TWELFTH ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

OF THE

State College of Kentucky

LEXINGTON, KY.

FOR THE YEAR 1899

019244

VAULT NO. 2
639.2
K3786eb
1899

5855
135

LETTER OF TRANSMITTAL.

To His Excellency,

HON. WILLIAM O. BRADLEY,

Governor of Kentucky:

SIR:—

Under the authority of the Board of Control, and in accordance with an Act of Congress, approved March 2, 1887, and entitled "An Act to establish Agricultural Experiment Stations in connection with the Agricultural Colleges established in the several states, under the provisions of an Act approved July 2, 1862, and of the Acts supplementary thereto," and of the Act of the Legislature of the State of Kentucky, approved February 20, 1888, and entitled "An Act to accept the provisions of an Act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with the Agricultural Colleges established by the several States and Territories under Act of Congress, approved July 2, 1862," I herewith submit the Twelfth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

M. A. SCOVELL,

Director.

Agricultural and Mechanical College

OF KENTUCKY.

BOARD OF TRUSTEES.

His Excellency, Gov. Wm. O. Bradley, ex-Officio, Chairman.

Jas. K. Patterson, President of the College, ex-Officio.
Gen. D. C. Buell, Paradise, Muhlenberg County.
J. C. Flournoy, Esq., Fulton, Fulton County.
Hon. J. T. Gathright, Louisville, Jefferson County.
Hon. A. P. Gooding, Mayslick, Mason County.
Hon. C. U. McElroy. Bowling Green, Barren County.
Hon. W. F Peak, Bedford, Trimble County.
Gen. E. H. Hobson, Greensburg, Green County.
John G. Mathews, Esq., Barbourville, Knox County.
Hon. Hart Boswell, Lexington, Fayette County.
John B. Kennedy, Esq., Paris, Bourbon County.
Capt. Thomas Todd, Shelbyville, Shelby County.
D. F. Frazee, Esq., Lexington, Fayette County.
Judge William H. Holt, Frankfort, Franklin County.
Judge Joseph I. Landes, Hopkinsville, Christian County.
J. B. Marcum, Esq., Jackson, Breathitt County.
R. C. Stoll, Esq., Lexington, Fayette County.

V. E. Muncy, Secretary.

LIST OF OFFICERS.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.
J. T. GATHRIGHT, Louisville, Ky.
THOMAS TODD, Shelbyville, Ky.
JAS K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.
A. M. PETER, Chemist.
H. E. CURTIS, Chemist.
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Agriculturist.
V. E. MUNCY, Weather Observer.
EDWARD RHORER, Secretary to Director.
W. H. SCHERFFIUS, Assistant Chemist.
W. A. BEATTY, Assistant Chemist.

Address of Station,
LEXINGTON, KENTUCKY.

The Kentucky Agricultural Experiment Station

In account with the United States Appropriation.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1899, as per Act of Congress, approved March 2, 1887. $15,000.00

Expenditures:

By salaries	$10,022.00	
Labor	2,981.26	
Publications	465.62	
Postage and stationery	136 35	
Freight and express	63.26	
Heat, light and water	176.66	
Chemical supplies	229 53	
Seed, plants and sundry supplies	160.09	
Library	330.67	
Tools, implements and machinery	18.60	
Furniture and fixtures	21.25	
Scientific apparatus	43.36	
Live stock	167.00	
Traveling expenses	67.95	
Contingent expenses	97.40	
Building and repairs	19.00	
		$15,000 00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for this fiscal year ending June 30, 1899; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are

shown to have been $15,000.00 and the corresponding disbursements $15,000.00 for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress, approved March 2, 1887.

Signed:
H. BOSWELL,
THOMAS TODD,
Auditors.

[SEAL]

Attest:
V. E. MUNCY,

ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

FOR 1899.

REPORT OF THE DIRECTOR.

Mr. W. H. Scherffius and Mr. W. A. Beatty have been added to the Station staff. With these exceptions, the Station staff is the same as last year.

Our Work.

In accordance with the State laws, the Station has charge of the inspection of fertilizers, and the law regulating the sale and manufacture of foods. This has increased our chemical work to such an extent that in order to systematize the work we have divided it into three divisions: Research Work proper, Fertilizer control work, and Food control work.

Chemical Division.

Bulletins Nos. 82 and 85 contain many of the analyses of fertilizers made, and the report now in progress will contain most of the analyses of the food samples. The miscellaneous analyses and other analyses may be found in the report of the Chemical Division.

Entomological and Botanical Division.

Prof. Garman has continued the investigation of the smut on wheat, both in reference to preventing the disease and

learning the effect of the treatment on the germination of the seed. Experiments have been made in reference to destroying the wheat weevil in the stored grain, also in the study of bisulphide of carbon used in such experiments. Some experiments on the blight of sugar beets have been made. Experiments with hydrocyanic acid gas, bisulphide of carbon, nicotin and sulphur have been made, with a view of learning their effect on various insects, and at the same time their effect on different plants. Study of fruit insects, tobacco worms and insects injurious to garden stuffs have been made during the year, and considerable illustrative material has been accumulated for instruction in economic entomology. Experiments with potato scab were continued; also experiments with different grasses, and new plots have been planted on the recently acquired farm. Considerable work has been done on the bacteriology of several butter cultures.

Under a law of the State recently passed, Prof. Garman, as State Entomologist, is required to inspect nurseries of the State each year. For this purpose he is paid his necessary traveling expenses.

Prof. Garman recommends that at the next meeeting of the Legislature the law covering the inspection of fruits, etc., be amended so as to be more thorough and provide funds for an assistant in the inspection work.

Horticultural Work.

The work of the Horticultural Division has been planned along the same lines as marked out in previous years.

Agricultural Work.

Under the direction of Mr. Harper experiments have been continued in testing fertilizers on wheat, hemp, tobacco, corn, oats, potatoes and meadow, and varietal tests of wheat and oats have been continued also.

The dairy work has been continued and many interesting results are ready for publication.

Office Work.

With the increased work under the Fertilizer control and the Pure food work, the office work has grown to such an extent that increased assistance is essential.

Publications.

We have published during the year the following bulletins:

Bulletin No. 80.—

1. Some Pests Likely to be Disseminated from Nurseries.
2. The Nursery Inspection Law.

Bulletin No. 81.—

1. A Method of Avoiding Lettuce Rot.
2. Potato Scab Experiments.

Bulletin No. 82.—

Commercial Fertilizers.

Bulletin No. 83.—Wheat.

1. Experiments with Fertilizers.
2. Variety Tests.
3. Notes and Descriptions.

Bulletin No. 84.—

The Elms and Their Diseases.

Bulletin No. 85.—

Commercial Fertilizers.

More detailed statements of the work may be found in the reports from the various divisions which follow, after which the bulletins published during the year are incorporated.

M. A. SCOVELL,
Director.

DIVISION OF CHEMISTRY.

M. A. SCOVELL, *Director*,

Sir:—I herewith submit a report of the Division of Chemistry for the calendar year 1899.

Very Respectfully,
ALFRED M. PETER.

Report.

The chemical work in 1899, besides the analyses of commercial fertilizers, most of which have been published in Bulletins Nos. 82 and 85, and the work done under the food law, which will be published in Bulletin 86, now in preparation, included many analyses of grasses and forage plants, sorghum juice, butter, mineral and potable waters, soils and other materials. In addition to the regular quantitative analyses, numerous samples of minerals, rocks, ores, clays, waters, fertilizers &c. have been qualitatively examined and reported upon for citizens of the State. Such of these analyses as are considered to be of general interest are reported in the following pages:

BUTTER.

The butter analyzed was made at the Station farm in churn tests of some Jersey cows.

Name of Cow.	No. of Sample.	From Milkings of	Fat per cent.	Water per cent.	Salt per cent.	Curd per cent.
Dolly's Valentine No. 105048	5161	Jan. 21-24, 1899	80.00	14.48	4.28	1.24
	62	" 25-27,	83.25	12.75	3.14	0.86
	73	" 28-31,	84.35	11.37	3.41	0.87
	74	Feb. 1-3,	82.20	13.20	3.58	1.02
	86	" 4-7,	83.14	12.53	2.84	1.44
	87	" 8-10,	84.44	12.19	2.62	0.75
	5216	" 11-14,	82.53	13.61	2.58	1.28
	17	" 15-17,	81.39	13.44	3.91	1.26
	25	" 18-21,	83.19	10 44	2.90	3.47
	26	" 22-24,	83.50	11.80	4 00	0.70
	71	" 25-28,	82 74	13.07	3.36	0.83
	72	March 1-3,	82.48	13.44	3.21	0.87
	88	" 4-7,	84.53	11.47	3.29	0.71
	89	" 8-10,	81.39	14.96	2.64	1.01
	5329	" 11-14,	83.63	12.37	2.54	1.46
	30	" 15-17,	83.01	13.08	2.95	0.96
	31	" 18-21,	82.19	13.30	3 73	0.78
	46	" 22-24,	82.59	13.20	3.17	1.04
	47	" 25-28,	79.84	14.44	4.47	1.25
	63	" 29-31,	83.26	11.69	3.93	1.12
	64	April 1-4,	82.70	12.63	3.70	0 97
	85	" 5-7,	82.65	12.09	4.48	0.78
	87	" 8-11,	81.10	13 52	4.51	0.87
	5472	" 12-14,	82.25	12.66	4 28	0.81
	73	" 15-18,	82.20	13.59	3 29	0 92
	54 4	" 19-21,	86 04	11.00	2.15	0.81
	85	" 22-25,	81.65	13.32	4.20	0.83
	93	" 26-28,	83.41	13.19	2.44	0.96
	94	" 29-May 2,	81 68	12.82	4.56	0.94
	5501	May 3-5,	84.88	14 11	0.09	0.92
	2	" 6-9,	81.51	13.55	4.09	0.85
	10	" 10-12,	81.17	13.89	3.78	1.16
	11	" 13-16,	79.58	15.08	4.28	1.06
Gladys Yakna	5488	April 23-26,	83.16	12.80	3.07	0.97
	89	" 27-29,	81.00	14.20	3 90	0.90
	99	" 30-May 3,	80.84	13.05	3.45	2.66
Bluster's Queen	5546	May 17-20, 1899	80.69	14.72	3 57	1.02
	47	" 21-23,	79.64	14.80	4.60	0.96
Double Oonan	5958	Oct. 10-13, 1899	82.09	13.59	3.36	0.96
	59	" 14-16,	83.47	13.10	2.75	0.68
	72	" 17-20,	83.17	12.87	3.31	0.65
	96	" 23-25,	83.23	11.48	4.50	0.79
	97	" 26-29,	82.88	12.67	3.69	0.76
	6011	" 30-Nov. 1	80.87	14.36	3.94	0.83
	35	Nov. 9-12,	82.42	12.91	3.70	0.97

BUTTER—Continued.

NAME OF COW.	No. of Sample.	From Milkings of	Fat per cent.	Water per cent.	Salt per cent.	Curd per cent.
Double Oonan.	36	Nov. 13-15, 1899	82.47	12.27	4.26	1.00
	37	" 16-19,	81.59	13.27	4.12	1.02
Butter Jean....	6088	" 27-30,	82.35	12 38	4.41	0.86
	89	Dec. 1-3,	83.74	12.05	3.34	0.87
	6112	" 4-7,	82.70	11.95	4 44	0.91
	13	" 8-10,	82.87	12.48	3 72	0.93
	32	" 11-14,	83.29	12.37	3.33	1.01
	57	" 15-17,	83.22	12 27	3.88	0.63
	58	" 18-21,	84.27	11.85	3.15	0.73
	75	" 22-24,	83.43	12.74	3 16	0.67
	92	" 25-28,	82.82	12.26	4 21	0.71
Bettie Oldham	6114	Dec. 7-9, 1899	81.06	12 77	4.73	0.84
	33	" 10-13,	83.27	11.68	3 86	1 19
	59	" 14-16,	85.28	10.33	3.43	0.96
	60	" 17-20,	84.81	11.35	3.05	0.79
	74	" 21-23.	84.02	10.34	4.81	0.83
	93	" 24-27,	83.44	12.25	3.65	0.66

5504—Butter sent by Mrs. E. H. Gaither, Harrodsburg, Ky., made from the milk of her herd of Jerseys. Sample received May 11, 1899.

ANALYSIS.

Fat	81.63 per cent.
Water	13.25
Salt	4.07
Curd	1.05
	100.00
Valenta test	39.6°

Sorghum Cane Juice.

In continuation of the experiment in the selection of sorghum seed, we planted, in 1899, the seed from a cane of 1898, which had yielded 255 c. c. of juice having a specific gravity of 1.090, equivalent to 21.3 degrees Brix and giving, upon analysis, 0.83 per cent. of reducing sugar, 16.05 per cent. of cane sugar and a coefficient of purity of 75.4. (11th Ann. Report, p. xvii.) The cane produced was sampled at different times in

the fall of 1899. The data for some of the best canes are given below:

When Cut.	No. C. C. of Juice.	Specific Gravity.	Degrees Brix.	Reducing Sugar per cent.	Cane Sugar per cent.	Coefficient of Purity.
Sept. 28, 1899.	400.	1.077	18.6	1.26	13.84	74.4
" " "	450.	1.078	18.8	1.22	14.29	76.0
" " "	380.	1.081	19.5	1.25	14.58	74.8
" " "	370.	1.081	19.5	1.13	14.66	75.2
Oct. 2, "	440.	1.075	18.1	1.93	13.16	72.7

Soils.

Four samples of soil from the farm of Mr. H. M. Reid, situated in Meade County, Ky., about 1 mile South of Brandenburg. Sent September 1st, 1899.

6039—labeled "No. 1—Has not responded to clover seeding. Is now in peach trees."

6040—labeled "No. 2—In oats in 1898; grows some clover now."

6041—labeled "No. 3—In clover for the last two years, yielding an average crop. Is now partly in pear trees."

6042—labeled "No. 4—Soil from four ponds or basins.

ANALYSES OF THE AIR-DRIED SOILS.

	6039. Pr. Ct.	6040. Pr. Ct.	6041. Pr. Ct.	6042. Pr. Ct.
Moisture	0.61	1.03	0.74	1.34
Organic and volatile matters	2.61	3.55	3.29	4.33
Humus	0.44	0.60	0.48	0.58
Nitrogen	0.045	0.052	0.087	0.084
Sand, &c., insoluble in HCl 1.115 sp. gr	90.42	86.54	89.08	82.41
Potash soluble in HCl 1.115 sp. gr	0.178	0.249	0.204	0.331
Phosphoric acid soluble in HCl 1.115 sp. gr	0.030	0.040	0.055	0.065
Potash dissolved by $\frac{n}{5}$ HNO_3	0.0072	0.0102	0.0112	0.0225
Phosphoric acid dissolved by $\frac{n}{5}$ HNO_3	0.0104	0.0125	0.0104	0.0125
Lime dissolved by $\frac{n}{5}$ HNO_3	0.060	0.070	0.097	0.146

Two samples of soil from the farm of G. W. Smith

situated in Meade county, two miles due east of Guston and 9 miles due south of Brandenburg. Taken for the purpose of determining the chemical difference between the dark colored soil, which is reasonably productive, and the red soil, which is unproductive.

6043—No. 1. Dark colored (drab) soil from a place not subject to washing. In favorable seasons this will produce 65 bushels of corn or 20 bushels of wheat. It has never received any fertilizer, unless it was a little stable manure about 30 years ago. It has been in clover once.

6044—No. 2. Red soil from the same field and about 75 yards from the place where No. 1 was taken and that has received the same treatment, but is on sloping ground, so that the top has been washed off. When first cleared, both parts were equally productive, but now, the red soil will not produce grain or grass without manure.

ANALYSES OF THE AIR-DRIED SOILS.

	6943 Pr. Ct.	6944 Pr. Ct.
Moisture	0.70	0.74
Organic and volatile matter	3.95	3.18
Humus	0.94	0.41
Nitrogen	0.122	0.032
Sand and insoluble in HCl, 1.115 sp. gr.	89.18	82.65
Potash dissolved by HCl, 1.115 sp. gr.	0.214	0.308
Phosphoric acid dissolved by HCl, 1.115 sp. gr	0.060	0.039
Potash dissolved by $\frac{n}{5}$ HNO_3	0.0324	0.0146
Phosphoric acid dissolved by $\frac{n}{5}$ HNO_3	0.0079	0.0076
Lime dissolved by $\frac{n}{5}$ HNO_3	0.296	0.079

The analyses show that these soils are both deficient in available phosphates and that No. 2 is deficient in nitrogen and lime and contains only about half as much available potash as No. 1. It is probably a subsoil that has been exposed by washing.

Tobacco Stems.

5740—Tobacco Stems—Sample taken August 2nd, 1899, from a load purchased of the Bluegrass Tobacco Co., Lexington, Ky., for use on the Station farm.

6141—Tobacco stems sent by the Green River Tobacco Co., Owensboro, Ky., December 7, 1899.

Analyses	5740 As received Pr. Ct.	5740 Air dry Pr. Ct.	6141 Pr. Ct.
Moisture lost in air-drying	7.69	....	....
Nitrogen	2.04	2.21	2.50
Phosphoric acid	1.01	1.09	....
Potash	6.76	7.32	7.90

5737—Hickory wood ashes, sent by J. B. Graham, Bowling Green, Ky., August, 1899.

Potash ..... 4.64 per cent

5219—Sulphate of potash made from tobacco stems, sent by Fried. Gloystein, Henderson Tobacco Extract Works, Henderson, Ky., in February, 1899.

Phosphoric acid ..... 0.60 per cent
Nitrogen ..... 0.63 " "
Potash ..... 26.28 " "

5752—Exhausted tobacco stems, sent for analysis by Mr. Fried. Gloystein of the Henderson Tobacco Extract Works, Henderson, Ky. Cattle are said to eat these extracted stems with avidity and to thrive upon the diet. Sample sent April 24, 1899. It was soaking wet when received.

	As received Pr. Ct.	Water-free Pr. Ct.
Water	77.79	
Ash	3.45	15.54
Protein	2.31	10.38
Fiber	6.62	29.80
Nitrogen-free extract	9.38	42.24
Fat	0.45	2.04
	100.00	100.00

Nitrogen	0.37	1.66
Potash	0.12	0.56
Phosphoric acid	0.17	0.76

Qualitative tests showed that the material was practically free from nicotine.

Judging by the analysis, this material should have considerable value as a food.

Per Algretta.

Per Algretta is manufactured and sold as an egg preservative by the "U. S. Salix Co.," New Concord, Ohio. Price $10 per pound. The material is a white crystalline powder having a saline taste like common salt and nitre.

5185—Sample obtained from Mr. L. M. Larue, Paris, Ky., Feb. 9th, 1899.

5500—Sample from another lot abtained May 10th from same source.

ANALYSIS.

	5185	5500
Moisture	0.15 per ct.	0.27 per ct.
Chlorine	40.20	47.56
Nitric anhydride	17.90	11.22
Sulphuric anhydride	0.54	0.55
Sodium oxide	35.25	38.97
Potassium oxide	15.02	9.98
Calcium oxide	0.42	0.51
	109.48	109.06
Deduct oxygen equivalent to chlorine	9.06	10.72
Total	100.42	99.34

Qualitative tests showed the absence of boric, salicylic and benzoic acids and fluorides. The material is a mixture of one part of nitre with two or three parts of common salt. One of the formulas given by the "U. S. Salix Co." for preserving eggs with Per Algretta is as follows: Per Algretta, 6 grains;

fresh slaked lime ⅔ oz.; salt ¼ oz.; baking soda 12 grains; borax 12 grains; water enough to cover a dozen eggs. The ingredients are to be dissolved in the water and the eggs placed in the solution, where they are to remain until used or marketed. The results are said to be satisfactory, but it is evident that the mixture would preserve eggs just as well if the Per Algretta were omitted. The scheme is a good one for inducing the unsuspecting egg-packer to pay ten dollars a pound for material that could be had for as many cents.

Kentucky Asphalt Rock.

"Asphalt rock" or bituminous sandstone from the field in Carter County, Ky., near Soldier, on the C. & O. Railroad. A section of the bed, beginning at the bottom, shows:

Rich asphalt rock, 2½ inches; average rock like No. 5166, three layers of 36, 10 and 10 inches respectively, with thin layers of rich asphalt between; rich asphalt rock, 2½ inches; clay, 4 inches; topped by sandstone.

No. 5166—A representative piece from the average rock.

ANALYSIS

Moisture, &c., at 100 degrees C	0.23 per cent
Volatile combustible matters	5.98 " "
Fixed carbon	1.01 " "
White sand	92.78 " "
	100.00
Total combustible matters	6.99 per cent
Bitumen dissolved by gasoline	5.93 " "

A sample of the rich rock from the top and bottom of the bed gave 10.09 per cent. of total combustible matters.

On account of the purity of the sand contained in these bituminous sandstones, it has been suggested that the residue left after extracting the bitumen might be utilized in the manufacture of glass.

Petroleum

5696—Petroleum from the old public well at Flemingsburg, Fleming Co., Ky., brought by Hon. Lucas Moore, Commissioner of Agriculture, August 1st, 1899. This well,

within the past few weeks, is said to have begun to yield petroleum. Sample a light brown, clear, thin oil, having a rather pleasant smell.

Specific gravity at 15 degrees C, 0.809

Distillate below 150°, C	1.6	% by vol. of specific gravity	0.762
" between 150°&300° C	93.2	" " " " " "	0.807
Residue of heavy oil	5.2	" " " " " "	0.841
	100.0		

Supposed Gold Ore.

5379—Ferruginous sandstone from Crittenden County, Ky., sent April 6th, 1899, by C. B. Hind, Tolu, Ky.

An assay proved the absence of gold and silver.

Analysis showed:

Peroxide of iron	39.46	per cent, equivalent to 27.62 per cent iron
Sand and silica	51.28	" "
Ignition	4.78	" "
	95.52	

Ferment for Ripening Cream.

6221½—Labeled "Danish Concentrated Zoffmann's Ferment for Ripening Cream. Made in Denmark." Sample obtained from Chas. E. Currie, Royal Danish Consul at Louisville.

A nearly clear, colorless liquid; specific gravity, 1.028; total solids by evaporation, 0.7 per cent; total acidity equivalent to 0.5 per cent of lactic acid. Qualitative tests showed that the principal constituents of the residue left upon evaporation were lactic acid and milk sugar.

The bacteria in this sample appeared to be inactive and it was tested to ascertain the nature of the medium.

Mineral Waters.

5309—From Chas. J. Greenwell, Bardstown, Ky., Dec. 29, 1898. The water contains 20.6 grains of solid matter to the gallon, consisting mainly of the carbonates of lime and soda with small quantities of the carbonates of iron, manganese and magnesia and traces of carbonate of lithia, small quantities of sulphate of potash and chlo-

ride of sodium and a very notable quantity of organic matter.

This is an alkaline water belonging to a class that has been found very valuable medicinally, but the large amount of organic matter present makes it somewhat questionable whether its use is to be recommended.

5310—From Dr. A. S. Weir, Tompkinsville, Ky. The water contains 224.6 grains of solid matter to the gallon consisting mainly of chlorides and sulphates of sodium, calcium and magnesium, carbonate of lime, sulphate of potash, biborate of soda, a trace of iodide of sodium and some sulphide of sodium. It is a saline sulphur water.

5585—From J. M. Buck, Bud, Wayne Co., Ky., marked No. 1. The water contains 16.1 grains of solid matter to the gallon, consisting mainly of carbonate of lime with a little carbonate of magnesia and traces of sulphates and chlorides of sodium and potassium.

The analysis corresponds to that of ordinary limestone water.

5586—From J. M. Buck, Bud, Wayne Co., Ky., labeled No. 2—The water contains 55.4 grains of solid matter to the gallon, consisting mainly of sulphates of magnesia, soda and lime and chloride of sodium, with some carbonate of lime, carbonate of magnesia, sulphate of potash and very marked traces of strontium and lithium compounds and slight traces of nitrates and organic matter.

This water should have medicinal value.

5697—Mineral water from a well 25 ft deep, near Nelson Creek Station, on the Illinois Central R. R., about 2 miles from Green River, in Muhlenberg County, Ky. Sent by M. P. Creel, M. D., Central City, Ky. Sample received July 13, 1899. The water was clear and tasted decidedly of epsom salts.

The water contains 176.7 grains of solid matter to the gallon, consisting mainly of the sulphates of lime, magnesia, soda and iron, with small quantities of the sulphates of alumina, man-

ganese, potash and lithia, some chloride of sodium and traces of bromide of sodium.

The analysis shows that this is an "alum" water or saline chalybeate. Waters of this character have valuable medicinal properties.

5698—Sulphur water from a well recently bored at a public school house in Warren County, just outside of the city limits of Bowling Green. Sent by W. J. Potter, Bowling Green, Ky.

The sample was turbid from deposited sulphur, but contained no free hydrogen sulphide when received.

The water contains 77.4 grains of solid matter to the gallon, consisting mainly of chloride of sodium, with some sulphate of lime, sulphate of magnesia, carbonate of lime, carbonate of strontia, sulphide of sodium and sulphate of potash, with notable amounts of iodides, bromides and lithia. The fresh water probably contains some free sulphuretted hydrogen gas, but this had all escaped when the sample was analyzed.

This is a mild alkaline sulphur water.

5931—Mineral water sent by Chas. J. Greenwell, Bloomfield, Ky., said to be the same as No. 5309. Sample received Oct. 6th, 1899, in jug marked No. 1.

ANALYSIS.

	Grains per Gallon
Carbonate of lime	17.0 grains
Carbonate of iron	0.2 "
Carbonate of soda	6.8 "
Chloride of sodium	1.9 "
Sulphate of potash	1.3 "
Sulphate of magnesia	11.3 "
Sulphate of soda	6.0 "
Silica	1.2 "
Carbonates of manganese, magnesia, strontia, lithia, traces of bromides, loss, &c	0.8 "
Total solid matter	46.5

An alkaline calcic water, which should have some value medicinally.

5932—Mineral water sent by Mr. Greenwell at same time as No. 5331, in jug marked No. 2.

The water contains 21.3 grains of solid matter to the gallon, composed mainly of carbonates of lime and magnesia, with some carbonate of iron; sulphates of soda, magnesia and potash, with traces of chloride of sodium, sulphate of manganese and sulphate of lithia.

The water is a mild chalybeate. It is more nearly like sample 5309 than is the other sample sent by Mr. Greenwell, and possibly the labels on the jugs were reversed.

5933—From J. F. Price, Lexington, Ky. Sample received Oct. 9, 1899.

The water contains 19.5 grains of solid matter to the gallon, consisting mainly of carbonates of lime, magnesia and iron, with some chloride of sodium, sulphate of soda, traces of sulphate of potash, carbonate of strontia, carbonate of lithia, nitrates and a very considerable amount of organic matter. The free ammonia was found to be 0.32 and the albuminoid ammonia 0.36 parts in the million. The original water also contained a small amount af sulphuretted hydrogen.

This would be classed as a weak alkaline sulphur water, but the presence of so much organic matter renders its purity very questionable.

5934—From the bored well of L. M. Bedford, Paris, Ky. Sample brought by Mr. J. B. Kennedy, Oct. 19, 1899.

The water contains 815. grains of solid matter to the gallon, consisting mainly of chloride of sodium, with a good deal of chloride of calcium and chloride of magnesium, small quantities of chloride of lithium, chloride of potassium, biborate of soda, carbonate of iron, bromide of sodium, and traces of iodide of sodium and sulphate of strontium and a small quantity of oxide or carbonate of zinc, amounting to a little more than a grain to the gallon.

This is a saline water, containing a very notable quantity of bromide and enough chloride of magnesium to render it mildly

laxative. It should have medicinal value. Water of this character is frequently obtained by boring into the limestone strata of the bluegrass region of Kentucky.

5973—Sent by Dr. J. E. Hawkins, Lexington, Ky.

The water contains 217. grains of solid matter to the gallon, consisting mainly of chloride of sodium, with a rather large proportion of carbonate of lime, a little carbonate of magnesia, and some carbonate of iron. There is also quite a notable amount of bromide and of lithium and strontium compounds and borates. It contains small amounts of sulphates of lime, potash and magnesia, and probably some chloride of calcium. No hydrogen sulphide was found, but some carbon dioxide.

Forage Plants and Grasses.

Horse weed. 3617—Young growth 2 to 3 ft. high, from wet ground on the college campus, July 10, 1896. The air-dried sample contained 9.14 per cent water. 3618—From the Station farm Aug. 3d, 1896. The air-dried sample contained 9.15 per cent water.

Kidney vetch. 3578—From Station farm June 28, 1893. The air-dried sample contained 8.59 per cent water. 5699—From Station farm May 19, 1897. Cut when just in flower. The air-dried sample contained 9.59 per cent water. 5733—From Station farm June 3d, 1899. The air-dried sample contained 10.00 per cent water. 5734—Roots of 5733. The fresh roots comprised 9 per cent of the entire plants and contained 13.5 per cent of their total water-free substance. The air-dried sample contained 9.17 per cent water. 5735—Kidney vetch from Station farm June 17, 1899. The air-dried sample contained 10.36 per cent water.

Desmodium torulosum. 3616—From Station farm May 28, 1896. The air-dried sample contained 11.20 per cent water. 3620—Same, July 18, 1896. The air-dried sample contained 8.43 per cent water. 3632—Same Sept. 8, 1896. The air-dried sample contained 8.01 per cent water.

Fenugreek. 5732—Grown in greenhouse of the Dept. of Entomology and Botany. Planted April 1, 1899; cut June

2nd. The air-dried sample contained 10.03 per cent water.

Field pea. 5725—From Station farm July 23d, 1898. The air-dried sample contained 10.47 per cent water.

Native bush clover, Lespedeza polystachia. 3569—From Col. Jay H. Northup, Louisa. Ky., July 19, 1895. Plant is native in that region and affords some pasturage for stock. Sample was sent in a tight box, but was somewhat wilted when received July 22 and had probably lost some water. The air-dried sample contained 8.25 per cent water.

Japanese bush clover. 3629—Grown in greenhouse of the Dept. of Entomology and Botany. Cut July 31, 1896. The air-dried sample contained 7.71 per cent water.

Black medick. 5701—From Station farm May 19, 1897. The air-dried sample contained 9.15 per cent water.

Alfalfa. 3570—From Station farm. Cut July 12, 1893, as for hay and air-dryed in the laboratory. The air-dried sample contained 8.07 per cent water. The water in the fresh material was not determined. 3571—Same; cut June 28, 1893. The air-dried sample contained 8.69 per cent water. 3585—From Plot 41, Station Farm; cut June 22, 1894. Plants well advanced in bloom; some heads have finished flowering. The air-dried sample contained 9.13 per cent water. 3608—From same plot May 24, 1895. The air-dried sample contained 9.44 per cent water.

