer in regard to the location and habitat of the plants in this State. In the above works whenever Alabama is mentioned only general references are made, and but little definite information is given when speaking of the location of species.

During the past few years botanical science has undergone material change in the classification of genera, the assignment of authority in the naming of species, the weeding out of superfluous names and the adjustment of synonyms. It is not safe, therefore, to trust entirely to publications issued ten or twelve years since without first consulting the corrections recently made by the light of authoritative investigations. In this bulletin, and in others that will follow from time to time on the same subject, an effort has been made to bring the names of species up to date. No doubt mistakes will occur and the author will esteem it a great favor to have such errors pointed out so that corrections may be made in the publications to follow.

In the migration of plants species have been found in

Alabama within recent years which were supposed formerly to be confined to other sections of the country.

For these and other equally important reasons this publication is issued with the confident belief that it will be gladly welcomed by the students of Botany.

This work will be printed in Parts, each of which will be issued only when the material on hand will warrant the publication. Whenever new material is secured after the printing of the part a supplement will be prepared in such form as to render it comparatively easy to attach it as an appendix. These Parts may not be published in consecutive order, but this will be of no material disadvantage since the entire work, when completed, may be bound in one volume and the orders will then follow each other in accordance with Botanic sequence.

A study of the orders has convinced the author that the most convenient grouping is as follows:

PART I. Ranunculaceæ, Magnoliaceæ, Anonaceæ, Menispermaceæ, Berberidaceæ, Nymphæaceæ, Sarraceniaceæ, Papaveraceæ, Fumariaceæ.

Comprising 9 orders and 41 genera.

PART II. Cruciferæ, Capparidaceæ, Resedaceæ, Cistaceæ, Violaceæ.

Comprising 5 orders and 27 genera.

PART III. Caryophyllaceæ, Portulacaceæ, Clusiaceæ, Elatinaceæ, Hypericaceæ, Ternstræmiaceæ, (Camelliaceæ), Malvaceæ, Tiliaceæ, Byttneriaceæ, Linaceæ,

Comprising 10 orders and 47 genera.

PART IV. Olecaceæ, Aurantiaceæ, Cedrelaceæ, Geraniaceæ, (Oxalidaceæ and Balsaminaceæ), Zygophyllaceæ, Rutaceæ, Simarubaceæ, Burseraceæ, Ilicineæ (Aquifoliaceæ) Celastraceæ, Rhamnaceæ, Vitaceæ, Sapindaceæ, (Aceraceæ and Staphyleaceæ) Anacardiaceæ, Polygalaceæ, Krameriaceæ.

Comprising 16 orders and 43 genera.

PART V. Leguminosæ, Rosaceæ.

Comprising 2 orders and 57 genera.

PART VI. Calycanthaceæ, Myrtaceæ, Saxifragaceæ, (Parnassiaceæ and Grossulaceæ), Crassulaceæ, Droseraceæ, Hamamelideæ, Halorageæ (Callitrichaceæ), Melastomaceæ, Lythoraceæ.

Comprising 9 orders and 36 genera.

PART VII. Onagraceæ, Turneraceæ, Cucurbitaceæ, Cactaceæ, Ficoideæ.

Comprising 5 orders and 16 genera.

PART VIII. Umbelliferæ, Araliaceæ, Cornaceæ.

Comprising 3 orders and 31 genera.

PART IX. Caprifoliaceæ, Rubiaceæ, Valerianaceæ.

Comprising 3 orders and 32 genera.

PART X. Compositæ.

Comprising 1 order and 99 genera.

PART XI. Lobeliaceæ, Goodeniaceæ, Campanulaceæ, Ericaceæ, Diapensiaceæ, Plumbaginaceæ.

Comprising 6 orders and 26 genera.

PART XII. Primulaceæ, Sapotaceæ, Theophrastaceæ, Myrsinaceæ, Ebenaceæ, Styracaceæ, Cyrillaceæ, Oleaceæ, Apocynaceæ, Asclepiadaceæ, Logoniaceæ, Gentianaceæ.

Comprising 12 orders and 38 genera.

PART XIII. Polemoniaceæ, Hydrophyllaceæ, Borraginaceæ, Hydroleaceæ, Convolvulaceæ, Solanaceæ.

Comprising 6 orders and 30 genera.

PART XIV. Scrophulariaceæ, Orobanchaceæ, Lentibulariaceæ, Bignoniaceæ.

Comprising 4 orders and 32 genera.

PART XV. Pedaliaceæ, Acanthaceæ, Verbenaceæ, Labiatæ.

Comprising 4 orders and 40 genera.

PART XVI. Plantaginaceæ, Nyctaginaceæ, Illecebraceæ, Amarantaceæ, Chenopodiaceæ, Phytolaccaceæ, Polygonaceæ.

Comprising 7 orders and 30 genera.

PART XVII Podostemaceæ, Aristolochiaceæ, Piperaceæ, (Saururaceæ), Lauraceæ, Thymelæaceæ, Loranthaceæ, Santalaceæ, Euphorbiaceæ.

Comprising 8 orders and 25 genera.

PART XVIII. Urticaceæ (Moraceæ), Platanaceæ, Juglandaceæ, Myricaceæ, Cupuliferæ, Salacaceæ, Empetraceæ, Batidaceæ, Ceratophyllaceæ, Coniferæ, Cycadaceæ, Palmæ.

Comprising 12 orders and 31 genera.

PART XIX. Hydrochardiaceæ, Burmanniaceæ, Orchidaceæ, Cannaceæ, Bromeliaceæ, Hæmodoraceæ, Iridaceæ.

Comprising 7 orders and 33 genera.

PART XX. Amaryllidaceæ, Dioscoriaceæ, Roxburghiaceæ, Liliaceæ (Melonthaceæ), Pontederiaceæ, Xyridaceæ, Mayaceæ.

Comprising 7 orders and 33 genera.

PART XXI. Commelinaceæ, Juncaceæ, Typhaceæ, Araceæ, Lemnaceæ, Alismaceæ, Naidaceæ, Eriocauleæ.

Comprising 8 orders and 28 genera.

PART XXII. Cyperaceæ.

Comprising 1 order and 21 genera.

PART XXIII. Gramineæ.

Comprising 1 order and 65 genera.

The author acknowledges with pleasure, material assistance from Dr. Chas. Mohr, of Mobile, in locating many of the species mentioned in this bulletin.

Order 42. **LEGUMINOSÆ.** Pulse Family.

1. **BAPTISIA,** Vent. *False indigo.* Perennial Herbs.

C. leucantha, Torr. and Gray. *Smooth wild indigo.* Growing on river banks from March to April. Specimens found in Washington county, (Dr. Mohr). Also reported growing in Tennessee (Killebrew), and therefore may be found in north Alabama.

B. alba, R. Br. *White flowered indigo.* Growing in south and middle Alabama—Russell county (Dr. Neisler), Mobile (Dr. Mohr), Lee (Mell), April.

B. perfoliata, R. Br. Dry sandy soils near Auburn, Lee county, (Mell) and probably south. May

B. lanceolata, Ell. Dry pine barrens in south and west Alabama. Baldwin county, (Dr. Mohr.)

2. **CROTALARIA,** L. *Rattle box.* Herbs.

C. sagittalis, L. *Virginian rattle box.* Growing in south and middle Alabama in barren sandy soils. Specimens obtained in Lee (Mell), Russell (Dr. Neisler), Tuscaloosa, Cullman (Dr. Mohr), counties—June, July. Found also growing abundantly in Tennessee, (Killebrew) and therefore may be looked for in North Alabama.

C. ovalis, Push. Dry pine soil throughout lower middle and south Alabama—May, July—Specimens obtained in Russell (Dr. Neisler), Washington, Mobile, Baldwin, Monroe (Dr. Mohr), counties.

C. Purshii, DC. South Alabama—May, June—Mobile, Baldwin (Dr. Mohr) counties.

3. **LUPINUS,** Tourn. *Lupine.* Herbs.

L. perennis, L. *Wild lupine.* From middle to north Alabama—April May—Lee (Mell), Russell (Dr. Neisler), Cullman, Tuscaloosa (Dr. Mohr), counties. Mountains Tennessee (Killebrew).

L. perennis, *Var* gracilis, Mobile (Dr. Mohr.)

L. villosus, Willd. *Villous lupine.* South Alabama, Mobile, Baldwin (Dr. Mohr) counties. April.

L. diffusus, Nutt. South Alabama, Mobile, Baldwin (Dr. Mohr) counties—April, May.

4. **TRIFOLIUM**, Tourn. *Clover, Trefoil.* HERBS.

T. pratense, L. *Red clover.* Escaped from cultivation in middle and south Alabama—Lee (Mell), Mobile (Dr. Mohr), counties. Also in Tennessee (Killebrew).

T. reflexum, L. *Buffalo clover.* From middle to north Alabama—Lee, Montgomery (Mell), Tuscaloosa, Autauga, Cullman, Winston (Dr. Mohr), counties—April, May.

T. repens, L. *White clover.* Generally throughout the State in sandy soils—Lee (Mell), Mobile, Baldwin (Dr. Mohr). Also in Tennessee (Killebrew). May.

T. Carolinianum, Michx. *Southern clover.* Middle and southern extending into north-west Alabama—Lee, Macon, Montgomery (Mell), Mobile, Baldwin, Tuscaloosa (Dr. Mohr), counties—March, April. Tennessee (Killebrew).

T. procumbens, L. *Low hop clover—Small yellow clover.* Middle and northern Alabama—in waste places—Lee (Mell), Madison, Tuscaloosa, Jackson (Dr. Mohr), counties.

5. **HOSACKIA**, Dougl. HERBS.

H. Purshiana, Benth. Introduced from Texas (Dr. Mohr).

6. **MELILOTUS**, Tourn. *Medick, Melilot, Sweet Clover.* HERBS.

M. officinalis, Willd. *Yellow clover.* An introduced species escaped from cultivation—Lee (Mell), and probably in other sections of middle Alabama.

M. alba, Lam. *White clover.* Throughout middle Alabama—Lee, Macon, Montgomery (Mell), Hale (Dr. Mohr), counties.

M. parciflora, Desf. Lower middle and south Alabama, Perry, Mobile counties (Dr. Mohr). Introduced.

7. **MEDICAGO**, Tourn. *Hop medick–Black medick.* HERBS.

M. lupulina, L. *Black medick—Nonesuch.* In waste places and in old fields in all parts of the State.—Lee, Russell, Dallas, Montgomery (Mell), Mobile, Baldwin, Monroe (Dr. Mohr) counties. Tennessee (Killebrew).

M. maculata, Willd. *Spotted medick.* Introduced into south Alabama with ballast, Mobile (Dr. Mohr), county.

M. denticulata, Willd. *Reticulated medick.* Introduced with ballast in Mobile (Dr. Mohr), county.

8. **PSORALEA**, L. Perennial Herbs.

P. melilotoides, Michx. Dry soils—May, June—Lee, Montgomery (Mell), Washington, Cullman, Monroe, Shelby, St. Clair, Calhoun (Dr. Mohr), Russell (Dr. Neisler), counties. Tennessee (Killebrew).

P. canescens, Michx. Dry sandy soils in south Alabama, probably extending into lower middle. Mobile (Dr. Mohr), county—April, May.

9. **AMORPHA**, L. *False indigo.* Shrubs.

A. herbacea, Walt. Middle Alabama, Lee (Mell), Russell (Dr. Neisler) counties.

A. fruticosa, L. *False indigo—Lead plant.* Tall shrub sometimes arborescent along banks of streams.—May, June. Montgomery (Mell), Mobile, Baldwin, Hale (Dr. Mohr), counties. Tennessee (Killebrew).

10. **PETALOSTEMON**, Michx. *Prairie clover.* Perennial Herbs.

P. gracilis, Nutt. Sandy soils in south Alabama, Mobile, Baldwin (Dr. Mohr), counties. August.

P. carneum, Michx. Dry sandy soils in lower middle and south Alabama—Henry (Dr. Mohr), Dallas (Mell), counties.

P. candidens, Michx. Montgomery (Dr. Mohr), county.

P. carymbosum, Michx. *Virginian lupnie—Silk, prairie clover.* Dry sandy soils in middle and south Alabama, Lee (Mell), Russell (Dr. Neisler), Mobile (Dr. Mohr) counties. It may also be found in north Alabama since Dr. Killebrew reports it as growing in Tennessee.

P. decumbens, Nutt. *Low prairie clover.* Northern portions of State. Franklin (Dr. Mohr), Jackson (Dr. E. A. Smith), counties.

P. violacens, Michx. Hale (Dr. Mohr), county.

11. **TEPHROSIA**, Pers. *Hoary pea.* Perennial Herbs.

T. Virginiana, Pers. *Goats rue.* Common in all parts of the State—June, July.

T. spicata, Torr. and Gray. Dry Soils extending from north to south Alabama—June, July. Mobile, Baldwin, Monroe, Escambia, Clark, Washington (Dr. Mohr), Lee, Cullman (Mell), counties, extending into Tennessee (Killebrew).

T. hispidula, Pers. Dry sandy soils in south Alabama, June, July. Mobile (Dr. Mohr).

T. onobrychoides, Nutt. Pine barrens near Mobile (Dr. Mohr).

T. chrysophylla, Pursh. Sandy soils in south Alabama, Mobile, Baldwin (Dr. Mohr), counties.

T. ambigua, Curtis. Dry sandy soils in south Alabama, Mobile (Dr. Mohr).

12. **INDEGOFERA,** L. *Indigo.* Herbs or Shrubs.

I. Caroliniana, Walt. *Wild indigo.* Dry sandy soils in middle and southern Alabama—July, August. Lee, Montgomery (Mell), Russell (Dr. Neisler), Mobile (Dr. Mohr), counties.

13. **ROBINIA,** L. *Locust.* Trees or Shrubs.

R. pseudacacia, L. *Common locust, False acacia.* Common throughout middle and north Alabama—April, May. Wood valuable for lumber because of hardness and beautiful color.

14. **ACACIA,** Neck. Mostly Trees or Shrubs.

A. Farnesiana, Willd. *Opoponax.* Growing in waste places in the lower part of the State. Naturalized near Mobile (Dr. Mohr).

15. **WISTORIA,** Nutt. Hardy Climbers.

W. frutescens, Poir. *Carolina kidney bean.* From Mobile westward and north in alluvial soils and along margins of swamps—Mobile, Baldwin, Monroe, Clark (Dr. Mohr) counties.

16. **ASTRAGALUS,** Tourn. *Milk vetch.* Chiefly Herbs.

A. Plattensis var Tennesseensis, Gray. Franklin (Dr. Mohr).

A. villosus, Michx. Dry sandy soils in middle and south Alabama—Lee (Mell), Russell (Dr. Neisler), Baldwin (Dr. Mohr) counties—extending into Tennessee (Killebrew).

17. **GLOTTIDIUM**, Des. ANNUAL.

G. Floridanum, DC. Damp soils in south Alabama. August—Mobile, Baldwin (Dr. Mohr).

18. **SESBANIA**, Pers. HERBS OR SHRUBS.

S. macrocarpa, Muhl. South Alabama—August, September—Mobile, Baldwin counties (Dr. Mohr).

19. **ÆSCHYNOMENE**, L. *Sensitive joint vetch.* HERBS OR SHRUBS.

Æ. hispida, Willd. Borders of swamps in south Alabama—August.

Æ. viscidula, Michx. South Alabama, in sandy soils—Mobile (Dr. Mohr).

20. **ZORNIA**, Gmel. PERENNIAL HERBS.

Z. tetraphylla, Michx. South and west Alabama, in dry sandy soils—June, August—Mobile, Baldwin (Dr. Mohr).

21. **DESMODIUM**, Des. *Tick, Trefoil.* PERENNIAL HERBS.

D. nudiflorum, DC. *Crowded leaved trefoil.* Rich soils in western Alabama—July, August.

D. acuminatum, DC. *Pointed Tick Trefoil.* Rich soils in shady places in nearly all portions of State—Lee, Macon, Montgomery (Mell), Russell (Dr. Neisler), Mobile, Cullman, Franklin (Dr. Mohr) counties—July, August.

D. pauciflorum, DC. *Few flowered tick trefoil.* From middle to north Alabama—August—Montgomery (Mell), Bibb (Dr. Mohr), extending into Tennessee (Killebrew); growing in rich woods soil.

D. rotendifolium, DC. *Round leaved tick trefoil.* In dry rocky woods soil from south to north Alabama—August—Lee, Montgomery (Mell), Russell (Dr. Neisler), Mobile, Baldwin, Autauga (Dr. Mohr) counties, extending into Tennessee (Killebrew).

D. glabellum, DC. (Resembles D. Marilandica and D. paniculatum)—Russell county (Dr. Neisler).

D. humifusum, Beck. Dry sandy soil in Russell (Dr. Neisler) and on Alpine mountain, Talladega (Dr. Mohr).

D. canescens, DC. Moist places in south, middle and north Alabama—July, August—Mobile, Talladega, Franklin (Dr. Mohr), Lee, Macon (Mell) counties.

D. cuspidatum, Torr. and Gray. *Sharp pointed tick trefoil.* Middle and north Alabama—Lee, Macon (Mell), Russell (Dr. Neisler), Calhoun (Dr. Mohr) counties, extending into Tennessee (Killebrew)—August.

D. lævigatum, DC. Middle and northeast Alabama—August—Russell (Dr. Neisler), Talladega (Dr. Mohr) counties.

D. viridiflorum, Beck. In dry rich soil in middle Alabama. Russell (Dr. Neisler), Lee (Mell), Montgomery (Dr. Mohr) counties.

D. Dillenii, Darl. In open woods from south Alabama to Tennessee. Mobile, Baldwin (Dr. Mohr), Lee (Mell), Tennessee (Killebrew)—August.

D. paniculatum, DC. *Smooth tick trefoil.* In shady places throughout Alabama—Mobile, Talladega (Dr. Mohr), Clay (Mell), extending into Tennessee (Killebrew)—August.

D. strictum, DC. *Stiff tick trefoil.* Pine barrens, from south to north Alabama—Mobile (Dr. Mohr), Russell (Dr. Neisler), Montgomery, Lee (Mell), extending into Tennessee (Killebrew)—July, September.

D. Canadense, DC. In north Alabama (Dr. Smith), extending into Tennessee (Killebrew).

D. rigidum, DC. Montgomery, Talladega, Calhoun (Dr. Mohr)—August.

D. ciliare, DC. Dry hills and sandy fields in most sections of the State—August—Mobile, Talladega (Dr. Mohr), Montgomery, Macon (Mell).