Sweet clover; Bokhara clover. 3577—Station farm June 28, 1893. The water in the fresh plant was not determined. The air-dried material contained 8.01 per cent water. 3607—From Plot 44, Station farm; cut May 24, 1895. The air-dried sample contained 9.41 per cent water. 3627—Same, July 30, 1896. The air-dried sample contained 8.42 per cent water. 3628—Same, Aug. 26, 1896. The air-dried sample contained 8.54 per cent water. 5702—Same, May 22, 1897. The air-dried sample contained 8.91 per cent water.

Serradella. 3584—From Plot 52, Station farm, cut June 22,

1894. Plants well in flower; some pods formed. The air-dried sample contained 8.91 per cent water.

Rostow sugar pea. 5724—From Station farm July 23, 1898. The air-dried sample contained 10.24 per cent water.

Russian field pea. 5726—From Station farm, Aug. 6, 1898. The air-dried sample contained 10.03 per cent water.

Alsike clover. 3572—From Station farm, June 14, 1892. 3573—Same, June 28, 1893. The air-dried sample contained 9.42 per cent water. 5704—Same, June 5, 1897. The air-dried sample contained 9.09 per cent water.

Crimson clover. 5700.—From Station farm, May 19, 1897. The air-dried sample contained 9.66 per cent water.

Mammoth clover. 3574—From Station farm. June 21, 1893. Just coming into bloom. The air-dried sample contained 9.19 per cent water. 3575—Same, June 28, 1893. The air-dried sample contained 8.76 per cent water.

Trifolium procumbens. 5708—From Danville, Ky., June 29, 1897. The sample was partly dried when received.

Rape. 5707—From Station farm, June 22, 1897. The air-dried sample contained 9.91 per cent water. 5714—Same, July 8, 1897. The air-dried sample contained 11.01 per cent water. 5715—Same, July 31, 1897. The air-dried sample contained 10.00 per cent water. 5718—Same, Nov. 4, 1897, second cutting. The air-dried sample contained 10.92 per cent water.

Russian vetch. 5728—Station farm, July 19, 1898. From seed imported by the United States Department of Agriculture. The air-dried sample contained 9.31 per cent water. 5729—Same, Sept. 15, 1898. Plants still flowering, but with some ripe seeds. The air-dried sample contained 10.65 per cent water. 5730—Same, Nov. 16, 1898. The air-dried sample contained 10.49 per cent water. 5731—Same, May 8, 1899. Spontaneous growth from planting of 1898. The air-dried sample contained 11.62 per cent water.

Whippoorwill pea. 5727—Station farm, Aug. 26, 1898. Seven entire plants weighed when fresh 1500 grams (3.3 lbs). The air-dried sample contained 9.55 per cent water.

Station Number.	Name of Plant.	In the Fresh or Air-dried Material—Per Cent					
		Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
3617	Ambrosia trifida, Horse weed	64.84	5.67	6.55	6.65	15.69	0.60
3618	Ambrosia trifida, Horse weed	80.47	3.06	3.52	4.52	7.99	0.44
3578	Anthyllis vulneraria, Kidney vetch	65.62	4.89	2.89	10.54	15.62	0.44
5699	Anthyllis Vulneraria, Kidney Vetch	83.55	2.40	2.91	3.36	7.40	0.38
5733	Anthyllis vulneraria, Kidney vetch	79 80	2 69	3.05	5.83	8.22	0.41
5734	Anthyllis vulneraria, roots of same	69.80	5.03	3.59	9.03	12.06	0.46
5735	Anthyllis Vulneraria, Kidney vetch	47.56	3.93	6.62	19.58	21.45	0.86
3616	Meiboma tortuosa, Florida beggar weed	78.86	4.32	5.27	3.45	7.62	0.48
3620	Meiboma tortuosa, Florida beggar weed	72.90	2.36	2.16	8.82	13.35	0 41
3632	Meiboma tortuosa, Florida beggar weed	67.07	2.78	5.19	10.17	14.10	0.69
5732	Fenugreek. Trigonella Foenum-Groecum	86.00	1.93	3.13	3.26	5.44	0.24
5725	Field pea (See Russian Field pea, 5726)	82 80	1.12	3.21	4.93	7.41	0.53
3569	Lespedeza polystachia. Native bush clover	50.00	2 85	5.01	19.99	21.05	1.10
3629	Lespedeza striata. Japan clover	63.36	3.47	6.73	10.72	14.69	1.03
5701	Medicago lupulina. Black medick	76.11	3 21	5.51	4.99	9.61	0.57
3570	Medicago sativa. Alfalfa. (air-dried)	8 07	8.41	15.25	27.59	39.40	1.28
3571	Medicago sativa. Alfalfa	57.98	3.03	5.95	14 03	18.48	0.53
3585	Medicago sativa. Alfalfa	66.56	2.61	4.60	9.50	16.20	0.53
3608	Medicago sativa. Alfalfa	74 58	2.34	5.42	8.16	9.15	0.35
3577	Melilotus alba. Sweet clover (air-dried)	8.01	4.81	11 38	34.65	40.03	1.12
3607	Melilotus alba. Sweet clover	82.79	1.47	3.63	5.11	6.67	0.33
3627	Melilotus alba. Sweet clover	75.08	1.76	5.02	6.79	10.88	0.47
3628	Melilotus alba. Sweet clover	69.50	1.76	5.08	9.81	13.22	0.63

In the Water-free Material—Per Cent.								Date of Cutting.	Station Number.
Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Phosphoric Acid.	Nitrogen.	Potash.		
16.13	18.64	18.90	44.62	1.71	1.23	2.93	4.80	June 10, '96. Young growth	3617
15.66	18.03	23.12	40.92	2.27	1.33	2.88	4.59	Aug. 3, 1896	3618
14.21	8.41	30.65	45.44	1.29	1.96	1.35	2.29	June 28, 1893	3578
14.57	17.70	20.42	45.08	2.23	0.50	2.83	1.19	May 19. 1897. In flower	5699
13.31	15.07	28.89	40.69	2.04	0.74	2.41	1.14	June 3, 1899	5733
16.65	11.90	29.92	40.02	1.51	1.27	1.90	0.65	June 3, 1899	5734
7.50	12.62	37.34	40.90	1.64	0.68	2.02	1.29	June 17, 1899	5735
20.43	24.92	16.33	36.07	2 25	1.43	3.98	5.08	May 28, 1896	3616
8.71	7.98	32.56	49.23	1.52	1.04	1.28	3.01	July 18, 1896	3620
8.44	15.76	30.88	42.84	2.08	0.64	2.52	1.20	Sept. 8, 1896	3632
13.79	22.37	23.29	38.83	1.72	0.82	3.58	1.99	June 2, 1899	5732
6.52	18 64	28.66	43.10	3.08	0.83	2.98	1.31	July 23, 1898	5725
5.69	10.02	39.98	42.11	2.20	0.23	1.62	1.44	July 19, 1895	3569
9.47	18.35	29.26	40.10	2.82	1.17	2.94	2.35	July 31, 1896	3629
13.44	23.05	20.90	40.24	2.37	0.83	3.69	0.75	May 19, 1897	5701
9.15	16.59	30 01	42.86	1.39	0.70	2.65	1.07	June 12, 1893	3570
7.21	14.17	33.38	43.98	1.26	0.72	2.27	0.60	June 28, 1893	3571
7.79	13.76	28.41	48.46	1.58	0.61	2.20	1.02	June 22, 1894	3585
9.20	21.32	32.11	35.98	1.39	0.83	3.41	1.14	May 24, 1895	3608
5.22	12.37	37.67	43.52	1.22	0.58	1.98	0.72	June 28, 1893	3577
8.53	21.12	29.68	38.76	1.89	0.90	3.38	1 13	May 24, 1895	3607
7.07	20.12	27.26	43.65	1.90	0.86	3.22	1.58	July 30, 1896	3627
5.77	16.67	32.15	43.34	2.07	0.84	2.67	1.14	Aug. 25, 1896	3628

Station Number	Name of Plant.	In the Fresh or Air-dried Material—Per Cent					
		Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
5702	Melilotus alba. Sweet clover	84.06	1.45	2.82	4.13	7.16	0.38
3584	Ornithorpous Sativus. Serradella	80.16	3.33	4.05	3.68	8.40	0.38
5724	Rostow sugar pea	82.05	1.31	3 20	5.17	7.77	0.50
5726	Russian field pea	76.80	1.74	3.90	7.42	9.60	0 54
3572	Trifolium hybridum. Alsike clover (air dried)	9.51	9.06	15.81	26.70	37.44	1.48
3573	Trifolium hybridum. Alsike clover	42.68	4.89	8.78	17.02	25.62	1.01
5704	Trifolium hybridum. Alsike clover	76.45	2.55	4.85	4.44	11.18	0.53
5700	Trifolium incarnatum. Crimson clover	82.01	1 70	3.31	5.04	7.48	0.36
3574	Trifolium medium. Mammoth clover	79 29	1.91	3.49	6.01	8.95	0.35
3575	Trifolium medium. Mammoth clover	66.51	2.77	4.66	12.00	3.52	0.54
5708	Trifolium procumbens. Low hop clover	11.18	7.40	12.75	25.25	41 79	1.63
5707	Rape. Dwarf Essex	89.91	1 84	2.68	1.22	4.00	0.35
5714	Rape. Dwarf Essex	88.34	1 76	1.65	1.85	5.95	0.45
5715	Rape. Dwarf Essex	84.79	1.91	1.94	2.30	8.66	0.40
5718	Rape Dwarf Essex	88.69	2.31	3.12	1.44	4 05	0.39
5728	Vicia villosa. Russian vetch	77.45	1.94	6.29	5.56	8.16	0.60
5729	Vicia villosa. Russian vetch	75.46	1.68	5.36	7.94	9.07	0.49
5730	Vicia villosa. Russian vetch	76 50	1.50	5.09	5.32	10.85	0.74
5731	Vicia villosa. Russian vetch	85.72	1.59	4.36	3.74	4.26	0.33
5727	Whippoorwill pea	80.76	1.76	3.04	5.32	8.69	0.43

In the Water-free Material—Per Cent.								Date of Cutting.	Station Number.
Ash.	Protein	Fiber.	Nitrogen-free Extract.	Fat.	Phosphoric Acid.	Nitrogen.	Potash.		
9.12	17.77	25.93	44.80	2.38	1.05	2.85	1.59	May 22, 1897	5702
16.80	20.39	18.53	42.36	1.92	1.14	3.26	1.67	June 14, 1894. In flower	3584
7.30	17.82	28.78	43.33	2.77	0.81	2.85	1.41	July 23, 1898	5724
7.50	16.82	31.99	41.37	2.32	0.84	2.69	1.40	Aug. 6, 1898	5726
10.01	17.47	29.50	41.38	1.64	1.07	2.80	1.49	June 14, 1893	3572
8.54	15.32	29.70	44.67	1.77	1.09	2.43	1.06	June 28, 1893	3573
10.82	20.59	18.85	47.48	2.26	1.03	3.29	1.03	June 5, 1897	5704
9.49	18.47	28.20	41.81	2.03	0.93	2.96	1.05	May 19, 1897	5700
9.22	16.86	29.04	43.21	1.67	0.86	2.70	1.22	June 21, 1893. Beginning to bloom	3574
8.25	13.91	35.85	40.39	1.60	0.68	2.23	0.92	June 28, 1893	3575
8.33	14.35	28.43	47.05	1.84	0.82	2.30	2.34	June 11, 1897	5708
18.26	26.57	12.11	39.64	3.42	1.60	4.25	6.35	June 22, 1897	5707
15.05	14.18	15.82	51.05	3.89	9.58	2.27	5.46	July 8, 1897	5714
12.59	12.78	15.11	56.91	2.61	1.37	2.05	3.52	July 31, 1897	5715
20.40	27.57	12.74	35.84	3.44	1.13	4.41	5.75	Nov. 4, 1897. Second cutting.	5718
8.62	27.91	24.67	36.16	2.64	1.39	4.47	2.19	July 19, 1898	5728
6.85	21.89	32.36	36.90	2.00	1.19	3.50	1.95	Sept. 15, 1898	5729
6.37	21.65	22.63	46.20	3.15	1.04	3.46	1.66	Nov. 16, 1898	5730
11.12	30.55	26.02	29.79	2.34	1.55	4.89	3.90	May 8, '99. Spontaneous Growth	5731
9.15	15.82	27.66	45.14	2.23	0.79	2.53	2.27	Aug. 26, 1898	5727

DIVISION OF ENTOMOLOGY AND BOTANY.

KENTUCKY AGRICULTURAL EXPERIMENT STATION.
LEXINGTON, KY., April 19, 1900.

Professor M. A. SCOVELL,
Director of the Station.

DEAR SIR:

During the current year work has been continued in this Division on the smut of wheat, with reference both to preventing the disease and for the purpose of learning the effect of treatment on the germination of the seed. Experiments have been made also with reference to destroying the wheat weevil in the stored grain, and at the same time tests were made of the treated wheat to determine the effect of the bisulphide of carbon used on the viability of the seed.

Some experiments on a blight of sugar beet appear to show that it is due more to the hot sun than anything else, and when the beets are kept under whitewashed glass they cannot be made to take the disease, and the percentage of sugar rises to that obtained in the best beet-raising sections of the country. At the Vivarium many tests have been made with hydrocyanic acid gas, bisulphide of carbon, nicotine, and sulphur with a view to learning their effects on various insects, and at the same time their effects on different plants, a feature of the subject that does not seem to have been given the careful attention that its importance makes desirable. Studies of fruit insects, of the tobacco worm, and of insects injurious to garden stuff, have been made during the season, and considerable illustrative material has been accumulated for instruction in economic entomology.

On the Experiment Farm the experiments with potato scab were confined to an acre of ground set aside for the purpose, but the season proved such that the scab did not appear on any of the potatoes. The tests will be repeated this coming

season, since I wish, if possible, to learn if formalin can be made to take the place of bichloride of mercury as a remedy for the disease.

The grass plots have been followed throughout the season, as they have been for a number of years, and my observations are now written up for a bulletin on the subject. New plots have been planned on the recently acquired farm at the edge of Lexington, and I would suggest the desirability of testing the old plots by grazing during the coming season, since this test is an important one to determine the value of a forage plant, and it has not hitherto been possible to make use of it. The plots might be enclosed by a movable fence, such as is used in feeding Dwarf Essex Rape.

During the winter considerable work has been done on the bacteriology of several butter cultures, and it is hoped that a bulletin may soon be issued on the subject; although I wish to make some photo-micrographs of the organisms we have been studying, before this is done.

From the middle of April, 1899, until July 7 of the same year, the Entomologist and Botanist was occupied pretty steadily with the work of inspecting nurseries, of which there were forty-two doing business in the State. With four exceptions they were found in satisfactory condition. One of these did not receive a certificate. The trees were dwarfed in growth from neglect, the ground choked with weeds, and at the time of my visit, stock was grazing over the ground. Another of the four received a certificate, excepting strawberry plants, which were found infested with the crown borer. A third was required to treat all strawberry plants sold. The fourth, after certain trees infested with a scale insect were destroyed by the owner, was inspected a second time before a certificate was issued. I am pleased to be again able to say that San Jose scale has yet to be found in any Kentucky nursery, and since this was the third annual inspection, the chances are that we have escaped the worst danger, so far as dissemination from our own nurseries is concerned.

Of course the usual routine work has been attended to, such as caring for collections, answering letters of inquiry with refer-

ence to farm pests, forage plants, etc., and some time has been given to the examination of samples of drinking water, generally in connection with Dr. A. M. Peter of the Chemical Division. A part of Bulletin 83 on the varieties of wheat was prepared in this division. Bulletin 84 on Elm diseases was issued last November.

The only addition to the apparatus belonging to the Division is a bichromate of potash ray filter for photographic work, and an improved form of knapsack sprayer for use in experiments. Recently a number of valuable special works on entomological and botanical subjects have been added to our working library, rendering it much more useful to the Division.

Respectfully submitted,

H. GARMAN,

Entomologist and Botanist.

DIVISION OF HORTICULTURE.

LEXINGTON, KY., April 27, 1900.

M. A. SCOVELL, *Director*,

DEAR SIR:

In compliance with your request, I submit the following report of the Horticultural Department of the Experiment Station.

As for years past, the time given by the writer to Experiment Station work has been only a portion of the whole, the major part of both time and energy being required in the several lines of college teaching included under Botany, Horticulture and Agriculture. There has, therefore, been but little room for more than the direction of routine work, and the correspondence connected with the Department.

In view of the proposed change in location of the fruit plantations, but few additions have been made to the varieties of grapes or other small fruits during the past year.

A considerable number of the varieties of grapes in our experiment vineyard suffered during the severe conditions of the winter of 1898–99 so that the fruit production of last summer was somewhat curtailed, although the injuries inflicted were themselves of interest as indicating the hardiness of the different varieties. Much attention will be given to grapes again this season.

As soon as a suitable allotment of land can be made for the purpose it is proposed to undertake a series of experiments in orchard management, with a variety of other studies. I consider it very desirable that the Station should possess a good collection of the varieties of the different orchard fruits, not mainly for mere variety testing, but because so many questions are constantly arising which require opportunities for a close and intimate acquaintance with a good collection of varieties.

No available collection now exists in this vicinity where such desired studies can be carried on.

I hope, therefore that a tract of land may soon be available, for this purpose, of eight or ten acres at first, so situated that the area can be extended as future needs require.

Respectfully submitted,

C. W. MATHEWS,

Horticulturist.

DIVISION OF METEOROLOGY.

M. A. SCOVELL, *Director*,

DEAR SIR:

A brief meterological summary for the year 1899 is herewith submitted.

Very respectfully,

V. E. MUNCY, *Observer*.

ANNUAL METEOROLOGICAL SUMMARY FOR 1899—LEXINGTON, KY.

Pressure.

(Corrected for temperature and instrumental error only).

ELEVATION OF BAROMETER CISTERN ABOVE MEAN SEA-LEVEL on Dec. 31, 990 ft.

(All barometer readings have been reduced to above elevation.)

MONTHS.	Monthly	Highest observed.	Date.	Lowest observed.	Date.	Absolute range.
	In.	*In.*		*In.*		*In.*
January	29.07	29.61	2	28.58	24	1 03
February	29.02	29 42	10	28.60	21	0 81
March	28.91	29.38	8	28.56	19	0.82
April	29.03	29.28	5	28.67	7	0.61
May	29.01	29.25	14	28.79	8	0.46
June	29.05	29.23	17	28.94	1	0.29
July	28.99	29.15	1	28.87	25	0.28
August	28.95	29.07	29	28.80	11	0.27
September	29.05	29.28	30	28.78	25	0.51
October	29.12	29.39	1	28.80	31	0.59
November	29.01	29.35	6	28.66	30	0.69
December	29.04	29.51	20	28.58	1	0.93
		Highest	Date.	Lowest	Date.	
Mean	29.02	29.61	Jan. 2	28.56	Mch. 19	0.61

MONTHS.	Elevation of Dry Thermometer Bulb Above Ground on Dec. 31, 75 Feet. From Self-Registering Instruments.										No. of Days.		
	Mean.			Highest.	Date.	Lowest.	Date.	Range.		Mean daily change	Max. below 32 degrees.	Max. above 90 degrees.	Min. below 32 degrees.
	Max.	Min.	Monthly.					Absolute.	Mean Daily.				
	°	°	°	°		°		°	°	°			
January	41.2	26.4	33.8	63	4	4	31	59	14.8	7.4	8	0	20
February	31.5	17.5	24.5	59	28	—20	13	79	14.0	8.4	11	0	20
March	51.5	33.0	42.2	70	11	1	7	69	18.4	9.1	2	0	13
April	62.4	48.2	55.8	86	29	24	2	62	15.2	5.4	0	0	5
May	74.8	58.6	66.7	87	16	46	23	41	16.3	3.5	0	0	0
June	83.9	65.3	74.6	95	23	51	18	44	18.6	3.6	0	4	0
July	87.6	66.7	77.2	95	16	55	9	40	20.9	3.5	0	14	0
August	86.5	67.4	77.0	95	3	59	8	36	19.1	2.2	0	6	0
September	78.3	57.0	67.0	98	6	32	30	66	21.3	4.5	0	8	0
October	70.1	51.2	60.6	84	14	37	1	47	19.0	3.9	0	0	0
November	55.7	40.7	48.2	70	10	32	6	38	15.0	5.0	0	0	3
December	40.7	26.1	33.4	62	11	—1	31	63	14.7	5.8	10	0	22
				Max.	Date.	Min.	Date.				Total		
Mean	63.8	46.5	55.1	98	Sept 6	—20	Feb. 13	54	17.3	5.2	31	32	83

PRECIPITATION.

(Amount in inches and hundredths.)

Elevation of top of gauge above ground Dec. 31, 68 feet.

Months.	Total Amount.	Greatest am't in any 24 consecutive hours.		No. of days on which 1 inch fell.	No. of days on which no rain except "Trace" fell.	Greatest number of consecutive days without rainfall. (Dates inclusive).	Normal rainfall.
		Am't.	Date.				
January. ..	6.69	2.58	12 & 13	2	16	19 to 23	3.82
February	2.84	0.67	26	0	14	13 to 15.....	3.70
March	8.61	2.04	3 & 4	4	12	8 to 11	4.90
April.....	2.16	0.73	6 & 7	0	19	26 to 30.....	3.72
May	3.63	1.69	12 & 13	1	15	23 to 28.....	3.49
June.....	2.55	1.10	9 & 10	1	21	2 to 8.....	4.25
July	0.97	0.39	16 & 17	0	23	9 to 13.....	5.10
August.....	4.18	1.91	10 & 11	2	23	14 to 20.....	3.52
September.	1.90	0.77	25	0	25	1 to 7.....	2.54
October.....	2.09	0.70	17	0	24	20 to 27.....	2.22
November .	1.70	0.69	22	0	20	5 to 10	3.72
December	2.92	0.83	11	0	19	28 to 31.....	3.40
Summary	40.24	.....	.....	10	231		44.38

CLOUDINESS.

Months.	Mean cloudiness (0 to 10)		Character of Day.		
	8 a. m.	Monthly.	Clear.	Partly Cloudy	Cloudy.
January	6.1	7.0	5	10	16
February	5.6	6.4	7	6	15
March	6.9	.....	5	8	18
April.	5.7	5.4	10	11	9
May	5.5	5.5	8	12	11
June.	3.9	3.7	17	7	6
July	4.1	5.1	9	15	7
August	4.5	4 1	14	15	2
September	3.3	4.2	13	11	6
October	4.6	4.9	12	6	13
November	6.8	6.7	7	7	16
December	6.3	6.2	9	7	15
Summary	63.3	66.1	116	115	134
Mean	5.3	5.5	....	.....	.....

WIND.

Elevation of the Anemometer cups above ground Dec. 31, 102 ft.

Months.	Prevailing Direction.	Maximum hourly velocity during month.			No. of days with gales*	No. of calms.
		Miles.	From.	Date		
January	S.	55	W.	14	3	0
February	W.	46	S. W.	28	2	0
March	S.	44	W.	5	6	0
April	S. E.	35	N.	15	0	0
May	S. W.	50	N. W.	12	2	0
June	S. W.	45	W.	1	1	0
July	S. W.	42	W.	16	1	0
August	N. E.	45	N.	12	1	0
September	N. W.	68	W.	8	1	0
October	S. E.	35	N. W.	28	0	0
November	S. W.	35	S. W.	14	0	0
December	W.	46	S. W.	12	2	0
Summary					19	0
Mean	S.					

*Days with 40 miles per hour and over.

NUMBER OF DAYS.

Months.	Thunder Storms.	Snows.	Hail.	Fog.
January	0	4	0	2
February	1	6	0	3
March	7	3	1	1
April	0	2	1	0
May	9	0	0	1
June	5	0	0	0
July	6	0	0	0
August	3	0	0	0
September	2	0	0	0
October	1	0	0	0
November	0	2	0	0
December	0	4	0	0
Summary	34	21	2	7

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN No. 80.

---

1. **Some Pests Likely to be Disseminated from Nurseries.**
2. **The Nursery Inspection Law.**

LEXINGTON, KENTUCKY,

March, 1899.

199

019244

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.

J. T. GATHRIGHT, Louisville, Ky.

THOS. TODD, Shelbyville, Ky.

J. K. PATTERSON, President of the College.

M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.

A. M. PETER, H. E. CURTIS, } Chemists.

H. GARMAN, Entomologist and Botanist.

C. W. MATHEWS, Horticulturist.

J. N. HARPER, Agriculturist.

V. E. MUNCY, Weather Observer.

EDWARD RHORER, Secretary to Director.

Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

BULLETIN No. 80.

1. SOME PESTS LIKELY TO BE DISSEMINATED FROM NURSERIES.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST OF THE STATION, AND STATE ENTOMOLOGIST.

In preparing the following accounts of pests likely to be disseminated on nursery-grown plants, I have been guided solely by a desire to help Kentucky nurserymen and fruit growers to recognize the most dangerous diseases and insects of this sort likely to be encountered in the State. With the exception of the Rosette of peach trees, all of the pests considered in these brief sketches have been observed by me in Kentucky, either in nurseries or orchards, or in both.

We have other insects and some fungus pests that with great carelessness on the part of dealer and buyer might become established in this manner in orchards. The large Cecropia moth, familiar to every farmer's boy because of its extraordinary size and attractive colors, places its big silken cocoons on the twigs of young fruit trees in the nursery, but is commonly so widely scattered that but little harm is done by it, and the cocoons are so striking in size and character that no nurseryman of intelligence would offer his customers trees to which they were attached. But while most that do serious mischief are noticed, there are others that are liable at any time to put in an appearance and claim attention. These may be treated in future publications, as occasion arises.

I might mention here, just to call attention to it, the occasional presence in Kentucky, of what is known as crown

gall on peach and raspberry. It is not yet known what causes the disease. The galls resemble somewhat those caused by the woolly aphis of apple. They appear on the underground part of the stem and on the roots.

A second disease, the nature of which is not yet known to me, causes the bark of young apple trees to become rough, corky, and finally to split, having thus in its effect a resemblance to potato scab. These rough places appear about the origins of lateral branches and about buds. It has been noticed as especially prevalent on Northern Spy, Rambo and Williams' Favorite.

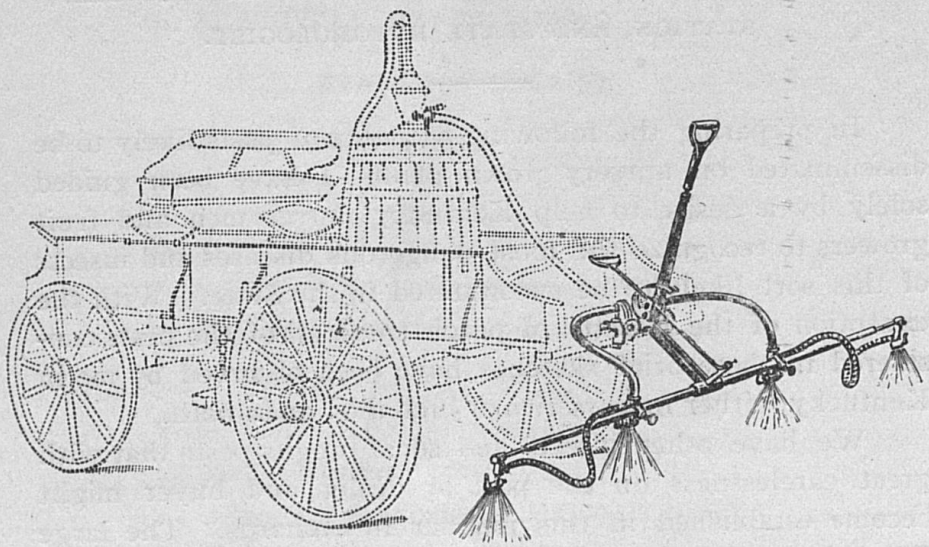


FIG. 1.—A field sprayer, suitable for spraying young trees or other low-growing field crops. The distributing bar bearing the nozzles can be attached to any ordinary spray pump. Manufactured by the Deming Company.

Spraying Machinery.—The subject of spraying machinery and insecticides and fungicides has not been discussed in our bulletins for some time, and since the directions for treating diseased trees given below imply a knowledge of such things, it may be well to give recipes for the preparations most often mentioned, and to say a few words about sprayers.

Spraying machinery has been greatly improved recently, and special forms have been devised suited to different kinds of crops. If one wishes to spray grapes only, perhaps the

best he can do is to buy one of the knapsack sprayers, made of copper and brass. But for spraying orchards this form does not throw the spray with sufficient force and does not furnish it freely enough. To spray an orchard of a thousand or more trees, one wants a strong pump with a large barrel or tank attached, holding at least forty gallons, since this provision saves time in making up fresh lots of the spraying mixture. The pump should in all cases be made of brass. Most pumps intended for orchard work are constructed so that they can be conveniently connected with a barrel or specially constructed tank, and the whole be hauled about in a cart or wagon. Some are attached to a barrel mounted on two wheels, with a handle and iron rest so that they can be hauled about by hand. As to which one of these methods is preferable will depend somewhat on the number of trees to be sprayed. The hand-cart arrangement serves very well even for a small orchard. For very large orchards or for nurseries, a horse to do the hauling is a great help and will save time. Without wishing to discriminate in favor of any firm or firms, but solely because I happen to have personal knowledge of their pumps, I mention from among those known to me the two following manufacturers of spraying machinery as able to furnish good spraying outfits of almost any sort the fruit grower or nurseryman is likely to want:

The Deming Company, Salem, Ohio.

The Goulds Manufacturing Company, Seneca Falls, N. Y.

Whale Oil Soap.—When a large number of trees are to be treated with soap solutions it is well to get this soap because it does not vary so much in quality as the various brands of laundry soap. Leggett & Brother, of New York City, some time ago gave me the following prices on their "Anchor Brand Whale Oil Soap:" 1 lb. boxes, 10c.; 50 lbs. $3.25; 100 lbs. $5.50; 1 barrel of about 400 lbs. $15.00.