D. Marilandicum, Boott. Dry open woods soil in northeast Alabama—Talladega, Calhoun (Dr. Mohr), Clay, Randolph (Mell) counties. August.

D. lineatum, DC. South Alabama—August—Mobile, Baldwin (Dr. Mohr) counties.

D. tenuifolium, Torr. and Gray. Dry pine barren in south Alabama—July, August—Mobile, Baldwin, Monroe counties (Dr. Mohr).

22. **LESPEDEZA**, Michx. *Bush clover.* HERBS.

L. procumbens, Michx. (L. repens Bart.) *Creeping bush clover.* Extending throughout the State—August—Mobile, Cullman, Talladega, Morgan (Dr. Mohr), Lee, Macon, Clay (Mell), Russell (Dr. Neisler), found also in Tennessee (Killebrew).

L. polystachya, Michx. (L. hirta, Ell.) *Hairy bush clover.* Dry hill soils throughout most of the State—Mobile, Baldwin, Clark, Washington, Bibb, St. Clair, Calhoun (Dr. Mohr), Lee, Montgomery, Clay, Cullman (Mell), Russell (Dr. Neisler)—July, August.

L. violacea, Pers. *Purple bush clover.* Russell (Dr. Neisler)—July, September.

L. reticulata, Pers. (L. violacea var angustifolia T. and G.) Generally distributed throughout the State—Mobile, Calhoun, Talladega, Madison (Dr. Mohr), Clay, Lee (Mell).

L. Stuvei, Nutt. *Downy bush clover.* In portions of North Alabama (Dr. Smith).

L. Stuvei, var. **Intermedia**, Wat (L. violacea var. sessiliflora Man.) has about the same distribution as last.

L. capitata, Michx. *Round headed bush clover.* Dry sandy soils—Lee, Montgomery, Cullman (Mell), Russell (Dr. Neisler), Mobile, Clark, Washington, Autauga (Dr. Mohr) counties, extending into Tennessee—August.

L. striata, Hook and Arnott. An introduced species found in old fields throughout the State.

L. Nuttallii, Darl. Talladega (Dr. Mohr).

23. **STYLOSANTHES**, Sw. *Pencil flower.* LOW PERENNIAL HERBS.

S. elatior. Sandy soils, common everywhere—June, August.

24. **VICIA**, Tourn. *Vetch. Tare.* MOSTLY CLIMBING HERBS.

V. sativa, L. *Common vetch or tare.* An introduced species found in cultivated soil in south and middle Alabama—Lee (Mell), Mobile (Dr. Mohr).

V. hirsuta, Koch. Introduced in ballast near Mobile (Dr. Mohr)—April, May.

V. micrantha, Nutt. *Small flowered vetch.* Shady banks of streams in Wilcox county (Dr. Mohr)—April.

V. Caraliniana, Walt. *Carolina vetch.* Dry open woods soil in north Alabama—Cullman (Mell), Blount (Dr. Mohr) —April, May.

V. acutifolia, Ell. South Alabama—Mobile (Dr. Mohr,) March, May.

V. Ludoviciana, Nutt. Southwest Alabama—Mobile (Dr. Mohr).

25. **LATHYRUS**, Tourn. *Everlasting pea—Bitter Vetch.* PERENNIAL HERBS.

L. venosus, Muhl. Shady banks throughout upper east Alabama, probably extending west—Lee, Clay (Mell), Russell (Dr. Neisler), Cullman (Dr. Mohr) counties—June, July.

26. **Apios**, Boerh. *Ground nut—Wild Bean.* PERENNIAL HERB.

A. tuberosa, Mœnch. Growing near swamps from middle to northern Alabama—Lee, Macon (Mell), Russell (Dr. Neisler), Cullman, Winston, Madison (Dr. Mohr) counties, extending into Tennessee (Killebrew)—July, August.

27. **CENTROSEMA**. DC *Spurred butterfly pea.* TWINING PERENNIAL HERBS.

C. Virginianum, Benth. Dry sandy soil from Lee (Mell) and Russell (Dr. Neisler), Mobile, Baldwin (Dr. Mohr) counties. June, September.

28. **PHASEOLUS**. Tourn. *Kidney bean.* PROSTRATE OR TWINING HERBS.

P perennis, Walt. *Wild kidney bean.* In woods and along field margins from middle towards north Alabama. Lee, Tallapoosa, Clay (Mell), Russell (Dr. Neisler), Talladega (Dr. Mohr), extending into Tennessee (Killebrew).

29. **STROPHOSTYLES**, Ell. PROSTRATE OR TWINING HERBS.

S. angulosa, Ell. (P. diversifolius Pers and P. helvolus L). *Creeping kidney bean.* Sandy banks of streams from Mobile to Tennessee. June, September. Lee, Coosa (Mell), Baldwin, Mobile, Calhoun (Dr. Mohr), Russell (Dr. Neisler) counties, extending into Tennessee (Killebrew). June, September.

S peduncularis, Ell (P. helvolus, Man) sandy soils over the same territory as preceding. June, September.

30. **VIGNA**. Savi. TWINING HERBS.

V. glabra, Savi. Brackish marshes along coast. June, September. Mobile (Dr. Mohr).

31. **ERYTHRINA**, L. TREES, SHRUBS RARELY HERBS.

E. herbacea, *Coral plant.* Light sandy soils in lower middle and south Alabama—Macon (Mell), Russell (Dr. Neisler), Mobile, Clark, Monroe (Dr. Mohr) counties. April, May.

32. **CLITORIA**, L. *Butterfly pea.* PERENNIAL HERBS.

C. Mariana, L. Dry sandy soils. Lee, Macon (Mell), Russell (Dr. Neisler), Mobile, Baldwin, Monroe, Clark, Washington (Dr. Mohr) counties, extending into Tennessee (Killebrew). July, August.

33. **AMPHICARPÆA**, Ell. *Hog peanut.* PERENNIAL HERBS.

A. monoica, Nutt. Rich moist soils throughout south, middle and northwest Alabama. Lee, Montgomery (Mell), Russell (Dr. Neisler), Mobile, Tuscaloosa (Dr. Mohr) counties, extending into Tennessee (Killebrew). August, September.

34. **GALACTIA**, P. Br. *Milk pea.* PROSTRATE AND TWINING HERBS.

G. glabella. Michx. *Smooth milk pea.* Extending throughout middle and probably into north Alabama, growing in sandy soils. July, August. Lee (Mell), Russell (Dr. Neisler), Autauga (Dr. Mohr) counties. Reported also from Tennesse (Killebrew).

G. pilosa. Ell. (G. mollis, Gray). Generally distributed over the State. July, September. Lee (Mell), Russell (Dr. Neisler), Mobile, Baldwin, Cullman (Dr. Mohr) counties.

G. sessiliflora. Torr & Gray. South Alabama, Mobile (Dr. Mohr). June, August.

35. **DIOCLEA**. Kunth. (Dolichos, L). TWINING SHRUB.

D. Boykinii. Benth. Hale county (Dr. Mohr).

36. **RHYNCHOSIA**, Lour. TWINING OR TRAILING PERENNIAL HERBS.

R. tomentosa. Hook & Arn. (R. tomentosa var volubilis T. & G). Dry soils in rolling pine lands of Mobile, Monroe, Washington, Cullman counties (Dr. Mohr).

R. erecta. DC (R. tomentosa var erecta T. & G). Dry pine wood soils from middle Alabama south. Lee (Mell), Russell (Dr. Neisler), Mobile (Dr. Mohr) counties.

R. galactioides, Endl. Dry sandy soils in south Alabama. June. Mobile, Baldwin (Dr. Mohr).

R. minima, DC. Damp soils in extreme south Alabama. Mobile county (Dr. Mohr), July.

37. **CERCIS**, L. *Red bud—Judas tree.* TREES.

C. Canadensis, L. Generally distributed over the upper half of the State. Handsome tree with bright pink flowers early in February. Lee, Coosa, Clay, Tallapoosa, Talladega (Mell), Russell (Dr. Neisler), Cullman, Winston, Madison, Lauderdale, Morgan (Dr. Mohr) counties, extending into Tennessee (Killebrew).

38. **CASSIA**, Tourn. *Senna.* HERBS.

C. Marilandica, L. *Wild American senna.* Growing in the lower half of the State in rich soil—Mobile, Clark, Choctaw counties (Mohr)—August.

C. tora, L. (C. obtusifolia, L). *Wild senna.* Extending over the State from south to north, along the banks of streams, Tennessee (Killebrew), Russell and Muscogee, Ga. (Dr. Neisler), Mobile (Dr. Mohr), Lee (Mell).

C. occidentalis, L. Introduced species in portions of middle and south Alabama. Lee (Mell), Russell (Dr. Neisler), Mobile, (Dr. Mohr).

C. chamæcrista, L. *Partridge pea.* Common in dry, barren soils in most sections of the State. Tennessee (Killebrew), Cullman, Lauderdale, Mobile, Baldwin (Dr. Mohr), Lee, Montgomery, Wilcox (Mell), Russell (Dr. Neisler).

C. nictitans, L. *Wild sensitive plant.* Rather common over the State, in sandy soils. Montgomery, Lee (Mell), Russell (Dr. Neisler), Mobile, Cullman (Dr. Mohr).

39. **GLEDITSCHIA**, L. *Honey locust.* THORNY TREES.

G. triacanthus, L. *Three thorned acacia.* Common throughout the State.

40. **NEPTUNIA**, Lourn. PERENNIAL HERBS.

N. lutea, Benth. Damp sandy soils along the coast—Mobile (Dr. Mohr)—June.

41. **DESMANTHUS**, Willd. HERBS OR SHRUBS.

D. brachylobus, Benth. In alluvial soils along streams, Mobile, Montgomery (Dr. Mohr).

42. **SCHRANKIA**. Willd. *Sensitive briar.* PERENNIAL PROSTRATE HERBS.

S. uncinata. Willd. Sandy soil. Lee county (Mell) June, August.

S. angustata. T. & G. *Narrow leaved sensitive briar.* From south to north Alabama. Mobile, Clark, Washington, Munroe, Cullman (Dr. Mohr), Tennessee (Killebrew).

In addition to the species mentioned in the preceding list, the following may also exist in Alabama. The evidence in the possession of the author is not, however, positive enough to warrant their insertion in the list given :

Baptisia tinctoria, R. Br.—B. leucophæa, Nutt—B. microphylla, Nutt—Cladrastis tinctoria, Raf—Trifolium amphianthum, T. & G.—Medicago sativa L—Psoralea lupinellus, Michx—Indigofera letosepala, Nutt—Robinia viscosa Vent—R, hispida L—Astragalus plattensis, Nutt—A Canadensis, L—A. glaber, Michx—A. obcordatus Ell—Lespedeza angustifolia, Ell—Lathyrus pusillus, Ell—Rhynchosia reniformis DC.—Gleditschia aquatica Marsh—Mimosa strigillosa T. & G.

Order 43. **ROSACEÆ.** (Rose Family).

1. **CHRYSOBALANUS, L.** Low Shrubs.

O. oblongifolius. Michx. Dry Sandy soils in south Alabama. May, June. Mobile, Monroe, Baldwin, Washington, Escambia, Choctaw counties (Dr. Mohr).

2. **PRUNUS.** Tourn. *Plum, Cherry.*

P. Americana. Marsh. *Wild yellow or red plum* Lee, Tallapoosa, (Mell), Clark, Cullman, Winston, Lauderdale (Dr. Mohr) counties. March, April.

P. maritima. Wang. *Beach plum.* Sea coast. Mobile. (Dr. Mohr).

P. umbellata. Ell. *Southern bullace plum. Sloe. Wild plum.* Tallapoosa, Montgomery (Mell), Baldwin, Mobile, Wilcox (Dr. Mohr), Russell (Dr. Neisler). February, March.

P. Chicasa. Mich. *Chickasaw plum.* Old fields. Marsh extending nearly over entire State.

P. serotina. Ehr. *Wild black cherry.* April, May. Lee, Macon, Tallapoosa (Mell), Russell (Dr. Neisler), Mobile, Clark, Blount, Cullman, Madison (Dr. Mohr).

P. Caroliniana, Ait. *Mock orange.* Lee, Macon (Mell), Russell (Dr. Neisler), Mobile, Pike (Dr. Mohr), an introduced species escaped from hedges.

3. **NEVIUSIA.** Gray. Shrub.

N. Alabamensis. Gray. Growing in only one place in the State, near Tuscaloosa. It was discovered in 1857 by

Rev. R. D. Nevius, an Episcopal clergyman. It is a handsome plant with many showy flowers.

4. **SPIRÆA**, L. *Meadow sweet.* SHRUBS OR PERENNIAL HERBS.

S. aruncus, L. *Goats beard.* Growing in the northeast portions of State. June. Coosa (Mell), Cullman (Dr. Mohr).

5. **PHYSOCARPUS**, Maxim. *Nine bark.* SHRUBS.

P. opulifolius, Maxim. Tallapoosa, Coosa (Mell), Lauderdale (Dr. Mohr). April, May.

6. **GILLENIA**, Mœnch. *Indian physic.* PERENNIAL HERBS.

G. trifoliata, Mœnch. *Bowman's root.* Cullman, Madison, Autauga (Dr. Mohr). June.

G. stipulacea, Nutt. *American ipecac.* Mountains of Alabama. Coosa (Mell), Cullman (Dr. Mohr). June.

7. **RUBUS**, Tourn. *Bramble briar.* PERENNIAL HERBS.

R. occidentalis. L. *Black raspberry, thimbleberry.* Winston county (Dr. Mohr). May.

R. villosus, Ait. *Common or high blackberry.* Common everywhere.

R. hispidus, L. *Running swamp blackberry.* Along the flank of Lookout Mountain, DeKalb county (Dr. Mohr). May, June.

R. cuneifolius, Pursh. *Sand blackberry.* Lee, Montgomery (Mell), Monroe, Clark, Escambia, Tuscaloosa (Dr. Mohr).

R. trivialis, Michx. *Low bush blackberry.* Common in sandy soil everywhere. April.

8. **GEUM**, L. *Avens.* PERENNIAL HERBS.

G. album, Gmel. Borders of woods. Montgomery (Mell), Autauga, Tuscaloosa, Lauderdale, Cullman, Madison (Dr. Mohr). April, May.

9. **FRAGARIA**, Tourn. *Strawberry.* PERENNIAL HERBS.

F. Virginiana, Mill. *Wild strawberry.* Rich woods.

Lee, Macon, Russell (Mell), Lawrence, Franklin (Dr. Mohr).

F. Indica, L. Introduced in south Alabama—Baldwin, Mobile, Choctaw counties (Dr. Mohr).

10. **POTENTILLA**, L. *Cinque-foil, Five-finger barren strawberry.* HERBS OR SHRUBS.

P. Canadensis, L. Lee, Coosa, Montgomery (Mell), Tuscaloosa, Lawrence, Cullman (Dr. Mohr). July, August.

11. **AGRIMONIA**, Tourn. *Agrimony.* PERENNIAL HERBS.

A. Eupatoria, L. *Common agrimony*, (or A. striata Michx). Growing in Russell (Dr. Neisler), Tuscaloosa, Autauga, Cullman (Dr. Mohr). August.

A. parviflora, Ait. *Small flowered agrimony.* Tuscaloosa (Dr. Mohr), Coosa (Dr. Smith), Clay, Tallapoosa, Talladega (Mell). August.

A. incisa, T. & G. Dry open woods in south Alabama, Baldwin, Mobile (Dr. Mohr), Coffee (Mell). August.

12. **ROSA**, Tourn. *Rose.* PRICKLY SHRUBS.

R. setigera, Michx. *Climbing or prairie rose.* Morgan county (Dr. Mohr). June. Chapman reports this species growing in Florida along swamps. It should therefore be also found in south Alabama.

R. Carolina, L. *Swamp rose.* Madison, Franklin (Dr. Mohr). June.

R. humilis, Marshall. *Dwarf wild rose.* Talladega, St. Clair, Madison (Dr. Mohr), Lee, Coosa, Randolph (Mell), Russell (Dr. Neisler). May, June.

R. canina, L. *Dog rose.* Introduced near Mobile and naturalized (Dr. Mohr).

R. bracteata, Wend. Naturalized near Mobile (Dr. Mohr).

R. rubiginosa, L. *Sweet briar Eglantine.* Tuscaloosa county (Dr. Mohr).

R. lævigata, Michx. *Cherokee rose.* Found in many sections of middle and south Alabama.

13. **PYRUS**, L. *Pear, apple.* TREES OR SHRUBS.

P. coronaria, L. *American crab apple.* April. Lee, Tallapoosa (Mell), Russell (Dr. Neisler).

P. angustifolia, Ait. Lee, Montgomery, Macon (Mell), Mobile, Baldwin, Clark, Choctaw, Cullman, Jefferson, Tuscaloosa (Dr. Mohr) counties. April.

P. arbutifolia, L f. *Red choke berry.* Lee (Mell), Russell and Muscogee, Ga. (Dr. Neisler). Growing in damp soils on borders of swamps.

P. arbutifolia, var. **erythrocarpa** Chap. *Choke berry.* Mobile, Baldwin, Cullman (Dr. Mohr) Tallapoosa, Clay (Mell).

14. **CRATÆGUS**, L. *Hawthorn, whitethorn.* THORNY TREES OR SHRUBS.

C. spathulata, Michx. *Spathula shaped leaved thorn.* Tallapoosa, Clay, Macon, Talladega (Mell), Choctaw, Autauga, Cullman, Morgan, Montgomery (Dr. Mohr) counties. April.

C. viridis, L. (C. arborescens, Ell). Mobile, Clark, Choctaw, Baldwin, Dallas, Hale, Wilcox counties (Dr. Mohr). March, April.

C. apiifolia, Michx. *Parsley leaved thorn.* Lee, Montgomery, Tallapoosa (Mell), Russell (Dr. Neisler), Baldwin, Mobile, Wilcox, Dallas, Tuscaloosa (Dr. Mohr). River swamps. March, April.

C. coccinea, L. Coosa, Clay, Talladega, Randolph (Mell), Montgomery, Tuscaloosa, Franklin, Madison (Dr. Mohr) counties. Open woods. April, May.

C. coccinea var **mollis**, T. & G. Clark, Cullman (Dr. Mohr) counties.

C. crus-galli, L. *Cockspur thorn, white thorn.* Montgomery, Macon, Tallapoosa (Mell), Cullman, Morgan, Franklin, Madison (Dr. Mohr). April, May.

C. æstivalis, T. & G. South Alabama. Mobile (Dr. Mohr). March, April.

C. flava, Ait. *Summer haw, yellow haw.* Clark (Mell), Baldwin, Monroe (Dr. Mohr) counties. May.

C. glandulosa, Michx. *Glandular thorn.* Mobile (Dr. Mohr).

C. parvifolia. Ait. *Dwarf thorn. Small-leaved thorn.* Sandy soil, Macon, Tallapoosa, Montgomery (Mell), Mobile, Clark, Cullman (Dr. Mohr). April—May.

15. **AMELANCHIER**, Medic. *June-berry.*

A. Canadensis T. & G. *Shadflower—Service-berry.* Quite common in nearly all sections of the State. February—March.

The following species of Rosaceæ have been also reported to the author as growing wild in the State, but the evidence is not strong enough to include them in the above list.

Prunus Virginiana L—Cratægus tomentosa L—Cratægus punctata, Jacq.

The following species mentioned in this bulletin are considered valuable for agricultural and commercial uses.

Forage plants: Crotalaria sagittalis, Trifolium pratense, T. repens, T. reflexum, T. procumbens, Melilotus officinalis, M. alba, Medicago lupulina, Astragalus plattensis var Tennesseensis, Desmodium nudiflorum, D. pauciflorum, D. cuspidatum, D. paniculatum, D. Canadense, Lespedeza procumbens, L. violacea, L. Stuvei, L. polystachya, L. capitata, L. striata, Vicia sativa, V. Caroliniana, V. micrantha, Lathyrus venosus, Apios tuberosa (root bears tubes which are eatable; hogs are fond of them). Centrosema Virginianum, Strophostyles angulosa, Galactia glabella, G. pilosa (excellent forage for cows). Desmanthus brachylobus.

Ornamental plants: Amorpha fruticosa—leaves large, of a pleasant green color and beautifully pinnated. Flowers purple and singular in structure. Wistaria frutescens, Erythrina herbacea, Cercis Canadensis, Prunus Caroliniana, Nevjusia Alabamensis, Spiræa aruncus, Physocarpus opulifolius, Rosa setigera, R. lævigata, Cratægus spathulata.

Lumber and Cabinet Work: Robinia pseudacasia, Cercis Canadensis, pruna serotina.

Medicinal and Commercial: Indegofera Caroliniana (indigo), Cercis Canadensis (dye wool of fine nankeen color), Cassia Marilandica (senna from leaves and pod), Prunus serotina (bark for tonic, &c.), Agrimonia eupatoria (with bismuth dyes wool beautiful color—a powerful astringent.)

Fruit plants: Prunus Americana, P. maritima, P. chicasa, Rubus occidentalis, R. villosus, R. cuneifolius, Fragaria Virginiana, F. Indica, Pyrus coronaria, Cratægus coccinea, C. flava, C. glandulosa.

Hedge plants: Prunus Caroliniana, Cratægus apiifolia, C. crus-galli.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

EXPERIMENTS WITH FOREIGN COTTON.

P. H. MELL.

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EXPERIMENTS WITH FOREIGN COTTON.

BY

P. H. MELL.

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 fibre, in some respects, is superior to the ordinary "upland" varieties grown in the South, and that there is danger of the importation 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 fibres 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 accomplish 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 fibre and the yield of lint that the conditions of the soil and climate would

permit; and thirdly, to so blend the best properties of the foreign cotton with those of the superior grades of American varieties as to produce an exceptionably fine cotton plant.

This bulletin contains the results secured through the first and second steps, and the data are much more gratifying than the author anticipated. During the season ot 1895 several hundred crosses were made between the best American cottons and these foreign species and the seeds were carefully gathered and assorted for cultivation during the coming season.. From the present outlook some very interesting facts will be secured from these experiments. It is the intention of the writer to issue a bulletin after this crop is gathered to discuss the results secured by the third step in the plan outlined above.

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,	Mirzapore,
Bamieh,	Mit Afifi,
*Bani,	"Mexican resists drought,"
*Bombay,	"Mexican,"
Broach,	"Mexican,"
*Bourbon,	*"Nagpur jari,
‡Creula,	Narma,
Deshi,	Nadam,
Ghoghari,	Nimari bani,
*Guchard,	*Painaa,
Herbucco,	‡Roji,
Indrepur,	Surat Kupas,
*Jari,	*"Tree cotton" (Mexico,)
Jakko,	"Upland Georgian" (Mexico,)
Mannoah,	*Wagaria Wadhwan.

*These failed to germinate.

‡Requires two years for maturing balls.

As an indication of the importance of continued and careful experiments with these cottons before final conclusions are drawn the following extracts are taken from bulletin No. 65 issued by this Station June, 1895. The Department sent out to the cooperative seed test experimenters some of these foreign cotton seeds before they were acclimated at this station and the reported results of one season's cultivation are thus given :

Franklin County.—"Bamieh, Egypt. Yield 600 lbs per acre; quality good; growth vigorous and large, but bolls are too small for a desirable cotton."

Perry County.—"India Cotton No. 1. Quality poor; growth large stalks; yield very poor; staple short, and is inferior to any of our native varieties."

Madison County.—"Afifi, Egyptian. Lint, cream colored, medium length and very fine and silky. Appears to be hardy as to cold; was not injured by spring frosts when other varieties were damaged. Grows from six to ten feet high. Yield about 300 lbs per acre.

Bibb County.—"Egyptian cotton. Yield per acre very poor; quality inferior; lint short and yellow."

Tallapoosa County.—"Egyptian cotton. Yield about 600 lbs per acre. Lint very long and strong. Another variety is worthless on account of the smallness of bolls and being so few on the stalk."

Pickens County.—"Egyptian cotton. Yield per acre about 200 lbs. Quality of product, fine strong fibre, dingy color. Stalk large, bolls small, does not pay for cultivating."

[The expression "fine strong fibre" seems to contradict this hasty conclusion.]

Morgan County.—"Egyptian cotton. Yield about 200 lbs per acre. Lint very fine and weak. Stalks from 3 to 6 feet high, very few limbs and bolls."

Chilton County.—"Egyptian cotton. Yield about one-third bale per acre. Lint short, bolls scattering, very large growth."

Etowah County.—"Egyptian cotton. Complete failure."

Hale County.—"Egyptian cotton. Yield per acre 1,200 lbs. Quality good."

Blount County.—"Egyptian cotton. Yield about 400 lbs seed cotton per acre. The quality of the lint was very fine and yellow. The growth tall, limbs long, bolls very small and scattering."

Pike County.—"Egyptian cotton. Yield about 300 lbs per acre. Growth rapid, stalks from 6 to 10 feet high."

Lauderdale County.—"Egyptian cotton. Yield about 250 lbs per acre. Quality of product good. Growth vigorous, 3 to 5 feet high. Yield poor on account of maturing so late. Afifi. Yield practically nothing. Growth extremely vigorous, from 6 to 10 feet high."

The statements made by these experimenters appear quite contradictory for the reason that three important factors are overlooked. 1. The term "Egyptian Cotton" is too indefinite. The list given on page 300 will show that there are several species growing in Egypt as prominently distinct from each other as exists between the so-called "Peerless" and the sea Island species. 2. The soil in one county differs materially from that in another—particularly is this true when the counties are separated by the length of the state. 3. The seeds sent out from Auburn were those direct from Egypt and India, and therefore not acclimated.

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 clean cotton, 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 the district of the same name in India not for exportation, al-

though it is used for adulterating the best grades which are sent to other countries. It is a triennial and poor bearer, and the fibre 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 fibre. 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.

Prior to 1810 the Indian and Egyptian cottons were coarse and of an inferior quality. But since that year a systematic effort was made by the English Government to improve the character of the plant by blending it with the American upland and sea Island varieties with remarkable success. The war between the states from 1861 to 1865 greatly encouraged the cultivation of cotton in these foreign countries. Commissioner Young in his report of the cotton exhibit at the Paris Exposition in 1878, says: "From this exhibition I learned that the cotton of all or nearly all of the Indian provinces has been greatly improved by the introduction of American seed. It was in Dharwar that our

American planters obtained the greatest success, and I am told that the entire crop in this province is now from seed originally American."

BOTANICAL CLASSIFICATION.

A careful examination of the foreign cottons under consideration would classify them as follows:

1. *Gossypium herbaceum* var *microcarpum* Tod: Broach, Ghoghari.
2. *G. Wightianum* Tod: Nadam, Deshi, Jakko, Roji, Nimari bani.
3. *G. roseum* var *albiflorum.* Tod: Indrepur, Ghoghari, Surat Kupas, Mirzapore, Roji.
4. *G. hirsutum* var *album* Tod: Indrepur, Herbucco, Surat Kupas, Mirzapore.
5. *G. maritimum* Tod: Jakko, Manuah, Mit Afifi.
6. *G. maritimum* var *polycarpum* Tod: Bamieh.
7. *G. Brazililiense* 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.

A detailed description of these species is given in accordance with "Relazione sulla Cultura dei Cotoni—Monografia del Genere Gossypium" by Agostino Todaro.

1. *Gosypium herbaceum*, var *microcarpum* 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 ovat · 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 fibre, in some cases white ash-gray, short, in other cases rather long and white.

Broach—Ghoghari.

2. *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 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 fibre; fibre short and closely adhering and white.

Nadam, Deshi—Jakko—Roji—Nimari barie.

3. *Gossypium martimum*, Tod. Glabrous, stem erect, branched, tall; branches graceful, spreading, subpyramidal ascending, and later recurving; leaves rotundate-ovate, sub-cordate, 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 themselvs, deeply cut into lobes, lobes near base slightly broader, lanceolote, terminating with an elongated point; corolla longer than bracts, petals yellow, or pale sulphur color, not entirely expanded during flowering period; lower part of style free from stamens and equal in length to anther-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.

Jakko, Manuah, Mit Afifi.

4. *Gossypium maritimum* var *poly carpum* Tod. Stem erect, simple; 1-3 peduncles in the axis of each leaf; few if any branches.

Bamieh.

5. *Gossypium roseum* var *albiflorum* Tod. Stem erect, branches slender, spreading profusely, pyramidal, slightly ascending; leaves palmate parted, cordate, marginally fringed with hairs, segments 5-7, lanceolate acute, base somewhat narrowed, depression rotundate,

two lower segments containing little interjected lobes; stipule near peduncle semiovate, dentate, the other linear-lanceolate, somewhat curved like a scythe, both acute and covered with downy hairs bracts rotundate covered with long weak hairs throughout its entire length, ovate, cordate, deeply dentate from apex to middle, in the lower portions much less dentate, half united; flowers bell shaped and corolla is about equal in length to the bracts. Short bract-like petals of corolla in the act of flowing approximately convolute in the tube, obovate, base coalescing to each other almost contracted into a claw, apex rotundate, dirty white, and purple spotted from the base nearly to the middle; calyx base contracted unequally dentate; naked anther column pubescent beneath, the remaining portion of style tube anther-bearing; boll very small ovate-acuminate, reddish, three celled, cells 5-6 seeded; seeds clothed with thick fibre, in some instances ash gray, very short and strongly adherent, while in other cases the fibre is short and rather reddish.

Ghoghari--Indrepur-Mirzapore—Surat Kupas—Rogi.

6. *Gossypium hirsutum* var *album*, 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 short point; seeds ovate covered with short white fibre firmly adherent.

Indrepur—Herbucco--Surat Kupas--Mirzapore.

7. *Gossypium Brazililience* Macf. Stem strongly, shrubby, erect, branched; leaves very deeply cordate, 5-7 lobes, widely radiate, spread out below the base nearly the length of the petiole; bracts ovate-rotundate, longer than the convoluted corolla, deeply cut into narrow lobes; boll ovate, acuminate, shorter than bracts, cells 7-9 seeded, seeds closely adherent, wrapped up in long fibre.

Guchard--Creulo.

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 fibre. Millimeters*.	Diameter of fibre. Millimeters*.	Maturity of fibre.	Condition of twist of fibre.	Rupture Strain of Fibre 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	0.024, 0.040	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
Ghoghari	30.0	0.032	Fair	Fair	12.200, 14.460.	13.330
Herbucco	30.0	0.032	Irregular	Fair	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
Mirzapur	38.4	0.032	Medium	Poor	6.250, 7.920	7.085
Mit afifi	38.0	0.032, 0.048	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	0.032, 0.048	Fair	Good	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 0.039 of an inch.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

A Study of Skin Tumors of Horses and Mules in Alabama.

S. L. COLEMAN.

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A STUDY OF THE SKIN TUMORS OF HORSES AND MULES IN ALABAMA.*

—BY—

S. L. COLEMAN.

It is my endeavor to give the results of my investigations of the common skin tumors which are so frequently found upon horses and mules that are brought to the free clinics for treatment.

I have made no new discoveries as to the origin and cause of these tumors, nor do I desire to advance any new theories as to their origin; but, by the advice of Dr. Cary who has kindly furnished me with the material for the study, I have attempted (by collecting several of these tumors from different animals, and studying them individually and collectively with special reference to their history and their macroscopical and microscopical appearances) to place them under their proper classification. In the first place, as their name indicates, they are tumors; that is, they are neoplasms or pathological growths of an embryonal character, developing without inflammation. This variety of tumor is almost painless; it is, of course, not entirely devoid of sensation; it may be more sensative than normal skin; yet, when compared with most sacomas and carcinomas, it may be called painless. These neoplastic growths are tumor-like in their origin; that is, they originate without any apparent cause—somewhat spontaneously. We do not know why or how they orig-

* Mr. S. L. Coleman was a post-graduate (1895-96) in the A. and M. College at Auburn, Ala , and worked up this bulletin as a thesis for a post-graduate degree while studying histology, pathology and bacteriology in the Veterinary Department.—C. A. C.

inate; but their history proves them to be non-hereditary. So far as we can learn by the aid of the microscope, they are not caused by parasites, and they are not of a nervous origin. However, there is some slight indication that they may be of a mechanical or inflammatory origin; but admitting this, it would not give us all the causal factors; since there must have been some unknown favorable condition of the system to produce the morbid growth that follows the mechanical irritation. These tumors are very frequently found upon regions of the body which, on account of their location, are little liable to irritation. For instance, in several cases which were brought to the college free clinic, these tumors were found upon the ears, the breast, the inside of the legs and on the sides of the neck—places little liable to irritation; hence, could not be so produced except by uncommon accidental mechanical irritation. It is true that after the tumors have begun to grow, mechanical irritation will augment their development, cause them to grow more rapidly and larger.

These tumors are composed of multiplying or proliferating cells; the growth or enlargement is not due simply to an increase in the size of the individual tumor cells, but to a multiplication and enlargement of the cells.

These tumors are vascular; are supplied with neutrient blood by branches from the vessels of the subcutaneous connective tissue, in which they are generally found imbedded.

The shape of these tumors depends upon their location; as a rule, they approximate a spherical form. If they are crowded or pressed by a limb or by another tumor, they will assume a shape corresponding to the pressure to which they are subjected; hence, they may be oval, pear shaped, or somewhat flattened, but when they occur on a free surface they generally approximate a sperical form.

According to one classification, tumors are divided into three groups:

1. The Simple or Histoid tumors which are composed

almost entirely of the tissues of which the body is composed, generally of some form of connective tissue; such as neuroglia, bone, cartilage, white fibrous tissue, or adipose tissue.

2. The Sarcomatous tumors are composed largely of embryonic tissues, which may, in some cases, reach a partial development, but the growth of the tissues always stops before reaching the highest stage of development.

3. Carcinomas or Cancerous tumors are those in which any of the elementary tissues of the body may be present, but these tissues are present usually in an erratic manner.

Since the morbid skin growths have been classified as tumors, the question arises, to which of the above three groups do the skin tumors belong?

Some writers classify similar tumors under the head of fibromas (fibrous tumors); others take a stand half way between the first and second groups and call them sarcofibromas. Evidently, it is rather difficult to distinguish between a young or embryonal fibroma and a spindle-celled sarcoma. A spindle-celled sarcoma is composed of young or embryonal fibrous connective tissue cells; the embryonal or young fibroma contains young fibrous connective tissue cells very like those found in a spindle-celled sarcoma. However, after the fibroma has reached a greater degree of maturity, it is comparatively easy to distinguish it from a sarcoma.

In none of the cases, which I have studied with the microscope, have I found anything characteristic of the sarcoma; but in every case, as I hope to show by the accompanying plates, I have found them to be distinctly fibromatous, fibrous tumors.

The fibromas are divided into the hard and soft variety.

The soft fibroma is nothing more or less than young connective tissue; the tumor contains more cells than fibres, and its cellular elements are not so highly developed as in the hard fibroma. The soft fibroma bears a greater similarity to the sarcoma than the hard fibroma.

A careful study of the microscopical sections (illustrated by the accompanying plates) proves, beyond question, that these tumors are distinctly fibromas; some of them approach more nearly the soft variety, while others are evidently hard fibromas.

The seat of the fibroma is in the mucous, the muscular or the subcutaneous connective tissue. All of the tumors or fibromas, studied by me were found in the subcutaneous connective tissue. But the sarcoma is also found in this same locality, so that we find nothing peculiar about the seat of these skin tumors to preclude the possibility of their being sarcomas.

Macroscopical Characteristics.—As before mentioned, these skin tumors vary in size and shape. Some of the young tumors are less than one-fourth of an inch in diameter, while others may be three or more inches in diameter. They are all somewhat spherical in form, but their shape is determined largely by the pressure of the surrounding tissues.

As a rule, more than one of these tumors appear on an animal at one time. In all cases that I have observed and investigated there were several tumors found on the same animal. In one instance, there were more than fifty tumors cut from one mule. However, it is not always the case that these tumors are multiple; but, in rare instances, a single tumor may be found on an animal.

These tumors varied somewhat in their action under the knife. In some cases the spherical, shining pearl-like tumors popped out with slight pressure as soon as the knife cut through the thin capsules or the skin overlying them. Other tumors belonging to the same group would require the knife to sever them from their connection with the surrounding tissue.

When microscopic sections were cut of these tumors, I found that each section presented a white shining waxy appearance. On pressure, these tumors vary in their relative degree of consistency; but, as a rule, they are quite firm.

Microscopical Characteristics.—An examination of thin sections of these tumors, with the microscope, show that they consist principally of dense bundles of white fibrous tissue, which in some cases presents a somewhat embryonal appearance; but still the tissue is too highly developed to admit the tumor to the group of sarcomas.

In the case of fig. 9 we have a section through a collection of young skin tumors, which have just burst through the skin. Note in fig. 9, A, the fibrous capsules encircling the little embryonal tumors. Fig. 9, C, shows the character of the tissue of the young tumors, when magnified 534 diameters; while D shows the character of the encircling capsules when magnified the same number of diameters. Also, note that in all these cuts the fibrous bundles, of which the tumors are largely composed, run in various directions. Furthermore, notice that these tumors, as a rule, are not very vascular; and that the blood vessels, which they do contain, have not very highly organized or developed walls.