Kerosene Emulsion.—To make an emulsion dissolve ½ pound of soap in one gallon of hot water; add to this while still hot two gallons of coal oil, then churn for 10 minutes by passing the two through a force pump, returning to the same

vessel whence sucked up by the pump. People are heard sometimes to direct that in the absence of a pump the emulsion be made by stirring vigorously with a stick. I very much doubt if a genuine emulsion can be made in this way, without an unreasonable expenditure of energy and a severe tax on one's patience. When the soap solution and oil have been churned together long enough they will not separate when

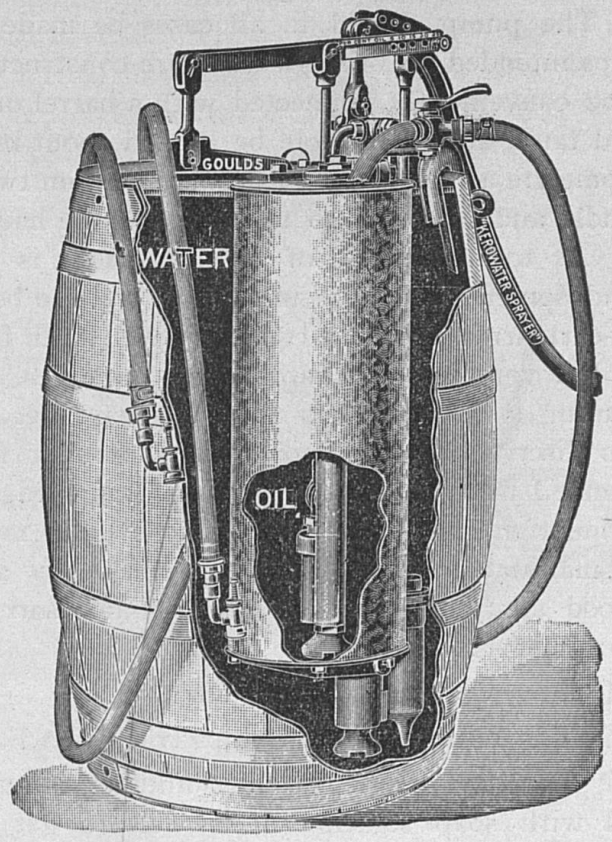


FIG. 2.—A new barrel pump with coal-oil tank in the barrel. Constructed so that the quantity of oil used can be made to vary from 5 to 25 per cent. Manufactured by the Goulds Company.

allowed to stand, and in this shape can be diluted at will with water. The extent of the dilution will vary with the use to which the emulsion is to be put. On the trunks and branches of trees during fall and winter it can be used much stronger than on foliage during summer. The three gallons of emulsion prepared as above directed may be diluted to make from 15 to 30 gallons.

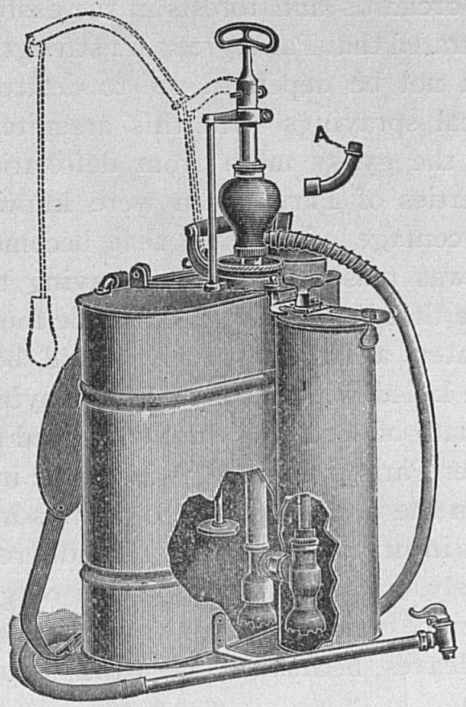


FIG. 3.—An improved knapsack sprayer, with a detachable kerosene tank. Provided with a foot-rest, so that it can be used as a bucket pump. Manufactured by the Deming Company.

Bordeaux Mixture.—The recipe generally given by me to those who write to the Station inquiring about this mixture is the following: Bluestone, 6½ lbs.; fresh lime, 3½ lbs.; water, 32 gallons. I like strong mixtures where the number of plants to be treated is not large. They increase the cost, of course, and on this account for extensive spraying, a dilute form of the mixture is preferable. The lime is slaked, and, a little water being added from time to time, is worked with a wooden paddle until it is about as thick as cream. Kentucky limes slake so completely that it is not absolutely necessary to strain them through a sieve, as is sometimes recommended. The bluestone being dissolved in four or five gallons of hot water, the lime is stirred slowly into it, and then water is added to make 22, 32, or 42 gallons, as may be desired. The bluestone should cost about 8 cents per pound.

Arsenate of Lead.—The work done by the State of Massachusetts in destroying the gypsy moth, which has proved

destructive in orchards and forests in the eastern part of that State, demonstrated that Paris green, in strengths not injurious to foliage, can not be depended on to destroy some caterpillars. Several sprayings with this arsenite did not in all cases prevent the gypsy moth from defoliating trees. The burning properties of Paris green were known to be due to the small percentage of arsenic that becomes dissolved in water, and it was reasoned by those having the gypsy moth work in charge that if something could be found that did not dissolve in water, a larger quantity could be used and the worms thus be killed without any accompanying injury to the leaves. Arsenate of lead was finally adopted as having these advantages over Paris green: It is insoluble in water and can be used even in the proportion of 30 pounds in 150 gallons of water, without injury to the leaves. It adheres to the foliage more tenaciously, and with the addition of glucose a single application can be made to last throughout a season. It is visible on the leaves, because of the whitish coating left when the spray dries.

It has its disadvantages, too, one of which is the danger to stock from strong mixtures when these drip upon grasses beneath trees. However, as suggested by Messrs. Forbush and Fernald in their report upon the gypsy moth, the strong mixtures necessary for the gypsy moth are not required for many other insects, and arsenate of lead can be used for these latter in about the same proportions as the more soluble Paris green.

The arsenate of lead is prepared by dissolving arsenate of soda in water, in which it is completely soluble, then adding to the solution sufficient lead acetate to form a precipitate, the arsenate of lead, which remains suspended in the water. In their field work the Massachusetts workers used 29.93 per cent. of arsenate of soda to 70.07 per cent. of lead acetate. Prof. Fernald himself advises the use of 4 ounces of arsenate of soda to 11 ounces of lead acetate. Two quarts of glucose was used in 150 gallons of water.

Paris green.—This useful insecticide should contain about 50 per cent. of arsenic. Imitations are on the market, and

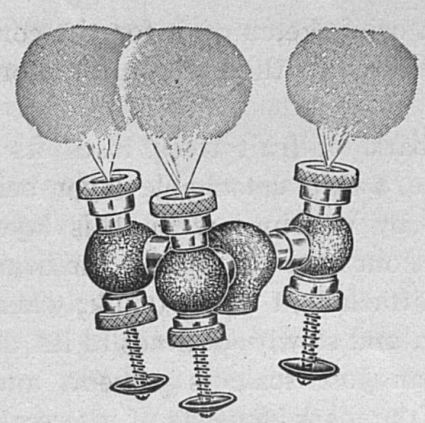


FIG. 4.—A three-discharge nozzle of the Vermorel type. Manufactured by the Goulds Company.

account for some failures to get the results which Paris green gives when it is properly made. The price varies from season to season, but in small quantities it should cost from 20 to 30 cents per pound. It is important to keep it stirred up while using.

Bisulphide of Carbon.—This may be bought in pound bottles from druggists, or in larger quantities from Edward R. Taylor, Cleveland, Ohio. In a circular issued by Mr. Taylor I find the following prices quoted :

50 lb. cans, 10 cents per lb.
30 lb. cans, 11 cents per lb.
10 lb. cans, 12 cents per lb.

This insecticide is sold in the form of a fluid. When exposed to the air its fumes escape and at the same time the fluid evaporates very quickly. No animal can breathe the fumes for any length of time, hence its destructive effect upon weevils when poured upon infested grain, and upon woolly aphis and grape Phylloxera in the ground. The fumes are inflammable, and must not be allowed to escape in the vicinity of fire.

SAN JOSE SCALE.

(*Aspidiotus perniciosus.*)

Bulletin 67, published in May, 1897, by this Station, contains a full account of this insect, and gives the best methods of treating infested trees. It will not be necessary to give

here more than a brief sketch of it for the convenience of the reader, who is referred to the bulletin for more detailed information.

When the bark of fruit trees loses its clean, healthy, glossy appearance, a thin detachable layer being present that can be removed by rubbing; when this layer is found over much of the tree, out near the tips of the branches as well as down near their attachment to the trunk; when the tree ceases to grow and bear, and slowly declines to its death, the probability is that San Jose scale is present, and that the thin scurfy layer on the bark consists of the scale-like coverings and flat bodies of this singular insect. The insects become fastened to the bark shortly after being born and do not afterwards move about. To the unaided eye the insect nature of the layer is not apparent. It is only with the compound microscope that it can be studied properly.

The pest is present in Kentucky, in Fayette, Jefferson, Grayson and Muhlenberg counties to my certain knowledge, and probably in isolated orchards elsewhere. *It is not in our nurseries.*

We are endeavoring to locate all infested orchards in the State. Will not our friends notify us of any suspected trees in their neighborhoods, sending us by mail a few twigs for examination when possible? Bulletin 67, giving directions for treatment, can be obtained by application to the Station.

THE WOOLLY APHIS OF APPLE.

(*Schizoneura lanigera.*)

Character of Injury.—The effect of attack by this insect is often visible chiefly as a general enfeeblement and gradual decline, resulting, when very severe, in the death of the tree. When the roots of such trees are exposed they are found to be extensively deformed by the growth of knot-like or wart-like masses of irregular shape and size. The main roots (now before me) of a young apple tree obtained at Winchester, are completely covered with such knobs and must have been of very little use to the tree. The aphides with their white

cottony covering may often be seen in crevices of the bark, especially where this has been injured, and often appear on the sprouts that grow up at the bases of trees. Their attacks cause the bark to become rough and warty, and sometimes fissures appear that admit water and thus induce decay. In this country the injury above ground is generally not serious, but in England and on the Continent the trees often become covered with the insects and even the twigs are so badly stung as to be killed. The injury to the roots is relatively slight there, but here the chief mischief is done by the insects working on the roots. The latter are not only distorted so that they do not perform their functions properly, but are often so injured that they die and rot away.

The Aphis.—The woolly aphis is a small brown or black, stout, soft-bodied louse, which secretes from its surface the white cottony material by which its presence on the bark is most often detected. The young are somewhat paler in color, but otherwise are not especially different from the adult. Fully grown wingless examples measure about .07 inch in length and about .05 inch in diameter. Late in the fall dark colored examples with relatively large thin and fragile wings, and with little trace of the cottony substance on their backs, are found among the wingless lice; but ordinarily on both roots and branches the most of the lice are without wings, and have to depend solely on six rather feeble legs for getting about. Their motions are rather clumsy as a consequence, and once established they do not move about much.

The young are born alive during much of the year, *and no males appear*, but toward winter a sexual generation of wingless egg-producing individuals is developed, and each female leaves its single egg, sometimes enwrapped in its skin, on the trunk of the tree attached to the bark close to the ground. These egg-laying individuals are very small, and when adult have no beak, their sole function being to produce eggs; this accomplished, they disappear.

Distribution.—For many years this aphis has been distributed throughout most the globe, wherever the apple is grown. The British are disposed to regard it as of American

origin, call it, in fact, American blight, and suggest that it may have lived before the advent of the white man in America, on our native crab-apple. It does attack this tree, it is true, but is known not to be partial to sour apples, and on other grounds its American origin has been questioned. The discussion of the subject is profitless at this late date, and indeed the only fact of economic value thus far brought out by the discussion is that the unrestricted sale of infested nursery stock is chiefly responsible for its present wide distribution.

The woolly aphis is often said to be particularly troublesome in countries where the mean temperature is low, this view seemingly having been adopted because of its prevalence in New England. I do not see how the root-infesting form could be more abundant than it is on neglected trees in Kentucky. It is abundant also in Missouri, as attested long ago by Dr. Riley, and more recently by Prof. Stedman. The twig and trunk-infesting form is abundant, too, in England, where the winters are probably even milder than our own. When all the facts are known it will probably be found to thrive wherever any considerable number of apple trees are grown.

As to the kind of soil and situation in which it is most at home, opinions of practical men vary. Some assert that it cannot do much injury in a stiff clay soil, still others that it is most injurious in such soil. A free use of stable manure, by loosening the soil, encourages it according to one man, and discourages it according to another. One man is very sure that low damp ground is just the place it prefers to all others, while his neighbor is just as positive that it is much more destructive on slopes where the natural drainage is good. The explanation of this conflict of opinion and experience is to be found in the fact that the woolly aphis thrives in a variety of situations, low and high. I believe that here in Kentucky it has oftenest been observed destructive on level land, but one of the worst infested lots of trees that has come under my observation in the State grew on rather high and sloping ground.

One of the most thorough-going of the early accounts* was published in 1830 by Mons. Blot, a Frenchman. He advises growers of trees to avoid for nurseries, low and humid places, because of the greater danger there from aphis. It is possible that the rank and succulent growth of both root and branch in places where there is abundant moisture may be inviting to the woolly aphis, not only as affording it tenderer food, but because of the concealment which a rank growth offers it. It is a common belief, at any rate, that the trees that are permitted to sprout at the base are most commonly the ones upon which the egg-laying females are produced. It is with this idea in mind, apparently, that Blot advises that in both orchard and nursery the heads of the trees be kept open to favor circulation of the air and drying of the soil. Rubbish and twigs should, he says, be removed from under the trees, and the plow be employed frequently.

Treatment.

The form which appears on the trunks and branches may be destroyed by spraying with a diluted coal-oil emulsion, or in some cases simply by rubbing the infested places with a cloth saturated with the emulsion. Mons. Blot advises using a torch made of straw, but suggests that it must be employed with some caution to avoid injury to the tree. As being more completely under control for this purpose, the gasoline blast-lamp used by mechanics for burning off old paint, melting metals, etc., may be mentioned. Such lamps are now made for insect work, selling for from $3.50 to $4.00, and are useful about a farm for other purposes. The air pump with which they are provided produces a large jet of intensely hot flame that can be passed quickly over infested trees, killing insects on the bark, but not penetrating the latter.

In this region the root-infesting lice are so much more prevalent that treatment must, in the majority of cases, be directed towards them. For the greater part of a century

*I have not seen the original publication, but have before me Amyot et Serville's Histoire Naturelle des Insectes, 1843, in which Mons. Blot's work is quoted (p. 612).

tobacco dust has been employed by fruit growers about the roots of infested trees. Blot, in 1830, recommended putting about the bases of trees a mixture of tobacco and fine sand. Some experiments recently made at the Missouri Station by Prof. J. M. Stedman, suggest that ground tobacco stems is more effective for woolly aphis than has been supposed. His method of using it was to dig away the earth for several feet about a tree, to a depth of from four to six inches, and in the depression spread from 2½ to 5 pounds of tobacco dust, this being covered with the earth taken out. Fifteen trees treated in this way on the 29th of June were treated again in the same way August 15. When they were inspected on the last of October only two of the trees had any trace of aphides on the roots, and these but one colony each, where possibly the tobacco had not been as thickly spread as elsewhere. Fifteen badly infested trees in another orchard were treated in the same way and were found in October to be entirely free from woolly aphis.

It is practicable to treat nursery trees in the rows with the same material, by plowing or hoeing furrows alongside. Prof. Stedman advises dusting tobacco in the earth in which young trees are being set.

Gas Lime.—In 1886 Mr. W. G. Klee published the results of his experience with this substance in a bulletin from the California Station, claiming that it is a very satisfactory remedy for use on orchard trees. In his first experiment with it he placed it close about the trunk and removed the earth, to bring it near the roots, with the result that the trees were in some cases injured by it, although it cleared the roots of aphides. He next put ashes about the trunk of the tree to keep the gas lime away and simply spread the latter on the ground. This was done in October. He says :

> "On the trees examined thus far, the result has been very satisfactory. They show by the knots and swellings on the roots that they were once badly infested; still, there is no aphis on them now, while on a few other trees left without treatment the insects are crowded."

The quantity to be used varies with the size of the tree and the character of the soil. A porous soil which allows the

matter washed out of the gas lime to pass through readily requires more, while a clayey soil keeps it about the roots longer, and if much is used they are liable to be corroded. One shovelful for a small tree and four for a large one is, he says, about what is needed.

Hot Water.—Boiling water, used on the roots after removing the soil so that it can reach them, is strongly advocated by some of our best horticulturists.

Bisulphide of Carbon.—This fluid can be introduced into soil either with a specially made injector (like a large syringe) or by driving a round stake into the ground and pouring the bisulphide into the hole thus made, then filling with earth. Prof. Stedman, who has experimented with this substance, also, advises using two or three ounces to a tree and injecting it a couple of feet from the trunk on two or more sides. A too free use of this fluid is liable to injure the trees, especially if injected too near the trunks.

Treatment of Nursery Stock.—Nurserymen are not likely to send out very badly infested trees. The conspicuous knots on the roots attract the attention of the purchaser at once and lead to complaint. But some of the less careful ones still neglect to treat trees that have some of the aphides on the stems. I had one complaint from a buyer this year concerning trees he had bought of a Virginia nurseryman and had not yet planted. *No infested trees*, no matter how slightly they are affected, should be allowed to go from the nurersy. It is such a simple matter to dip trees, where suspected, in a dilute coal oil emulsion kept in a vat for the purpose, that there would seem to be no excuse for neglecting this precaution. Buyers should examine trees before planting to see if they are infested with the insect. As I have said in other connections, they will never after planting the trees have so good a chance to get rid of the insects.

The nurseryman is urged to burn promptly all refuse trees. It is not enough simply to take them up and throw them aside. Neglected, overgrown stuff attracts such pests, and thus keeps a nursery infested. When trees are past the

salable age the sooner they go to make up a good bonfire the better. The same may be said of all useless apple trees, old or young, growing about a place; they often serve as breeding places for pests of this sort.

Resistant Varieties.

It is very commonly held that there are resistant varieties, among which Rawles Janet is often mentioned. The subject is worthy of closer attention than it has yet received in this country. It is not improbable that varieties exist that might be used as stocks that would be but little injured by woolly aphis, just as American grapes are largely immune to the attacks of Phylloxera. Mons. Blot, the French writer referred to, among other "precepts" adopted as a result of his observation along this line, says: "Use for planting only the seed of sour varieties." Sweet apples are believed to be especially subject to attack. In Australia this subject of resistant varieties has been given a good deal of attention, and fruit growers there sometimes claim that they have mastered the subject so far as injury to the roots is concerned. As one writer expresses it, by the intelligent use of resistant stocks they can snap their fingers at the American blight.

In his work on the destructive insects of Victoria, published at Melbourne in 1891, Mr. C. French, the Government Entomologist, writes in explanation of the discovery of resistant varieties:

"According to the late Mr. Treen, the first systematic experiments with the non-blighting stock, the 'Majetin,' were carried out by Messrs. T. Lang & Co., the well-known nurserymen of Melbourne and Ballarat, in 1868-70, their attention having been drawn to this apple in 1862, and to the descriptions thereof given by Geo. Lindley in his 'Guide to the Orchard.' Lindley says that, at the time of the publication of his book, 40 years ago, it was noticed that an old apple tree growing at Norwich, in England, which had been grafted three feet high, had been attacked by the '*Aphis lanigera*' or 'American Blight,' below the grafted part, but never above it; the limbs and branches continuing perfectly free, although all the other trees in the same garden were infested, more or less, with this blight. The variety was a Norfolk apple named the 'Winter Majetin,' and the Messrs. Lang & Co. concluded that, if this variety was so

very free from blight as described, it should form a valuable stock for the apple, and they accordingly procured some trees from England; and such, I understand, and have no reason for doubting, is the history of the introducton of blight-resisting stocks into Victoria."

"The variety called the 'Northern Spy' was raised in America, and was also introduced by Messrs. Thos. Lang & Co. It is said to be superior in every way to the 'Majetin,' and but little else is now used on which to work young trees of the apple."

Still another new variety, the "Perfection Paradise," is mentioned by Mr. French as even better than the Northern Spy. In concluding his account of the insect Mr. French gives a list of blight-proof varieties, which will be of interest to our nurserymen and fruit growers:

"Appended is a list of those varieties of apples which are not susceptible to blight. I am indebted to Mr. George Neilson, the well known curator of the Royal Horticultural Society's Gardens, of Melbourne, for this list, which may be useful to those about to plant new orchards throughout the colony."

APPLES PROOF AGAINST ATTACK OF WOOLLY APHIS.

Autumn Tart.
American Golden Pippin.
Chastatee,
Early Richmond.
Fall Beauty.
Golden Queen.
Irish Peach.
Lord Wolseley.
Lincolnshire Holland Pippin.
(Nearly blight-proof.)
Menagere.
Magg's Seedling.
New England Pigeon.
Northern Spy
(The best blight-proof stock.)
Primate.
Ruby Pearmain.
Stubbart Codlin.
Striped Beaufin.
Tetofsky.
Winter Majetin.
Yarra Bank.

Of the above varieties, American Golden Pippin, Irish Peach, Menagere, Northern Spy, Primate, Striped Beaufin, Tetofsky, and probably others, are handled by American nurserymen.

A clue to the reason why one variety is distasteful to the aphis while another is not, is perhaps revealed by the results of a chemical analysis which Mr. French had made of young trees, one a "Majetin," the other a crab that was not blight-proof. The analyses showed that the crab contained only 7·5 per cent. of carbonate of lime, while the blight-proof

Majetin contained 16.3 per cent. Otherwise the two were very nearly alike, except that the crab contained considerably more clayey and siliceous matter.

At the Cape of Good Hope, South Africa, too, the resistant stocks are being used, and nurserymen demand a higher price for them than for others. The Northern Spy and the Majetin are most used.

With a view to learning to what extent the observations of our own nurserymen confirm those of the Australians and South Africans, I applied to Mr. H. F. Hillenmeyer, of Lexington, for his views on the subject of resistant varieties and soil influence. To render intelligible the first sentence quoted below, it is necessary to say that Mr. Hillenmeyer contends that the injury of woolly aphis is not very serious to bearing trees. He writes as follows:

"The injury of the aphis is to the trees in the nursery row; aud here it is, or may be, a source of much loss and annoyance. It is not so often found on the twigs, but on the depressions of the stems, formed by pruning, and not yet grown over, it is sure to be found in abundance after wet or warm winters. No protuberances are here formed, there is no apparent puncturing of the bark, and perhaps little injury follows.

"The underground work of the aphis begins on the crown roots, gradually extending outward and downward until the entire system is, or may be, a mass of knots and protuberances.

"It is well known to all nurserymen that the aphis of the apple is affected by season, soil and variety; that in some years it may be found almost anywhere, and then in others it has entirely disappeared; that in some blocks it is prevalent, and in others nearly absent, and that some kinds are more prone than others. In an experience of over twenty-five years, during which millions of apple trees have passed through the writer's hands, convictions have naturally forced themselves on his mind, hardly open to change.

"His first pr ctice was to plant on clover sod, but the soft, fluffy mould of this preparatory crop seemed to be so favorable to the rapid spread of aphis, that clover was entirely discarded in his rotation. All subsequent experience indicated that the humus of legumes, as also that of barnyard manure, invited loss, and his practice was changed in accordance. Rich soil is required for a healthy and vigorous growth, but for the apple, let the manure, if needed at all, be applied the year before.

"There is as much difference in the firmness and texture of the twigs of apple trees as that of oak and poplar. Each kind has a root

system all its own, and both these characteristics determine exactly to what extent they are liable to injury by the aphis. Milam and Northern Spy, with their hard wood and deep-plunging roots, in any soil, season, or situation, may be expected to turn out free of aphis, while Rome Beauty and Golden Sweet, with soft wood and fibrous or shallow root structure, are likely to be just the other way.

"Some varieties of the apple have very soft wood, but very deep-extending roots, and from these we may learn a lesson of value in combating the aphis. Stark and White Winter Pearmain are as liable as any to be infested on their crown roots, and very certain to be exempt where these deeply penetrate the firm soil below. And then, in the undulations of the ground and its varying texture, and the impaction at the ends of the rows, this same fact is presented. It is for these reasons that we have discarded soft soils and manures, and have made the needed preparation the year before.

"Tobacco dust and tobacco stems are said to be a perfect remedy. Two blocks were treated with these—every row in one block, and alternate rows in the other. The growth has been vigorous, and there is no aphis, or very little. A third block of equal size, was not so treated, but all three have been washed with a mixture of kerosene emulsion and strong potash soap. This block is equally exempt, and the interesting question arises, whether the slow washing down of the kerosene-potash compound destroyed the aphis that may have been present. I am not familiar with the life-history of the aphis, but assuming that the insect makes its way from the stem to the crown, the kerosene would have destroyed it.

"In conclusion, while we may not hope to exterminate the aphis, its control by the use of firm soil, by refraining from loosening the surface where the stem enters the earth, by the application of tobacco, and washes that stimulate growth and destroy lichens, scales and aphides, is quite within our power."

THE OYSTER-SHELL BARK-LOUSE.

(*Mytilaspis pomorum.*)

This scale insect is large enough to be recognized without being magnified. As the name implies, it looks like half of the shell of a small oyster fastened closely to the bark. When it becomes abundant the scales touch each other and overlap so that a layer is formed consisting of the closely crowded scales of numerous individuals. To the eye the bark of such infested trees looks rough and discolored, as is the case when San Jose scale is present, but the surface appears more

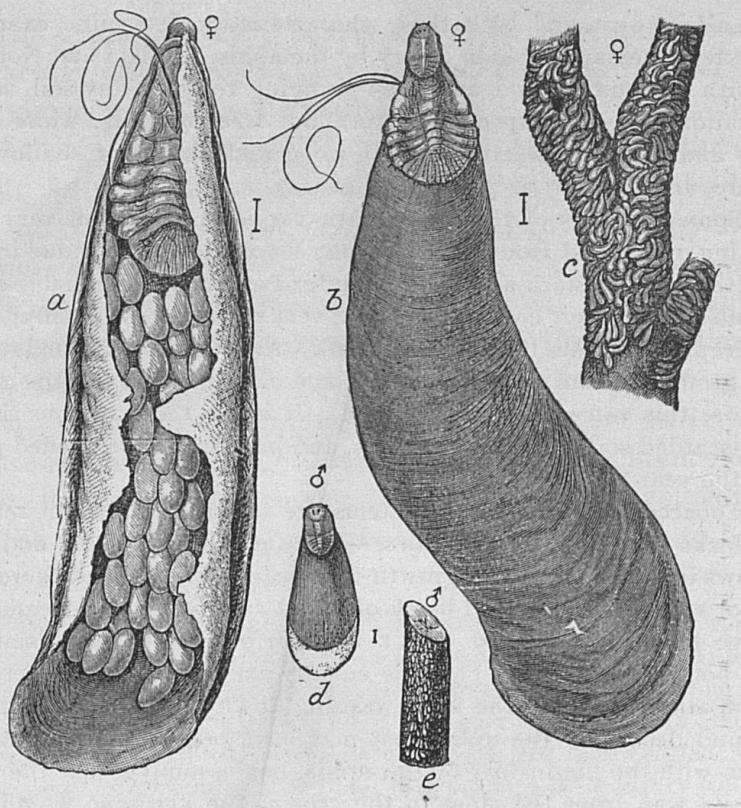


FIG. 5.—The oyster-shell bark-louse. *a*, showing female scale from below; *b*, female scale seen from above; *c*, female scales, natural size; *d*, male scale; *e*, male scales, natural size. (From L. O. Howard, Division of Entomology, U. S. Dep. Agr., 1894 report.)

uneven. The oyster-shell bark-louse is in fact a closely related insect, and injures the trees in exactly the same manner—by sucking up the sap. Its large size and peculiar shape will always distinguish it from the recently imported pest. Examples sent to the Station by F. O. Rives, of McCracken Co., Ky., measure .125 inch in length with the greatest diameter about one-third of the length. Others sent me by W. J. Crandall, of Chattanooga, Tenn., are about the same in size, as are still others from Henderson Co., Ky. When closely examined individual scales are seen to be umber-brown in color, verging upon chestnut, the surface somewhat shining, the shell decidedly convex from side to side. Before the tree becomes thickly covered with them they are generally most abundant in the forks of branches; on young trees

in the nursery during the winter a few may be found in the axil of each bud. Such positions are chosen by the young probably, because of the concealment and protection they afford.

As in the San Jose scale, the shell-like part visible is largely a secretion, serving for the protection of the insect beneath it. The latter adds to the shell only at one edge, and hence builds a long shell instead of a round one. The insect differs, too, from the San Jose scale in its manner of producing young. The recently imported scale brings forth living young, while the oyster-shell bark-louse lays eggs, and during the winter if a scale is detached from the bark, these will be found beneath.

At the North the young hatch and leave the mother scale late in May or in early June. In my rooms at the Station at Lexington the young became active on the 14th of April. Two broods are developed during a season at the North, and at least two are produced here.

While this scale insect prefers apple or pear, it is found on other trees at times, and occasionally is very destructive to them. It seems to thrive on willows. One of the worst infested branches I have seen came from a tree of this sort and was given to me some years ago by Prof. H. E. Weed. The scales on this specimen are so crowded that the bark cannot be seen.

Distribution.—Like the woolly aphis, this insect has an almost world-wide distribution. It occurs throughout this country wherever the apple is grown, in England and most of its colonies, in continental Europe, and doubtless elsewhere. Its natural means of dispersion are limited, and it would probably never have become so widely known as a pest if it had not been for its dissemination on nursery trees.

Injuries.—At the North and in Europe the oyster-shell bark-louse often kills trees outright, and in consequence is greatly feared by fruit growers. It is found in this country as far south as Mississippi, but is not prevalent south, does not thrive there seemingly. In Kentucky it has been found in isolated orchards and nurseries, but always in rather small numbers. Possibly

its scarcity is due to an abundance of its parasites, such as the small 4-winged fly (*Aphelinus mytilaspidis*) which attacks it in other parts of the country. Some of the scales sent me from this section were perforated with small round holes, such as parasites of this sort make when they emerge. Whatever the cause may be, our experience with the chinch-bug warns us that it is unwise to trust to this general immunity, and our fruit growers and nurserymen will do well to keep in mind the fact that the oyster-shell bark-louse is capable of doing as severe injury as its cousin, the San Jose Scale, and cannot with safety be ignored.

Treatment.—Infested trees should be treated exactly as if they were infested with San Jose scale. Strong soap solutions, made either with soft soap, or, whale oil soap, should be brushed over the trees during the fall or early spring when they are inactive. If it seems desirable to treat the trees at other times coal oil emulsion is recommended as the safest, because it appears to be rather more effective in the dilute form required to avoid injury to the leaves. Prof. A. J. Cook long ago claimed that he had repeatedly proved by practice that strong solutions of soft soap rubbed over the infested bark in early June with a cloth, repeating the treatment about three weeks afterward, were completely effective in clearing trees of the scale. In his later practice he used a quart of soft soap in two gallons of hot water, and at once stirred into this a pint of crude carbolic acid.

THE SCURFY BARK-LOUSE.