Nos. 2, 3, 4, 5, show very few blood vessels.

Fig. 9, B, represents two arteries, a cross section of one and a longitudinal or oblique section of the other. The two vessels are in the subcutaneous connective tissue and not in the tumor proper. This illustration is given to show the difference between the degree of development of the walls of the blood vessels in the surrounding normal tissues and the tumor proper.

In almost every point these tumors agree microscopically with the fibroma. Their highly developed white fibrous connective tissue cells, and the general lack of embryonal sarcomatous cellular character will serve to distinguish them from the sarcoma. Moreover, the sarcoma is always very vascular, much more so than the average fibroma.

I learned from the clinical experience of Dr. Cary, that these tumos have never given metastasis; that is, they have never extended to internal organs or surfaces. This is another point which goes to prove that they are not sarcomas. The only sarcoma that recurs without metastasis

is the myeloid or giant celled variety. But the common skin tumors do not in the least resemble this variety of sarcoma. So far as I can see, there is only one point of resemblance between these skin tumors and the spindle-celled sarcoma. The embryonal cells in the young skin tumor may resemble the spindle cells of a sarcoma; but the tissues surrounding these cells and the further development of the cells in the fibroma prove conclusively that the young skin tumors are not sarcomas.

After the removal of one of these skin tumors, a peculiar tumor may form in its place, which is nothing more or less than an abnormal growth of granulation tissue, or "proud flesh" as it is commonly called. These exuberant granulation tumors occur in the following way: When the original skin tumor is removed, the cavity must be filled up and closed by granulation tissue, forming what is commonly known as scar tissue. Layer after layer of embryonal granulation cells are formed on the sides and bottom of the wound, made by the excision of the original tumor. (Sometimes the original tumor drops out or is torn out leaving a wound very similar to, but smaller than, the wound usually made when the tumor is cut out.) The layers of granulation cells are supplied with nutriment by the loops of capillary blood vessels; new capillary loops accompany the rapidly growing, dividing embryonal granulation cells. But, before the lips of the wound unite, there must be a formation of epithelium, either from the extension of the epithelial cells on the edges of the wound or from the granulation cells. When the epithelium is formed by neither of these processes, we have, as a result, a growth of what is called exuberant granulations or "proud flesh." If the wound is irritated by the animal's biting or rubbing it, and possibly by the action of septic germs, this epithelial covering can not be formed. In other words, periodic irritation will prevent the healing of a wound and produce a granulation tumor.

Some sarcomas are composed largely of embryonal con-

nective tissue cells; granulation tumors are composed of very similar embryonal cells; hence, the latter are sometimes called sarcomas. It may be that an examination of these secondary granulation tumors has led some observers to classify the common skin tumors under the head of sarcomas.

The common skin tumors are frequently called warts, and this mistake is due to the fact that many persons designate all surface tumors as warts.

The wart is technically called a papilloma; its prototype is the papillae of the skin. The connective tissue sends up papillae which become greatly enlarged and are supplied with a network of blood vessels from the subcutaneous connective tissue. These enlarged papillae become surrounded with epithelium which varies in character with the location; foı instance, if the papilloma is on the skin it is surrounded with flat scale-like epithelium, but if it is on a mucous membrane it is surrounded with a thinner and more delicate capsule. The papilloma (wart) of the skin is usually much smaller and less vascular than the skin tumors of fibromas. In some instances it may require a microscopical examination to determine whether a tumor is one of these fibromas or a papilloma.

Treatment.

1. *Surgical.*—First, cut away the long matted and filthy hair around the tumor; clean the tumor and the surrounding skin with soap and water and then apply some antiseptic; such as, a two per cent. creolin solution, or 1 to 1000 mercuric chloride solution. Take the knife in the right hand, cut the skin from around the tumor, preserving as much of the skin as possible, but taking great care to remove completely all of the morbid growth. In most cases where the skin has not been broken, the tumor will pop out as soon as an incision is made through the skin and the capsule, and a little pressure is applied. In other cases, the knife must be used to remove the tumor from its at-

tachment to the surrounding normal connective tissue. Where the tumor is quite small it may be cut out with the curved scissors; this, of course, will remove a small amount of skin that surrounds and covers the tumor. In some instances, where the tumor has broken through the skin and has grown to any size, it may be torn from its attachment by a sudden pull with the hand. Occasionally, the tumor may have dropped out or have been cut out and its place filled with exuberant granulations; in such cases the superfluous granulations may be removed with the knife, the scissors, or the curette. After completely removing the tumor, apply strong carbolic acid, or pulverized copper sulphate. These may be applied and held in place for a short time by means of a small pledget of cotton.

The after treatment consists in cleaning the wound once per day with clean cotton, and water that has been boiled and cooled; then apply enough to cover the surface, of one of the following prescriptions:

(a) ℞. Creolin..... 4 fluid drachms.
Glycerine..... 3 fluid ounces.
Pure water..... 1 pint.

Mix. Apply after cleansing the wound as above directed.

(b) ℞. Carbolic acid..... 2 fluid drachms.
Zinc sulphate..... 4 drachms.
Glycerine ..... 3 fluid drachms.
Pure water ..... 1 pint.

Mix. Apply as directed for (a).

(c) ℞. Iodoform..... 1 drachm.
Tannic acid..... 3 drachms.
Sulphur..... 1 ounce.
Vaseline .... 1 "
Glycerine, quantity sufficient to make make a free flowing mixture (6 to 12 fluid ounces).

Mix. Apply as directed for (a).

2. *Potential Cautery or Sloughing.*—This method of treatment may be used when the knife is considered dangerous,

because the operator is inexperienced or the base of the tumor is very large and too much bleeding would follow the use of the knife.

Clean the tumor and the skin around it with soap and water; oil the skin around the tumor with lard or vaseline; cover the raw tumor with a thick layer of pulverized copper sulphate; place a large wad of cotton over the tumor and hold it in place by a bandage applied very tightly. (Avoid cutting off the circulation by having a broad bandage and plenty of cotton under the bandage during its application.) Leave this bandage on for a week; keep the animal standing as quietly as possible, tied in a single stall. At the end of a week, remove the bandage and if the tumor can not be readily pulled away with the fingers, apply the pulverized copper sulphate, the cotton and the bandage as before. Keep up these weekly applications until the tumor is entirely gone; then treat the wound with prescription (a), (b) or (c). It may be well to state that the bandage must be kept fixed or it will irritate and thus stimulate the growth of the tumor.

This method of potential cautery can be used only when the tumor is on a limb or in some place where a bandage can be readily applied. In places where a bandage can not be applied, the following caustic may be used:

℞.	Arsenious acid (white arsenic)...	4 drachms.
	Caustic potash (stick).....	2 "
	Gum arabic.....	4 "
	Pure water	1 fluid ounce.

Mix and label "Poison." Thoroughly clean the tumor and the skin around it; oil the skin around the tumor with lard or vaseline; apply with a swab a thick layer of the sticky mixture all over the free and raw surface of the tumor; tie the animal's head so that it can not reach the tumor with its mouth, at least for one day. (In fact, it is essential to devise some means to prevent the animal from biting or gnawing the tumor or the healing wound, all the time.) In ten or twelve days, the whole tumor or part of it

that has been destroyed by the arsenic, may be pulled or torn away by the fingers. In case the tumor is not all destroyed by the first application, apply it again, being very careful to cover the skin around the tumor with lard or vaseline previous to the application in all instances. Never apply this very strong caustic a second time sooner than twelve to twenty days after the first application. Usually, one application is sufficient. On the abdomen, the lips, the cheeks and the eye-lids, this remedy should be used with great caution, because it is liable to make a hole entirely through the walls of these parts.

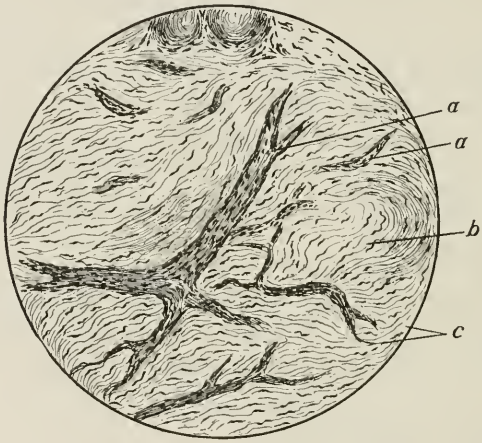
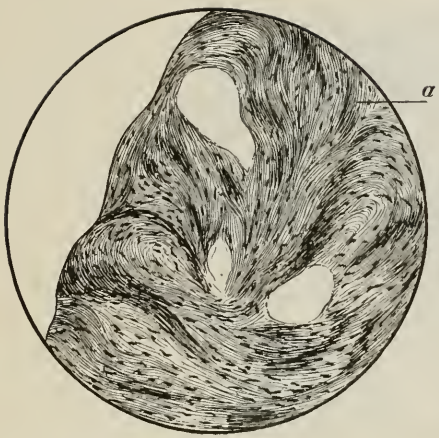
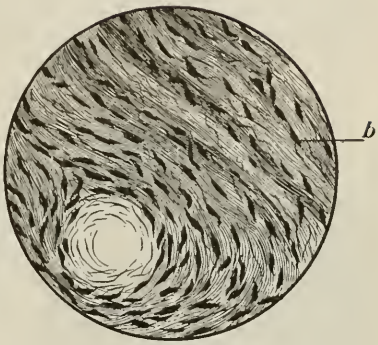
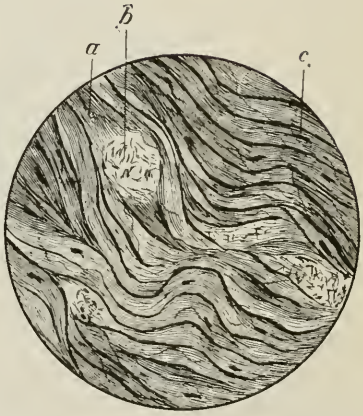


Fig. 1.—Section of tumor from side of mule. Tumor, 3 inches in diameter. a, a, blood vessels situated between the fibrous bundles; walls of vessels not well developed; b, fibrous tissue; the fibres running in various directions. Magnified 74 diameters and nuclei brought out with borax carmine.





Fig's. 2 and 3.—Section of hard fibrous tumor, one of many taken from skin of horse. Bundles of fibres run in various directions; blood vessels very few. a, bundles of fibres showing distinct nuclei (x74); b, nuclei under higher power (x534).



Fig's. 4 and 5.—Section of tumor from subcutaneous connective tissue of horse. a, dense fibrous bundles; b, dense fibrous bundles cut across; c, nucleus of connective tissue cell. Note that the nuclei or cells are less numerous in this section than in Fig's. 1 or 3. Fig. 4, x74; Fig. 5, x534.

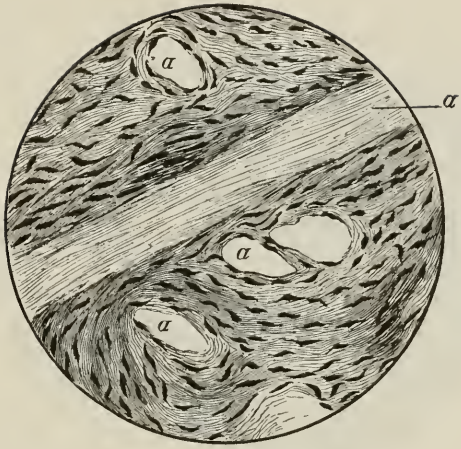


Fig. 6.—Section of fibrous tumor from subcutaneous connective tissue of horse; nuclei of cells very distinct and numerous; blood vessels large but their walls are not well organized; a, blood vessels. Magnified 534 diameters.

Fig's. 7 and 8.—Section of tumor from subcutaneous connective tissue of horse. A x74; B x534. Tumor smooth, firm; not very vascular; in loose capsule. Bundles of fibres wavy and nuclei of cells very distinct.

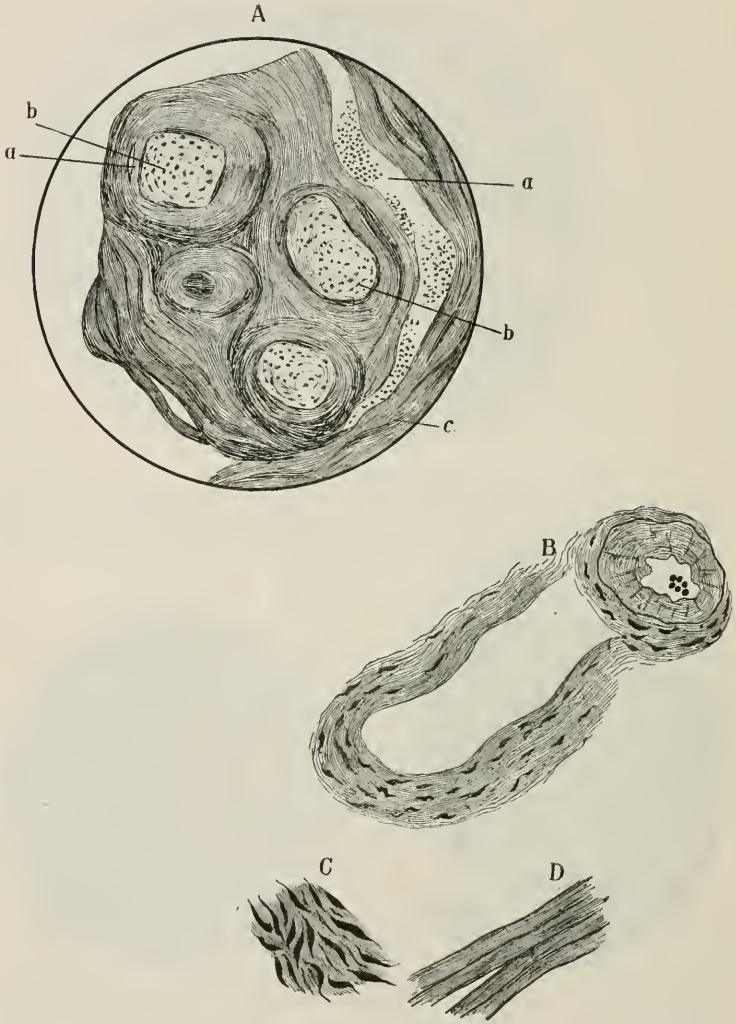


Fig. 9.—Section of multiple skin tumors, from the same horse as Fig's. 7 and 8. The blood vessels in the tumors are not well developed, but the vessels, just below the tumors in the subcutaneous connective tissue, are numerous and large. The young tumors are surrounded by concentrically arranged fibres, and young tumors are made up chiefly of young, spindle-shaped connective tissue cells.

A, (x74) a, Blood vessels; b, encapsulated multiple tumors; c, fibrous tissue. B, (x534) cross and oblique section of two arteries, just below the multiple tumors in A. C, (x534) represents b of A under a higher power. D, (x534) represents c of A under a higher power.

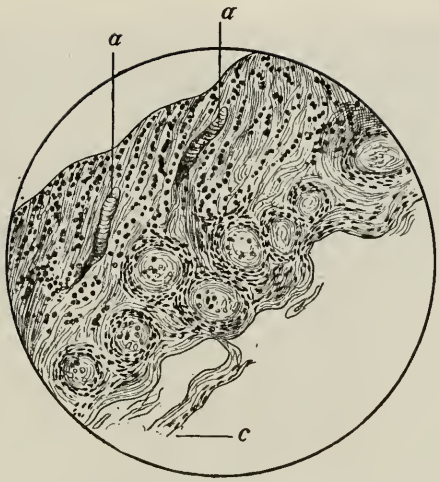


FIG. 10.- Section of multiple tumors from same horse as 7, 8. 9. a, blood vessels; b, small young fibrous tumors; c, cut off, pigmented epithelial cells (x74).

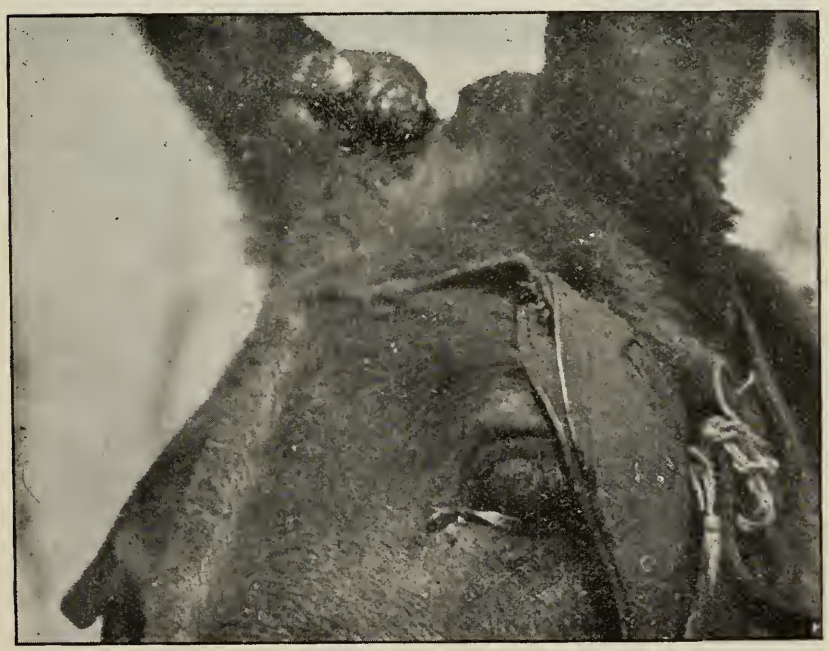


FIG. 11.

Fig. 12.

Fig's. 11 and 12.—Photographic representations of fibrous tumors on the ear and fore-arm; tumors have broken through the skin and look very like granulation tumors.

APPENDIX.

Classified List of Tumors taken from the Free Clinic Records for the Four Years Ending July 1st, 1896.

Fibromas.

1. Gray gelding, 4 years old, several tumors, excised and cauterized surfaces with thermo-cautery; results unknown.

2. Mule with a large raw tumor on lower part of right flank, one small tumor on sheath; excised, result unknown.

3. Mule with raw tumor on right ear, one on outside of left thigh, one on outside of forearm; excised; prescribed equal parts of tar and vaseline to be applied daily. Did not return. (These tumors illustrated in cuts Nos. 11, 12.)

4. Gelding with 2 large and 2 small tumors; removed with the knife and ecraseur; applied chromic acid; prescribed (c) page 318.