(*Chionaspis furfurus.*)

This is another relative of the San Jose scale, but, unlike that species and the oyster-shell bark-louse, this is a native of this country, where in the days of the buffalo and red Indian it probably lived upon our native crab-apple. It is about as large as the oyster-shell bark-louse, but it is generally broader in proportion to its length, and its form is only remotely suggestive of the shell of a clam or oyster. Yet now and then an individual approaches the oyster-shell bark-louse very

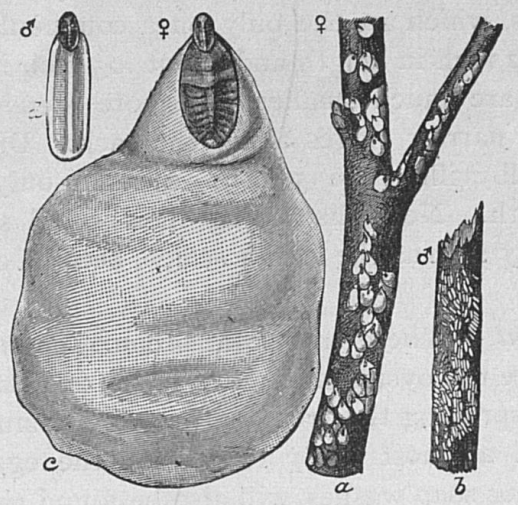


FIG. 6.—The scurfy bark-louse. *a*, females, natural size; *b*, males, natural size; *c*, female; *d*, male. (From L. O. Howard, Division of Entomology, U. S. Dep. Agr., 1894 report.)

closely in shape. It is pure white or grayish white in color and this alone will distinguish it from either of the other species. Besides apple and pear it attacks quite a list of related plants, among which are crab-apple, mountain ash and cherry.

It occurs everywhere in the United States, wherever the apple is grown, and has been carried abroad. It infests both young and old trees, and so far as observed has no special favorite among the varieties. In Kentucky it has been observed by me in most of the localities I have visited, from the Valley of the Big Sandy to the Mississippi River. But while it is generally distributed I have never known it to occasion extensive loss in the State. Upon most old trees a few scattered individuals may be found, but these do not commonly increase in numbers as they would if any large proportion of their eggs hatched and the young reached maturity. Now and then a neglected tree is encountered that is pretty badly infested, but taking the State as a whole and one season with another the scurfy bark-louse is not with us a dangerous pest.

Its life history is similar to that of the oyster-shell bark-

louse. One or two* broods develop each year. The larger female scales, which are the only ones commonly seen, measure about .12 inch in length and about .05 inch in width. The male scales are much smaller and more slender, and have besides three narrow ridges along the back. Dried examples taken at Shelbyville, June 5, 1897, measure only about .0533 inch in length. Notwithstanding their small size they are quite as easily seen as the female scales, because of their snow-white color.

Treatment.—Where this scale becomes common it should be treated like the oyster-shell bark-louse and San Jose scale. Brushing or spraying the trees with coal oil emulsion is to be recommended as most likely to destroy the eggs under the scales. Strong soap washes will also be found useful, though it is questionable if these are as effective for the destruction of eggs as is the coal oil.

I have frequently seen this scale in nurseries in small numbers, and while it is not at the present time a dangerous insect, it is so easy for nurserymen to avoid future trouble by destroying them on infested trees that there would seem to be no excuse for sending them to buyers. The simplest way to treat young trees that are infested is to dip them in a tank containing dilute coal oil emulsion.

THE APPLE APHIS.

(*Aphis mali.*)

Small, soft-bodied green lice are seen at times thickly crowded on the tender new leaves and twigs at the ends of branches of either young or old trees. The largest measure only about .09 inch in length, but among the hordes usually associated in these colonies are all sizes from the largest to those just born and not more than 1-5 as large. At times

*So far as I know the number of broods has never been determined by careful methods for either of these insects. The fact that the oyster-shell bark-louse is sometimes found on nearly mature apples and out at the tips of the twigs on the latest growth, led Lintner to believe that two broods were developed annually, even in Canada.

winged adults are interspersed with the others, which they resemble in general character.

The habits of this aphis are like those of other common species infesting familiar plants of the garden and conservatory. The injury is done by puncturing the tender growth and abstracting the sap, resulting in a curling up and unsymmetrical development of the leaves and dwarfing of the growth. Late in the fall (in November at Lexington) egg-laying lice are produced and place small black eggs in the axils of buds and on the outer scales, leaving them to hatch the following spring. These egg-laying individuals have been observed by me only on old trees, but the lice frequently appear in the nursery, where in all probability they sometimes lay their eggs.

Treatment.—A good eye can detect the eggs, small as they are, and where the lice have been abundant among blocks of trees during the summer it is well to examine them with reference to the presence of eggs before they leave the nursery. If eggs are present, dipping in coal-oil emulsion is to be recommended as the treatment most likely to destroy them.

Of course the destruction of the lice is to be accomplished if possible before the egg-laying season comes. This can be done either by using a spray of coal-oil emulsion, diluted to avoid injury to the leaves, or of strong tobacco decoction. The former is to be preferred as the more effective. If the tobacco is used, several applications are ordinarily required to complete the destruction of the aphis.

The apple-leaf aphis is not ordinarily a destructive pest, and can be controlled without much difficulty by adopting the precaution of destroying such colonies as appear from time to time, and thus keeping it from gaining headway.

Lady beetles are generally found among the colonies, and should be carefully preserved, since they are the natural foes of all plant lice and are correspondingly useful to the fruit grower. Not a great while ago a gentleman of intelligence informed me that he had seen numbers of these insects among plant lice on certain of his fruit trees, and considering them

the adult of the lice had destroyed every one he could find, flattering himself at the same time that he was laying his ax at the very root of the trouble.

THE APPLE LEAF-SKELETONIZER.

(*Canarsia hammondi.*)

Orchards and blocks of young trees in the nursery may assume a rusty appearance in late summer, due to the work of small brown or dull green worms resembling in shape and general structure the apple worm. They gnaw away the green substance from the upper surfaces of the leaves until nothing is left but a brown network of veins and veinlets; in other words, the leaves are skeletonized. Several leaves are generally drawn together by silken webs, and concealed in this shelter the worm or worms, for they often show a disposition to be social, work their will. The greater part of a nursery has thus sometimes been overrun, and orchards upon which the skeletonizer is at work can sometimes be recognized at a distance by their brown appearance. The adult insect is a small gray moth with two conspicuous silvery white cross-marks, the outer one not reaching entirely across the wing. Wing expanse a trifle less than half an inch. The insect is frequently observed in Kentucky, and is very abundant among the nurseries and orchards of the upper Mississippi Valley. At the East it is not known to fruit growers.

Treatment.—In the nursery the best treatment is spraying the leaves with Paris green, or arsenic in some form, together with a little air-slaked lime to make the poison stick. The worms sometimes lurk about the trees until November, and since they generally pupate among crumpled leaves, are liable to be carried into the orchard on young trees unless these are carefully cleared of all dead leaves before they leave the nurseryman's hands. They are not difficult to detect, and it is only by gross carelessness on the part of tree dealers that their patrons ever receive this unwelcome guest.

THE APPLE LEAF-CRUMPLER.

(*Mineola indiginella.*)

The adult of this is a moth with wing-expanse of about 0.75 inch, the front wings pale brown with lines and spots of white; the hind wings whitish. In June these moths visit apple trees to deposit their eggs. The small worm which hatches from these eggs constructs and lives in an odd-looking case, more or less twisted, and conceals this by drawing down to it the leaves near by. From this retreat it comes out when hungry, oftenest at night, and feeds on the leaves. When fall comes the cases, still containing immature worms, remain attached to the twigs, and the worms lie torpid in them all winter, to complete their growth in the spring, change to pupæ, and eventually become adult moths, as already recounted. The singular protective cases are very commonly seen, even where the insect is doing no great harm, and are doubtless familiar objects to most of our fruit growers and nurserymen. It is not rare in Kentucky, but I have not thus far had complaints of serious injury due to it.

The conspicuous character of the cases, with the crumpled leaves often attached, suggests to most growers the desirability of plucking off and burning them when handling the trees. During the summer while the worms are actively at work on the foliage they are not so easy to find, and one can only deal with them conveniently by putting some poison, such as Paris green, on the leaves, where it will catch them sooner or later. This treatment has been tried in the nursery and found all that could be desired. It is advisable to add a little lime to the fluid so as to keep the poison longer on the leaves. I would use the proportion commonly recommended for codling moth—1 pound of Paris green to 140–160 gallons of water. Four or five pounds of lime added will help the mixture, but this is not absolutely necessary.

APPLE-TREE TENT-CATERPILLAR.

(*Clisiocampa americana.*)

Now and then the forks of young apple trees in the nursery are seen to be occupied by a close-spun, glistening, whit-

ish web, with openings at its angles next the branches. Such webs may appear before the leaves are fully expanded, and gradually grow until they are of considerable extent, eight inches or more across. These tents differ from loose webs produced in large numbers here in Kentucky in the fall of the year by the fall web-worm. These latter are made to enclose a good deal of foliage, upon which the worms feed while enjoying the protection of the web. The insect we are considering, on the contrary, makes its web solely for concealment and shelter from inclement weather. It goes out to feed, through the openings left for the purpose, generally once in the forenoon and once in the afternoon, and may be found at home during the night, during storms, and when not feeding at other times.

The worms become grown in June, when they have attained a length of nearly two inches, are thinly clothed with soft hairs, through which the colors of the skin show clearly. The general effect of these is a rather dark ground color, marked by a pale line along the middle of the back, with less conspicuous markings on the sides of blue, yellow and black. The head is black.

These worms desert the web and find, about fences and elsewhere in retired nooks, places to spin their rather long oval cocoons in which the pupæ are formed, and from which come the adult moths during July. The latter have a wing expanse of from about 1.12 to 1.50 inch, the male being decidedly the smaller of the two sexes. Among our numerous small moths they may be recognized by their uniform, purplish brown color, with two clearly marked, nearly parallel white lines near the middle of each forewing.

The eggs which these moths place on the twigs of apple and other trees during the summer are entitled to special mention, because of the fact that they remain over winter and are so conspicuous that they are very likely to attract the attention of one who is at all observing. Several hundred are placed by each female in a broad band or girdle completely encircling the twig, and are then covered with a gummy coat

that hardens and serves to protect them from the weather. When finished the mass looks like a swelling on the twig.

Treatment.—These egg-masses left on the trees over winter give origin to the worms that appear so promptly in spring. They are always removed by careful fruit growers while the trees are bare, a certain preventive of injury the following season. The insect has a special fondness for wild black cherry (*Prunus serotina*), a common tree along Kentucky roadsides, and if these are allowed to grow about a place they ought to be carefully searched each winter for the egg-masses.

If the eggs have not been destroyed during the winter, or have escaped inspection, the early spring is a good time to find and destroy the webs with their owners, although care must be exercised to destroy the tent when the worms are at home, *i. e.*, very early in the morning, or in the evening.

The tent-caterpillar is not a difficult one to control, and it continues to hold its own to some extent in orchards chiefly because fruit growers are not familiar enough with its habits to know when it is most completely at their mercy.

It attacks a variety of plants belonging to the same family as the apple, and works both in the nursery and orchard in Kentucky.

THE WHITE-MARKED TUSSOCK MOTH.

(*Orgyia leucostigma.*)

Its habit of leaving its masses of eggs attached to the twigs of various fruit trees over winter makes it necessary to include this insect among those liable to be disseminated from nurseries. The female moth, which is wingless, places her eggs on the outside of her small cocoons, spun among the leaves on the tree, so as to cling there all winter. If one examines the scattered tufts of dead leaves and other rubbish attached to the twigs of orchard trees at that time he is likely in most Kentucky orchards to find some of the eggs of the tussock moth. Winter, as in the case of the tent caterpillar, is the time to get rid of the insect, and it can be done with special ease because of the fact that the female moth has no

functional wings, and hence the species is very slow in migrating from orchard to orchard. The male moth has ample wings of a dull brownish gray color, each front wing with a small white dot near the hind angle, and some obscure dusky and gray markings elsewhere. It measures from about 1.12 to 1.25 inch from tip to tip of the front wings.

The moths are not often seen by the fruit grower, but the worms, or larvæ, are so strikingly ornamented with long brushes of hairs that they more often attract attention, and this is the more likely to be true because they are the mischief workers. The head is a bright coral-red in color; a long black plume of hairs extends outward and forward from each side of the head, and a third of the same character arises near the hind end of the body; a short distance behind the head are four large but short tufts of whitish hairs, ranged along the back; elsewhere the body is rather loosely clothed with long, pale hairs.

When abundant the worms are very destructive to plum, apple, willow and other trees in Kentucky. They are very easily controlled, however, by keeping the trees free from egg-clusters.

APPLE SCAB.

Attacks cultivated apple and native crab-apple. Forms soot-colored spots with indefinite outlines, generally on the upper sides of the leaves; spots varying from an eighth to one-half inch in diameter, often fusing and occupying most of the surface, then causing leaf to blacken, curl up and fall; deadened part sometimes falls out, leaving holes; growth sometimes follows the veins and thus assumes a branched form. Petioles and young growth of twigs are attacked. Fruit stems are occasionally injured so that young apples fall. Spots also appear on growing fruit, producing there what is known as scab, or black spot; restricted to the skin and tissue immediately beneath, but checks the growth of the part attacked, making fruit one-sided and small; gradually extends if season is damp so as to occupy most of surface; during droughts its growth may be checked, and then does little injury.

The scab fungus is known to botanists as *Fusicladium dendriticum*. It attacks both young and old trees, being especially prevalent in nurseries among trees that have been left in the rows after they are too old to sell, and have thus become crowded and, it may also be, weedy. Some varieties are more subject to it than others, but crowded trees and those on low or badly drained soil are liable to it without much regard to variety. Its injury to the foliage consists in reducing the size of the leaves, in causing them to fall prematurely, and thus checking growth and preventing proper ripening of the wood and maturing of the buds. The injury to the fruit consists in reducing its size, rendering it unsymmetrical and unsightly, and thus lessening its value in the market. The scabbed apples are more liable to rot, also, when stored, than are sound ones.

The object for which this bulletin is prepared makes it undesirable to go deeply into the facts of the development and life history of this fungus. It is sufficient to say that it is a plant parasite very similar to others that are here described and probably identical with one that causes scabbing of pears, though this latter has received a different scientific name. It remains alive on the twigs and branches in crannies of the bark, and on the fallen leaves under the trees, during the winter, and is conveyed from these to the new leaves and fruit the following spring.

Distribution.—The disease probably occurs wherever the apple is grown. It is prevalent everywhere in Kentucky, where it constitutes a most serious hindrance to raising first-class market apples.

Treatment.—The statements made concerning the conditions under which the apple scab fungus does most injury will suggest to most people what should be done to save the trees from its attacks. Tile-draining low land, on which young trees are grown, is to be suggested. Overgrown, crowded trees should, of course, be taken up and burned, to prevent the spread of the disease to the valuable stock in their neighborhood. Too often such trees are left in the rows to work mischief of this sort. In the orchard the disease is less

likely to be troublesome when the trees are planted well apart and are properly pruned and cultivated.

Experiments made by me (See bulletin 44, p. 25.) at this Station show that the scab can be controlled to a great extent by spraying the trees with Bordeaux mixture. They should be sprayed once before the leaves expand in the spring. As soon as the fruit sets, a second application can be made, when it is desirable to add a quarter of a pound of Paris green to each barrel full of the mixturé, as a means of preventing codling moth injury. During dry seasons a single additional spraying, about two weeks later, should be sufficient, but when frequent and heavy rains prevail, four applications in all is nearer the right number. With a mixture containing 6½ pounds of bluestone, 3½ pounds of lime and 32 gallons of water, no fear need be entertained that either fruit or foliage will be injured by the spraying. The leaves should appear of a decided gray color when the spray is dry.

APPLE LEAF-RUST.

(Red rust of apple, orchard rust, cedar apple.)

Attacks apple, crab-apple, hawthorn, red cedar, etc.

Characters.—Rust-colored spots, with a rather indefinite outline, but clearly visible because of their sharp contrast of color with the green of the leaf, appear on the upper sides of leaves of both young and old plants in the early part of the growing season. By the middle of July they have reached a diameter of one-fourth inch or more, and then show a cluster of black dots at the center, under a hand-magnifier appearing as small swellings; the color of the spot beneath is at this stage brown, and each of the swellings has a round opening with a series of minute threads extending outward from its edge; in other cases, instead of a little cup like that described, each swelling produces a tube, the extremity of which splits apart and curls up like the stem of a dandelion in the mouth of school boy, the curled parts of the tube remaining attached about the opening in the swelling.

Two distinct fungi are concerned in this injury in Ken-

tucky, but the common one in nurseries is *Gymnosporangium macropus*. The second species has been most often observed by me on the leaves of various hawthorn trees, but has sometimes been found on apple leaves associated with the other species, and doing most of the injury. We have other species of the same genus in the State, but they have not thus far been found on cultivated fruit trees.

A singular fact about the parasites belonging to the genus Gymnosporangium, is that they have two very different forms, one of which is found on the red cedar (*Juniperus virginiana*). The form growing on cedar is the well-known cedar apple, a brown, corky, more or less spherical body, often seen clinging to the twigs in winter, and which in early spring, during rainy weather, puts out numerous long, soft, orange-colored processes like fingers. These processes bear the spores which, after germinating produce still smaller spores (sporidia), and these falling upon apple leaves, produce the rust-colored spots already described. The spores from the latter develop in turn on the cedar, producing cedar apples, and thus the round is kept up. The cedar apples produced by the two rusts are as unlike as are the little cluster-cups on the under side of apple leaves. The one (*G. macropus*) most often seen in Kentucky on cedars is in some cases fully an inch in diameter and its soft finger-like processes are from three-fourths to an inch in length. The rarer rust (*G. globosum*) produces a wart-like growth on red cedar that, in specimens now before me, measure about an one-eighth of an inch in diameter.

Some varieties are attacked by the rust more freely than others. It is not restricted to the leaves, but attacks fruit as well, though it is not so often observed on the fruit of cultivated apple as it is on native crab-apple and hawthorn. It is not at all uncommon also on the young growth of twigs.

Distribution.—Occurs with the red cedar throughout much of Eastern North America. Common everywhere in Kentucky.

Treatment.—On several occasions badly rusted leaves of apple have been sent me by correspondents, and on inquiry it was shown that red cedar trees were growing in close

proximity to the affected trees. It is, I believe, invariably the case that badly infested orchards are near cedars. I remember on one occasion passing a small orchard near Hickman, Ky., and observing that the leaves were so badly blotched with rust spots that they were falling prematurely, looked about for the cause, which was soon revealed in the shape of a clump of cedars on which were numerous cedar apples. It is known that the sporidia are carried for miles by winds, yet as suggested many years ago by Prof. Thaxter, of the Connecticut Station, the abundance of the rust spots on apple leaves is proportionate to the distance of the trees from cedars, and hence it is desirable to destroy cedars growing close about orchards when they are evidently harboring the parasite. Where it is desired to keep a few cedars about a place, the rust can doubtless be kept from being destructive on the apple trees by going over the cedars every year and removing all cedar apples that may develop.

Spraying orchard trees with Bordeaux mixture is recommended where the disease is already established. Some experiments made with copper compounds have shown that while the number of rust spots on the leaves is not always decidedly reduced, yet the yield of fruit is perceptibly increased.

THE BAG WORM.

(*Thryidopteryx expemeræformis.*)

During the winter leathery cases, or sacks, with bits of leaves fastened over the outside are often seen suspended to the twigs of various trees. When one attempts to remove them they prove to be securely fixed to the twigs, it having evidently been the intention of their owners that they should not be detached by the storms of winter. Each one is securely held in place by a band of silk that passes around the twig. Some of the cases will at this time be found empty, but now and then one proves heavier than the others and when cut open a cylindrical brown object which it contains is seen packed with small whitish eggs. These are the bags that were occupied by females the preceding summer; the empty ones were inhabited by males.

The insect which makes these bags was described and figured in 1893 in our bulletin 47 on shade tree pests, and it will not be necessary to give it further attention here than to say that the adult male is a small moth with four wings, and the female is without wings, and must consequently remain at all times in her bag until her eggs are laid, when she wriggles out out of the lower end and drops to the ground, leaving the eggs to carry her kind through the winter.

The insect is especially fond of red cedar, but spreads from this tree when abundant to trees of almost any sort, evergreen or deciduous, in the immediate neighborhood. It is a common object on the twigs of shade trees along the streets of Lexington, and has been observed wherever I have been in the State, from Ashland to Hickman.

The bags are now and then seen in nurseries, but they are so conspicuous that they rarely fail to attract the attention of those who handle the trees and so are very rarely allowed to go out to the buyer.

Treatment.—The bag-worm is very easily dealt with when the general features of its life history are known. In the nursery and on the lawn there is for most cases no simpler or better means of getting rid of it than to have boys go over the trees in winter and remove and burn all of the sacks. This disposes of the eggs that will, if left, produce a new crop of worms the next spring.

In the height of an outbreak, when the foliage is still on the trees and the worms are devouring it, the best treatment is spraying with Paris green, to which a little whitewash is added, using one pound of Paris green in 150 gallons of water.

The bag-worm and one stage of the red rust of apple, are sometimes left to flourish on neglected and worthless cedars in a fence corner, to the hurt of valuable fruit and shade trees near by. A little familiarity with these two pests will reveal the importance of getting rid of such breeding places.

THE CHERRY TREE APHIS.

(*Myzus cerasi.*)

A deep brown, almost black, plant-louse, resembling the black peach-aphis in the general features of color and structure, infests cherry trees of all ages to such an extent as to prove very annoying at times. Leaves, young twigs, blossoms and even fruit, may become blackened with multitudes of these lice. Sometimes they are abundant during the early part of summer and then suddenly disappear, and are not again seen until the following spring. The infested leaves curl up in the manner common to injury by puncturing insects, and growth may cease completely. Adult lice measure abont .06 inch in length, are rather broad, the abdomen almost rotund, and shining. They may easily be mistaken for the peach aphis, though details of structure have led entomologists to put them in different genera. Unlike the peach aphis, the cherry-infesting species does not infest the roots of the trees. It is not restricted to cherry, but severely injures plum trees and may occur on other trees of the genus Prunus.

The eggs are said to be laid in the fall about the buds, as is the case with the apple-leaf aphis.

Treatment.—For this, as for other insects of the same family, I have only one suggestion as to treatment when the aphides live exposed on the leaves, and it is to spray with coal-oil emulsion, diluted so as to avoid burning the foliage, or with tobacco decoction. Either can be made to kill the aphides, but the former is more certain and prompt in its effect.

CHERRY LEAF-SPOT.

(Cherry-leaf blight, plum-leaf blight.)

Attacks cherry (cultivated and wild), plum (cultivated and wild), apricot, peach, and in fact most or all members of the genus Prunus.

Character.—Appears as small purplish or dusky dots which soon show on both sides of the leaves; outlines indefinite at first, but when old the centers may become blackish and

break away at one side, eventually falling out and leaving a round hole in leaf, this result appearing most often on plum; at this stage surrounded by a narrow rim, sometimes lighter in color than the rest of the spot. Spots scattered unevenly over leaf, when abundant causing it to turn brown at length and to fall long before the proper season. Young trees especially subject to it, and suffer extremely from premature loss of foliage, leaving them unprepared for winter. Especially destructive to cherry and plum, so much so in Kentucky that some varieties of the former are considered in some quarters hardly worth planting. Early Richmond less injured here than the sweet cherries. Appears very early in the season, and may cause most of leaves to fall before end of July.

The spots are due to the attacks of a fungus known to botanists as *Cylindrosporium padi.* Small swellings or pustules develop in the diseased regions within which grow the fruit of the parasite. Certain threads of the parasite bear at their extremities long, somewhat curved spores which are set free by the rupture of the leaf-cuticle and are carried elsewhere to continue their destructive attacks. A second condition of the fungus develops in the fallen leaves, where a winter form of fruit appears and carries the disease over to the following spring. This winter form occupies the same position as the pustules already described. In spring the third and last stage of the fungus appears in the form of little sacks in which are seen slender thread-like spores, which in time germinate on the young leaves and produce the spotted appearance by which the fungus is generally known.

Distribution.—The cherry and plum spot-disease is perhaps as widely scattered in the country as any plant ailment known to us. It has long been the cause of complaint from Eastern fruit men, is everywhere in Kentucky, where it is particularly destructive, and occurs throughout the Western States to the Pacific coast. It is known also in European countries, but I find no mention of it in a general work on the parasitic fungi of Australia, published in 1895.

Treatment.— The fact that the parasite lives in the dead leaves under the trees during the winter suggests at

once the advisability of raking up and burning the leaves under infested trees as soon as they are all on the ground.

Thorough spraying of the naked tree with Bordeaux mixture in the spring might then be expected to destroy any traces of the fungus left upon the twigs or trunk. After the leaves expand one or two additional applications of Bordeaux mixture should be given. Careful experiments by several workers in this country have demonstrated the value of spraying in preserving the foliage of young trees.

If the fungus is in the dead leaves on the ground it may be suggested that nursery trees are not likely to carry the fungus on the bare twigs. I have observed some cases of the disease on young trees taken from the nursery, that had every appearance of having been brought to new ground, to which the trees were transplanted, on the trees, though I am unable to speak positively with regard to how the disease was conveyed, whether by summer spores on the bark or on a few old leaves that by some chance adhered to the branches.

CURRANT LEAF-SPOT.

(Currant rust.)

This disease manifests its presence by the appearance of spots irregularly scattered over the leaves. They are evident both above and below, are soon whitish or grayish at the center and are surrounded by a brown ring. They show at first as very small brown dots, of indefinite outline, but the pale center appears when they are not more than .04 inch in diameter. They increase about .28 inch in diameter when isolated, maintaining a more or less circular outline, but when abundant become confluent, forming large discolored areas often involving most of the leaf. Their general appearance is much like that of the rust spots of strawberry leaves, and they are caused by a similar fungus parasite.

The disease is so common in Kentucky that it makes the raising of currants very uncertain in many sections. The bushes become deprived of most of their leaves long before the proper season, and the new growth is thus shortened and the buds for the next season are enfeebled.

The treatment to be suggested is spraying the naked bushes with Bordeaux mixture early in spring before the leaves unfold, and again several times at intervals during the growing season.

GRAPE MILDEW.

(Downy mildew.)

During wet seasons, such as that of 1898, the cultivated grapes are badly injured in Kentucky by a disease which in its later stages gives rise to whitish patches of a mealy or floury nature scattered unevenly over the under sides of the leaves. Sometimes a leaf shows only small patches, but in large numbers; again the patches may become ¼ to ½ inch in diameter and may grow until they meet and cover the whole under side. This mealy substance is the fruiting part of a fungus known as *Peronospora viticola*, a near relative of the blight fungus of the potato, so destructive in Eastern States and in European countries. As the patches grow old their position becomes marked above by a brown spot, and when the attack is severe the whole leaf is killed, curls up and becomes brittle. Quite often the mildew attacks the tender growth of vines, and sometimes the fruit is so badly injured that it shrivels and turns brown. Some of the less vigorous varieties, such as Catawba, are especially subject to the disease, but any neglected vines are likely to be attacked, especially such as are not kept free from weeds or are not properly pruned and trained.

The disease occurs everywhere in the United States, from the Atlantic to the Pacific. It is said to be less common in the elevated plains west of the Mississippi River; but, while it is favored by a moist, warm atmosphere, it endures drought very well, and can be counted on to make its appearance wherever there are vines not properly cared for. As to its bad effect on the vine and fruit, even when the latter is not directly attacked, there can be no question. The claim that it does no more than destroy the surplus foliage and thus permits the sun access to the fruit, to the advantage of the latter, certainly does not hold for Kentucky. I have seen the fruit of whole vines rendered worthless by its attacks.

Treatment.—The disease can be controlled if taken in season, i. e., before the downy patches appear on the under sides of the leaves. In regions where the mildew appears every season more or less abundantly I would advise spraying with Bordeaux mixture before the leaves expand in the spring, and two or three times later, once shortly after the fruit has set. In fact, the treatment commonly recommended for black rot of the fruit serves equally well for this ailment, and the two diseases can, luckily, be controlled by the same applications.

The fungus passes the winter within the old leaves and shriveled berries. Infested vines should therefore be carefully overhauled during the winter, all dead and unnecessary wood be pruned away, and the refuse in the shape of shriveled fruit, destroyed either by black rot or mildew, should be removed and, together with all trimmings, be burned.

The disease is not a difficult one to manage when taken in season.

Another disease known as the Powdery mildew (due to *Uncinula necator*) causes whitish patches of indefinite outline on the *upper surfaces* of leaves and has been seen by me on bearing vines on several occasions in Kentucky. It thrives best during rather dry weather and seems to be rather rare in the State. It has not been observed on nursery plants. Flour of sulphur dusted on the plants is a safe treatment for this trouble. Potassium sulphide may be used, if preferred, and is quite as effective. Prof. Galloway, of the Department of Agriculture, states that he obtained excellent results with ½ ounce of potassium sulphide in a gallon of water. This disease also attacks Virginia creeper, and is supposed to be the same as the notorious *Oidium tuckeri* of European vineyards.

THE BLACK PEACH APHIS.

(*Aphis persicæ-niger.*)

A small dark brown or black plant louse infests the roots and leaves of the peach, occurring in such large numbers at

times as to blacken the parts on which it is crowded, and preventing growth—not infrequently killing young trees. The insect when mature is stout-bodied (.065 to .095 inch long, by .040 to .060 inch broad), the broadly oval body shining as if polished. It is rather sluggish in motion, remaining motionless much of the time with beak inserted in the twig, leaf, or root, sucking up the sap. Winged lice sometimes appear among the wingless individuals, which are also dark brown and black in color, the wings relatively large, hyaline and with a slight play of colors (iridescence). Young lice are paler in color, but do not otherwise differ in any very important respect from the adults.

The insect is very much like a dark aphis sometimes seen on the tender growth of cherry, and somewhat resembles also the louse often troublesome on chrysanthemums. The eggs are believed to be placed under the bud scales in fall.

It undergoes no transformation of consequence, living the year round in some condition on the peach, either in or above the ground. When abundant its effect is a general weakening of the tree, visible in a sickly appearance and lack of vigorous growth. Yellows has sometimes been thought to be induced by its attack, but that disease is known to appear when no aphides are about. Its injury is exactly like that caused by the rose aphis, the chinch-bug, and other puncturing insects.

The twig and leaf-infesting form is most common very early in the spring; at other times the lice are most likely to be encountered on the roots. It is most injurious to young trees in the nursery or to those recently set out in the orchard. These latter suffer especially from the presence of the aphis during the first two or three years after they are transplanted from the nursery.

The black peach aphis has long been known to growers of peaches because of the severe injury it does in the nursery and orchard, but was not described scientifically until 1890, when it was recognized by Dr. Erwin F. Smith, of the U. S. Department of Agriculture, who was led to study it while investigating the yellows of peach trees. Subsequently Dr. C. V. Riley suggested that the peach aphis had been previously

described by the German entomologist Kaltenbach, under the name *Aphis prunicola.** It is becoming common in Kentucky near Louisville.

Treatment.—This is one of the species most likely to be distributed with young trees, and in fact is known to have been introduced in this way into orchards. It is easy to avoid, however, by treatment like that suggested for the woolly aphis.

Young trees can be cleared of the insects on the leaves and twigs by spraying with a very dilute coal-oil emulsion, or else with a strong and warm tobacco water. This latter is rather less effective than the coal-oil, and in case it is used several applications may be required to rid the young trees of the aphides, whereas a single spraying with coal oil emulsion can be made to do the work. When the aphides are on the roots the whole plant should be dipped before it goes out of the nursery in a tank containing the coal-oil emulsion. Ground tobacco stems should be used along the rows for the root-infesting form, by making with a hoe or plow a furrow along each side of the row, then dusting the ground stems in it and covering it with earth. This practice brings the tobacco near the roots while it is still strong, and prevents its being scattered by the wind and rain.

In the orchard similar treatment is to be recommended, namely, spraying the twigs and leaves with coal-oil emulsion and digging away a few inches of earth about the bases of infested trees and putting in the depression four or five pounds

---

*Kaltenbach's description (Monographie der Familien der Pflanzenlause, 1843, p. 122) is so brief and general that it might apply to any one of a half dozen known species of the genus Aphis. No clue is given by Kaltenbach to the food plant except that contained in the specific name *prunicola*. While therefore Riley may have been right in his surmise, there is not sufficient evidence in Kaltenbach's description to warrant one in adopting his name for the peach aphis. Kaltenbach's description is as follows:

Wingless form: Broadly oval, somewhat rotund, blackish brown and very glossy; tubes (cornicles) at hind end of body short, black. Tail scarcely visible. Length ½ inch.

Winged form: Shining black. Abdomen black, at base and tip brownish yellow. Cornicles short, black, yellowish at base. The brown tail (cauda) very small, ⅓ the length of the cornicles.

of ground tobacco stems, after which the tobacco may be covered by the removed earth.

Tobacco stems, when within reach, should be used in preference to anything else. They are worth what they cost as a fertilizer alone, and can be used with the greatest freedom without fear of injury to the plants about which they are placed.

PEACH ROSETTE.

Attacks peach, almond and plum.

Symptoms.—Fruit, none when the disease is very severe; often shriveling and falling while still green; sometimes ripening in the normal way when only a part of the tree is affected; not blotched with red. *Leaves* develop in close tufts or rosettes, often several hundred in a tuft; color yellowish; somewhat rigid, and rolled together; mostly small; not concealing the branches. *Flowers* expand later than normal. *Roots* often with cavities filled with gum; rootlets soon dead. No tufts of fine twigs. Course rapid—six to eighteen months, commonly.

An infectious and contagious disease, resembling yellows in its general character. Manner in which contagion is carried in nature, not yet determined. Conveyed artificially in buds, and by root-grafts. Appears to attack all varieties. No germ or fungus yet proved to be the cause of it, but probably a germ disease.

Distribution.—Rosette has thus far been discovered only in Georgia, being very destructive in the northern part of the State, in the western part of South Carolina, and at Manhattan, Kansas. Dr. Smith says it has been reported also from Arkansas. It has never been observed in Kentucky, but is liable to be introduced, hence it is important that our fruit growers should familiarize themselves with its characteristics.

Treatment.—The rapidity with which this disease runs its course, invariably resulting in the death of affected trees, is an advantage to the fruit grower, since he is not long left in doubt as to what he is dealing with. Rosetted trees are worse than none, and the sooner the ax and pick are

brought into use when they are discovered the better. They should not only be dug up but every fragment of branch, root and fruit ought to be burned. One frequently sees heaps of diseased or insect-infested trees that have been dug up and thrown aside. This procedure is better than doing nothing, but one who has taken this trouble should make sure that his labor is not wasted by making a good bonfire of the stuff at the earliest possible moment. Fire has no equal as a disinfectant; it should be brought into requisition on the farm and in the nursery more frequently than it is.

PEACH YELLOWS.

Attacks peach, apricot, nectarines, almonds and Japanese plum.

Symptoms.—Fruit ripens prematurely, from three or four days to as many weeks before healthy fruit; blotched with red, the flesh beneath the blotches also red, and with more than the normal amount of red about the pit, the extent of red coloring varying with variety; taste insipid or bitterish; fruit worthless; often of normal size; affected fruit sometimes appearing on a single seemingly healthy branch, but later the disease spreads to whole tree. *Buds* develop prematurely, sometimes in latter part of summer, sometimes in spring shortly before the normal buds unfold; produce feeble growth, with more or less yellowish, and often narrow, leaves. Branches normal at first, bnt gradually checked in growth, while numerous slender twigs push out at their sides, and sometimes at a late stage tufts of fine twigs develop in the interior of trees. Foliage finally yellowish or reddish; dwarfed.

An infectious and contagious disease which gradually extends spontaneously throughout an orchard and eventually a whole neighborhood; manner in which the taint is carried not understood; insect-diseased pollen and the pruning-knife have each been considered as possible agents for conveying disease from tree to tree, but thus far proof against any one of them has not been secured; believed not to be conveyed by the soil, since healthy trees planted where diseased ones

have been grubbed up are not more subject to yellows than when planted elsewhere. Conveyed artificially, and invariably, by using buds from diseased trees whether characteristic symptoms have appeared in latter or not. Pits do not develop, as far as known; should not be planted in any case. Not due to character of soil. No variety proof against it. Attacks either strong or feeble trees. Affected trees helped only temporarily by fertilizers; always die sooner or later, no matter what the treatment—sometimes in one year, but oftener in four, five, or more. No germ or fungus thus far discovered that has anything to do with the disease, but has much the appearance of a germ* disease, and may yet prove to be such.

Distribution.—Yellows has thus far been observed only in the Eastern and Middle States. It has not been encountered outside of this country. The disease is known to occur in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Virginia (northern and central part), Pennsylvania, West Virginia, Ohio (northern and southern), Indiana (northern and southern), Michigan (southern), Illinois (southern), and possibly in Kentucky along the Ohio river. Careful fruit growers tell me they have seen occasional cases of yellows in this State, but no unquestionable case has ever come under my own observation. Quite frequently trees have been pointed out to me in different parts of the State as possibly suffering from the disease, but the enfeebled condition and yellow foliage proved to be due to something else. Scores of young peach trees left in nursery rows and neglected, have been seen, that bore some appearance of yellows, the foliage being dwarfed and yellowish, the trees themselves stunted. The trouble was due to neglect and the consequent depredations of the borer. While the disease probably does occur in the State, it is certainly not common, and has in some instances unquestionably been reported as occurring here by people who did not know.

Treatment.—Since trees that are affected are certain

*Dr. Erwin F. Smith, of the National Department of Agriculture, has somewhat recently announced his belief that the disease is akin to what is styled *variegation* in plants.

to die and will not produce fruit fit to use, the only reasonable thing to do is to cut them down, grub up their roots, and burn them as soon as it is known that they are diseased. This is the only treatment that has proved in any degree satisfactory; persistence in practicing it enables growers still to raise peaches in regions where yellows is most prevalent. The disease is most often introduced into orchards in young trees obtained from infected regions. But it is impossible in the present state of our knowledge of the disease to recognize it in very young trees. They may be perfectly sound as far as appearance goes, and yet contain the taint. Probably in many cases it has been introduced into them in buds taken from trees that were supposed to be healthy. It sometimes happens that a single branch or twig of a tree shows signs of the disease, the greater part of it appearing to be in excellent condition. Yet that branch marks the tree as unfit to be used for propagating. Buds taken from any part of the tree will convey the disease. It should not only be avoided for propagating, but should be destroyed without hesitation. This is a matter of primary importance to the nurseryman, but should be known to everybody.

PEACH FRUIT-SPOT.

(Black-spot, peach-freckle, plum-scab, cherry-scab, gun-shot peach-leaf blight.)

Attacks fruit, twigs and leaves of peach; attacks the fruits of almonds, apricots, plums and cherries.

Character.—Dull brown or black spots, at first more or less circular in outline appear on fruit, gradually increase in size and often blend so as to occupy most of the skin on the upper side, then sometimes causing skin to crack, admitting rot fungi which complete the work of destruction. Spots do not ordinarily extend deep into flesh of fruit. Attacks twigs when these are young, especially of neglected nursery stuff, producing purple blotches on the bark which, like the fruit, may split when the attack is severe. Checks growth of young trees, but objectionable even when not abundant, because it is conveyed from twigs to any fruit that

may subsequently develop. Attacks the leaves, at times producing what are known as shot-holes.

An unmistakable fungus disease, similar in its effects to the scab fungus of apple, and due to the attacks of *Cladosporium carpophilum*. Very destructive to fruit some seasons. It is often perpetuated about farms on seedling peach left growing along fences; the fruit of such trees is often nearly all destroyed by it. Smocks are said to be especially liable to its attacks. Twigs of young trees are sometimes badly blotched by it during the growing season, and from them spores are developed in the spring to be scattered to leaves and fruit in their vicinity.

Distribution.—The fungus has been observed throughout much of the Eastern United States, from Canada to Texas, and probably occurs on peach in the fruit-growing sections of the West. Common in Kentucky on both fruit and twigs. It has long been known in Europe.

Treatment.—Where prevalent, spraying with Bordeaux mixture in early spring just before the leaves unfold, is to be recommended. Seedling trees which harbor the disease ought to be burned and their places given to something better. Other trees that show the marks of the disease on the recently-grown twigs should be made the subject of some careful pruning with a view to getting rid of the worst affected parts, after which an application of Bordeaux mixture should follow. All affected twigs from seedling stock in the nursery should be burned as promptly as possible, to prevent the spores being carried to the budded trees. To those buying from nurseries it may be suggested that the trees should be examined for traces of the disease on the young bark.

PEAR LEAF-BLISTER MITE.

(*Phytoptus pyri.*)

The leaves of pear trees often show numerous very slight swellings irregularly scattered over the surface and raised so little above the general level of the leaf that they would not be observed at all were it not that they differ a trifle in color from the rest of the surface. They appear very early in the

spring, when they are often red in color, being visible before the leaves are fully expanded. As the leaves grow older the blisters assume very nearly the same color as the rest of the leaf, and in mid-summer they become dark and, somewhat later, quite black and dry.

If one of these galls is examined attentively with a hand magnifier a minute round opening will be visible on the under side of the leaf. If it is cut open a slight cavity will be seen within the swollen part of the leaf, and if it is placed in a drop of water, teased apart and then examined with a compound microscope its owners and occupants, very minute, slender, four-legged mites, will be revealed. They are exceedingly small, and dozens might creep across a leaf before the eyes of an untrained observer, and not be perceived. Even when located with a hand magnifier and one afterward looks for them without its aid, the most that can be seen, is a moving whitish speck. They are pigmies even among mites, and for a long time were regarded as young of other eight-legged forms of larger size. This has proved not to be the case, for they have been observed to produce eggs and their whole round of existence from the time they hatch has been carefully followed.

Many other species of the same genus have been described, some of which produce deformities on the leaves and twigs of other plants, but this is the only one that has thus far proved very troublesome on deciduous fruit trees. In England another species attacks the buds of currant.

The pear blister mite was long ago described in Europe, where it is probably native, in which case it has most likely been brought to us on nursery trees. It was observed first in the United States by Townsend Glover who in 1873 described it and its work in his report as Entomologist of the U. S. Department of Agriculture (Report of 1873, p. 113). Prof. T. J. Burrill of the University of Illinois next discovered it and wrote it up in the Gardeners' Monthly for January, 1880. The third notice of it appeared in an article of mine, on various species of the genus, in the report of the Illinois State Entomologist for 1882, p. 123, the matter on the pear

Phytoptus being furnished by Prof. Burrill. Since then the mite has become generally prevalent over the Eastern states, and has been frequently noticed by writers.

Injury.—The injury consists in dwarfing the growth of the leaves and otherwise disturbing their functions. Leaves are frequently badly galled, so that but little of their substance is not affected. The mites are provided with puncturing and sucking mouth apparatus, and hundreds of them are constantly engaged in pumping out the sap, while they are at the same time protected in the interior of the galls they produce. I have not observed that they prefer any particular variety, nor are they restricted to young trees. The blister mite is not to be regarded as a dangerous pest, since its attacks do not result in the death of the trees, at least I have never observed anything more than an enfeebled appearance as a result of attack. But there can be no doubt that they affect the bearing power of trees when they become abundant and should on this account be avoided if possible. They are to be seen on the young trees of many of our nursuries, and from the fact that its power of locomotion is so poor I judge it has been introduced into our orchards in the majority of cases from the nursery.

Treatment.—During the summer the mites remain most of the time in the blisters on the leaves, and it is not easy to reach them then so as to check their injuries. When the leaves are about ready to fall the mites betake themselves to the buds and creeping under the outer scales remain there over winter, or in some cases find shelter under loose bark. This would seem to be the best time to apply mixtures that will kill them and coal oil emulsion diluted with about three parts of water, applied to the trees a couple of times early in the spring, before the leaves unfold, is believed to be a fairly effective treatment for the injury done by the mite.

PEAR BLIGHT.

(Pear blight, frozen sap blight, twig blight, anthrax of fruit trees.)

Attacks pear, quince, apple, crab-apple, mountain ash,

service berry, hawthorn, raspberry, blackberry, and other plants of the same family.

Symptoms.—A sudden dying and blackening of the new growth of twigs, beginning generally at or near the tips and extending thence downward. Leaves and twigs soon assuming an inky black color, and remaining among the green and healthy leaves during much of the growing season. Attacks the trunk sometimes, when this has been bruised or otherwise injured. Extends rapidly at times, and again but slowly. Sometimes attacks only one or two branches, but often destroys much of the new growth. Attacks twigs and blossoms mainly, but does not often invade leaves, though these turn black with the affected twigs.

A contagious disease, caused by the attacks of a microscopic organism known as *Bacillus amylovorus*, discovered in 1879 by Prof. T. J. Burrill, of Illinois. Contagion carried by insects, by winds, and sometimes probably by pruning knife. Organism easily cultivated artificially on gelatine or on cut surface of fresh twigs, and the disease may be induced by inoculating healthy twigs with such cultures. Remains dormant over winter in some of the affected trees, to be carried from blossom to blossom the succeeding spring by insects. Attacks both young and old trees. No variety entirely free from it, but Keiffer and Duchess are commonly less subject to its injury. Most prevalent in damp hot weather and in early part of season, but is found active on trees throughout the summer. Checked very largely duriug droughts. Severe pruning favors it by encouraging luxuriant growth of new twigs. Free use of fertilizers also encourages it for same reason. Differs markedly from yellows and rosette of peach in its injury being local, and affecting only the part attacked.

Distribution.—Pear blight or fire blight, as it is sometimes called, occurs throughout this country wherever the pear is grown. It is more prevalent at the South, very probably because the winter temperature there does not so often kill the microorganism, though this latter is known to endure zero weather at times. It does not however thrive when weather is cool, and extreme heat always encourages its most

rapid and destructive invasion of the trees. Troublesome on apple trees during very hot weather following periods of excessive rainfall.

Treatment.—The treatment calculated to be most effective is here, as in most other cases, preventive. Fruit growers should go over their trees systematically when other work is not pressing and cut off and burn all affected twigs, no matter how small, and without regard for the value of the tree. A worthless tree standing in a fence corner may during a season convey the disease to a whole orchard of valuable trees. The cutting should be generous also, the affected branches being severed some distance below the diseased wood. Keep the knife free from the taint; if by any chance it cuts into diseased wood, wash it thoroughly with formalin (1 part of formalin to 1 part water) before cutting other trees. When the trunk becomes affected, as sometimes happens where it has been cut, bruised, or blistered by the sun, cut away all diseased wood, then wash thoroughly with Bordeaux mixture and wrap with ordinary newspaper until the wound heals.

A good many of the injured branches contain no living germs when winter comes, but Mr. M. B. Waite, of the National Department of Agriculture, has discovered that in some of the diseased wood living Bacilli remain over winter. If the blighted twigs can be removed at this time, the chances of injury during the following season are very greatly lessened, for the germs must be brought from a distance if they attack the trees at all.

PEAR SCAB.

Attacks cultivated pear.

Pear scab is so like the scab disease of apple that the description of one applies very well to the other. There are some microscopic differences between the fungi as they appear on the two plants, which are considered of species value by botanists, though they may be merely the effect of differences in the host plants. Whether they are really distinct might be decided by some carefully managed artificial cultures in which spores from scab on one plant were made to grow on the other.

It is not a question of special practical interest, however, since the two parasites are so much alike in character and life history that the same treatment serves for both. My own preference is for applications of Bordeaux mixture as recommended under apple scab, but at the Delaware Station, potassium sulphide (½ ounce in one gallon of water) was found, by Prof. F. D. Chester, to increase the yield of marketable fruit 25 per cent., while at the Vermont Station ammoniacal copper carbonate was found to increase the value of the fruit one-half, the sprayed trees yielding 69 per cent. smooth fruit as against only 28 per cent. smooth fruit from unsprayed trees. The spraying was begun May 19, and continued until August 8, seven applications being made at as many different dates. The copper carbonate preparation used, was made by dissolving 5 ounces of copper carbonate in 3 pints of the strongest ammonia, then diluting with 45 gallons of water.

BLACK KNOT.

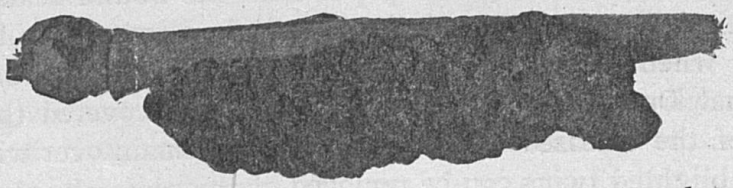


FIG. 7.—The black knot of plum. Slightly enlarged.

Attacks plum and cherry.

Produces large wart-like black growths along the twigs and branches. Affected limbs gradually swell up, generally more on one side than on the other, until finally the bark where most distended breaks apart and reveals the cause of the swelling in a spongy mass which now pushes up between the edges of the ruptured bark and at length becomes thicker, it may be, than the limb itself. It is at first of an olive color, with felt-like surface, and retains this color for some time, the growth meanwhile extending along the limb for several inches, or in some cases for a foot or more. When old the growth becomes a dull coal-black, and the uneven, slightly granular surface becomes broken by deep fissures, mostly run-

ning across the growth. Growth of the knots occurs in the spring, at which time the old knots extend under the bark and subsequently the extension breaks through, or else new centers develop from spores that have by some means reached the inner layer of bark, and thus new and independent knots are formed. Since the knot generally occupies only one side of the limb, it does not entirely check the life processes, and the part of the limb beyond continues to grow and put forth leaves. It is only where the knot extends completely around the twig or branch that the part beyond is killed at once. When the knots are abundant trees may be killed in a couple of years, and indeed whole orchards may in the course of a few years become so infested as to be worthless, although the injured trees may survive in a feeble way for a longer period.

At a late stage the knots are often mined by various insects, the grubs of which being found in the swollen wood gave rise to a notion, not yet completely eradicated, that the knots were galls due to the attacks of insects. The plum curculio itself is known to lay its eggs in the knots sometimes, and its young develop there. But some knots have no insects of any sort in them, and it is now well known that black knot is due to the attacks of a fungus, bearing the name *Plowrightia morbosa*.

The new knots break through the bark early in the spring, during the growing season for the tree. They at once produce over their entire surface myriads of minute spores (conidia) which are carried by the air to other trees. This method of increase continues for some time, but ceases before fall and the surface of the knot then becomes smoother, though under a hand magnifier it is seen to be minutely roughened by little mounds each with a pit at its center. Each one of these mounds represents another style of fungus fruit and when cut into and inspected with a microscope is found to contain a number of small sacs in which are the oval, two-celled winter spores (ascospores). These are regarded as the fruit of the mature fungus. They develop slowly and do not ripen until about the middle of January.

It is believed that all the varieties of plum are attacked

by black knot. The sour or morello cherries are, among cultivated sorts, most subject to the disease, but the sweet or mazzard varieties are not exempt. The bird cherry (*Prunus pennsylvanica*) of northern woods is especially subject to it, as is also the native choke cherry *(*P. virginiana*). The common wild black cherry (*P. serotina*) of Kentucky is rarely attacked by the fungus. Years ago B. D. Walsh of Illinois, claimed that he had in one instance encountered it on peach. He was a fairly accurate observer, yet may have slipped, as suggested by Prof. Farlow † later.

The capacity of black knot for mischief is not as fully appreciated in Kentucky as it should be. It is an American disease and began its destructive work when fruit growing was in its infancy in the Eastern States, probably having hitherto affected only the native cherry and plum trees of our forests. It has proved especially troublesome in the New England states. Writing in 1879, Farlow says: "An idea may be formed of the small crop of plums now raised in New England from the fact, that two dollars and a half were given in Boston last autumn for a peck of Damsons for preserving." A thriving plum-growing industry once existed along the Hudson River below Albany, New York; single growers receiving as much as $1,980.00 for a single week's picking, and netting in one season as much as $8,000.00. The knot became very destructive in 1869, and in the course of a few years‡ had destroyed thousands of trees, and soon put a stop to the business

The disease is to be observed in all parts of Kentucky on cultivated and wild plums. It has never been observed on nursery stock, and is probably very rarely sent to the fruit grower on young trees. But in two instances it has been observed on orchard trees belonging to nurserymen, where the spores from the knots could readily be conveyed to the

*Although the choke cherry is a native Kentucky species, the Station herbarium contains no specimen Will not some kind friend send us during the summer of 1899 material from which dried specimens of the leaves, flowers and fruit can be prepared?

† Bulletin of the Bussey Institution, 1876, Part V, p. 440.

‡See Bulletin 40, 1892, New York Station.

young trees near by. The importance of keeping the disease from the neighborhood of young trees cannot be too strongly insisted on; for although no evidence of the disease may be apparent on such young trees when sold, yet they may have received upon their bark the spores that will subsequently develop into the dreaded knot.

Treatment.—The parasite does not extend far beyond the extremities of the knots, and hence by cutting off all affected parts the disease can be kept from extending, excepting as it appears at newly infected centers. When a tree is badly affected about the main branches it is often best to remove and burn the entire tree to prevent the disease spreading. It is not enough simply to cut off the knot, unless the cut is deep enough to take out all the growing parts of the parasite, and I would not advise such treatment except in case of a specially valuable tree. In all cases the cut surfaces should be washed from time to time with Bordeaux mixture. Nor is it sufficient simply to cut away diseased wood and throw it on the ground about the trees. It has been shown that the spores of the fungus develop on such severed knots as abundantly as if they were on the trees. Burn all such trimmings. Make a habit of it.

Since the spores are developed both in the summer and winter, it does not matter greatly when the cutting and burning is done. It is perhaps most conveniently attended to when the leaves are gone, but it is a good plan to go through orchards from time to time, in both summer and winter, and remove in this way any pest of this character that may have appeared. Quite often the knots are perpetuated on a place on neglected trees, wild or cultivated, that are of no value whatever.

Painting the forming knots with turpentine, coal oil or linseed oil, prevents the maturing of the fungus fruit; but owing to the spreading of the oils over the bark, injury is done to the tree. To avoid this a pigment of some kind may be mixed with the oils to form a thick paint. This treatment was first adopted at the Hatch Experiment Station in Massachusetts, where red oxide of iron was employed to thicken the

oils. The time required to go over the knots in this way, one by one, is against the method, excepting where a few trees are to be treated. The fruit grower will find spraying with Bordeaux mixture more convenient and just as effective.

My own preference is for prompt cutting out and burning all diseased wood. This treatment may be supplemented to advantage in some cases by spraying or painting, but I wish to be understood as *recommending* nothing but the most heroic treatment.

One of the greatest difficulties in dealing with black knot comes from the common lack of familiarity with the disease. Trees sometimes stand for years in a fence corner bearing the unsightly black knots and no attention is paid them, because their dangerous character is not understood. It was to meet this difficulty that our black knot law was enacted some time ago (1894), and it is to be hoped that all nurserymen and fruit growers will take it upon themselves to have the law enforced. For convenient future reference the law is quoted below:

[From Kentucky Statutes, Sections 1918–1925.]

AN ACT to prevent the spread of a disease known as "black knot" in plum, cherry and other trees.

Be it enacted by the General Assembly of the Commonwealth of Kentucky: § 1. It shall be unlawful for any person, knowingly or willfully to keep any plum, cherry or other trees infected with the contagious disease or fungus known as the "black knot"; that every tree so infected is hereby declared to be a public nuisance, and no damages shall be awarded in any court in this State for entering upon premises and cutting away or severing the diseased part or parts of any tree so infected, and destroying the same, or cutting down or removing such infected tree altogether, and destroying the same, if done in accordance with the provisions of this act.

§ 2. In any county in this State in which such contagious disease exists, or where there is good reason to believe it exists, or danger may be justly apprehended of its introduction, it shall be the duty of the county judge of any county, upon the application made in writing and signed by at least three freeholders, who are residents of said county, to appoint forthwith three competent freeholders, who are residents of said county, who shall be fruit-growers of said county, as commissioners, who shall hold office during the pleasure of said county judge, and such

order of appointment and of revocation shall be entered at large on the county records.

§ 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptances of the same with the clerk of the county court of said county, and said clerk shall be *ex officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said county.

§ 4. It shall be the duty of the commissioners, or any one of them upon or without complaint, whenever it comes to their notice that the disease known as the "black knot" exists, or is supposed to exist, within the limits of their county, to proceed without delay to examine the trees supposed to be infected, and if the disease is found to exist, a distinguishing mark or marks shall be placed upon that part or those parts of every tree so infected, which, in the judgement of the commissioner or commissioners should be removed and destroyed; or if in the judgment of such commissioner or commissioners any tree so infected should be entirely removed and destroyed, then the trunk of such tree shall be thoroughly girdled, and a written notice given to the owner personally, or by leaving the same at his usual place of residence, or if the owner be a non-resident, by leaving such notice with the person in charge of such trees. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually remove and destroy by fire the part or parts of every tree so marked and designated, or every such tree entire which shall be so girdled as the case may be, within ten days from the date of the notice above required. Such notice and order to be signed by the commissioners, or any two of them.

§ 5. Whenever any person shall refuse or neglect to comply with the order mentioned in the last section, it shall become the duty of the commissioners to carry out the directions of said order, and forthwith to remove and destroy by fire, every tree, or part of tree so girdled or marked aforesaid, employing all necessary aid for that purpose, the expenses of such removal and destruction to be a charge against the county; and for the purpose of such removal and destruction, the said commissioners, their agents and employes shall have the right and authority to enter upon any and all premises within their county.

§ 6. If any owner, or if such owner be a non-resident, then, if any person in charge of such trees neglects to remove and destroy by fire every tree, or part of tree, so found to be infected, and marked or girdled as aforesaid, after notification, and within the time hereinbefore prescribed, such person shall be guilty of a misdemeanor, and punished by a fine not exceeding twenty-five dollars, or by imprisonment in the county jail not exceeding ten days, or both, in the discretion of the court; and any justice of the peace of the county in which such offense

shall be committed shall have jurisdiction thereof, and all such fines so collected shall be turned over to the treasurer of said county, or other proper officer, to be designated by said county judge, to be held by him subject to the order of said court.

§ 7. The commissioners shall be allowed for services under this act, two dollars each for each full day and one dollar each for one half day, and other reasonable charges and disbursements hereunder to be audited, as well as any other charges and disbursements under this act by said county judge, to be paid to such commissioners as other county claims are paid. Such fees and all reasonable charges and disbursements of said commissioners in each case may be recovered by the county in its own name from the owner of the diseased trees on account of which such fees, charges and disbursements became payable or were incurred.

§ 8. In counties where there are cities of the first and second classes, the mayor shall discharge the duties, and the cities make the payments provided for in this act, so far as said disease exists in any of said cities.

QUINCE LEAF SPOT.

(Pear leaf spot disease, pear and quince fruit spot.)

Attacks quince, pear, and a few other related plants.

Character.—Small reddish or purplish illy-defined dots appear on the leaves and increase to about one-eighth inch in diameter when isolated, finally becoming nearly or quite circular in outline and clearly defined; when numerous, uniting and forming extensive patches of irregular shape, the union occurring soonest at the tip of the leaf which then becomes entirely brown, while the spots remain separate elsewhere; sometimes the whole leaf becoming involved; old spots often appear of an ash-gray color; visible on both sides of leaf; center of each spot occupied by a minute black dot, a pustule, containing the fruit or spores of the fungus (*Entomosporium maculatum*), which causes the disease. When attack is severe leaves fall, so that the branches may be bare early in July; new leaves often take the place of these before end of season; blossoms also sometimes expand in fall. Attacks tender twigs, sometimes killing them. Fruit of both quinces and pear attacked, causing at first spots of red, which at a later period blacken and when abundant result in extensive fissures; when attacked early in the season fruit becomes unsymmetrical; fungus does not penetrate very deeply into

fruit, but checks growth and mars its appearance so as to make it unfit for market. Attacks young and old trees, but is especially destructive to seedling pear trees, so much so that it is in some sections very difficult to raise them. Attacks all varieties, but some, such as Keiffer, not as much injured as others.

Nature.—As intimated above this is a fungus disease, due to the invasions of one of the more highly organized parasitic fungi. The little black pustules at the center of each spot are at first covered by the cuticle of the leaf, but when mature the fungus fruit beneath ruptures this and leaves the curious jointed spores exposed, to be carried by wind and on the feet of insects to other plants. The spores are completely invisible to the eye, but are seen with the microscope to consist of about four little bodies (cells) attached together and mounted on a short stalk, the upper body being provided with a small bristle. Spores remain in leaves on the ground over winter. They remain also about twigs, as demonstrated by the fact that young seedling pear brought from abroad are sometimes very badly affected as soon as leaves appear, whereas the disease is not present on other plants in the neighborhood. It is especially destructive on quince when these are crowded, or weeds and other vegetation are allowed to grow up about them. On pear the disease is sometimes wrongly thought to be the same as pear blight.

Distribution.—Very common in Kentucky, becoming more and more destructive towards the western end of the State. In some parts of Eastern Kentucky trees are but little injnred by it. Common throughout the United States. Prevalent also in European countries, where it has been known for more than a century.

Treatment.—All leaves about affected trees should be raked up and burned either in the summer, in case they fall at that season, or at any rate in the fall. An application of Bordeaux mixture when the twigs are bare is also desirable as a means of destroying the spores remaining about the bark, and may be followed by two or three applications to foliage or fruit during the season. Of course any badly diseased twigs

should be cut away and burned. It may be suggested that seedling pear, and young quince in any shape, that have been bought and whose history is not known, might well be immersed in Bordeaux mixture before planting as a precaution against the disease. Plants treated in this way and subsequently planted on land that has not become infected, ought not to suffer greatly from leaf-spot, since it is known to spread from tree to tree somewhat slowly. For young trees in the nursery rows and for bearing trees, three or four sprayings with Bordeaux mixture, as suggested above, one of them being applied just before the buds expand in spring, are to be recommended. This treatment has proved effective in saving both foliage and fruit.

RASPBERRY ANTHRACNOSE.

(Blackberry anthracnose, raspberry and blackberry cane rust.)

Attacks raspberry, blackberry, and other plants of the genus Rubus.