5. Colt, 2 years old, 1 tumor on leg, 1 on the abdomen and 1 on the ear; removed with shears and ecraseur; applied strong carbolic acid; never returned.

6. Mule with tumor on lip and one on rib region; excised and applied strong carbolic acid; result unknown.

7. Mule with skin tumor on side of abdomen; excised; applied strong carbolic acid; prescribed tannic acid 1 part, glycerine 4 parts; results unknown.

8. Mule with one small fibrous tumor on breast; excised; never returned.

9. Mule with a large "bleeding" fibroid on abdomen and several small ones on the perineum. Excised; no return.

10. Dark gray mule with about 50 fibrous tumors; largest ones on abdomen and around base of left ear; many small

ones, from the size of a pea to one inch in diameter, were located over the abdomen, on sides of thorax, in the groins and axillae, and over the limbs. There were so many small ones that some were over-looked in the process of cutting them out. Applied pulverized copper sulphate; prescribed (b) page 318. In six months, many of the small ones, that had been over-looked in previous operation, were now large enough to be easily located and removed. Two years after the second operation, three or four small tumors were found on this mule.

11. Gray horse with tumor in anterior part of a left axillae; upon cutting through the skin it was easily pressed out of its capsule; prescribed (c) page 318.

12. Mule with skin tumor on left knee; excised and applied strong carbolic acid; prescribed (c).

13. Colt, 2 years old, with bleeding tumor on fore-arm; excised; applied strong carbolic acid; prescribed (c). Never returned.

14. Gelding, 11 years old, with one large raw tumor on abdomen, a few small ones on the sheath, on the breast and in the axillae; excised and applied strong carbolic acid; prescribed (c). In six months the small tumors that were not easily located at the first operation were now distinct and readily removed.

15. Mule, 7 years old, with fibrous tumor in right groin and involving right side of mammary gland. excised; prescribed (b).

16. Mule, 10 years old, with fibrous tumor at base of ear; excised; applied strong carbolic acid; prescribed (c).

17. Mule, 3 years old, with a fibroid on right elbow for three weeks; excised; applied strong carbolic acid; prescribed carbolized oil.

18. Mule, 8 years old, with fibroid on sheath for two years; excised; applied strong carbolic acid; prescribed (c). Never returned.

19. Bay stallion, 3 years old, with fibroid on right upper eye-lid; excised; applied strong curbolic acid; prescribed carbolized oil.

20. Bay mare mule, 4 years old, with fibromas in left axillae; excised; applied strong carbolic acid; prescribed (b).

21. Mare, 3 years old, with fibroma on right ear; excised; cauterized with strong carbolic acid; prescribed carbolized oil.

22. Mule, 7 years old, with several fibromas; excised; applied copper sulphate; prescribed (b).

23. Bay mule, 5 years old, fibroid on abdomen; excised. Owing to neglect, a granulation tumor developed in a short time; it was excised; pulverized copper applied, and (b) prescribed. Never returned.

24. Sorrel gelding, 3 years old, with fibromas in right axilla; excised; applied strong carbolic acid; prescribed (b).

25. Bay mare mule, 10 years old, with large fibroid on abdomen just in front of mammary glands; excised; applied copper sulphate; prescribed (a). Never returned.

26. Black gelding, 5 years old, with a hard fibroid lying deep in the fascia of the external tibial region; excised; prescribed a 2 per cent. creolin solution. Never returned.

This tumor contained small pockets of fine chalky material and the fibrous tissue was thoroughly impregnated with lime in the central portion of the tumor.

27. Mule, 3 years old, with numerous fibroid tumors on upper eye-lid and on the breast. These tumors were so little and numerous that it was impossible to remove them all without cutting away large patches of skin. As many as practicable were cut out; applied copper sulphate and prescribed (b).

In twelve months, the little tumors that were not removed had developed until they were larger than those that were first removed; also, tumors were then visible on other parts of the body.

28. Gray mare, 4 years old, with fibromas on various parts of body. Excised; applied pulverized copper sulphate; prescribed (b).

29. Black mare, 7 years old, with fibromas on mammary gland, abdomen, groin and flank; excised; applied copper sulphate; prescribed (b).

30. Black mare, 5 years old, with small hard fibroid on border of lower jaw; cut out; applied copper sulphate; prescribed (b).

31. Bay mule, with fibrous tumors on pole and on left hind limb; excised; applied copper sulphate; prescribed (b).

32. Bay gelding, 5 years old, with fibrous tumors on the ears; cut off; treated same as No. 31.

33. Bay mule, 15 years old, with hard fibroid on left rib rigion, 3 to 4 inches in diameter, growing for 5 years; excised; prescribed (a). Never returned. Microscopic examination proved it to be a hard fibroid with calcareous degeneration.

34. Sorrel gelding, 5 years old, with fibrous tumor on left fore-arm; excised; applied copper sulphate; prescribed (b). Never returned.

35. Sorrel mare mule, 6 years old, with fibrous tumors on external surface of right ear; cut off; treated same as No. 34.

36. Mule, 10 years old, with fibrous tumor on right rib region, very large and hard. Excised; applied copper sulphate; prescribed (a). Never returned. This tumor had been growing for 5 years. It was a hard fibroid with calcareous degeneration.

37. Bay mule, 8 years old, with fibroid in right axilla; excised; applied pulverized copper sulphate; prescribed (a). Never returned.

38. Mule with hard fibroid in thigh region; excised; never returned. It had undergone calcareous degeneration.

39. Sorrel mule with fibrous tumor on external tibial region; excised; applied copper sulphate; prescibed 2 per cent. creolin solution.

40. Sorrel mule, 8 years old, with fibrous tumors all over the body, chiefly in the groins and axilla and on the ears. Excised (40 or 50) as many as could be easily found; prescribed (a).

41. Sorrel mule, 4 years old, with fibrous tumor on posterior surface of right knee; excised; applied copper sulphate; prescribed (a).

Granulation Tumors.

1. Mule with granulating "sores" on rib region and on breast. In curetting away the exuberant growths a slight grittiness was perceptible, indicating calcareous degeneration; this made the growths more consistent and more definitely granular. Another peculiar characteristic was observed; this hard granular growth extended quite a distance under the skin, and could be easily removed by pushing the curette up under the skin. After removing as much of the granular growths as possible with the curette, strong carbolic acid was applied and the following was prescribed: Carbolic acid, 2 drachms; Iodoform, 1 drachm; Tannic acid, 1 ounce; Glycerine, 1½ pints. Mix. Apply daily after washing. In 4 or 5 weeks the wounds had all healed and there were no more signs of their return that year. But the next spring "the same kind of sores broke out all over the body and got so bad that I took the mule off and killed him" (owner).

2. Bay mule, 6 years old, with exuberant granulations on inside of left hind pastern. Cut it off even with the surface, applied pulverized copper sulphate and then a bandage. As soon as the bandage was removed the mule was worked; the opposite foot struck the raw surface and the mule habitually gnawed it. Consequently, new growths were removed from this place eight times during the next two years. At present (June, 1896) a new growth as large, or larger than, any that were removed from the same place is now to be found; also, another tumor of the same nature has appeared, and has been removed 3 or 4 times, on the inner surface of the upper end of the canon region of the same leg. Microscopical sections of these tumors show that they are made up largely of embryonal cells not unlike the spindle cells of a sarcoma.

In one sense this tumor might be called a malignant, spindle-celled sarcoma. However, it is best to regard it as resulting and recurring from mechanical irritation, and most probably extending from the same cause. It is well to add that the mule was kept quiet only a short time dur-

ing these attempts at treatment and much of the time he was at work in the plow or wagon.

3. Mule, 12 years old, with a very large granulation tumor on inside of left hock. Caused by sticking a knife into a varicosed vein (blood spavin) and injurious applications. Sliced away the greater part of the granulations; applied pulverized copper sulphate and bandaged for two weeks; prescribed (a). Good recovery in 6 or 8 weeks.

4. Spanish Jack, 4 years old, with large granulation tumors on each limb. On one hind limb the growth covered the entire outside and part of the front surface of the fetlock, the canon and the hock. The jack was greatly emaciated and had a very poor appetite. Applied pulverized copper sulphate and bandaged as directed on page 319. This jack was kept in the college hospital and the bandages were maintained in a fixed position by keeping the animal quiet and by close attention. In nine or ten weeks the bandages were left off and thereafter only creolin washes and carbolized oil and tannic acid were applied. In about six months these places had healed and the jack was in a greatly improved condition. But from some unknown cause he was impotent; "he had no ambition." It is very probable that he was impotent when received for treatment.

Recently, Dr. W. A. Heck of Keokuk, Iowa, has been very successful in treating granulation tumors by cutting them down even with the surface and then giving internally a teaspoonful of fluid extract of ergot three times daily. The ergot tends to cut off the extra blood supply to the granulation tumor.—(C. A. C.)

Papillomas (Warts).

1. Gray colt, 2 years old, with extensive growth of "seed warts" (papillomas) on inside surface of both ears. Clipped them off with the scissors; curetted the surfaces, and applied corrosives sublimate by rubbing large crystals over the raw surfaces. One week later, applied strong carbolic acid, and prescribed (c). These growths were so heavy that the ears were bent over. They never returned.

2. Colt, 1 year old, with warts on the internal surface of each ear; excised and cauterized with strong carbolic acid; never returned.

3. Filly, 3 years old, with papillomas on internal surface of each ear; curetted away the warts; applied strong carbolic acid; prescribed (c). Some of the warts were not entirely removed; hence, a second operation was required.

4. Bull calf, 2 years old, with papillomas on right thigh and groin; excised; applied strong carbolic acid; prescribed (c). Never returned.

5. Dog with papilloma on toe of front foot; excised; cauterized with strong carbolic acid; never returned.

6. Bay filly, 18 months old, with papillomas on internal surface of each ear; excised; applied pulverized copper sulphate; prescribed (c).

7. Hen, 2 years old, with two abnormal growths on one wing. Microscopic examination proved them to be composed of imperfectly developed papillae and feathers.

8. Grade Jersey heifer, 2 years old, with numerous papillomas on abdomen and limbs; excised all that were large enough to find; applied pulverized copper sulphate. In the course of a year, many of those that were invisible at the time of the operation developed into prominence.

9. Sorrel mare, 5 years old, with papillomas on inside surface of each ear; cut and curetted them away; applied copper sulphate; prescribed (c). Never returned.

10. Bay stallion, rising 3 years old, with papilloma on end of the tail; clipped it and part of tail off with bone cutting forceps; prescribed (a). Never returned.

Sarcomas.

1. Gray mare with melanotic (pigmented) sarcoma just below the inferior commissure of the vulva; removed with the ecraseur; cauterized with strong carbolic acid; never returned.

2. Bay mare mule, 6 years old, with sarcoma in eye socket; removed the entire contents of the eye socket; the tumor returned, invaded the frontal sinus and possibly the

cranial cavity; mule died in about five weeks after the operation.

3. Gray mule, 24 years old, with melanotic sarcoma on left buttock; excised; prescribed "white lotion." Result unknown.

4. Pointer dog, 8 years old, with melanotic sarcoma on side of scrotum; excised and wound healed nicely in short time. Six months later a great number of tumors appeared in the subcutaneous connective tissue in various parts of the body; the dog exhibited symptoms of indigestion, lung trouble, and brain lesions (inability to properly control voluntary movements). Post mortem revealed numerous melanotic sarcomas in the pleura and peritoneum and two in or under the pia mater. Microscopic examination showed them to be round-celled sarcomas with less pigment than is usually found in melanotic sarcomas of the horse.

5. Gray mare, 17 years old, with numerous melanotic sarcomas in the subcutaneous connective tissue, scattered over the surface of the body. There were some signs that the lungs and other internal organs had been invaded. Only one large tumor was removed.

Carcinomas.

1. Mule with fungus-like growth on membrana nictitans (eye washer); removed with the shears the tumor and the "washer." The tumor returned in about six months; removed it again; result unknown.

2. Black Essex sow, 3 years old, with tumor in mammary gland; removed by excision three times within a year; at present no sign of return or of extension. Microscopic examination proved it to be a round-celled carcinoma.

3. Sorrel horse with a malignant tumor involving the right side of the face and extending from the right eye downward and forward into the right maxillary sinuses and destroying all the outer wall of the sinuses with which it came in contact. The animal was destroyed.

Reports of all infectious, contagious or peculiar diseases occurring in Alabama will be thankfully received by the Veterinary Department.

BULLETIN No. 73. OCTOBER, 1896.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Edible Fungi: A Wasted Food Product.

LUCIEN M. UNDERWOOD.

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EDIBLE FUNGI: A WASTED FOOD PRODUCT.

—BY—

LUCIEN M. UNDERWOOD.

Among the neglected products of America suitable for food, none are so little understood as the mushrooms. The same is more or less true among all Anglo-Saxon peoples, yet the English are more accustomed to their use than either the Americans or the inhabitants of the colonies. Strikingly in contrast with this is the condition that prevails in continental Europe where various species of fungi form a very general article of diet and are prized alike by the nobleman in his palace and the peasant in his hut. Many species are dried during the growing season and saved for winter use when a fresh supply cannot be obtained, and in this form large quantities are imported to this country and used as food by emigrants from various European countries. In some countries, France especially, they are extensively canned and in this form are exported to America where they are used at the larger hotels and restaurants, and frequently in private families, though the price of the imported material is usually so high that their use under these conditions cannot become very general. In this connection it should be noted, that, while immense quantities of finer mushrooms annually go to waste in this country than those imported in cans from France, the native forms are rarely collected and sold for food except in the immediate vicinity of the larger cities. We pay from thirty-five to fifty cents for a small can of inferior French mushrooms, and allow bushels of the same species in much finer quality to rot in our fields and forests. A few years since I was obliged to wait for a train at a railroad crossing in Indiana. It was soon after the early fall rains and in a field adjoining the crossing I could easily have picked two or three bushels of *Agaricus campestris* while waiting for my train. When I reached Chicago on the train I found an inferior quality of the same species selling for fifty cents a pound in the open market.

Many people are not aware that a considerable number of our common fungi or "toadstools"* are valuable articles of food, equal in nutritious elements to oysters, fish, or flesh, which various forms of our native species resemble in flavor and composition.

I find many others who are well aware that certain forms of mushrooms are useful for food, but are afraid to attempt their use because they fear they will be poisoned by the use of some unwholesome species. While it is a fact that many species are unfit for food, and a certain few are undoubtedly poisonous, this is no reason why we should neglect all mushrooms as articles of food. It would be as senseless to reject all kinds of berries because some berries are poisonous, or all kinds of root-foods because certain roots are poisonous. While the discrimination of the many species of fungi in a strictly scientific way is possible only to the few, certain common fungi that are useful for food are as readily distinguished from each other as currants are from pokeberries, or wheat from barley. In Germany, children are taught to discriminate the ordinary edible and poisonous fungi as a part of their school training and they can easily separate the edible forms from among a miscellaneous pile of many species. It argues a lack of good common sense for people to claim that they cannot learn how to distinguish one form of mushroom from another, for if they know beans from corn they can learn to distinguish the more common forms of edible fungi so as to recognize them at sight.

The species of fungi growing in the state of Alabama have not yet been sufficiently studied to give a complete list of the edible species that occur here, nor even to indicate the forms that are the most common during successive years. Rev. M. A. Curtis who studied the fungous flora of North Carolina for many years, published a list of over one hundred

* Also called "frog stools" in some parts of Alabama. Some people suppose that the so-called "mushrooms" are edible while "toadstools" are poisonous. We know no such distinction, and in different places they are called either mushrooms or toadstools irrespective of their edible or non-edible characters.

edible species occurring in that state. There is no reason why most of the same species and perhaps others should not occur within our limits. We can only give at present notes on a few species that are common and have come under our direct observation during the past season.

Mushrooms, as we are familiar with them, are seemingly of rapid growth and appear most frequent, soon after a warm rain, though at the latitude of the central portion of Alabama they may be looked for during almost any season of the year. Certain species have a somewhat definite period in which to develop and do not vary far from their season year after year. Other species seem to appear at all seasons of the year whenever the conditions of heat and moisture are favorable for their growth. The real growing or vegetative parts of the mushroom are rarely seen; they consist of slender interlacing threads called *mycelium*, which penetrate the soil or other subtratum on which the mushroom grows, and often extend to great distances and thus draw nourishment from a wide area. The mushroom having no green coloring-matter (*chlorophyll*) like ordinary vegetation, is unable to produce starch from inorganic materials, so must depend for its food on materials that have been already organized; these are found in decaying vegetable matter of various kinds scattered through the soil. The portion of the mushroom which we know as such is simply the spore-producing part of the plant. Many people cultivate mushrooms in stables or cellars or even in special pits prepared for the purpose. These mushroom beds are sown with the so-called "spawn," sold by dealers in garden seeds, which consists merely of masses of this mycelium grown among the fragments of a mixture of stable manure and muck. The species most commonly grown is one that is more or less common in a wild state throughout the United States and is known as

THE FIELD AGARIC OF FIELD MUSHROOM (*Agaricus campestris*). [Figure 1].

This is a typical umbrella-shaped mushroom, of which form we have many species. The plant consists of a cap or

pileus (*pi*) resting on a central stalk; underneath the cap appears a series of thin radiating plates which are known as the *lamellæ* or *gills;* part way down the stem appears a shreddy membranous ring called the *annulus;* this ring (*an*) is orignally in the form of a veil which extends from the stem to the margin of the pileus so as to completely cover up the gills; as the pileus grows larger the veil breaks away from the edge of the pileus and remains in the form of a more or less complete ring about the stem. These parts are shown in Figure 1 which illustrates this species.

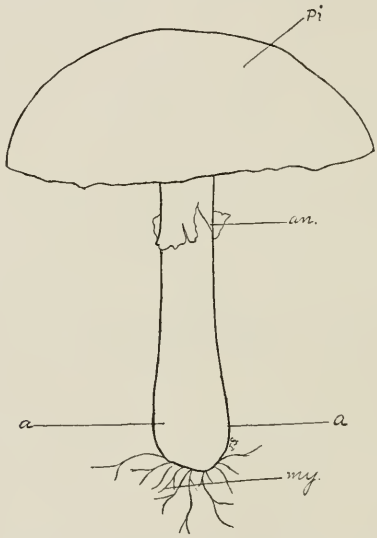

Fig. 1 Agaricus campestris; Edible; showing mycelium (*my*) constituting the underground *growing* portion of the plant; the annulus (*an*); and the pileus or cap (*pi*) being turned toward us does not show the gills or lamellæ beneath. The line *a a* represents the surface of the ground. Color of pileus white or grayish. About ⅔ natural size of ordinary specimens, though the size varies grea ly; the stem also is often very short.

The common field agaric has a normally white pileus though this may be more or less varied with grayish flecks or spots. It can be readily distinguished by the four following marks, all of which should be present to be certain of the species, though the first two will separate it from all the deleterious forms that might be confused with it:

1. The gills are at first pink and with age turn brownish and finally become watery and nearly black.*

2. There is a distinct veil which later appears as a ring or annulus on the stem.

3. The gills do not reach entirely to the stem.

4. The stem is either solid or stuffed with a cottony substance.

The field agaric more commonly appears in the fall of the year dependent to a great extent on the time of the fall rains. In Alabama it appeared last year at intervals from November to February. It more commonly appears in open places, notably in fields where sheep or horses are pastured. It can be cooked in any method which is adapted to oysters, though is best fried in a minimum of butter with proper seasoning. It is the most commonly eaten species of cool or moderately warm countries and is the species mentioned above as being imported from France as canned goods.

Another species which appears to be very common in the summer season in Alabama is known as

CÆSAR'S AMANITA (*Amanita cæsarea*). [Fig. 2.]

The species of *Amanita* are quite commonly regarded as poisonous and a number of them are known to be violently so. This noble fungus, however, is an exception to the rule and has been in use as an extensive article of food in Southern Europe since the time of the Romans. Under the name of "Boletus" it was fully described by Pliny as to its growth and development, and it was regarded as a dish of great excellence by the Roman epicures. In September, 1893, I saw hundreds of bushels of this fungus brought daily

* This darkening is due to the ripening of the spores which are borne on the gills. A pretty experiment to show the spores of this or other kinds of mushrooms can be easily performed by cutting off the pileus and placing it on a piece of white paper, gills downward, under a tumbler or bowl. In from two to twelve hours (according to the ripeness of the plant) the spores will drop down on the paper in lines radiating out from the position of the stem. In the field agaric these spores will be dark brown or almost black. In other species they may be white, salmon colored, rusty yellow or various shades of brown up to black.

into the street markets of Genoa by the peasant women and sold as a common article of food. During the past summer when it was next to impossible to procure fresh beef in the markets at Auburn, bushel upon bushel of this fungus grew and went to waste in a single piece of woods within a mile of town, and in traveling on the railroads quantities of the same bright-colored fungus could be seen from the car windows in various other parts of the State.

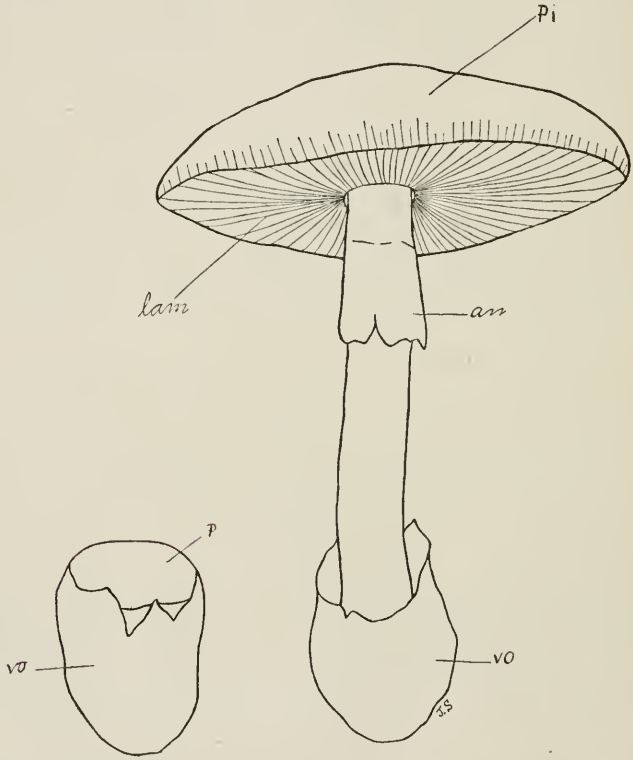

Fig. 2. Amanita cæsarea; Edible, showing young plant at the left just emerging from the volva, and fully expanded plant with cup-like volva (*vo*). annulus or ring (*an*), lamellæ or gills (*lam*) and smooth pileus (*pi*). Color of pileus usually bright or orange yellow. About $\frac{1}{3}$ natural size.

The genus *Amanita* presents an additional structure to the ones above discussed and a character which is of vital importance in discriminating this particular species. By reference to Figure 2, this structure can be clearly seen. At the base of the stem of the mature fungus appears a cup with a somewhat irregular border; this is called the volva (*vo*) for in the young condition of the plant, the volva envelopes the entire fungus like a wrapper; as the plant expands, the pileus pushes through this wrapper leaving its remains in the form of a persistent cup at the base of the stem. The species is a large one, often standing 8 to 10 inches high, and with a pileus 5 to 8 inches across when fully expanded. The pileus is of a bright reddish-yellow color, sometimes fading to a paler yellow color when older; the pileus is smooth and is never adorned with shreddy fragments of the volva; the gills and stem are pale yellow and there is a distinct veil which ultimately hangs like a skirt-like annulus on the stem; *the distinctive character, however, is the persistent cup at the base of the stem,* in connection with the combination of colors in pileus and gills above noted; if the cup (*volva*) is not present, the plant is not Cæsar's Amanita but is likely to be the fly-agaric which is poisonous! A *white* species with such a persistent cup is likely to be the white Amanita which is also poisonous! No one, however, having once seen Cæsar's Amanita with its bright orange or reddish-yellow pileus and delicate pale yellow stem and gills and distinct cup at the base could mistake it for anything else. In order, however, to emphasize the contrast between the two somewhat common members of the same genus we will present them in parallel columns:—

Caesar's Amanita (*edible*)!	The Fly-agaric (*poisonous*)!
1. Volva persistent at the base of the stem in the form of a cup.	1. No cup; base of stem mostly bulbous and scaly.
2. Pileus bright orange or rarely paler yellowish, smooth.	2. Pileus orange or yellow adorned with flocculent warts consisting of patches of the ruptured volva.
3. Gills and stem pale yellow.	3. Gills and stem white, the gills rarely slightly yellow-tinted.
4. Gills free, *i. e.* separate from the stem.	4. Gills attached to the stem and appearing to run down it in the form of slight ridges.*

Fig. 3. Amanita muscaria; Poisonous, showing scaly bulbous base without a cup, and the floccose volva appearing in patches on the pileus. Color of pileus pale yellow to reddish yellow. About ½ natural size.

In Figure 3 we give an illustration of the fly-agaric which resembles Cæsar's Amanita slightly. It will be noted that the cup is not present at the base of the stem. This one character combined with the bright color of the fungus is the one character on which we must rely to determine the question of its edibility. If the cup is present the plant is safe; if it is absent the plant is poisonous.

* A second smaller species (*Amanita Frostiana*) closely allied to the fly-agaric and doubtless often confused with it, differs by lacking this striate upper portion of the stem. It rarely has a pileus more than one or two inches in diameter while the fly-agaric is much larger. In other characters it is very much like the fly-agaric.

Hitherto Cæsar's Amanita has been reported from Vermont (*Frost*), New York (*Peck*), Ohio (*Morgan*) and North Carolina (*Schweinitz, Curtis*). It is very abundant in Alabama where the soil seems especially favorable for this species; it appears to be less common in more northern countries, being rare in the northern states mentioned and is found neither in England nor in northern Continental Europe. It is commonly found in open woods, occasionally growing in more shaded places. When it appears, usually soon after the first summer rain, it is found for a time in great abundance. Experiments with reference to the best methods of preserving this species for use at later seasons are very desirable. During the past season it was most common in July, but this period is likely to vary with the time of the summer rains.

The Puff Balls (*Calvatia, etc.*)

A second group of fungi less related to the two species of edible fungi above discussed, than they to each other, are the plants commonly known as puff balls. These when dry are variously known as "puff balls" or "smoke balls" and in some portions of our state are known under the name of "devil's snuff boxes." The clouds of dust which rise from these when crushed, are the reproductive bodies or spores and are produced in prodigious quantities. These appear only when the plants are fully ripe. It is in the young condition that these "puffs balls" are edible and they are fully as nutritious weight for weight as beefsteak. There are a large number of species widely distributed throughout the country and several of these are common in Alabama. The various species vary in size from that of a marble to that of a man's head or even larger. When young they will appear of a pure white color when broken in two, and of a consistency somewhat intermediate between cottage cheese and curd. When the spores commence to ripen the interior become softer, and soon takes on either a purplish or olive color according to the color of the mature spores. It is only when the flesh is white that they are suitable for food, and at this time they may be sliced thin and fried in butter after first removing the outer skin. All the species of thin skinned puff-balls are edible* but with few exceptions the smaller ones are not as valuable as the species that vary from the size of one's fist upward.

* The tough skinned species of *Scleroderma* with a blue black interior would not be likely to attract anyone as articles of food. With this exception all the puff balls belonging to the genera *Calvatia*, *Lycoperdon*, *Bovistella* and *Bovista* are edible and could not be confused with anything else.

In conclusion, it should be said that there is a wide field of unused food products which may be made valuable articles of domestic consumption; these products are produced by nature with a lavish hand. The use of them as an article of food requires careful discrimination to distinguish the edible from the deleterious, but the discrimination of certain useful species when they are once known is as simple as the discrimination of cereals, or small fruits. Species are as clearly marked as among higher plants and the characters are just as constant. There is much to be done (1) In further learning what species occurring in this state, are useful for food; (2) In methods of cultivation or of extending the natural season of the native plants, and (3) In methods of preserving the plants so that they may serve as an article of export, or be made available for domestic use after their natural or prolonged season has passed by.

Literature.

The literature relating to the edible fungi that can be recommended is unfortunately not very extended, corresponding with the slight extent to which the plants are used in this country. In Germany where fungi form a common article of diet, small works with colored illustrations of from forty to fifty edible and poisonous species can be obtained for a mark and a half (about thirty-five cents). The only work of a similar kind published in this country is Gibson's "Our Edible Toadstools and Mushrooms" which costs seven dollars and a half. Mr. Gibson has, however, an article in Harper's Monthly for August, 1894, that is valuable as far as it goes, giving good black and white illustrations of several species.

The Agricultural Experiment stations have published very little on this subject. Dr. Sturgis of the Connecticut station has recently issued (Annual Report for 1895) an excellent account of edible and poisonous fungi, illustrated by a series of half-tone plates which unfortunately do not bring out the best results. The U. S. Department of Agriculture has issued under the title of "Food Products," an account of various edible and poisonous fungi with fairly good colored plates. Nos. I, II and III have been issued already. The "Report of the Microscopist for 1892," issued from the same authority, also contains some illustrations. Dr. Farlow of Cambridge, also published "Notes for Mushroom Eaters" in Garden and Forest, Nos. 309–314 (Jan., Feb., 1894). Beyond the above, little American literature is available to the general public.

BULLETIN No. 74. OCTOBER, 1896.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Flour Considered from the Standpoint of Nutrition.

LUCIEN M. UNDERWOOD.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1896.

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

FLOUR CONSIDERED FROM THE STANDPOINT OF NUTRITION.

LUCIEN M. UNDERWOOD.

There is a German proverb involving a play of words in similar sounds which says: "*Was ein Mann isst, er ist,*." This is translatable into our tongue as, *What a man eats he is.* Without entering into the philosophic consequences that would result from a complete acceptance of such a doctrine, we can content ourselves with learning a few lessons that are suggested by the large germ of truth that is involved in the proverb. The question of "what shall we eat and what shall we drink and [with what clothes] shall we be clothed" is perhaps the most important personal question that can be considered by the American people. Although it might not be so considered at first thought, it is a question of *biology*, and moreover one of the most important practical questions biology has to consider, for it involves directly the welfare, happiness and productiveness of all of our people, as dependent upon the biological principle of nutrition. There can be no question but that the amount and quality of food directly affects man's actions; courage, disposition, mental activity are more or less directly dependent on what and how much food a man eats and the time and manner in which he eats it. There is much more wisdom than humor in the answer to the question: "Is life worth living?" that was asked in the funny column of the newspaper; and answered: "It depends upon the liver."

The customs of a people regarding food, change from time to time and ought to change, for people ought to take advantage as soon as possible of any discovery of science, or of any improvement in the method of the production or manufacture of articles of domestic use. The man who

lives as his grandfather did, works as his grandfather worked, and eats only the kind of food that his grandfather ate, is out of place in these closing years of the nineteenth century—he is a worm crawling in a rut with no ideas of the possibilities outside it. We are so much the creatures of custom and do things because they have been done, that unless we are rudely interrupted, we are sometimes likely to keep on doing the same old things in the same old way.

One or two illustrations will show how the habits of the American people change with regard to food. Thirty years ago if a resident of a town of 5000 or less wished for some oat-meal he would call at the drug-store instead of the grocery. The druggist would hand down from among his jars and packages of drugs a can containing some stale, granular, often mouldy oat-meal imported from across the sea. This with all its mouldiness and taints resulting from standing among vile-smelling drugs, would be weighed out by apothecaries' weight as a prescription for invalids or for some one whose delicate appetite needed something tempting. This was the relative position of oat-meal as a food supply only a generation ago. None of the nutritious and appetizing cereal preparations that are now so abundantly manufactured in this country and so universally used for food, were even known or thought of in those days. And I might add a remark that so soon as people learn the simple art of properly cooking these breakfast cereals and give us the light appetizing dishes that are possible where now we often have only the soggy, sloppy, flavorless preparations that are far from inviting—the favor of these healthful breakfast cereals will still more rapily extend.

Thirty years ago bananas were rarely seen outside the large cities and they were scarcely more than an occasional luxury even there, within the means of the better classes. Only now with the largest port of entry for bananas within our own State, and with special trains loaded with that fruit alone moving northward from Mobile every day to be distributed from Chicago and St. Louis into every little

town and hamlet in the upper Mississippi Valley, we see a vast change in the use of fruit as an article of diet compared with the custom of a generation ago. Right here let me interpose another protest that more of this fruit should be stopped before it leaves the borders of Alabama, for of all peoples that need fruit as a considerable article of diet, those who live in a warm climate need the most, and more fruit could well replace much of the fatty foods that are in common use throughout our State in city, town, and country homes.

We must, therefore, outgrow the customs of our fathers in regard to our food just as we have replaced the horse of our grandfathers by steam and electricity, and the blaze of the pine knot by the electric light. We owe it especially to the children of the rising generation that we give them the best food that science can discover, and give it to them in that form, that their dispositions, which are none too good by inheritance, may be improved, their mental capacity, which depends far more than we realize on what they eat, may be largely increased, and their happiness and long life which depend on their state of health and proper nutrition and these in turn on what they eat and how they eat it, may be conserved in the best possible way.

Since wheat is one of the commonest and most widely used food plants in America, it is strange that the question of its nutritive properties have so long given way to questions of color and appearance. The object among most maufacturers seems to have been to produce the whitest and finest flours possible, regardless of the nutritious qualities involved in the food product itself, thus depending for sales on *looks* rather than on *life giving function*—another pernicious custom far too prevalent in America. The purpose of this bulletin is to call attention to the constituents of wheat flour that have resulted not only from a study of the structure and composition of the wheat kernel itself but from a long series of practical experiments respecting the bread produced from various flours.

The kernel of wheat as nature produces it is covered with a tough, almost horny outer layer which in portions of the kernel, especially at its upper end and often within the groove is fringed with hairs. This outer covering, which forms the greater part of the bran when ground, is composed of cellulose with more or less hardening elements all of which are indigestible and consequently not suitable for food. Underneath the outer husk is an inner husk that contains considerable gluten and a large part of the phosphates and other mineral elements of the kernel. Under these two coverings is a layer rich in the gluten and other nitrogeneous elements of the wheat, and usually of a darker color than the interior which contains principally starch, with a much less proportion of gluten. The nutritive food elements of the kernel, therefore, increase from the interior outward. In the ordinary process of making flour, in which whiteness is regarded as a mark of the greatest purity, all the inner covering and much of the nutritive outer layer of the kernel is bolted out and only the inner, whiter portion containing more starch and less proteids is left. In other words the finer and whiter a grade of flour is, the less likely is it to contain the most nourishing elements of the wheat.*

A knowledge of these facts led, many years ago, to the introduction of "Graham" flour, which, for the most part, is either an unbolted flour or one in which only the very coarsest part of the bran or outer husk is removed after the wheat is ground. Graham is an improvement on ordinary white flour, so far as the question of nutritious constituents is concerned, but it contains the indigestible outer coat of the grain which is not only indigestible but irritating to the mucous membrane which lines the alimentary canal. Graham flour, moreover, is usually ground without thorough cleaning of the wheat, and the flour often contains various particles of dust that accumulate in the groove of the kernel

*It should not be understood that a *dark* grade of *white flour* is necessarily better on that account. As a rule it is made of an inferior quality of wheat or from wheat improperly cleaned.

and in the hairs at the end of the kernel, and the finely broken fragments of the hairs themselves, all of which are a detriment to the flour.

The ideal flour, so prepared that all the objectionable elements of the kernel are removed while all the nutritious parts are left in, is prepared by subjecting it to a process which removes the husky outer coating of the kernel before the grinding takes place, and then grinding the flour without separating any of the proteid portions of the grain from the starch, thus conserving all the nutrition in the grain; the product thus obtained is known as the "flour of the entire wheat." The bread made from this flour is of a light brown color, is more moist, richer in flavor and lacks the dry and unsubstantial character so common in white bread, especially that made by bakers. Having personally used bread made from this flour for the past fourteen years, and having compared it with many other kinds, I am prepared to say that I cannot find its equal in nutrition or flavor. It must be said, however, that something depends on the method by which it is made, and for that reason I have appended the most approved method followed in its preparation. It will be seen that it is more easily made than any other kind of bread. Unlike most bread it does not deteriorate with age if properly kept, up to a reasonable limit of time. I have taken it on camping expeditions and had it keep for a week with no necessity for renewal and no loss of flavor. In 1891 I met a gentleman at Lake Worth, who had spent three weeks in Florida. He was a chronic dyspeptic and could eat no other bread than this. He had brought a supply of it with him and had used from it during the three weeks of his stay, and was then obliged to go home because his supply was exhausted. If the bread becomes dry it is only necessary to wrap it in a moist cloth and place it in the oven for fifteen minutes, when it resumes its usual condition. It also makes the most delicious form of toast imaginable.

It should also say that this bread is not so palatable when

perfectly fresh as when at least a day or two old. In fact from a hygienic standpoint no bread when first baked is suitable for food. There is no question but that the wide spread dyspepsia that is common throughout the country is largely due to the excessive use of fatty foods, strong coffee and hot bread.