Character.—Appears on the canes at or near the ground as very small purple spots which spread and soon acquire a grayish-white center and finally grow to a large size, then with a clearly defined purple rim; often uniting and covering much of the bark; spreads to the petioles of the leaves when abundant and eventually to the leaves themselves, occasionally even to the fruit; spots often a quarter of an inch in diameter; not penetrating the wood to any distance; surface opaque, slightly ribbed longitudinally when old and assuming a scab-like character; when at an advanced stage splitting and admitting water so as to cause rot to extend into the underlying wood. Due to a well-known fungus (*Glœosporium venetum*) which causes the scab spots by attacking the bark, in which it remains dormant over winter. Young shoots attacked by spores as soon as they appear in spring and most of the growth and development takes place during the growing season. Attack results in dwarfing growth and reducing quality and yield of berries. When very bad, berries may shrivel up about time of picking, and not infrequently the canes themselves die when the disease is of long standing.

Black raspberries especially subject to it, in some cases to such an extent that whole plantations are ruined. Anthracnose must not be confounded with black spots, due to attacks of pear-blight Bacillus, such spots sometimes occurring among spots due to attacks of the anthracnose fungus.

Distribution.—Occurs throughout eastern North America, also in Europe. Appears to be most prevalent on low and ill-drained soil, but occurs everywhere. Common and destructive in Kentucky, where it is the occasion of frequent complaints sent to the Station by small fruit growers. I have seen less of it in the western end of the State. It is especially common along the Ohio river.

Treatment.—This disease is certain to be sent out of the nursery on canes of raspberry and blackberry, if it is present there. It is highly important, therefore, that our nurserymen keep a close watch on their stock to prevent its becoming established; and if by chance it is introduced, to get rid of it promptly. It can be exterminated. It is only necessary to burn all trimmings and to remove and burn old canes when they cease growing, rake up all leaves aud burn them, and spray with Bordeaux mixture as soon as the young shoots push out in spring; following this up by two or three later sprayings with the same preparation. It is my judgment that no diseased canes should be sent out by the nurseryman.

The buyer is advised to examine any plants he may receive, and if any of the characteristic blotches appear the whole lot should be dipped in Bordeaux mixture before planting, the plants being observed closely when they begin to grow and applications of Bordeaux mixture be made with a sprayer if any appearance of the anthracnose is witnessed.

It is so serious a matter to get the disease established on a place that one may well hestitate about setting out plants that are in any wise affected.

The disease is encouraged by too rank a growth of canes or of other vegetation about them. They should be set well apart, in the first place, and carefully pruned and cultivated to guard against its introduction after the patch is once established.

FIG. 8.—The crown-gall of raspberry, referred to on page 201. Natural size.

Here at the Station we have generally used a Bordeaux mixture containing 6½ pounds of bluestone, 3½ pounds of lime and 32 gallons of water. If properly made *and applied* it can be used freely on a variety of plants without injuring them in the slightest degree. I have had no opportunity to test it on raspberry leaves, which are said to be more tender than those of many other plants, but Mr. William T. Green,

of the Ohio Station, after some experience in treating anthracnose, recommends a weaker mixture as follows :

Bluestone, 4 pounds.
Lime, 4 pounds.
Water, 50 gallons.

Dilute mixtures such as this are easier to spray because of the smaller proportiou of solid matter to pass through the pump and nozzle, but I have sometimes had results that indicate that they are not as effective in checking disease as the stronger ones. Mr. Green's conclusion is, however, the result of an actual test of the question and it is just as well to follow him in using the weaker mixture for anthracnose until the two can be thoroughly tested side by side and a comparison be made of their effects.

THE STRAWBERRY CROWN BORER.

(*Tyloderma fragariæ.*)

Character of injury.—Strawberry plants are killed or greatly enfeebled at times by a small white grub which works in the interior of the underground stem where it is concealed from observation. If an infested plant is cut open lengthwise a broad mine filled with refuse is disclosed extending from the bases of the petioles of the leaves down towards the lower end of the stem. After the grub has been at work for some time the whole interior of the stem may be eaten away.

The borer.—Generally but one grub is found in each plant. It lies at the lower end of its burrow with its body bent upon itself like that of the large "grub worm" common in manure heaps. It looks in shape much like a very small grub worm, but it is unlike all grub worms in lacking jointed legs. It does not travel from plant to plant, and so has no use for legs. Its head is yellowish brown, the jaws dark at the tips; the rest of the body is white. The length of a specimen preserved in alcohol and taken from a plant August 11, 1897, is ¼ inch; its body measures about 1-12 inch in diameter.

The pupa.—During the latter part of August the grubs

change to pupæ, singular white objects with antennæ, legs, and wings folded against the body and incapable of motion. The insect is now without a mouth-opening and lies at the lower end of the burrow, the cavity at this point having been slightly enlarged for its accommodation. It remains here as if dead until about the first of September when it undergoes its final change and becomes adult.

The adult beetle.—The fully developed crown borer is a small curculio or snout-beetle. If infested plants are cut open about the middle of September, instead of grubs or pupæ small light-brown insects will be found, each with its three pairs of legs which it can use for a rather sluggish locomotion. When disturbed it trusts to its obscure colors to escape observation and curls up its legs and remains motionless. Its wings cannot be used for flight, because of their small size. An example measures .18 inch in length. The colors of these recently transformed individuals are very light, at first almost white, with little or no trace of markings. With age they grow darker, finally assuming a dark brown color, with the head and thorax nearly black. On each side of the back are three black blotches, the middle one of each side being largest and squarish; it is separated from the spot in front and behind by a pale line. The impression one gets by ordinary examination is of a smooth-bodied insect, but under a hand-magnifier the head and thorax are found to be very closely punctured, and the wing covers are coarsely punctured in longitudinal lines.

The beetles seem in no hurry to leave the plants, but late in the fall they bore straight through the plant and escape into the earth, where they pass the winter months.

Treatment.—Because of its imperfect powers of locomotion the crown borer is not as generally distributed as are many more active insects, but its small size, obscure colors, and manner of attack make it dreaded notwithstanding. Once it becomes abundant on land it is exceedingly difficult to get rid of it again. The grubs, pupæ and beetles are during the summer months so completely protected by the plant that it is impossible to apply any fluid, powder or gas that would not

destroy the plant as soon or sooner than it would the insect.

When it is decided to destroy an infested bed it should be done in summer, and all the plants ought to be taken up and burned. Even this will not make the land at once safe for a new planting, for during a considerable period in spring the beetles are engaged in laying their eggs on the plants. (They seem to be placed at the bases of the leaves.) August is a good month in which to destroy such beds, because the egg-laying season is then past, and the young beetles have not yet left the plants.

In starting new beds plants should never be taken from beds already infested with the pest. Of course the young plants formed from runners during the summer are least likely to be infested, but the older ones even of these are sometimes found to have been visited by an egg-laying adult. Very late plants formed from runners are generally without borers. Yet it is so serious a matter to get the borers established in land that it is only safe to follow the advice given above, namely, get young plants for new beds only where the borer has not appeared, and, it may be added, make your new beds at a distance from any that may have become infested.

It is of special importance that nurserymen should not get the pest among their stock, and their attention is called to it in the hope that they will familiarize themselves with its injuries. It must not be confounded with the small grubs that sometimes destroy the fibrous roots and occasionally gnaw into the crown from the side. We have several such insects in Kentucky, but while they are troublesome locally at times, they are not likely to be disseminated with the plants.

STRAWBERRY LEAF BLIGHT.

(*Strawberry leaf spot, strawberry rust.*)

Character.—When strawberry leaves are nearly grown in spring small black spots appear on their surface, and somewhat later become light brown or even white at the center and are surrounded by a purple ring. By spreading and uniting these spots soon occupy much of the foliage and may kill it

completely. While the spots are likely to appear during either dry or wet weather, they become most abundant immediately after showers of rain in hot weather. Young plants are not much injured the first year unless planted near badly affected old plants. The disease is much more destructive to some varieties than to others. It varies in prevalence with the character of the season and to some extent with the location and soil; soil which does not retain water tenaciously, either because of artificial or good natural drainage furnishing the best sites for beds.

It is, like others here described, a fungus trouble, due to a special parasite (*Ramularia tulasnei*). The disease is known throughout America, Europe and Australia. The fungus is believed to remain over winter in the old leaves.

Treatment.—Some experiments in treating this blight were reported by me in Bulletin 31 of this Station, published in 1890. It was found that it could be controlled very well by spraying plants from time to time after the berries were removed, with Bordeaux mixture. Mowing, raking up, and finally burning the old leaves late in the season is to be recommended as a means of getting rid of the fungus as it lies dormant in the dead leaves. When old beds are to be plowed up it may be wise, if they have been badly infested, to burn them over first, and this is of special importance if the land is to be used again for strawberries. Injury may be avoided in some cases by care in selecting plants, by removing all blighted leaves, and if possible putting them some distance from land on which the disease has become established.

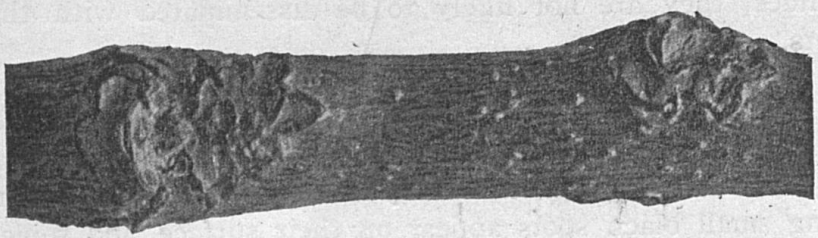


FIG. 9.—Showing rough places about buds and small lateral branches of young apple trees, mentioned on p. 202. Slightly enlarged.

INDEX.

APPLE.
Bag worm 232
Leaf aphis 222
Leaf crumpler 225
Leaf rust 230
Leaf skeletonizer 224
Oyster-shell bark-louse 217
San Jose scale 207
Scab 228
Scurfy bark-louse 220
Tent-caterpillar 225
White-marked tussock moth ... 227
Woolly aphis 208

CEDAR.
Bag worm 232

CHERRY.
Bag worm 232
Black knot 250
Leaf aphis 234
Leaf crumpler 225
Leaf spot 234
San Jose scale 207
Scurfy bark-louse 220
Tent-caterpillar 225
White-marked tussock moth ... 227

CURRANT.
Leaf spot 236

EVERGREENS.
Bag worm 232

GRAPE.
Mildew 237
San Jose scale 207

PEACH.
Black peach aphis 238
Crown gall 201
Fruit spot 244
Rosette 241
San Jose scale 207
Yellows 242

PEAR.
Blight 247
Leaf blister 245
Oyster-shell bark-louse 217
Rust (Entomosporium) 256
San Jose scale 207
Scab 249
Scurfy bark-louse 220

PLUM.
Bag worm 232
Black knot 250
Leaf crumpler 225
Leaf spot 234
San Jose scale 207
Tent-caterpillar 225
White-marked tussock moth ... 227

QUINCE.
Bag worm 232
Leaf crumpler 225
Leaf spot 256
San Jose scale 207

RASPBERRY.
Anthracnose 258
San Jose scale 207

STRAWBERRY.
Crown borer 261
Leaf blight 263

2. THE NURSERY INSPECTION LAW.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST OF THE STATION, AND STATE ENTOMOLOGIST.

At its special session held in the spring of 1897 the General Assembly of Kentucky enacted a law entitled "An act to provide for the inspection of nursery stock and to prevent the dissemination of noxious insects and fungi," which has for its object the protection of fruit growers and nurserymen from losses caused by insect and other enemies of young trees. The immediate and pressing need for such a law was occasioned by the introduction into some of the Eastern States of the very destructive San Jose scale,* and the consequent danger that it would be brought to Kentucky on imported nursery stuff and spread among our orchards and nurseries.

The scale was already present in New York, New Jersey, Maryland, Delaware, Virginia, West Virginia, Ohio, Indiana, Illinois and other states, being especially prevalent in the coast states named, while it was present only in isolated spots in the interior. The danger that Kentucky orchards and nurseries would soon become infested was imminent, and it was the aim of members of the State Horticultural Society, who were chiefly instrumental in bringing the matter before the General Assembly, to have a law passed that would keep the scale out of the State; and hence the act that subsequently became a law was drafted† mainly with reference to this purpose.

It was anticipated that a trial of such a law might reveal defects not then apparent, especially since the time in which to put the act in shape for introduction was brief. The law

*See Bulletin 67 of this Station for an account of the insect and remedies for its injuries.

†The Kentucky law is the same in its general features as one that had previously been adopted by the State of Maryland.

has now been in force two seasons, during which every nursery in Kentucky has been inspected twice. The San Jose scale has not been discovered in any one of them.

But it is known to have been brought direct from the Pomona Nurseries at Parry, New Jersey, into an orchard at Highland Park, Jefferson County; into another orchard at Horntown, Grayson County; to a place at Bremen, Muhlenberg County, and to another at South Carrollton in the same county. It has been introduced also into the Lexington Cemetery on plum trees bought at the Star Nurseries at Dayton, Ohio. In all these cases the infested trees were bought several years before our law was enacted.

Cases such as these, coming to light from time to time, have drawn attention to that part of the law relating to people other than nurserymen, among whose trees destructive pests may find lodgment. Now, while Section 5 of the law makes it the duty of any one, whether a nurseryman or not, to notify the State Entomologist of any trees on his premises believed to be infested with destructive pests, no penalty is prescribed for failure to perform this duty, and hence an opinionated and obstinate person has it in his power to neutralize to some extent the work of inspection by maintaining on his place a center from which the scale may spread in the neighborhood. People of this character are fortunately the exception, but it is always the few that make stringent laws necessary. I would suggest that this section might appropriately be amended so as to *require* the extermination of destructive pests, wherever they may be found.

Certificates of Inspection.—The Kentucky law (See Section 3, below.) authorizes two kinds of certificates, one from the inspector to the nurseryman stating that the stock has been examined and found free from destructive pests, without which the nurserymen cannot sell in this State, and another made out and signed by the nurserymen himself to accompany each and every package of plants delivered by him.

Attention is directed to this matter because there has been some misunderstanding of the law in this particular. A glance at Section 3 (See below.) of the Kentucky law will

show that it is not intended that the nurseryman simply print on his shipping tags a copy of the inspector's certificate, but that he certify under his own hand that each separate package is made up of stock which has been examined by the inspector. Laws of other states are not the same in this respect and this has probably in some cases contributed to the misunderstanding. Yet the reason for the requirement will be plain when it is remembered that the inspector cannot be at hand when the packages are made up for delivery, and could not therefore honestly say that the contents of a given package were free from destructive pests. In other words, the nurseryman is, in the nature of the case, the proper person to say that his packages have been inspected and found healthy. The inspector simply pronounces on the growing stock belonging to a nurseryman, whereas his packages may be made up of stuff from several outside nurseries. This outside material has of course been received by him under a certificate, and our law requires him to certify to the fact as well as to the fact that his home-grown stock has been pronounced upon by an official inspector.

Inquiries sometimes reach me as to the proper form of this nurseryman's certificate. The law does not prescribe any special form, but the following may be suggested.

Have the inspection certificate printed on the back of your shipping tags and below it certify under your own hand that the stock bearing the tag is covered by this or other official certificates, as follows:

CERTIFICATE OF INSPECTION OF NURSERY STOCK.

No. 60.

AGRICULTURAL EXPERIMENT STATION OF THE STATE COLLEGE OF KENTUCKY,
Office of the State Entomologist.

LEXINGTON, June 15, 1899.

I hereby certify that the nursery stock growing on the place of John Norwood at Williamsburg, Whitley County, Kentucky, has been inspected by me as required by law and I

believe the same to be free from San Jose scale and other destructive pests. This certificate is invalid after June 15, 1900.

H. GARMAN,
State Entomologist.

WILLIAMSBURG, KY., October 25, 1899.

I hereby certify that all of the stock in this package is covered by certificate from official inspectors.

JOHN NORWOOD.

In case the nurseryman handles only home-grown stock he might, after printing the inspector's certificate as above, append in his own hand the following:

WILLIAMSBURG, KY., October 25, 1899.

I hereby certify that all of the stock in this package is covered by the above certificate. JOHN NORWOOD.

The law is printed below as it appears on page 25, Chapter 19, of the "Acts of the General Assembly of the Commonwealth of Kentucky passed at the Special Session of the General Assembly, which was begun and held on the Saturday the thirteenth day of March, one thousand eight hundred and ninety-seven."

AN ACT to provide for the inspection of Nursery Stock and to prevent the dissemination of noxious insects and fungi.

WHEREAS, The agricultural and horticultural interests of Kentucky have been injuriously affected in the past by the introduction from abroad of insects and fungi which destroy plants or their fruits; and

WHEREAS, A destructive insect known as the San Jose scale has been imported on trees into the United States and is liable to appear at any time in Kentucky,

Be it enacted by the General Assembly of the Commonwealth of Kentucky:

§ 1. That all nurseries in Kentucky, where trees, vines, plants or other nursery stock are grown and offered for sale, shall be inspected by the Entomologist and Botanist of the State Agricultural Experiment Station once each year at such time as he may elect, and he shall notify, in writing, the owners of such nurseries, the Commissioner of Agriculture and Statistics, the Director of the State Agricultural Experiment Station, and the President of the State Horticultural Society of the presence of any San Jose scale or other destructively injurious insects or

fungi on the trees, vines, plants or other stock of such nurseries, and shall also notify, in writing, the owner of any affected stock that he is required, on or before a certain day, to take such measnres for the destruction of such insects or fungus enemies of nursery stock as have been shown to be effectual for this purpose. Said Entomologist and Botanist shall, for the purposes of this act, be, and he is hereby declared to be the State Entomologist, and shall serve without pay other than that he may receive as an officer of the State Agricultural Experiment Station, but his expenses shall be paid as hereinafter provided.

§ 2. The owner of this affected nursery stock shall, within the time specified, take such steps for the destruction of San Jose scale or other destructively injurious insect or fungus enemies present as will exterminate the same, and it shall be a misdemeanor to ship or deliver any of such stock, punishable by a fine of fifty dollars for every such offense, the fine recoverable before a justice of the peace or by indictment by a grand jury of the county in which the nursery is situated, or of that to which such stock may have been shipped.

§ 3. Whenever a nurseryman or seller of trees, vines, plants or other nursery stock, who is a resident of this Commonwealth, shall ship or deliver any such goods, he shall send on each package so shipped or delivered a written certificate, signed by him, stating that the whole and every part of such stock has been examined by a State or Government Entomologist and found free from San Jose scale or other destructively injurious insect or fungus enemies Failure to furnish such certificate, or furnishing a false certificate, shall render him liable to the penalty of a fine of fifty dollars for each and every such shipment or delivery without such certificate.

§ 4. When the State Entomologist examines any trees, vines, plants or other nursery stock in this State under the provisions of this act, and finds such nursery stock free from San Jose scale and other destructively injurious insect and fungus enemies, he is hereby authorized and directed to make out and deliver, in writing, to the owner of such stock, a certificate stating that he has inspected such stock and found the same free from San Jose scale and other destructively injurious insect and fungus enemies, and he shall file similar certificates with the Commissioner of Agriculture and Statistics and with the President of the State Agricultural and Mechanical College, which certificates shall at all times be subject to public inspection.

§ 5. Whenever a nurseryman, fruit grower or agriculturist in this Commonwealth shall know or have good reason to believe that his trees, vines or plants are affected with San Jose scale, yellows, rosette or other destructive insect or fungus enemies, he shall have the privilege and it shall be his duty to notify the State Entomologist, who shall proceed to the premises designated and examine the same and suggest and recom-

mend the proper remedies for the destruction of such insect or fungus enemies as may be present.

§ 6. Every package of trees, vines, plants or other nursery stock shipped into this State from another State shall be plainly labeled on the outside with the name of the consignor, the name of the consignee, the contents, and a certificate, signed by a State or Government inspector, showing that the contents have been examined by him, and that such stock is free from San Jose scale, or other destructive insect or fungus enemies. Whenever any trees, vines, plants or other nursery stock are shipped into this State without such a certificate plainly fixed on the outside of each package, the fact may be reported to any justice of the peace of this Commonwealth, and said justice shall issue a summons for the consignee of such package, and the agent of the consignor, if he be known, to appear before him on a certain day, to be therein named, to show cause why such trees, vines plants or other nursery stock should not be seized, as being in violation of the provisions of this act, and on trial thereof, if said justice be satisfied that the provisions of this act have been violated, he shall order such agent or consignee to return such package of trees, vines, plants or other stock immediately to the shipper or consignor, unless said consignee or agent shall forthwith, and at his own expense, have such trees, vines, plants or other nursery stock examined by the State Entomologist, or such person as he may appoint to make the examination, and he certifies to the justice of the peace that such nursery stock is free from San Jose scale or other destructive insect or fungus enemies. If such consignee or agent fail to have such inspection made, or fail to return such packages to the shipper or consignor thereof, then the justice of the peace shall order and direct the constable or sheriff to burn and destroy, at the expense of the agent or consignee, all such trees, vines, plants or other stock as have been shipped into this Commonwealth in violation of law.

§ 7. The sum of five hundred dollars annually, or so much thereof as may be necessary, is hereby appropriated for the purpose of paying the expenses of the State Entomologist in the performance of his duties under the provisions of this act, and the Auditor of Public Accounts is hereby directed to honor requisitions made by said State Entomologist for expenses incurred in the performance of his duties, and the State Entomologist shall make annual report to the Treasurer of the amount expended.

§ 8. Inasmuch as the insect known as the San Jose scale has appeared in some sections of this Commonwealth, and great destruction of fruit and fruit trees is imminent, therefore an emergency is declared to exist, and the act shall take effect from and after its passage and approval by the Governor.

Approved May 20, 1897.

KENTUCKY NURSERIES.

Forty nurseries have been inspected by me in Kentucky this year (1898). They vary in extent from a few square rods to sixty acres or more, and though they contain a little of everything, are devoted in the main to growing apple, peach, plum, grape, and ornamental trees. Probably three-fourths of the nursery stock in the State at the present time consists of apple and peach trees. The condition of the trees in these different nurseries varies of course with the character and intelligence of the proprietor. Some are kept in excellent condition. Where not actually diseased, others are sometimes not in first rate condition because of neglect, this being true especially where they are grown only incidentally to some other business. One cannot buy first-class trees from ill-managed nurseries such as these, and I think it is to be regretted that they should continue in the business. Inspection and certificates cannot, however, control this matter, and they must be left to their fate. The subject is referred to here in the interest of fruit growing as an industry in Kentucky. For manifestly it would be much to the advantage of both buyers and nurserymen if there were but half the present number of nurseries in the State, and these were all conducted on approved modern methods. I cannot with propriety designate nurseries that are plainly going to their death, but with the intimation given above must leave the choice in buying to the intelligence of the buyer.

The following nurseries were inspected and received certificates in 1898. The names are arranged in alphabetical order:

P. F. Adams & Son, Waco, Madison County.
Christian Aebersold, Rockhaven, Meade County.
J. A. Allen & Son, Bloomfield, Nelson County.
W. S. Ashby, Cloverport, Hancock County.
L. Z. Ashlock, Hazelton, Muhlenburg County.
Ashlock & Dunking, Yelvington, Daviess County.
Baldwin & Summers, Cairo, Henderson County.
J. C. Bingham & Sons, Russell, Greenup County.
Bowser & Vernon, Elizabethtown, Hardin County.

R. N. Brown, Congleton, McLean County.
James Childres, Auburn, Logan County.
John R. Childres, South Carrollton, Muhlenburg County.
O. & M. Combs, Shepherdsville, Bullitt County.
G. P. Dietrich, Maysville, Mason County.
Donaldson & Gibson, Warsaw, Gallatin County.
Downer & Briggs, Bowling Green, Warren County.
Downer & Bro., Pembroke, Todd County. (Nurseries at Fairview and Guthrie).
Gardiner Bros., Deatsville, Nelson County.
M. E. Edens, Catlettsburg, Boyd County.
B. G. Ellis, Auburn, Logan County.
Mrs. A. S. Hancock, Casky, Christian County.
S. G. Hanson & Son, Winchester, Clark County.
H. F. Hillenmeyer, Lexington, Fayette County.
Horace Klinglesmith, Cecilian, Hardin County.
J. W. Knadler, Valley Station, Jefferson County.
A. A. McGinness, Bowling Green, Warren County.
J. A. McKee & Co., Kingsville, Lincoln County.
Nanz & Neuner, 582 Fourth Avenue, Louisville, Ky. (Nursery at St. Mathews, Jefferson County.)
R. H. Parker, Cave City, Barren County.
O. Piper, Clinton, Hickman County.
Virgil Popham, New Fruit, Hardin County.
J. Q. A. Rahm, Leitchfield, Grayson County.
The Ream Company, Hustonville, Lincoln County. (Nursery in Casey County.)
R. G. Roland, Congleton, McLean County.
J. M. Samuels, Clinton, Hickman County.
W. A. Sandefur, Robards, Henderson County.
Edwin Stovall, Vine Grove, Hardin County.
E. K. Taliaferro, Newport, Campbell County.
M. S. Van Meter, Meeting Creek, Hardin County.
F. Walker & Co., 644 Fourth Avenue, Louisville. (Nursery at New Albany, Ind.).

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN No. 81.

---

1. **A Method of Avoiding Lettuce Rot.**
2. **Potato Scab Experiments.**

LEXINGTON, KENTUCKY,

March, 1899.

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.

J. T. GATHRIGHT, Louisville, Ky.

THOS. TODD, Shelbyville, Ky.

J. K. PATTERSON, President of the College.

M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.

A. M. PETER, H. E. CURTIS, } Chemists.

H. GARMAN, Entomologist and Botanist.

C. W. MATHEWS, Horticulturist.

J. N. HARPER, Agriculturist.

V. E. MUNCY, Weather Observer.

EDWARD RHORER, Secretary to Director.

Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

BULLETIN No. 81.

1. A METHOD OF AVOIDING LETTUCE ROT.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

This disease is troublesome in Kentucky on lettuce grown under glass during winter and early spring. It appears to be due to several organisms, including what is known as lettuce mold (*Botrytis sp.*), but the result, so far as the grower is concerned, is *lettuce rot*, and the thing he wants most to know is how it may be checked or avoided.

From its manner of growth lettuce is not conveniently treated by spraying, and the same peculiarity of the plant renders it undesirable to spray the leaves with poisonous preparations, since, because of its quick growth, it must come to the table a short time after treatment, and the poison is thus likely to be retained.

The conditions under which the rot is most prevalent have suggested a remedy that, so far, in the Vivarium of my Division, works well, seems in fact to be all that could be desired.

Moisture on the leaves, or in contact with them, appears to be a necessary condition for the growth of the rot. When a hot-house is kept very damp and the plants are watered frequently by sprinkling, the rot often starts in the axils of the leaves and works outward, because the moisture retained in the axils gives the organisms causing the disease opportunity to get into the plant at these places. Likewise when the leaves rest on the ground, they begin to rot at their tips and the disease then works inward, leaf after leaf rotting away, as they come in contact with the ground.

Is it practicable to avoid these conditions?

It is practicable, and the remedy is a very simple one. Never water the plants from above. To avoid this lay several series of tile in each bench, the number of series depending of course on the width of the bench; close the joints with cement around the under two-thirds of their circumference; fit the end tile closely to the wooden frame at one end of the bench, and bore a hole through the frame so as to open into the tile. One can then keep the earth moist by introducing hose connected with a hydrant, or by using the spout of a watering-can, the rose having been removed. In other words, the plants are watered by the sub-irrigation method.

But water may drip from the glass overhead. If the joints between panes are not good, some water is likely to come through during showers, then run down the side, where it will splash the plants even if it does not drip directly on them. Much of this trouble can be obviated by shifting the glass over beds from time to time, so as to close the joints; and I would suggest in addition a series of panes set upright against the outer frame of the bed, where they will shield the plants from the splashing, and will at the same time not interfere with the light, as would boards.

To avoid the rot which creeps up from the tips of leaves resting on the soil, I have adopted a mulch of fine excelsior, as shown in the half-tone figure, and it answers the purpose perfectly. The fine chips produced at planing mills do not answer so well, since they soon become compacted and then soak up and retain moisture from the soil.

The central idea of the method is: *Keep the exposed surfaces of the plants dry.*

E, hot water pipes connected with heater.

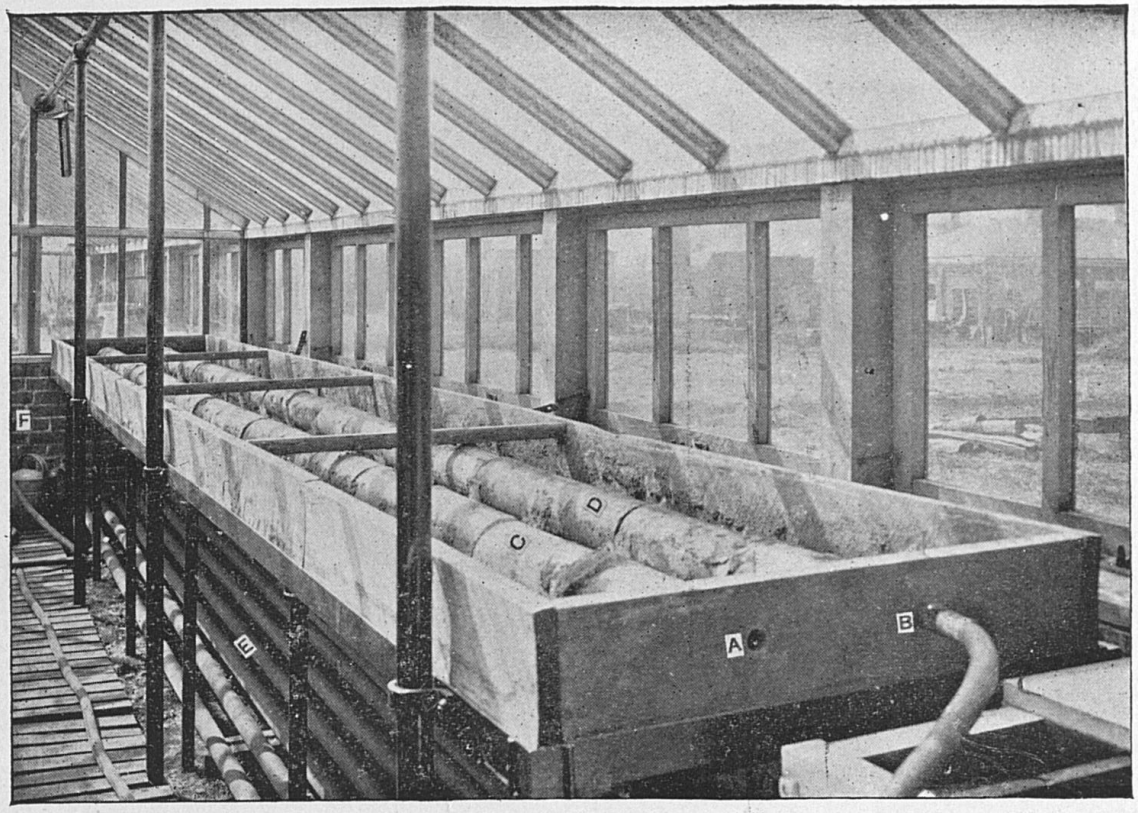


FIG. 1.—Bench used for lettuce experiment in the Vivarium of the Division of Entomology and Botany, the soil removed to show series of tile, *C*, *D*, used in watering. *A*, hole in wooden frame for introducing water; *B*, hose applied as in watering, the hydrant supplying water at left of *F*; *E*, hot water pipes connected with heater.