The peculiarities of bread made from the flour of the entire wheat as a food, are, of course, due to its flour containing all the nutritious elements of the wheat. It thus adapts itself to the needs of the system and builds brawn, bone and brain. It is, therefore, specially valuable for young people whose bodies are growing, or for those whose brains are in the process of growth and expansion. It is a pitiable sight to see so many children and young people robbed of the food elements necessary to their proper development by the use of those forms of food from which the chief good has been thrown away, for in the preparation of white flour, the middlings or *canaille* is bolted out and is used in the preparation of various food stuffs for our domestic animals. In this way we treat our domestic animals better than we do our children by giving the children the flour from which the best and most nutritious elements have been separated, and then giving these same nutritious portions to pigs and cattle.

Another special advantage of this bread is its regulative action on the human system. Probably the largest number of chronic disorders of the human system can be traced to the matter of indigestion and the attendant constipation that follows as a natural result. The most ordinary method employed for this difficulty is the one that is most unreasonable from the standpoint of either biology or common sense. When the system has become overcharged by unsuitable food or by too much of it, it is manifestly folly to follow this up by an additional load in the form of drugs of any kind. It would be considered insane to load a beast of burden, already staggering with its pack, with an additional weight of merchandise, and yet we do this same

thing with our poor overloaded digestive system, when we follow the ordinary plan of dispensing physic. Shakspeare uttered a sublime command when he caused Macbeth to utter the words, "Throw physic to the dogs." The simple and rational method of treating such conditions is through the proper use of food. There are sufficient forms of food supplies among our standards so that any one by a proper selection and combination can secure that which will at once supply proper nourishment to the body and at the same time act as a regulative that will render unnecessary either drugs or doctors. Perseverance will be necessary in obstinate cases, *but they can be overcome by this treatment.* In the list of foods that stand high in regulating the system against a tendency to constipation is this flour of the entire wheat.*

It should be said that several other forms of hygienic flours are made which claim to be equal to this, but so far as I have tested them they lack both in nutritive qualities and flavor, the high character of the preparations above described. The cereal foods prepared at Battle Creek, Michigan, and recommended by its well known sanitarium, are valuable additions to the list of useful foods.

In order to verify the results of microscopic examination and experience, samples of the "flour of the entire wheat" manufactured by the Franklin Mills Company of Lockport, New York, together with samples of the best grades of white

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*Constipating Foods.—Hot bread, bread and rolls made with baking powder, cake, custards, salted, dried and smoked meats, poultry, potatoes and starchy foods generally, blackberries, raspberries, tea, coffee and chocolate.

Laxative Foods.—Rolled and cracked wheat, all forms of bread made from the entire wheat, fresh acid fruits like the orange or lemon, tropical fruits like bananas, stewed dried fruits, especially peaches, prunes and apricots, tomatoes, oysters, raw cabbage, and most green vegetables, wild game, etc.

Foods of Neutral Character.—Lean, fresh meats, fresh fish, eggs, uncooked milk, oat-meal and sweet potatoes.

flour offered for sale in Alabama, were submitted to Prof. B. B. Ross, State Chemist of Alabama, with the following results:

Constituents.	Flour of the Entire Wheat.	Best white flour. Sample I.	Best white flour. Sample II.
Water	6.36	11.07	10.74
Fats	1.51	0.88	0.79
Protein	14.19	9.94	9.22
Carbohydrates	77.03	77.73	78.91
Ash	0.91	0.38	0.34
	100.00	100.00	100.00

The greater percent of ash in the first column is largely due to excess of phosphates, the percent of phosphoric acid being 0.50 for the flour of the entire wheat and only 0.23 for the white flour.

It will be noted that while the percent of water is less in the flour of the entire wheat, the percents of proteids (gluten), fats and phosphates are larger than in the best white flour, while the percent of carbohydrates (mainly starch) remains very nearly the same.

After the first analysis of the flour of the entire wheat, made from the barrel, two additional tests were made from samples of flour furnished by the Franklin Mills Company direct to the chemist. These samples did not materially differ from the first analysis except that the percent of protein was a trifle higher, the ratio being 228 and 229 as against 227 in the first analysis.

To show more forcibly the comparative values, we present the ingredients of a standard barrel of flour (196 pounds) in actual weights; we use the average of the two samples of white flour for this comparison:

Ingredients.	Flour of the entire Wheat.	Average of two Samples of White Flour.
Water	12.47 pounds.	21.36 pounds.
Fats	2.96 "	1.64 "
Protein	27.81 "	18.68 "
Carbohydrates	150.98 "	153.61 "
Ash	1.78* "	0.71† "
Totals	196 00 pounds.	196 00 pounds.

* Of this 0 98 pounds is phosphoric acid.

† Of this 0.45 pounds is phosphoric acid.

It will thus be seen that Dr. Cutter of Harvard University, was not very wide of the mark when he used the following language with reference to the flour we commonly eat. We quote from the *American Medical Weekly*, and use his italics: "The gluten of cereal foods is their nitrogenized element, the element on which depends their life-sustaining value, and this element is, in the white and *foolishly fashionable* flour, almost entirely removed, while the starch, the inferior element, is left behind and constitutes the entire bulk and inferior nutriment of such flours. To use flour from which the gluten has been removed, is *almost criminal*."

The flour of the entire wheat is recommended by a large number of prominent physicians who have made a study of nutritive foods; and either this or similar grades of flour are used at all first-class sanitariums where invalids are built up in accordance with the most advanced ideas of nourishment.

In order to make this bulletin as practical as possible, we add a recipe for using the flour of the entire wheat, since the process is somewhat different from that followed in ordinary bread making:

"For making bread from the flour of the entire wheat, take two quarts of unsifted entire wheat flour, a little less than a quart of warm water, one-half cup of sugar (or less if desired), one-half cake of compressed or ordinary dry yeast, and a little salt. Dissolve the yeast in part of the water, mix sugar, flour and salt and add the yeast and the remain-

der of the water. Stir well and set in a warm place. When the dough has risen to twice the original amount, stir down and put in tins for baking, allowing it to rise a second time. This bread requires longer and slower baking than ordinary white bread. This quantity makes two loaves of bread of ordinary size."

It will be seen from the above that this bread requires no kneading and its preparation is consequently much simpler than that of ordinary white bread. All forms of cake made with molasses, all fruit cakes and steamed breads are much better made of this flour and keep moist for a much longer time. The flour also makes most excellent gems and griddle-cakes, so that those who will persist in using hot breads can find this flour adapted to their purpose and can at least take advantage of its added nutriment.

It is proper to acknowledge, with thanks, the assistance rendered by the Chemical Department through Prof. B. B. Ross, under whose direction the analyses were made, and to the Franklin Mills Company for kindly furnishing samples of their flour for analysis.

BULLETIN No. 75. DECEMBER, 1896.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

EXPERIMENTS WITH CORN.

J. F. DUGGAR, Agriculturist.

MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1896.

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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.

EXPERIMENTS WITH CORN, 1896.

By J. F. Duggar.

SUMMARY.

I. The spring and early summer of 1896 were extremely dry.

II. Among fourteen varieties of corn tested, the largest yield was made by St. Charles, followed by Early Mastodon and Blount Prolific.

Averaging many tests of varieties made in Southern States, the varieties giving the largest yields were found to be as follows: (1) Cocke Prolific, (2) Mosby Prolific, (3) Calhoun Red Cob, (4) St. Charles, (5) Mammoth White Surprise, and (6) Blount Prolific.

III. In the unusual season of 1896, seed corn from Illinois afforded a larger yield than did that from Alabama and Georgia.

IV. Kernels from the middle of the ear of dent varieties afforded a smaller yield than grains from the butt and tip ends of the ear.

This result was confirmed by averaging the relative yields obtained in fourteen tests at five experiment stations.

V. In this dry season the yields were practically the same whether the distance between single plants in rows five feet apart was three or four feet; a distance of two feet in the row greatly reduced the yield.

VI. On sandy branch bottom land the yield of corn was 3.1-10 bushels greater where 426 pounds per acre of crushed cotton seed was used than where 180 pounds of cotton seed meal was employed, the amount of nitrogen furnished per acre being the same in each fertilizer.

VII. On sandy branch bottom land which had borne two crops of weeds, the loss when the weeds were burned, instead of being plowed under, was 2.8 bushels of corn per acre.

VIII. The yield of grain was less when the entire stalks were cut and cured before pulling the ears and also less when topping was practiced than when the plants were not disturbed before gathering the ears. Financially, topping was unprofitable, and the profit in harvesting the entire stalks was doubtful where no shredder was available to prepare the stalks for feeding and when corn was valued at 45 cents per bushel, and stalks at 25 cents per 100 pounds.

A compilation of results of stripping the blades or pulling fodder showed an average loss of 2.9 bushels of corn per acre from pulling fodder. Only when fodder is high and corn low in price can fodder-pulling be regarded as profitable. Hay making would generally give better returns than fodder-pulling for the labor employed.

I. The Rainfall During the Growing Season of 1896.

Of all the factors in crop production that are beyond the farmer's control, the most important is the amount and distribution of the rainfall. With ample and well distributed rainfall in April, May, June, and July, a relatively good crop is almost certain. A deficiency in the total rainfull for these months, or the occurrence of long dry spells at this time, almost invariably causes a poor yield, no matter what the method of fertilizing and cultivating the crop.

The greater part of the growing season of 1896 was abnormally dry. The rainfall for March and May was only about half the normal, and in April and June it was only about one-third the usual quantity.

Very heavy rains, accompanied by damaging winds, fell about the middle of July, but this was too late to be of much benefit to the corn crop.

The following table shows the periods in which there was little or no rain :

					Rainfall in inches.
28	days	immediately	preceding	April 29, ...	0.00
9	"	"	"	May 14, ...	0.00
7	"	"	"	May 22, ...	0.00
18	"	"	"	June 21, only	0.22
14	"	"	"	July 6, only	0.13
24	"	"	"	Aug. 16, only	0.26
27	"	"	"	Sept. 21, only	0.05

Some of these periods of drought appear short, but many of them were in reality longer than they seem, for the showers separating them were light and altogether insufficient.

The effect of the dry season is shown by the low yields obtained in nearly all experiments conducted on upland.

II. Variety Test of Corn, 1896.

For this test sixteen plots were used. The land was quite uniform in fertility as was indicated by the close agreement between the duplicate plots. Fertilization, culture, etc., were identical for all plots. The distance, 4⅔ by 3 feet, or 14 square feet per plant, is probably less than is advisable for most of the upland of this vicinity.

The following table gives the number of pounds of thoroughly dry unshucked corn required to afford 56 lbs. of shelled corn, the percentage of grain in the unshucked corn, and the yield per acre of each variety, arranged in order of productiveness:

Variety test of corn.

Plot No.	Variety.	Unshucked corn per bushel.	Grain in unshucked corn.	Yield of shelled corn per acre.
		Pounds.	*Per cent.*	*Bnshels.*
8	St. Charles	71.1	78.8	25.1
13	Early Mastodon	73.7	76.	22.7
16	Blount Prolific	74.1	75.6	22.3
11	Golden Giant	77.3	72 4	21.2
14	Champion White Pearl	72.9	76.8	21.3
5	Hickory King	71.8	78.	20.7
4	Yellow Dent	71.8	78	19.8
1	Peabody	82.8	67.6	18.2
10	Experiment Sta. Yellow	81.4	68 8	16.9
7	Jones Pearl Prolific	84.3	66.4	16.8
12	Chester County Mammoth	77 3	72.4	15.9
2	Mosby Prolific	83.3	67.2	15.5
3, 9, 15	Renfro, average	81.3	68.8	14.7
6	Higgins	86 4	64.8	12.2

In this test St. Charles, a white variety, stood first, followed by Early Mastodon and Blount Prolific.

As the Alabama Experiment Station has no seed for sale or distribution, a list is given below of the parties from whom our seed corn was obtained :

Variety.	Color of grain.	Seed From—
Peabody	W	W. B. Tucker, Opelika, Ala.
Mosby Prolific	W	Miss. A. & M. Col., Starkville, Miss.
Hickory King	W	C. C. L. Dill, Dillburg, Ala.
Higgins	W	W. J. Higgins, Larkinsville, Ala.
Jones Pearl Prolific	W	H. P. Jones, Herndon, Ga.
Blount Prolific	W	" " " "
St. Charles	W	J. C. Suffern, Voorhies, Ill.
Champion White Pearl	W	" " " "
Yellow Dent	Y	" " " "
Golden Giant	Y	E. G. Packard, Dover, Del.
Early Mastodon	Y	" " " "
Chester County Mammoth	Y	" " " "
Renfro	W	Ala. Exp't Station, Auburn, Ala.
Experiment Sta. Yellow	Y	" " " "

The result of a single test of varieties is apt to be misleading, especially in such an unusual season as 1896. Much more reliable conclusions are obtainable by taking average results for a large number of tests.

In order to learn what varieties succeed best in the South, a compilation was made of all published tests conducted at the Agricultural Experiment Stations in the Gulf States, Arkansas, Georgia and South Carolina. Since no one variety entered into all of these tests, it was impossible to use any one variety as a standard of comparison. To make comparisons possible the average of the yields of all varieties in each test was calculated and this average yield was taken as 100 ; any variety yielding more than the average in a certain test was given its proportional grade above 100, and any variety falling below the average was given a rating correspondingly below 100.

By averaging all relative yields calculated as above for each variety, a figure is obtained for each variety which is more satisfactory than is the result of a single test.

In making this compilation calculations were made for nearly 700 tests with 260 varieties. The greater the number of experiments into which a given variety enters the more reliable is the average yield for that variety. The list given below contains the average for only such varieties as have each been tested five or more times, and the varieties are arranged in the order of productiveness :

Relative yields of varieties of corn repeatedly tested in the Gulf States, Arkansas, Georgia, and South Carolina.

	No. of tests.	Relative yield.
Cocke Prolific	5	136
Mosby Prolific	19	126
Calhoun Red Cob	6	122
St. Charles	11	121
Mammoth White Surprise	6	115
Blount Prolific	26	111
Banks Improved	7	111
Early Mastodon	6	110
Experiment Station Yellow	5	110
Virginia Gourd Seed	5	110
Welborn Conscience	18	109
McQuade	9	109
Piasa King	10	107
Brazilian Flour	8	107
Patterson	7	107
Maryland White Gourd Seed	5	107
Giant White Normandy	13	106
Pride of America	5	105
New Madrid	5	103
Giant Broad Grain	9	103
Shoe Peg Improved	7	103
Clarke Early Mastodon	7	102
Champion Early White Pearl	8	101
Clayton Bread	6	100
Mexican Flint	5	99
White Mexican	6	99
Alabama	7	98
Hickory King	19	96
Hendron White Bread	5	95
Leaming White	8	93
Common White	5	93
Golden Beauty	20	92
Chester County Mammoth	7	92
Improved Leaming	8	88
Champion White Pearl	11	86
Golden Dent	9	86
Western Yellow	5	85
Riley Favorite	5	83
New Hickory King	5	81

The results of two tests in which St. Charles was the most productive variety are unavailable for the above compilation because published only in the form of a summary. If these figures could have been used, St. Charles would have ranked higher, possibly first, instead of fourth, in the above table.

Three of the varieties standing near the head of the list, Cocke Prolific, Mosby Prolific, and Blount Prolific, bear several small ears on each stalk.

III. Seed Corn from Different Latitudes.

Early in 1896 Hickory King corn was obtained from Illinois, Delaware and Alabama, and Blount Prolific corn from Illinois and Georgia. Six plots, each one-tenth acre in area, were used for this experiment; plots 1 and 4 were both planted in Hickory King corn grown in Alabama, the purpose of this duplication being to learn whether the different plots were nearly of uniform fertility.

Preparation, fertilization, and culture were the same for all plots. The young plants were thinned so as to leave the same number on each plot, the distance between plants averaging 2.4 by 4.5 ft., which is at the rate of about 4,000 plants per acre.

The following table gives the locality from which seed was procured, the yield of shelled corn per acre on each plot, and the increase or decrease of Northern seed over Southern seed:

Seed corn from different latitudes.

		Shelled corn per acre.	
		Yield.	Increase (—) or decrease (—) from Northern seed.
	Hickory King.	*Bus.*	
1	From Pickens Co., Alabama..	16	.....
2	From Voorhies, Illinois	19.3	—2.8
3	From Dover, Delaware	15.6	— 9
4	From Pickens Co, Alabama..	17.1	.....
1& 4	Average of Alabama seed...	16.5	.....
	Blount Prolific.		
5	From Voorhies, Illinois	14.2	—1.1
	From Herndon, Georgia.....	13.1	.....

The above table shows that with both varieties seed corn from Illinois produced a larger crop than that from the South. However, since the differences are only slight in most cases, it is not safe to conclude that Northern seed will generally afford a larger yield than that of the same variety grown in the South. But it is an interesting fact that in the abnormally dry season of 1896, Hickory King corn grown in Illinois, was more productive than the strain of that variety already acclimatized in this State.

The results secured in the test of varieties (p. 364) are also suggestive as showing relatively heavy yields produced by Northern varieties.

The average yield in 1896 for eight Southern varieties was 17.2 bushels per acre; for six Northern varieties 21 bushels. Of the Northern varieties in that experiment the three from Illinois averaged 22 bushels, while the three varieties from Delaware averaged 19.9 bushels per acre. Results of a variety test in Oklahoma (Bulletin No. 10) in a very dry season also showed a larger yield of grain from Northern than from Southern varieties. However, results from averaging a number of varieties of Northern origin and comparing the average yield with that of dissimilar varieties of Southern origin are valuable in this connection only when the number of varieties from each section is large.

The results recorded in the preceding table do not confirm the common belief that Northern seed corn is inferior to pure Southern varieties.

Differences in yield between the same varieties from different latitudes are not wholly due to climate, but also to the kind of soil and culture which produced each strain. Thus seed of the same variety grown on adjacent farms may vary in productiveness—an encouraging fact for one who may desire to improve his corn by good culture and careful selection.

IV. Butt, Middle, and Tip Kernels for Seed.

It is a common practice in selecting seed corn to discard the kernels growing at the tip and butt ends of the ear. To obtain more light on the advisability of this practice, the experiment recorded below was undertaken.

There were selected good, well filled ears of Experiment Station Yellow corn, a variety with ears of medium size, and usually a single ear to the stalk. From each ear the grains which grew within one inch of the tip end were shelled to obtain tip kernels for planting. Likewise kernels growing within an inch of the butt end were obtained. Near the center of the ear, a space of one inch was shelled to obtain middle kernels for planting.

The field used for this experiment was divided into nine plots, each one-ninth acre in area.