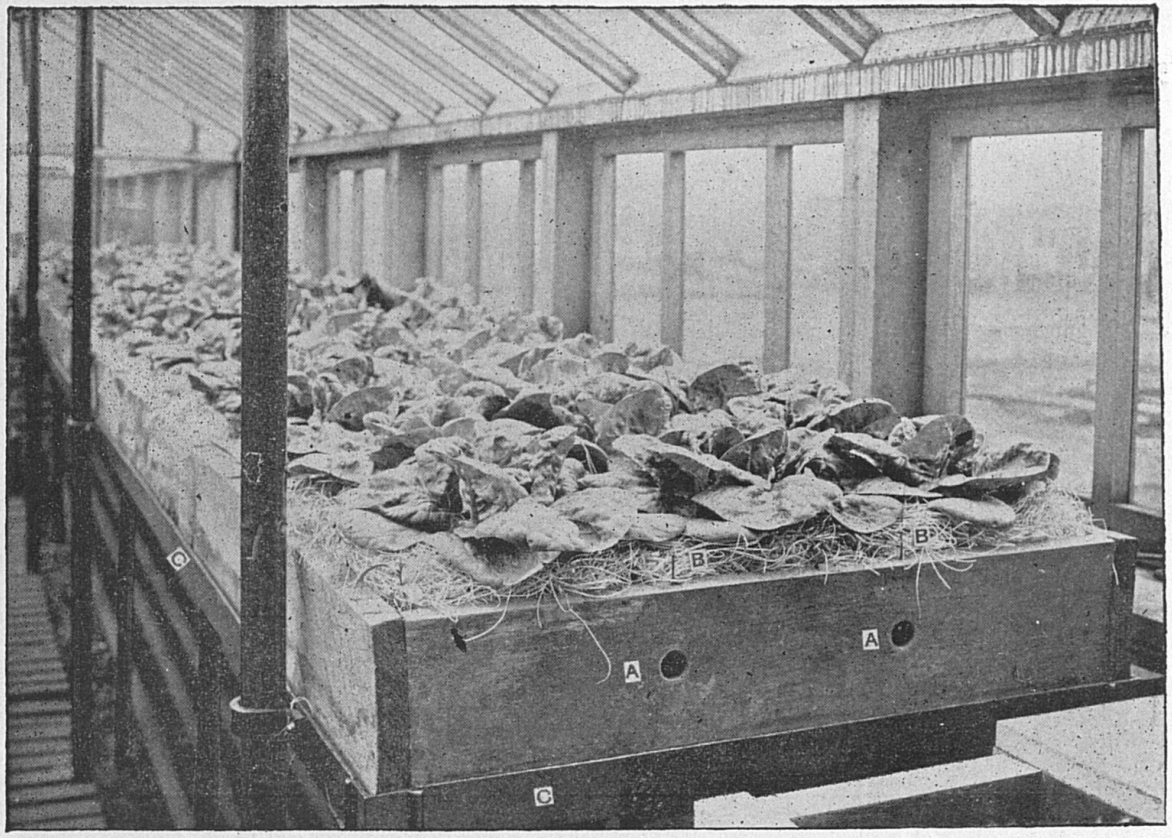


FIG. 2.—Experimental bench of lettuce as it appeared in the Vivarium, March 24, 1899. *A A*, openings in frame for watering; *B B*, excelsior mulching about plants; *C C*, iron frame supporting bench, the bottom being of heavy slate.

2. Potato Scab: Experiments Made in 1898.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

The following experiments with reference to treating seed potatoes to prevent scabbing, continue those reported in former bulletins. An acre of ground was divided into 10th-acre plots of eight rows each, half of each plot being planted with untreated seed and constituting a check on the adjacent rows planted with treated seed. The potatoes used for seed were Early Ohio, and were planted April 21, 1898. They were very badly scabbed. The treatment adopted was as follows:

Plot 1.—Seed for four rows soaked one hour iu a solution consisting of 4 ounces of corrosive sublimate dissolved in 30 gallons of water.
Check on the above: Seed for four rows not treated.

Plot 2.—Duplicate of Plot 1.
Check on above.

Plot 3.—Seed for four rows soaked one-half hour in a solution consisting of 6 ounces of corrosive sublimate in 30 gallons of water.
Check on above.

Plot 4.—Duplicate of Plot 3.
Check on above.

Plot 5.—Seed for four rows soaked for one-half hour in a mixture consisting of one pint of formol in 15 gallons of water.
Check on above.

Plot 6.—Duplicate of Plot 5.
Check on above.

Plot 7.—Seed for four rows soaked one hour in a mixture consisting of one-half pint of formol in 15 gallons of water.
Check on above.

Plot 8.—Duplicate of Plot 7.
Check on above.

Plot 9.—Seed for four rows soaked two hours in one-half pint of formol mixed with 15 gallons of water.
Check on above.

Plot 10.—Duplicate of Plot 9.
Check on above.

Objects of Experiments.

It had been previously demonstrated (See our Bulletin 72, February, 1898.) that corrosive sublimate, in solutions ranging from 4½ ounces in 30 gallons of water to 8 ounces in 30 gallons of water, was an effective remedy for the disease. The corrosive sublimate is very poisonous and somewhat costly, making it desirable, if possible, to find something else for the purpose, to which these objections do not apply.

Formol, or formalin, has of late been very extensively used as a preservative and germicide, for which purposes it has proved so useful that it was inevitable that it should soon be tested as a fungicide in field experiments made at the Agricultural Experiment Stations. Tests of this sort were made last year with favorable results at the Indiana Station, and it was decided last spring to use formol, at the Kentucky Station, side by side with corrosive sublimate with a view to a comparison of their effects as remedies for scab.

A further object kept in view was to get a solution that will disinfect seed potatoes quickly, and with the least possible injury.

Formaldehyde, Formol, Formalin, Formalose.— These names are applied by dealers to solutions of a gas obtained by the oxidation of wood alcohol. Formol and formalin are the names most commonly employed in this country for 40 per

cent. solutions in water. This 40 per cent. preparation is the one used in our experiments. In this condition it is sold for about 50 cents per pound at retail. Solutions of this strength when brought near the face are very irritating to the membranes of the eyes and nostrils, but one becomes somewhat accustomed to the fumes in time, and no permanent injury is done by them. As diluted for use on potato seed it is perfectly harmless and the hands may be freely immersed in it.

The great advantage formol has over corrosive sublimate is in its being a much less dangerous material to have about. A considerable quantity of the diluted formol can be taken into the mouth and swallowed without ill effect. Indeed some of the preservatives now sold to dairymen for use in milk consist largely or entirely of formol. If formol is as effective as corrosive sublimate in checking scab, there should, therefore, be no hesitation in employing it in place of the more poisonous substance. The experiments following will show to what extent this is true.

Corrosive Sublimate, Bichloride of Mercury, Mercuric Chloride.—Violent poisons like this are always to be avoided on the farm in favor of less poisonous ones, because of the danger to stock and to man himself, due to careless or ignorant help. Small quantities of those generally employed and recommended will do no harm, but in using them one must be constantly on his guard against mistakes and neglect. A solution of corrosive sublimate standing in a barrel may be the means of poisoning stock which get access to it. When treating potatoes such solutions should be kept under lock and key, if possible, in a room of a shed or barn where cattle can not reach them. When seed potatoes have been soaked and are spread out to dry preparatory to cutting, they should be kept where they can not be eaten by either poultry, hogs or cows. A single treated cut potato dropped on the ground in carrying the seed to the field may result in mischief. If there are no conveniences at hand for preserving the fluid safe from stock, after the potatoes have been treated the remainder of the solution should be disposed of at once by

digging a hole in some out of the way place, pouring the solution into it and covering with earth.

If, however, the solution can be stored in a tight vessel, a barrel with wooden hoops is preferable for the purpose, it will keep its properties for some time and can be used repeatedly. The solution is very destructive to metals and in course of time is liable to destroy iron barrel hoops.

It should be remembered though that corrosive sublimate forms an inert compound when it attacks the proteid matter of germs or fungi, and hence solutions cannot be expected to retain their properties indefinitely.

Field Notes.

June 23, the plants were observed to be in excellent condition, with no evident difference between treated and untreated plots.

July 6, the blossoms were noted as all gone and the growth of plants in treated and untreated plots was still alike. None grew as large as they should, possibly because of too frequent rains.

July 19, the plants were noted as turning brown, as if ripening, and on August 2 most of them showed little appearance of being alive.

The potatoes were harvested October 1. The yield and percentage of scab are shown in the table.

Results.

The results from the use of corrosive sublimate were in every case all that could be expected. The lots from treated seed were invariably smoother and finer than those from the untreated potatoes. The scab present in these lots was not such as would affect their market value in any degree. The average from the two plots planted with seed treated with corrosive sublimate solution containing 4 ounces of the sublimate, was 12½ per cent. scabbed and 1½ per cent. badly scabbed. The untreated rows of these same plots give an average of 76 per cent. scabbed and of 30½ per cent. badly scabbed.

SHOWING TREATMENT FOR POTATO SCAB, AND RESULTS.

Plot.	Treatment of Seed.	Per cent. scabbed.	Per cent. badly scabbed.	Yield in pounds.
1	1 hr., 4 ozs. sublimate, 30 gals. water.	20	3	208½
	None.	83	34	238¾
2	1 hr., 4 ozs. sublimate, 30 gals. water.	5	None.	221½
	None.	69	27	313¼
3	½ hr., 6 ozs. sublimate, 30 gals. water.	29	2	229¾
	None.	89	57	273¼
4	½ hr., 6 ozs. sublimate, 30 gals. water.	45	None.	311¼
	None.	94	41	292½
5	½ hr., 1 pt. formol, 15 gals. water.	69	12	241½
	None.	91	49	314½
6	½ hr., 1 pt. formol, 15 gals. water.	58	11	249½
	None.	91	53	271
7	1 hr., ½ pt. formol, 15 gals. water.	46	11	272
	None.	96	54	285¾
8	1 hr., ½ pt. formol, 15 gals. water.	60	21	249½
	None.	89	39	265½
9	2 hrs., ½ pt. formol, 15 gals. water	96	24	269¼
	None.	83	27	306
10	2 hrs., ½ pt. formol, 15 gals. water.	84	28	233
	None.	84	30	262½

The stronger solution (6 ounces in 30 gallons of water) of corrosive sublimate used in plots 3 and 4 give no better average result, in fact the percentage of scabbed potatoes is somewhat higer (37 per cent), though the badly scabbed ones constitute a sligtly smaller percentage (1 per cent.). The time required in treating the seed of these plots was however only half as long, and this is a distinct gain where many potatoes are to be treated.

The treatment with formol did not come up to expectations in checking scab. The best result obtained was from plot 7, where 46 per cent. of the treated potatoes was scabbed, as against 96 per cent. of scabbed potatoes in the untreated half of this plot. The results as to badly scabbed potatoes are better (see table) but are not nearly so good as in the plots treated with corrosive sublimate, where indeed there were practically no badly scabbed potatoes.

A glance at the table will show that there is an increase in the number of scabbed potatoes from treated seed, passing from plot 7 to plot 10. In fact in plots 9 and 10 there is no apparent benefit from treatment. This result puzzled me for some time, for at first thought one would expect that ½ pint of formol for two hours would destroy more of the scab fungus than the same quantity for one hour, as used in plots 7 and 8. The table shows that the reverse of this was true, and I now think that the potatoes used for plots 7 and 8 may have exhausted the formol in the water to such an extent that it did not so completely disinfect the seed for plots 9 and 10. A repetition of the experiments another season will show how completely this hypothesis is justified.

Conclusion.

In our own experiments corrosive sublimate has shown itself much the most effective preventive of scabbing that has been tried. With from 4 to 4½ ounces in 30 gallons of water it is possible to prevent the disease almost entirely, the spots that occur being few and usually very small and superficial in character.

In the interest of a fair conclusion I must finally point

out that in every case but one (plot 4) the untreated rows yielded a few more pounds of potatoes than the treated, but when the worthless scabbed potatoes are thrown out, and the inferior quality of the remainder is considered, the advantage is still in favor of the treated potatoes.

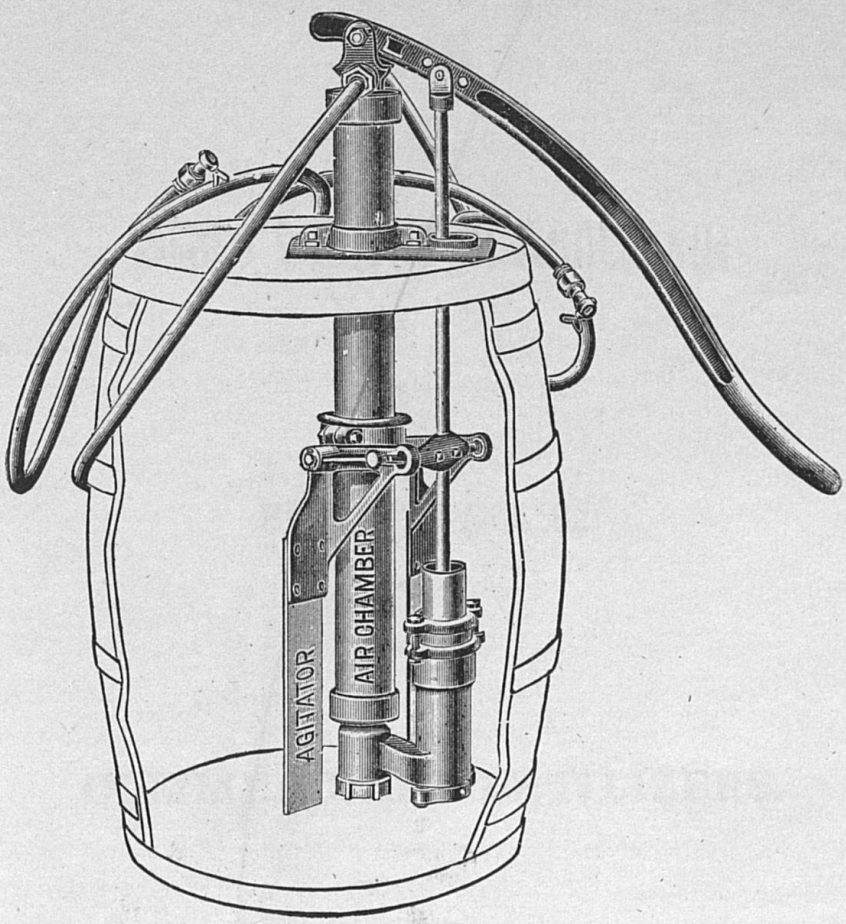
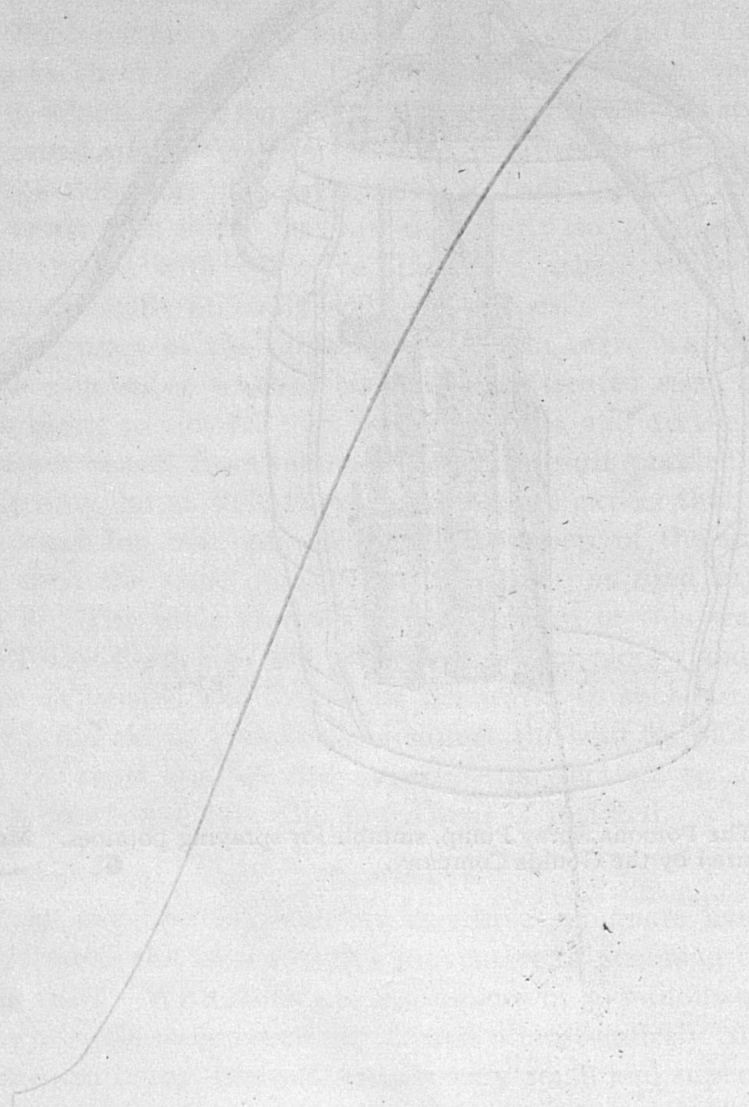


FIG. 3.—The Pomona Spray Pump, suitable for spraying potatoes. Manufactured by the Goulds Company.



KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

State College of Kentucky:

BULLETIN NO. 82.

COMMERCIAL FERTILIZERS.

LEXINGTON, KENTUCKY,
July, 1899.
13

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.
J. T. GATHRIGHT, Louisville, Ky.
THOS. TODD, Shelbyville, Ky.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.
A. M. PETER, } Chemists.
H. E. CURTIS, }
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Agriculturist.
EDWARD RHORER, Secretary to Director.
Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:
KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

Bulletin No. 82.

COMMERCIAL FERTILIZERS.

In this bulletin are published the names of all fertilizers that have been entered for sale in the State this year up to the date of this bulletin, together with the guaranteed analysis of each, taken from the affidavit of the manufacturer, showing the lowest percentages of essential ingredients which each fertilizer will contain as put on the market. This information is published now for the use of farmers in the fall season, but at the end of the year we will publish all the analyses that have been made, side by side with the manufacturers' guaranteed analyses, and the estimated value per ton calculated from each, as required by law.

FERTILIZER LAW.

The present law regulating the sale of fertilizers has been published in Bulletin 75, copies of which will be furnished on application, but we desire again to call attention to some of its provisions which most concern purchasers of fertilizers.

Free Analyses for Farmers. The law provides for free analyses to be made at the Station for the benefit of purchasers in order to see that the goods sold are up to the guarantee of their manufacturers. Any purchaser of a fertilizer, *who is not an agent or dealer*, may take a sample of the same under proper regulations, and have it analyzed at the Station free, and such purchaser shall not be required to give the name of the fertilizer or of the person from whom it was bought until after the analysis has been made and reported, but after the purchaser has received the report of analysis he must give the Director all information about the fertilizer that

may be required for publication in the Station bulletins or for prosecution of the case if it appears that the law has been violated. It is desirable that the farmers of the State take advantage of this privilege as much as possible, and it is recommended that in every large purchase a sample be taken for analysis.

IMPORTANT TO CAREFULLY SAMPLE. It is very important that samples for analysis be carefully taken in such a way as to be sure that they fairly represent the fertilizer purchased, and we request that any one intending to have an analysis made will read Section 8 of the law very carefully before taking the sample. To avoid the charge of unfairness in sampling, the law provides that the person or agent who sold the fertilizer be present when the sample is taken, but if this is not possible or convenient, the sample may be taken in presence of two disinterested witnesses. It is required that the sample be taken from at least a tenth of the whole number of sacks purchased, but the more sacks sampled the better, and it is always best to take the sample from at least two or three sacks. A quantity should be taken from each of the sacks selected to be opened, and all mixed together in one pile, and a quart jar filled from the mixture. The jar should be sealed and marked with the name and address of the sender in such a way that there can be no mistake about the identity of the sample, and forwarded at once to the Director of the Station. The station will furnish blank forms for the certificate, which is to go with the sample, but if there is not time to write for them, it may be made out after the form printed herewith. (See page 17.) All such samples must be taken at, or soon after, the time of purchasing the fertilizer, as it is not intended that a fertilizer be kept for months, possibly subject to change from exposure, and then be submitted to analysis.

FORM OF CERTIFICATE. The following is the proper form of certificate to accompany samples for free analysis. The words in italics are supposed to have been written in the blanks of one of our printed forms by the sender of the sample and give an idea of how these blanks should be filled. Anyone intending to send a sample for free analysis can get these blank certificates by writing to the Station.

CERTIFICATE FOR FREE ANALYSIS.

Smithville, Ky., June 1st, 1899.

M. A. SCOVELL, Director,
LEXINGTON, KY.

This is to certify that I am not a dealer in, or agent for the sale of any fertilizer, and that the fertilizer, a sample of which I have sent by express to you for free analysis was purchased by me for my own use and not for sale.

I further certify that the sample was taken at the time of purchase from at least 10 per cent. of the sacks or other packages comprising the whole lot purchased, and that it was taken as provided in Section 8 of the fertilizer law, in the following described manner, to wit: *I opened four sacks of the fertilizer and took two shovels full from each and mixed them all together thoroughly on a clean floor and immediately filled a quart jar with the mixed fertilizer and labeled it "No. 1, from John Smith, Smithville, Ky."*

Upon receipt of the analysis from you, I agree to furnish you with a tag taken from one of the sacks sampled, the name and address of the firm or agent of whom the fertilizer was purchased and the amount purchased.

John Smith,
(Signature.)

Smithville, Ky.
(P. O. Address)

Signature of Witnesses:
Sam Jones,
Will Brown.

SECTION PROVIDING FOR FREE ANALYSES. We print, also, the section of the Fertilizer Law relative to the taking of samples for free analysis, and we invite particular attention to it:

SEC. 8 Any person not a dealer in, or agent for the sale of any fertilizer who may purchase any commercial fertilizer in this State for his own use and not for sale, may take a sample of the same for analysis, which analysis shall be made by the said Experiment Station free of charge. Such samples for free analysis shall be taken by the purchaser in the presence of the person, company or agent selling the fertilizer, from at least ten (10) per cent. of the sacks or other packages comprising the whole lot purchased, and shall be thoroughly mixed and at least one pound of the material after mixing must be put into a jar or can, securely sealed and marked in such a way as to surely identify the sample and show by whom it was sent, without

giving the name of the fertilizer or the person from whom it was purchased, and must be forwarded to the Director of the Kentucky Agricultural Experiment Station, Lexington, Ky. The purchaser shall also send with the sample a certificate signed by himself and witness, or by two witnesses, stating that the sender has purchased the fertilizer for his own use and not for sale, and that the sample was taken in the manner prescribed in this Section. Provided, however, that if the person, company or agent shall refuse to witness the taking of the sample, then the sample may be taken at the time of the purchase in the manner already described in the presence of two witnesses who shall certify to the manner of taking the sample. The purchaser shall preserve the official label from one of the bags or other packages sampled to be sent to the Director after having received the report of analysis of the sample, and at the same time he shall furnish to the Director the name and address of the firm of whom the fertilizer was purchased and the amount purchased; and any person having sent a sample for free analysis, under the provisions of this section, who shall, after having received the report of analysis of the same, refuse to furnish the required information, shall thereafter forfeit the privilege of free analysis of fertilizers under this section. But if any sample shall have been submitted for free analysis without all the requirements of this section having been complied with, the Director shall inquire into the case and may accept the sample for free analysis if he believe that it is a fair sample of the fertilizer as it was delivered to the purchaser.

THE PROPER SELECTION OF FERTILIZERS.

In regard to the proper selection of fertilizers we can only say briefly that their profitable use will depend upon knowledge of the needs of the particular soil to which they are to be applied, and the requirements of the crop to be grown. The latter knowledge has been gained once for all for most farm crops by a scientific study of these crops, but the needs of the soil must in most cases be learned by the farmer himself, either from systematic field experiments, or by observation and experience. If it is necessary for a farmer to use commercial fertilizers, and he is working upon a kind of soil that has not already been tested, we believe it will pay him to learn its needs by carrying out systematic experiments with fertilizers. The experiments made at the Station amply illustrate this. It

would be very unprofitable to buy phosphates for use on soil like that of the Station farm, but potash salts could be profitably used there with most crops. This is because the soil is already rich in phosphates. But if it were deficient in phosphates, as is the case with many soils in this State, it would be unprofitable to use potash salts alone, and one would have to supply phosphates. It is therefore necessary in purchasing a commercial fertilizer to consider, first, what our soil needs for the crop to be raised, and then to look for that fertilizer containing most of those substances, in an available form, as shown by its chemical analysis and guaranteed by the manufacturer, at the least cost. It is well to bear in mind, also, that nitrogen compounds are the most expensive constituents of commercial fertilizers, and if we can keep up our nitrogen supply by means of clover, cow peas, or other leguminous plants, or by barnyard manure, and purchase only such phosphates and potash as may be needed, we will have accomplished a great saving.

THE TABLES.

The following tables are self-explanatory. They give the minimum analyses, expressed in per cents, of all fertilizers that have been entered under the law this year up to the date of this bulletin. These tables contain the names of all brands legally on sale in the State on the date of the present issue.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis.—Per Cent.							
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.	
			Soluble.	Reverted.	Available.	Total.			From Muriate.	From Sulphate.
	A. D. Adair and McCarty Bros., Atlanta, Ga....	See Furman Farm Improvement Co.....								
5113	The Armour Fertilizer Works, Chicago, Ill....	Bone Meal.....	.....	.....	.....	24.00	2.47	3.00	....	.....
5114	Same.....	Acidulated Bone Meal.....	.....	.....	11.00	18.00	1.65	2.00	.....	.....
5115	Same..... ...	Raw Bone Meal.....	.....	.....	.....	22.00	3.71	4.50	....	.....
5116	Same.....	Grain Grower.....	6.00	2.00	8.00	10.00	1.65	2.00	2.00	... ..
5117	Same.....	Ammoniated Bone, with Potash..	4.00	2.00	6.00	8.00	2.47	3.00	.....	2.00
5118	Same.....	Tobacco Grower.....	6.00	2.00	8.00	10.00	1.65	2.00	.....	5.00
5119	Same.....	Bone, Blood and Potash....	6.00	2.00	8.00	10.00	4.12	5.00	.....	7.00
5120	Same.....	Star Phosphate.....	9.00	3.00	12.00	16.00	.....	.....	.....	.....
5365	Same.....	White Burley and Black Tobacco	2.00	6.00	8.00	10.00	2.88	3.50	....	4.00
5274	Geo. S. Bartlett, Cincinnati, O.....	Indian Brand Tobacco and Potato Fertilizer.....	.....	.....	9.00	11.00	3.29	4.00	....	5.00

5275	Same	Indian Brand Ohio Valley Phosphate			8.00	11.00	1.65	2.00	2.00	
5367	Same	Indian Brand Pure Gilead Phosphate			9.00	11.00	2.47	3.00	2.00	
5368	Same	Indian Brand Phœnix Phosphate			7.00	10.00	1.65	2.00	1.00	
5390	Same	Indian Brand Ky. and Tenn. Tobacco Grower			8.00	10.00	1.65	2.00	3.00	
5180	The Chicago Fertilizer Co., Chicago, Ill	No. 2 Acid Phosphate			9.00	10.00				
5181	Same	Western Bone and Potash			12.00	13.00			1.00	
5182	Same	Bone, Blood and Potash			9.00	10.00	1.23	1.50		2.00
5183	Same	Standard Truck Fertilizer			8.00	9.00	2.47	3.00		4.00
5301	The Cleveland Dryer Co., Cleveland, O	Ohio Seed Maker			10.00	15.00	1.65	2.00		
5302	Same	Ohio Seed Maker with Potash			10.00	15.00	1.65	2.00	2.00	
5303	Same	Phospho Bone			10.00		0.82	1.00	1.00	
5304	Same	Horsehead Phosphate			10.00	12.00				
5371	Same	Buckeye Ammoniated Bone Superphosphate			9.00	11.00	2.47	3.00	1.00	
5372	Same	XXX Phosphate			13.00	15.00				
5373	Same	White Burley Tobacco Fertilizer			9.00	11.00	2.47	3.00	1.00	1.00
5374	Same	Kentucky Tobacco Grower			10.00	12.00	1.65	2.00	1.00	1.00
5375	Same	Potato, Tobacco and General Crop Fertilizer			10.00	11.00	1.03	1.25	6.00	

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis—Per Cent.							
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.	
			Soluble.	Reverted.	Available.	Total.			From Muriate.	From Sulphate.
5376	The Cleveland Dryer Co., Cleveland, O.	Square Bone	....	.....	6.00	20.00	2.06	2.50	.....	.....
5377	Same	Superior Bone Meal	.....	.....	.....	22.00	3.29	4.00	.....	.....
5168	Continental Fertilizer Co., Nashville, Tenn.	Bear Beef Blood and Bone	8.00	2.00	10.00	11.00	1.65	2.00	2.00	.....
5169	Same	Bear High Grade Dissolved Bone	8.00	6.00	14.00	15.00	.....	.....	.....	.....
5170	Same	Bear Special Tobacco Guano	8.00	2.00	10.00	11.00	1.65	2.00	2.00	.....
5171	Same	Bear Special Wheat and Corn Guano	8.00	3.00	11.00	12.00	.....	.....	2.00	.....
5344	Crocker Fertilizer&Chem. Co., Buffalo, N. Y.	Crocker's Ammoniated Practical Phosphate	6.00	2.00	8.00	9.00	0.82	1.00	1.08	.....
5345	Same	Crocker's Kentucky Tobacco Phosphate	8.00	2.00	10.00	11.00	2.06	2.50	3.24	.....
5280	The Currie Fertilizer Co., Louisville, Ky.	Currie's Soluble Bone	.....	.....	9.50	11.25	0.82	1.00	1.00	.....
5281	Same	Currie's Climax Tobacco and Potato Grower	.....	.....	9.50	11.25	0.82	1.00	1.00	.....
5282	Same	Currie's Golden Leaf Tobacco and Potato Grower	.....	.....	8.00	10.50	1.23	1.50	3.00	.....