Three plots were planted with butt grains, three with middle grains, and three with tip grains, the arrangement of plots being such as to distribute equally to all classes of seed any advantage due to differences in the fertility of different plots.

Preparation of land, fertilization, and culture were the same for all plots. The yields from all three kinds of seed were poor, the unusually severe drought causing an undue proportion of nubbins and poorly filled ears.

Yield of shelled corn produced by seed corn from middle, butt, and tip of ear.

Kind of Seed.	Yield corn per acre.	Grain in unshucked corn.
	Bus.	*Per cent.*
Middle kernels (average of 3 plots).....	11.7	68.3
Butt kernels (do).....	12.6	69.2
Tip kernels (do).....	12 7	70.1

The differences in yield are probably too small to point to the superiority of the kernels from any particular part of the ear. There is certainly no evidence here that the re-

moval of tips and butt grains from seed corn is advantageous.

As a check on the above experiment a more comprehensive test was undertaken on plots so small as to permit of the weighing on chemical balances of all the seed planted. In this experiment butt, tip, and middle grains were obtained from spaces of one inch located respectively at the butt, tip, and middle portions of the ear. All unsound kernels, found chiefly among the tip grains, were rejected; otherwise the kernels which were weighed were not selected but represented average grains from the several parts of the ear.

From each large, well filled ear, used in this experiment, 50 grains from each part of the ear were weighed, and these 50 kernels were planted in 24 hills, spaced 4 by 4 ft. Later the stand was reduced to one stalk per hill and the missing hills were replanted with Brazilian Flour corn, the replanted hills equalizing the stand, but forming no part of the experiment.

The following table gives the weight of the middle, butt, and tip kernels planted, and the weight, in apothecaries' grains, of the shelled corn grown from each kind of seed :

Weight of middle, butt, and tip kernels planted and yield of shelled corn produced by middle, butt, and tip seed.

Plot No.	Ear No.	Variety.	Seed kernels from	Weight of 50 kernels planted.	Yield of shell'd corn per plant.
				Grains.	*Grains.*
1	A	Expt. Sta. Yellow...	Middle...	210.2	1836
2	"	do	Butt. ...	212.6	2100
3	"	do	Tip	153.9	1789
4	B	Expt. Sta. Yellow. .	Middle...	306.6	2360
5	"	do	Butt	323.9	2346
6	"	do	Tip	214.1	2294
7	C	Renfro.....	Middle...	427.3	2221
8	"	do	Butt.	491.3	3350
9	"	do	Tip	391.2	2916
10	D	Hickory King.....	Middle...	352.9	1950
11	"	do	Butt	437.3	1960
12	"	do	Tip	276.7	1750

In three instances the butt grains led in productiveness and in the fourth case they wanted only a very slight weight of taking first place. In three cases tip grains were least productive. Taking an average for the four ears planted, the weight of the shelled corn produced was as follows :

WEIGHT OF SHELLED CORN PER PLANT.	*Grains*
From planting butt kernels, ...	2439
" " middle kernels, ...	2092
" " tip "	2187

Attention is called to the fact that butt kernels led in average weight and in productiveness ; that tip kernels fell much below the others in weight, and that tip kernels were least productive in three out of four cases, although the relatively large yield with tip kernels of the Renfro variety made the average figure for tips higher than for grains from the center of the ear. The frequent correspondence between weight of seed and productiveness in this test is suggestive and is worthy of further study in future experiments.

The following table brings together in a form for easy reference the results of our tests and of previous tests at other experiment stations on the relative productiveness of grains from different parts of the ear.

In each test the lowest yield, whether made by middle, butt, or tip kernels is graded at 100, and the two higher yields at correspondingly higher figures :

Summary of results of planting kernels frm middle, butt, and tip of ear.

Station.	Variety.	Relative yield produced by seed from—		
	Dent Varieties.	Butt.	Middle.	Tip.
Alabama....1896	Experiment Sta Yellow... (Six small plots.)	109	103	100
" "	Experiment Sta. Yellow... (Nine large plots.)	109	100	109
" "	Renfro.....	151	100	131
" "	Hickory King.....	112	111	100
Arkansas...——	.....	112	101	100
Kansas.... 1891	St. Charles.....	108	102	100
Ohio.....1886	——Dent.....	120	100	111
" 1888	——Dent.....	105	106	100
" 1889	——Dent.....	100	100	101
" 1890	——Dent.....	117	100	112
	Flint Varieties.			
N. Y. State, 1882	—— Flint.....	101	100	104
" " 1883	—— Flint.....	100	101	106
" " 1884	—— Flint.....	100	103	103
" " 1885	—— Flint.....	100	105	103
Average of all	tests with dent varieties...	114	102	105
" "	" " flint " ...	100	102	104
" "	" " " & dent variet's	110	102	106

The average of all tests shows that butt kernels have been most productive, and that tip kernels have stood ahead of grains from the middle of the ear. The few figures for flint varieties do not agree with the average, but favor tip kernels.

The most striking fact about the above table is that in no case do the middle kernels show a marked superiority over those from other parts of the ear. This indicates that the farmer can advantageously dispense with the labor of removing the butt and tip grains from the ears used for seed.

V. Distance for Upland Corn.

This experiment occupied 6 plots near the top of a hill. Plot 1 was on the highest ground, from which there was a slight slope to plot 6.

The altitude of all the plots and the sandy character of the soil made the position a dry one and hence unfavorable to thick planting. The very dry season also militated against thick planting.

Fertilizers and culture were the same for all plots. Seed of Renfro corn, a variety with large ears, was planted at measured distances March 23. A single plant was left in each hill and the stand was regular. On plots 1, 2 and 3, the distance between the rows was the same, 5 feet, but the distance between plants in the drill varied from 4 to 2 feet, affording wide variations in the number of plants per acre. On the other hand the thickness of planting was the same on each of plots 4, 5 and 6 ; the only difference between these latter plots was that on plot 6 the rows were close together and the distance between plants in the drill was considerable, while on plot 4 the rows were 6 feet apart and the plants correspondingly closer in the drill. The arrangement on plot 5 was intermediate between that of plots 4 and 6.

The following table gives the number of stalks and the yield of corn per acre when the plants stood at different instances apart :

Yield of corn when Plants stood at different distances apart.

Plot No.	Distance.		Number of plants per acre.	Yield per acre.
	Between Rows.	Between plants.		
				Bus.
1	5 feet.	4 feet	2178	12.4
2	5 feet.	3 feet	2904	12.9
3	5 feet.	2 feet	4356	9 8
4	6 feet.	2 feet 6 in.	2904	13.1
5	4 feet 10 in.	3 feet 1½ in.	2904	15.6
6	4 feet.	3 feet 9 in.	2904	16.9

Where the rows were 5 feet apart there was practically no difference in yield for distances of 3 and 4 feet between plants. A space of two feet between plants was much too close for this poor soil and dry season. On the three plots where

the thickness of planting was constant, but the arrangement of plants different, the figures at first view suggest a continuous increase in yield as the constant area devoted to each plant approaches a perfect square in shape. However the land was not perfectly uniform, as seemed the case when the plots were located. There is a slight increase in fertility towards the lower plots, which is apparent on comparing the yields of plots 2 and 5,—plots which are practically duplicates.

Allowing for this natural advantage which their position gives to the narrow rows, the yield becomes practically the same for rows nearly 5 feet apart as for narrower rows less thickly planted. For land of this character, high, sandy, dry, and poor, 5 feet between rows is the minimum distance that can be recommended, and on very poor land wide rows are best. Rather wide rows are necessary to economy of cultivation and to allow the planting of a row of cow peas in the middle between the corn rows.

In order to make this test as accurate as possible, our usual custom of planting a row of cowpeas in each middle was not followed in this experiment. As compensation for this omission, crimson clover seed was sown broadcast soon after the corn was gathered, and covered by using a Planet, Jr., cultivator, supplied with five very small shovel points. This seeding was made in September with the expectation of plowing under the growth of crimson clover late in March, 1897.

VI. Cotton Seed Meal Versus Crushed Cotton Seed for Corn.

An experiment to compare the fertilizing effect of nitrate of soda and cotton seed meal and to test the effect of applying only half the cotton seed meal at planting time and the other half later was located on a poor hill-side, having a rather stiff soil. This spot suffered more from the pro-

tracted drought and gave a smaller yield, only 6.9 to 8.7 bushel per acre, than any other field on the Station farm. The failure of the crop on all plots on this hillside rendered the experiment worthless.

A test of the relative values of cotton seed meal and crushed cotton seed was made on a piece of sandy branch bottom which had borne a crop of oats in 1894 and had since grown up in weeds. The heavy growth of weeds was plowed under with a one-horse turn plow February 27, 1896, and Renfro corn planted March 18. Immediately before planting, rows were marked off with a shovel plow; in this furrow fertilizers were drilled. Then a scooter was run once in this furrow to mix the fertilizer with the soil, after which corn was planted and covered with a double-foot plow stock furnished with two small scooters. Each plot received acid phosphate at the rate of 360 pounds per acre and kainit at the rate of 120 pounds per acre, the mixture of these two fertilizers constituting what is frequently, for convenience, called "mixed minerals." In addition, one plot received 180 pounds of cotton seed meal per acre, the other 426 pounds of crushed cotton seed. Both cotton seed meal and cotton seed are valued as fertilizers chiefly because of the nitrogen which they contain. The same amount of nitrogen is contained in 180 pounds of cotton seed meal as in 426 pounds of cotton seed.

The yields in bushels per acre were as follows, 83.8 pounds of corn in the shuck being required for 56 pounds of shelled corn:

With 426 pounds crushed cotton seed, (and mixed minerals)	26.7 bushel
With 180 pounds cotton seed meal (and mixed minerals)	23.6 bushel
Difference in favor of cotton seed . . .	3.1 bushel

The increased yield from cotton seed is 3.1 bushels per acre, or 13 per cent in excess of the yield from the same amount of nitrogen in the form of cotton seed meal. Cotton seed is believed to pay better on land deficient in vegetable matter than on soil well supplied with this material. And yet even on this piece of weed land, fairly well supplied with organic matter, cotton seed was the most efficient source of nitrogen.

It does not necessarily follow that cotton seed is the most profitable fertilizer. That depends on the relative prices of cotton seed and meal, or on the quantity of cotton seed meal which the oil mills are willing to give in exchange for a ton of cotton seed.

The cotton seed meal used in this test cost $20.00 per ton delivered in Auburn, or $1.82 per acre.

The 426 pounds of crushed cotton seed on one acre also cost $1.82, if we assume a price of $8.56 per ton or 42.8 cents per hundred pounds. With both articles at prices named above, one ton of cotton seed would purchase only 845 pounds of cotton seed meal, and the results reported above indicate that such an exchange would have been unprofitable to the grower. The oil mills usually give considerably more than 845 pounds of cotton seed meal for one ton of seed.

The exchange value of cotton seed and cotton seed meal will be more fully discussed in a future bulletin from this Department.

Burning Weeds vs. Plowing Them Under.

This test was made on two plots in a sandy bottom (the same as that noted in the preceding section) where the land had been given over to weeds after harvesting the oat crop in 1894; so that there was considerable accumulation of litter from two crops of weeds. The dead weeds on both plots stood about five feet high at the time when the trash

on plot 1 was burned, February 27, '96. Plot 2 was plowed without first setting fire to the vegetable matter. Fertilizers, culture, etc., were the same for both plots.

The yield of corn in bushels per acre was as follows:

Burning trash vs. not burning it.

Plot No.	Treatment.	Yield per acre.
		Bus.
1	Trash burned	24.5
2	Trash not burned but plowed under	27.3
	Difference in favor of not burning	2.8

The increase of nearly three bushels per acre on the plot where fire was not used is a strong argument against wholesale burning preparatory to breaking land. While it is often inconvenient both in preparation and in subsequent cultivation to contend with dead weeds, cornstalks, etc., yet one can scarcely doubt the good effect of such material in the permanent improvement of the soil. The crying need of the majority of Southern soils is for vegetable matter, which is valuable (1) for its fertilizing ingredients, and (2) especially for its effect in so changing the texture of the soil as to make the latter less sensitive to drought. The custom of always burning cornstalks and weeds must inevitably result in decreased productiveness, and this is true of prairie land as well as of sandy and clay soils.

VIII. Methods of Harvesting Corn.

For this experiment one measured acre of branch bottom land was used. Mosby Prolific corn, a variety with several small ears per stalk, was planted April 6 in rows 4½ feet apart. Fertilizers, which were applied in liberal quantity, were separately weighed for each row.

The original plan was for the entire stalks on every fourth row to be cut and cured, for the tops to be cut from a second set of rows, for the blades or "fodder" on a third lot of rows

to be pulled, and for the ears alone to be harvested from another set of rows. Circumstances prevented a test of the effect of stripping or fodder pulling, but the other comparisons were carried to a conclusion.

August 13, on a portion of the field the tops were cut just above the ear. At that date the lower leaves had "fired" too much to make good fodder.

August 22 on other rows the entire stalks were cut, put into large shocks and left until Sept. 12.

A third set of rows remained undisturbed until Sept. 12. On this last date the ears were pulled from all three classes of plants, viz: (1) those not previously disturbed, (2) those plants which had been topped, and (3) those stalks which had been cut near the ground and shocked.

Weather conditions were favorable to the curing of the stalks.

The following table gives the yields per acre both of grain and forage on the plots differently treated:

Yield per acre of corn and forage from different methods of harvesting.

Methods of Harvesting.	Corn per acre.	Forage per acre.
	Bus.	*Lbs.*
Only ears harvested	34.9	00
Tops cut and ears harvested	30.2	312 (tops)
Entire stalks cut and ears afterwards harvested	29.2	2103 (stalks)

Apparently both topping and cutting the stalks before pulling the ears injuriously affected the yield of grain.

We have next to consider whether the forage gained by harvesting tops or stalks exceeded in value the grain which seems to have been lost by these processes.

With corn at 45 cents per bushel, tops at 50 cents per 100 lbs., and entire stalks with adhering blades at 25 cents per 100 lbs., and assuming that the different plots were uniform in fertility, we obtain the following financial results:

Value per acre of products from different methods of harvesting corn.

Method of Harvesting.	Value of grain.	Value of forage.	Value of total product.
Only ears harvested	$ 15 70	$ 0.00	$ 15.70
Ears and tops harvested	13 59	1.56	15.15
Ears and entire stalks harvested	13 14	5.26	18.40

At the prices assumed above, the highest value was secured by cutting and curing the entire stalks, this process showing a gain of $2.70 per acre over harvesting only the ears. Will this amount cover the cost of handling a weight of fresh stalks sufficient to produce about one ton of cured stalks? That is a local question the answer to which is largely dependent on the price and efficiency of labor. The value assumed for entire stalks, or stover, is necessary only on estimate, as the feeding value of stover from large southern corn has never been determined.

The low price of 25 cents per 100 lbs. of stalks has been assumed because of the immense waste in feeding the coarse forage, a waste which is inevitable unless one purchases a shredding machine and expends considerable labor in preparing shredded forage. Chemical analysis shows that even the butt of the stalk, the part which, unless shredded, is rejected by cattle, has some feeding value.

In an experiment at the Georgia Experiment Station, (Bulletin 30), where a shredder was used, a price of 40 cents per 100 lbs. was assumed for the cured stalks. In that test no reduction in yield of grain resulted from cutting the entire stalks, and at 40 cents per 100 lbs. of stalks, this method afforded a total product valued at $9.59 per acre more than the worth of the grain alone.

The effects of topping corn plants are variable. Results at the Arkansas Experiment Station, (Bulletin 24) showed a reduction in grain where the entire stalks were cut at a time when the bottom leaves of the plant were dying, and the kernels, nearly past the milk stage, were denting; the loss from cutting and curing the stalks before pulling the ears was nearly 3 bushels per acre.

Summarizing the results of experiments in topping we find that four* experiments show a loss of grain as a result of topping and that in three† others topping did not diminish the yield of grain.

It is apparent that topping, if postponed rather later than the usual time for pulling fodder, may be practiced without reducing the yield of grain.

If sufficient hay is not available and either topping or fodder pulling must be resorted to, topping is probably preferable. For though blades form a more palateable forage, topping has the advantage of requiring less labor, of affording a somewhat larger yield of forage per acre, and being less injurious to the crop of grain.

That stripping reduces the yield of grain more than does topping has been demonstrated in several experiments.

In an experiment in Texas the labor of pulling and storing a ton of "fodder" was three times as much as in harvesting a ton of tops.

Not only does fodder pulling require a large amount of labor, which could be more effectively employed in making hay, but its more serious disadvantage is that it almost invariable reduces the yield of grain. Summarizing the results

* Arkansas Bulletin 24; Alabama (Col.) Bulletin 75; Kansas Report '88, p. 27; and Mississippi Report '90, p. 20.

†Alabama (Canebrake) Bulletin 10; Illinois Bulletin 20; and Texas Bulletin 19.

of numerous experiments made in Southern states, we find that on an average stripped stalks have yielded 2.9 bushels per acre less than those not stripped. This loss, together with the cost of pulling the blades on an acre, which has been variously estimated at from 78 cents to $1.69, should be charged against fodder pulling, and the value of the fodder obtained should be credited. In the experiments where the yield of fodder is recorded, the average amount per acre is 542 lbs.

Assuming the prices below, which each reader can change to suit his judgment, we have the following financial statement relative to pulling fodder:

To 2.9 bus. corn at 45c	$1.31	
To cost of pulling, tying and storing fodder from 1 acre (estimated)	1.35	
By 542 lbs. fodder at 60c per 100 lbs.		3.25
Balance in favor of fodder pulling	59	
	$3.25	$3.25

If values assumed are correct the margin of profit in pulling fodder here averages only 59 cents per acre, which is probably insufficient to cover the single item of risk from bad weather, which sometimes almost completely destroys this forage. Moreover, the yield of fodder obtained in these tests was much above the average, as shown by the fact that in one instance it reached 936 lbs. per acre and by the additional fact that the yield of corn even on the stripped plots averaged nearly 25 bu. per acre, a yield which shows a vigor of growth much above the average of southern corn fields. Probably 350 lbs. of fodder would be a more correct estimate as the amount likely to be obtained on fields yielding 15 bushels of corn per acre. This yield would make the financial statement show a direct loss from fodder pulling in ad-

dition to risk from unsuitable weather. Undoubtedly labor could be more profitably employed in saving hay, especially if cow peas, melilotus, lespedeza, or other renovating plant were grown for hay, thus benefiting the land through the roots and stubble left in the soil, while furnishing a cheap and highly nutritious forage for live stock.