5283	Same	Currie's Corn and Wheat Special	.....	.....	9 50	11.00	0.41	0.50	.....	0.50
5284	Same	Currie's Corn Grower	.....	.....	9.50	11.00	0.82	1.00	.....	1.00
5285	Same	Currie's Corn and Oats Special	.....	.....	7.00	8.50	0.82	1.00	.....	2.50
5286	Same	Currie's Acid Phosphate	.....	.....	12.00	14.00	.....	.....	.....	.....
5287	Same	Currie's Tobacco and Potato Grower	.....	.....	7.00	9.00	1.65	2.00	.....	7.50
5650	Same	Currie's Wheat Grower	.....	.....	10.00	12.00	1.23	1.50	.....	1.50
5651	Same	Currie's Butchertown Raw Bone Meal	.....	.....	10.00	15.50	1.85	2.25	.....	1.25
5652	Same	Currie's Fine Ground Raw Bone Meal	.....	....	.....	18.00	1.23	1.50	.....	.....
5653	Same	Currie's Raw Bone Meal	.....	....	.....	20.50	3.29	4.00	.....	.....
5341	Furman Farm Improvement Co., Atlanta, Ga	Furman High Grade Fertilizer	7.00	3.00	10.00	.....	1.65	2.00	2.00	.....
5342	Same	Farish Furman Formula	7.00	3.00	10.00	.....	.....	.....	2.00	.....
5343	Same	Furman Soluble Bone With Ammonia and Potash	7.00	3.00	10.00	.....	0.82	1.00	2.00	.....
5134	Globe Fertilizer Co., Louisville, Ky	Kentucky Standard Tobacco Grower	.....	.....	8.00	10.00	2.47	3.00	.....	3.00
5212	Same	Globe Special Tobacco Grower	.....	.....	8.00	9.00	2.47	3.00	.....	10.00
5213	Same	Globe Potato Grower	.....	.....	8.00	9.00	3.29	4.00	.....	4.00
5259	Same	Eagle Corn and Wheat Grower	.....	.....	9.00	11.00	2.06	2.50	.....	2.00
5260	Same	Big Four Tobacco Grower	.....	.....	8.00	10.00	1.65	2.00	.....	2.00

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis.—Per Cent.							
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.	
			Soluble.	Reverted.	Available.	Total.			From Muriate.	From Sulphate.
5261	Globe Fertilizer Co., Louisville, Ky.	Golden Harvest Bone Meal	.....	.....	10.00	12.00	2.47	3.00	.....	.....
5262	Same	Progress Wheat and Corn Grower	.....	.....	9.00	10.00	1.65	2.00	.....	1.00
5263	Same	Globe Wheat Grower	.....	.....	9.00	11.00	2.06	2.50	.....	2.00
5264	Same	Bone and Potash	.....	.....	11.00	.....	.....	.....	.....	1.00
5265	Same	Globe Bone Dust	.....	.....	9.00	11.00	1.23	1.50	.....	.....
5266	Same	Globe Soluble Vegetable Manure	.....	.....	8.00	10.00	2.47	3.00	.....	3.00
5649	Same	Globe Bone Meal	.....	.....	.....	20.00	3.29	4.00	.....	.....
	Greer Machinery Co., Knoxville, Tenn.	See Southern Fertilizer Co.								
5383	The Jarecki Chemical Co, Sandusky, O.	Lake Erie Fish Guano	.....	.....	10.00	11.00	1.65	2.00	0.50	0.50
5384	Same	C. O. D. Phosphate	.....	.....	14.00	15.00	.....	.....	.....	.....
5549	Same	Fish and Potash Tobacco and Potato Food	.....	.....	9.00	10.00	0.82	1.00	4.00	.....

5550	Same	Number one Fish Guano			10.00	11.00	0.82	1.00	1.00	
5159	J. B. Jones, Louisville, Ky.	Corn Grower			9.00	11.00	2.47	3.00		1.50
5160	Same	Tobacco and Potato Grower			10.00	12.00	2.88	3.50		6.50
5269	Same	Jones' Bone Meal				20.00	2.47	3.00		
5270	Same	Ammoniated Bone Meal				15.00	2.06	2.50		
5380	Same	Raw Bone Meal				21.50	3.50	4.25		
5381	Same	Wheat Grower			9.00	11.00	1.70	2.06		2.00
5125	The Jones Fertilizing Co., Cincinnati, O.	Bone Meal				20.00	3.30	4.00		
5126	Same	Acidulated Bone Meal			7.00	14.50	3.30	4.00		
5127	Same	Ammoniated Bone				15.00	4.12	5.00		
5128	Same	Bone and Potash			8.00	10.00	1.65	2.00		4.00
5129	Same	Tobacco and Potato Grower			10.00	12.00	3.71	4.50		5.00
5130	Same	Miami Valley			9.00	13.00	2.47	3.00		2.75
5131	Same	Jones' Reliable			8.50	10.00	1.23	1.50		1.25
5132	Same	Jewel Phosphate			8.00	10.00	0.82	1.00		
5133	Same	Acid Phosphate			8.00	10.00				
5334	Same	Kentucky Tobacco Grower			8.00	10.00	1.65	2.00		4.00

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis—Per Cent.							
			Phosphoric Acid.						Potash.	
			Soluble.	Reverted.	Available.	Total.	Nitrogen.	Eqivalent to Ammonia.	From Muriate.	From Sulphate.
5177	The Loudenback Fertilizer Co., Urbana O.	Urbana Bone Phosphate and Potash.	.....	....	9.00	.....	1.23	1.50	2.00	.....
5189	Louisville Fertilizer Works, Louisville, Ky..	Corn and Wheat Grower....	.....	.....	10.00	11.00	0.21	0.25	0.25	.....
5190	Same.....	Special Tobacco and Corn Grower.....	.....	.....	8.00	9.00	0.82	1.00	.....	1.50
5191	Same.....	Potato and Tobacco Grower	.....	.....	7.00	10.00	1.65	2.00	.....	4.00
5218	Same.....	Soluble Bone and Potash..	.....	....	8.00	9.00	0.82	1.00	.....	1.50
5268	Same.....	Corn Grower.....	....	....	10.00	11.00	.....	.....	2.00	.....
5358	Same.....	Dissolved Bone	.....	.....	10.00	11.00	.....	.....	.....	.....
5495	A. B. Mayer Mfg. Co., St. Louis, Mo.....	Anchor Brand Complete Fertilizer.....	4.00	4.00	8.00	12.00	2.88	3.50	.....	3.50
5496	Same.....	Anchor Brand Corn and Wheat Grower.....	4.00	5.00	9.00	12.00	3.29	4.00	....	2.50
5497	Same.....	Anchor Brand Pure Bone Meal.....	.....	.....	.....	22.00	3.71	4 50	.....	.....
5222	Meridian Fertilizer Factory, Meridian, Miss...	Meridian Home Mixture....	7.00	2.00	9.00	10.00	2.25	2.73	2.25	.....

5223	Same	Meridian Corn and Wheat Grower	7.00	2.00	9.00	10.00	2.25	2.73	2.25		
5194	Michigan Carbon Works, Detroit, Mich	Homestead Corn and Wheat Grower			9.00		2.26	2.75	1.75		
5195	Same	Homestead Tobacco Grower			10.00		2.88	3.50	3.50		
5196	Same	Desiccated Bone				25.00	1.23	1.50			
5197	Same	Acid Phosphate			14.00	15.00					
5198	Same	Red Line Phosphate With Potash			10.00	12.00			3.00		
5199	Same	Red Line Complete Manure			8.00	9.00	1.03	1.25	1.50		
5200	Same	Red Line Crop Grower			8.00	9.00	1.65	2.00	2.00		
5279	Same	Red Line Ammoniated Phosphate			8.00	9.00	1.65	2.00			
5290	Same	Homestead Potato Grower			8.50	10.00	1.94	2.35	5.00		
5357	Same	Jarves Drill Phosphate			8.00	10.00	1.03	1.25	0.75		
5276	National Fertilizer Co., Nashville, Tenn	Corn Grower			12.00		0.82	1.00	1.00		
5278	Same	Tobacco Grower			10.00		1.65	2.00	2.00		
5352	Same	Acid Phosphate			15.00						
5353	Same	Sadler's Formula			12.00				2.00		
5476	Same	Tobacco Fertilizer			10.00		2.06	2.50	3.00		
5486	Same	Bone Meal				20.00	2.47	3.00			

Station Number.	Name and address of Manufacturer.	Name of Brand.	Guaranteed minimum analysis.—per cent.							
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.	
			Soluble.	Reverted.	Available.	Total.			From Muriate.	From Sulphate.
5487	National Fertilizer Co., Nashville, Tenn	National Dissolved Bone			12.00		0.82	1.00	1.00	
5505	Same	Tennessee Guano			10.00		1.65	2.00	2.00	
5506	Same	Twentieth Century Guano			12.00				4.00	
5507	Same	Vegetable Grower			10.00		2.47	3.00	2.00	
5143	North-Western Fertilizing Co., Chicago, Ill	Horse Shoe Brand Fine Raw Bone				22.00	3.29	4.00		
5144	Same	H. S. B. Pure Ground Bone				18.00	2.47	3.00		
5145	Same	H. S. B. Raw Bone and Superphosphate Mixture	4.00	3.00	7.00	13.00	2.47	3.00		0.50
5146	Same	H. S. B. Tobacco Grower	5.00	3.00	8.00	10.00	3.29	4.00		2.50
5147	Same	H. S. B. Kentucky Tobacco Grower	4.00	2.00	6.00	8.00	2.47	3.00		1.50
5148	Same	H. S. B. Challenge Corn Grower	5.00	3.00	8.00	10.00	2.47	3.00		1.50
5149	Same	H. S. B. Potato Grower,	4.00	4.00	8.00	10.00	3.29	4.00		3.50

5150	Same	H. S. B. Corn and Wheat Grower	7.00	3.00	10.00	12.00	2.06	2.50	.....	1.00
5151	Same	H. S. B. Acidulated Bone and Potash	7.00	3.00	10.00	12.00	0.82	1.00	.....	1.50
5152	Same	H. S. B. Bone and Potash	8.00	2.00	10.00	12.00	.....	.....	.....	1.25
5153	Same	H. S. B. Acidulated Bone	7.00	3.00	10.00	12.00	0.82	1.00	.....	.....
5154	Same	H. S. B. Dissolved Bone Phosphate	8.00	3.00	11.00	13.00	1.23	1.50	.....	.....
5155	Same	H. S. B. Quick Acting Phosphate	9.00	4.00	13.00	15.00	.....	.....	.....	.....
5156	Same	H. S. B. Prairie Phosphate	4.00	2.00	6.00	9.00	1.65	2.00	.....	1.00
5157	Same	H. S. B. Special High Grade Tobacco Grower	5.00	4.00	9.00	11.00	3.29	4.00	.....	10.00
5044	The Ohio Farmers' Fertilizer Co., Columbus, O.	Acid Phosphate	.....	.....	9.00	10.00	.....	.....	.....	.....
5045	Same	Soluble Bone and Potash	.....	.....	12.00	13.00	.....	.....	.....	1.00
5046	Same	Grain and Grass	.....	.....	12.00	13.00	.....	.....	.....	1.00
5047	Same	Corn, Oats and Wheat Fish Guano	.....	.....	9.00	10.00	1.24	1.50	.....	2.00
5048	Same	Tobacco Special	.....	.....	8.00	9.00	2.47	3.00	.....	4.00
5049	Same	Fine Ground Bone Meal	.....	.....	.....	20.00	1.65	2.00	.....	.....
5214	Queen City Fertilizer Co., Cincinnati, O	High Grade Corn and Wheat Grower with Potash	8.00	3.00	11.00	12.00	.....	.....	2.00	.....
5207	Read Phosphate Co., Nashville, Tenn	High Grade Tobacco Grower	.....	.....	8.00	9.00	1.65	2.00	4.00	.....
5208	Same	Blood and Bone No. 1	.....	.....	8.00	9.00	1.65	2.00	2.00	.....

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis—Per Cent.							
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.	
			Soluble.	Reverted.	Available.	Total.			From Muriate.	From Sulphate.
5209	Read Phosphate Co. Nashville, Tenn.	Alkaline Bone	.....	.....	10.00	11.00	.....	.....	2.00	.....
5210	Same	Farmers' Special Manure	.....	.....	10.00	11.00	0.82	1.00	3.00	.....
5211	Same	X. X. X. Dissolved Bone	.....	.....	13.00	14.00	.....	.....	.....	.....
5382	Same	Vegetable, Fruit and Vine Fertilizer	.....	.....	6.00	.....	1.65	2.00	8.00	.....
5677	Same	Read's Wheat and Clover Grower	.....	.....	10.00	12.00	0.82	1.00	2.00	.....
5386	John S. Reese & Co. Agts. Baltimore, Md.	Reese's Pacific Guano	3.50	5.00	8.50	10.50	1.85	2.25	1.20	.....
5369	The J. & F. Schroth Pkg. Co., Cincinnati, O.	Corn and Wheat Grower	.....	.....	9.00	11.00	3.29	4.00	4.00	.....
5370	Same	Schroth's Special Phosphate	.....	.....	7.00	10.00	1.65	2.00	1.00	.....
5307	Southern Fertilizer Co., Atlanta, Ga.	Greer's Compound Fertilizer	9.00	3.00	12.00	14.00	.....	.....	2.00	.....
5308	Same	Greer's Challenge Fertilizer	7.50	2.50	10.00	12.00	1.65	2.00	2.00	.. ..
5247	Swift & Co., Chicago, Ill.	Raw Bone Meal	.....	.....	.....	23.00	3.71	4.50	....	.....

5248	Same	Ground Steamed Bone	.....	.....	.....	25.00	2.47	3.00	.....	.....
5249	Same	Bone and Potash 3%	.....	.....	.....	23.50	2.47	3.00	.....	3.00
5250	Same	Superphosphate	6.00	2.00	8.00	12.00	2.47	3.00	.....	2.00
5251	Same	Potato and Tobacco Grower.	8.00	2.00	10.00	11.00	3.29	4.00	.....	5.00
5252	Same	Bone Tankage	.....	.....	.....	17.00	4.94	6.00	.....	.....
5253	Same	Acid Phosphate	10.00	6.00	16.00	17.00	.....	.....	.....	.....
5254	Same	Bone Tankage and Potash 3%	.....	.....	.....	16.00	4.74	5.75	.....	3.00
5255	Same	Complete Fertilizer	6.00	2.00	8.00	11.00	1.03	1.25	.....	1.00
5256	Same	Phosphate and Potash	8.00	4.00	12.00	13.00	.....	.....	.....	2.00
5257	Same	Diamond [S] Phosphate	7.00	3.00	10.00	11.00	.....	.....	.....	.....
5258	Same	Vegetable Grower	6.00	3.00	9.00	10.00	3.29	4.00	.....	10.00
5139	Tennessee Chemical Co., Nashville, Tenn	Ox Alkaline Bone	9.00	3.00	12.00	13.00	.....	.....	2.00	.....
5140	Same	Ox Special Tobacco Guano	8.00	2.00	10.00	11.00	1.65	2.00	2.00	.....
5141	Same	Ox Bone and Potash	7.00	5.00	12.00	13.00	.....	.....	1.00	.....
5142	Same	Ox High Grade Dissolved Bone	8.00	6.00	14.00	15.00	.....	.....	.....	.....
5192	Same	Ox Bone with Ammonia and Potash	6.00	4.00	10.00	11.00	0.82	1.00	1.00	.....
5317	Same	Ox Special Wheat and Corn Guano	9.00	3.00	12.00	13.00	0.82	1.00	1.00	.....

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis—Per Cent.							
			Phosphoric Acid.						Potash.	
			Soluble.	Reverted.	Available.	Total	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.
5104	S. W. Travers & Co., Branch, Richmond, Va	Beef, Blood and Bone Fertilizer	5.00	2.00	7.00	8.00	1.65	2.00	.....	2.00
5105	Same	National Tobacco Fertilizer.	5.00	2.00	7.00	8.00	1.85	2.25	.....	4.00
5106	Same	Capital Truck Fertilizer	6.00	2.00	8.00	9.00	3.30	4.00	.....	3.00
5107	Same	Capital Bone Potash Compound	8.00	2.00	10.00	11.00	.....	.....	.....	2.00
5108	Same	Capital Dissolved S. C. Bone	9.00	3.00	12.00	....	.....	....	.....	.....
5158	Same	Champion Corn Grower	6.00	2.00	8.00	9.00	0.82	1.00	....	2.00

M. A. SCOVELL, Director,
A. M. PETER,
H. E. CURTIS.

July 20, 1899.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 83.

WHEAT.

1. Experiments with Fertilizers.
2. Variety Tests.
3. Notes and Descriptions.

LEXINGTON, KENTUCKY,
August, 1899.
33

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.
J. T. GATHRIGHT, Louisville, Ky.
THOS. TODD, Shelbyville, Ky.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.
A. M. PETER, H. E. CURTIS, } Chemists.
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Agriculturist.
V. E. MUNCY, Weather Observer.
EDWARD RHORER, Secretary to Director.
Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

Bulletin No. 83.

WHEAT.

1. EXPERIMENTS WITH FERTILIZERS.

The field experiments with fertilizers on wheat conducted at the experiment Station farm in 1898–9, as in the season before, gave only negative results, the yields from the fertilized plots being little, if any, greater than where no fertilizer was applied. Commercial fertilizers used on wheat on the soil of the station farm appear to yield no profitable result, as the slight increase that has occasionally been observed has not been sufficient to pay for the fertilizer used. The season was unfavorable to such experiments, as wheat was generally sown late and the stand was thin and irregular and this affected the co-operative experiments that were undertaken last season, as well as those at the station farm. Two of these experiments, however, it is thought proper to publish, as they show a marked increase from the use of fertilizers on very poor soil. The first of these experiments was made by Mr. E. G. Austin of Prentiss, Ohio county, Ky., upon soil similar to that on which he made the experiments last season, described in Bullitin 77, but not on the same field. The experimental plots were $\frac{1}{10}$ acre each and the same system was followed as is used in fertilizer experiments at the station and already described in many bulletins except that Mr. Austin added two plots, on one of which he applied "floats" or very finely ground phosphate rock, and on the other bone meal. Each plot was harvested separately and the yields, calculated to the acre, are given in the following table, which shows also the fertilizer used on each plot and the rate per acre at which it was applied; the value of the crop per acre, estimated at 70 cts. a bushel; the cost of the fertilizer and the difference between cost of fertilizer and value of crop.

RESULTS OBTAINED WITH FERTILIZERS BY MR. AUSTIN.

Number of Plot.	Fertilizer Used and Rate Per Acre.	Yield of Wheat Bu. per Acre.	Value of Wheat @ 70c per bu.	Cost of Fertilizer.	Value of Wheat less cost of Fertilizer.
1	None	6⅔	$4.67	0	$4.67
2	Nitrate of Soda, 160 lbs	10⅝	7.58	$3.60	3.98
3	Acid Phosphate, 320 lbs	11½	8.05	2.25	6.80
4	Muriate of Potash, 160 lbs	8⅝	6.18	3.60	2.58
5	None	7	4.90	0	4.90
6	Nitrate of Soda, 160 lbs. / Acid Phosphate, 320 lbs.	15⅙	10.62	5.85	4.77
7	Nitrate of Soda, 160 lbs. / Muriate of Potash, 160 lbs.	11⅓	7.93	7.20	0.73
8	Acid Phosphate, 320 lbs. / Muriate of Potash, 160 lbs.	14½	10.15	5.85	4.30
9	Nitrate of Soda, 160 lbs. / Acid Phosphate, 320 lbs / Muriate of Potash, 160 lbs,	12	8.40	9.45	(1.05)*
10	None	10⅙	7.12	0	7.12
11	Floats, 400 lbs	10½	7.35	.....	.....
12	Bone Meal, 160 lbs	10⅓	7.25	.....	.....

*Less than cost of Fertilizer.

The results bear a general similarity to those obtained by Mr. Austin last season. The greatest increase in yield from the use of any single constituent of fertilizers was given by the acid phosphate, and the use of nitrate of soda and acid phosphate more that doubled the yield. The results from floats and bone meal are not as good as from acid phosphate and acid phosphate with nitrate of soda. Mr. Austin says in his report: "The land upon which these tests were made is very old and

poor. It has been in meadow for a number of years; was broken up in the fall of 1897 and planted in corn the following spring. The yield of corn was about 20 bu. per acre, which was removed from the field and the same sown in wheat on October 21 and 22. The land being wet at the time, the heavy rains that followed caused the wheat to run together and to not all come up. The wheat made very little growth during the fall and winter, and the ground was almost bare at the approach of spring. Very little difference was noticed between the fertilized and the unfertilized plots until near harvest time, when a perceptible difference was observed in favor of plots 3, 6, 8 and 9, which made a slightly ranker growth and ripened a few days in advance of the other plots. Nos. 2, 7, 11 and 12 made a slightly ranker growth than Nos. 1, 4, 5 and 10, but ripened at the same time and were harvested the same day. Plot No. 9 was the nearest level of any in the test and possibly suffered worse than any of the others from winter-killing. The rest of the field was fertilized with 100 lbs. acid phosphate per acre and yielded 10 bu. per acre. Other land near by of about the same quality, sown two weeks earlier and fertilized with the same kind of fertilizer, made a better yield and showed a greater difference between the fertilized and the unfertilized portions. I am convinced that wheat should be sown in time to make some growth before winter sets in, to obtain the best possible results from the use of fertilizers."

It appears from the figures that the ground on which the experiment was made is somewhat richer near plot 10 than on plots 1 to 5, and the latter produced about 7 bu. of wheat to the acre without any fertilizer. If this is accepted as correct, it appears that the increase in yield caused by the use of acid phosphate, paid about $2.00 per acre over and above the cost of the acid phosphate. In the case of plot No. 6, on which the largest actual yield was obtained the increase barely paid the cost of the fertilizer. Comparing plots 11 and 12 with plot 10, it appears that "floats" and bone meal had very little, if any effect, on the yield. It was to be expected that plot 12, on which the complete fertilizer was used, would give the largest yield, and the deficiency may be due to some accidental cause, perhaps

winter-killing on this plot, due to its level situation, as suggested by Mr. Austin. The yield on the unfertilized plot No. 10 is higher than was to be expected, judging by plots 1 and 5 and by plots 11 and 12, which should have shown more contrast with the unfertilized plot. Plot No. 6, which produced the largest yield, did not give any profit on the money expended for the fertilizer because of the great cost of the nitrate of soda. If the nitrogen had been supplied in a more economical way, perhaps, by a crop of clover or by barnyard manure, it is quite likely that this plot would have given the largest profit, as well as the largest yield. It must be remembered, however, that the price of wheat has much to do with this calculation. If the wheat were worth $1.00 per bushel, the largest profit would come from plot 6, being about 40c more per acre than plot 3, where only acid phosphate was used.

The following described experiment was made by the late Mr. J. C. Bingham, of Russell, Greenup County, Ky., after the same plan as the one already described, and was reported by Mr. W. T. Bingham.

RESULTS OBTAINED WITH FERTILIZERS BY J. C. BINGHAM.

Number of Plot.	Fertilizers Used and Rate Per Acre.	Yield of Wheat, Bu. Per Acre.	Value of Wheat, @ 70c Per Bu.	Cost of Fertilizer	Value of Wheat Less Cost of Fertilizer.
1	None	4¼	$2.98	0	$2.98
2	Nitrate of Soda, 160 lbs	5⅛	3.62	$3.60	0.02
3	Acid Phosphate, 320 lbs.	4½	3.15	2.25	0.90
4	Muriate of Potash, 160 lbs.	6	4.20	3.60	0.60
5	None	5½	3.85	0	3.85
6	Nitrate of Soda, 160 lbs Acid of Phosphate 320 lbs.	8½	5.25	5.85	(0.60)*
7	Nitrate of Soda, 190 lbs. Muriate of Potash, 320 lbs.	4⅝	3.38	7.20	(3.82)*
8	Acid Phosphate, 320 lbs. Muriate of Potash, 160 lbs.	7⅛	5.02	5.85	(0.83)*
9	Nitrate of Soda, 160 lbs Acid Phosphate 320 lbs Muriate of Potash, 160 lbs.	9½	6.36	9.45	(3.09)
10	None	5⅔	3.97	0	3.97

*Less than cost of Fertilizer.

Mr. Bingham says "The wheat was sown October 8th, before the fertilizer reached us, and had been in the ground 5 or 6 days when the fertilizer was sown. By October 14th the wheat was showing through the ground, and was well up on all the plots by the 20th. When the wheat was well up there was a marked difference in the appearance of the different plots. On No. 1 it was very short, and the plants seemed spindling and weak. It was still very short at harvest, with very poor heads, only partly filled with grain.

On No. 2 the wheat was somewhat better and seemed to have a better color. No. 3 made a still better showing than No. 2, although when the wheat was threshed, No. 2 turned out more grain. It did not appear to stand the winter as well

as No. 2. No. 4 did not appear much, if any, better than No. 3 in the fall, but seemed to stand the winter better and looked much better by the first of May. No. 5, for some reason unaccountable to me, turned out more grain than some of the fertilized plots. It is possible that the soil contained more natural fertility than some of the other plots, although I could not perceive that it did. No. 6 made a much better showing last fall than any of the other plots except Nos. 8 and 9, and stood the winter well. No. 7 did not seem to get as good a start as No. 6 in the fall, but stood the winter fairly well. The heads, however, were rather short. No. 8 seemed about equal to No. 6 last fall, but appeared to be damaged more by the cold weather. The grain was not as large and plump as in No. 6. No. 9 was much better than any of the other plots except No. 6. The wheat grew much better, stooled more and was in much better condition in the spring. The grain also seemed more plump and sound and weighed more, according to bulk, than that from any of the other plots. Plot No. 10 received more protection form snow than the others, being somewhat on the protected side of a hill while the other plots were on top of the ridge, which may account for the slightly better result obtained here than on the other unfertilized plots."

The experiment seems to have been conducted with great care by Mr. Bingham, but the results are unsatisfactory. A much larger increase from the use of fertilizers on such a poor soil was to have been expected. The complete fertilizer gave the largest increase in yield, but none of them produced increase enough to pay the cost of the fertilizer.

2. VARIETY TESTS.

The number of varieties tested during the season of 1898-1899, was increased to 33, the additions being mostly red wheats. They were all planted October 20, after having first been treated with copper sulphate, to prevent smut. As usual, they were sown in twentieth-acre plots. The stand was not good, but the quality of the grain was better than in either 1897 or 1898, and some of the new varities proved remarkably fine. It is with the desire of bringing some of these to the attention of our wheat growers that this brief bulletin is prepared. The wheat was harvested June 24.

The Season.—The following table shows the rainfall per month, highest, lowest and average temperature, and the amount of sunshine during the wheat season:

Months, 1898-1899.	Per Ct. Sunshine.	Clouds.	Amount of Rainfall in inches.	Temperature Degrees.		
				Mean.	Highest.	Lowest.
September	47.	53.	3.55	72.0	82.1	61.9
October	38.	62.	5.27	56.0	63.9	48.2
November	37.	63.	2.89	43.0	51.0	34.9
December	44.	56.	2.80	32.9	41.1	24.7
January	40.	70.	6.69	33.8	41.2	26.4
February	46.	64.	2.84	24.5	31.5	17.5
March	43.	69.	8.61	42.0	70.	1.
April	63.	54.	2.16	56.0	86.	24.
May	64.	55.	3.63	66.7	74.8	58.6
June	77.	37.	2.55	74.6	95.	51.

List of Varieties and Field Notes

The following field notes were made by Mr. Harper on June 16, and serve to give a list of the varities tested, as well to indicate the period at which they ripen. Varieties 1-19 inclusive, are red wheats.

No. 1. Jones's Winter Fife. Averages 10 stalks to a stool. 42 inches high. Still green.

No. 2. American Bronze. 9 stalks to a stool. 43 inches high. Still green.

No. 3. Beech-wood Hybrid. 11 stalks to a stool. 45 inches high. Ripe.

No. 4. Pride of Genesee. 9 stalks to a stool. 46 inches high. Still green.

No. 5. Indiana Swamp. 6 stalks to a stool. 40 inches high. Almost ripe.

No. 6. Rice Wheat. 11 stalks to a stool. 45 inches high. Ripe.

No. 7. Jones's Bearded. 11 stalks to a stool. 41 inches high. Green.

No. 8. Pride. 13 stalks to a stool. 45 inches high. Green.

No. 9. Kansas Mortgage Lifter. 14 stalks to a stool. 45 inches high. Almost ripe.

No. 10. Fultzo-Mediterranean. 12 stalks to a stool. 44 inches high. Almost ripe.

No. 11. Rudy. 15 stalks to a stool. 40 inches high. Beginning to ripen.

No. 12. Diamond Grit. 10 stalks to a stool. 42 inches high. Beginning to ripen.

No. 13. Turkish Red. 12 stalks to a stool. 44 inches high. Beginning to ripen.

No. 14. Lancaster Red. 13 stalks to a stool. 44 inches high. Almost ripe.

No. 15. Fulcaster. 10 stalks to a stool. 41 inches high. Almost ripe.

No. 16. Harvest King. 12 stalks to a stool. 40 inches high. Ripe.

No. 17. Fultz. 9 stalks to a stool. 44 inches high. Almost ripe.

No. 18. Jersey Fultz. 15 stalks to a stool. 42 inches high. Almost ripe.

No. 19. Extra Early Oakley. 9 stalks to a stool. 38 inches high. Almost ripe.

No. 20. Democrat. 12 stalks to a stool. 39 inches high. Beginning to ripen.

No. 21. Early White Leader. 8 stalks to a stool. 40 inches high. Green.

No. 22. Harvest Qneen. 10 stalks to a stool. 37 inches high. Beginning to ripen.

No. 23. Oatka Chief. 8 stalks to a stool. 39 inches high. Green.

No. 24. Longberry Amber. 7 stalks to a stool. 36 inches high. Green.

No. 25. Gold Coin. 8 stalks to a stool. 34 inches high. Beginning to ripen.

No. 26. Early Genesee Giant. 10 stalks to a stool. 35 inches high. Beginning to ripen.

No. 27. Early Arcadian. 7 stalks to a stool. 36 inches high. Green.

No. 28. Bearded Winter Fife. 10 stalks to a stool. 40 inches high. Beginning to ripen.

No. 29. Gold Coin? 6 stalks to a stool. 32 inches high. Green.

No. 30. White-seeded Golden Cross. 7 stalks to a stool. 34 inches high. Green.

No. 31. Jones's Longberry, No. 1. 5 stalks to a stool. 33 inches high. Green.

No. 22. Long Amber. 7 stalks to a stool. 32 inches high. Green.

No. 33. Dawson's Golden Chaff. 6 stalks to a stool. 30 inches high. Beginning to ripen.

Samples of the threshed wheat were submitted to Mr. A. B. Bleidt (with C. S. Brent, Seedsman, Lexington) and Mr. W. W. Patterson of the Lexington Roller Mills, who rated them as follows, the numbers of varieties being arranged according to milling quality.

RED WHEAT.

Mr. Bleidt: 13, 6, 9, 10.

Mr. Patterson: 5, 8, 6, 18, 9, 10, 3, 14, 19, 4, 12, 2, 3. Mr. Patterson considers No. 13 as "very fine, but too hard for this country."

WHITE WHEAT.

Mr. Bleidt: 29, best; 20, second.

Mr. Patterson: 28, best.

YIELD.

There is some difference of method among buyers in getting the weight of samples of wheat. A small measure containing a known portion of a bushel is sometimes filled loosely with wheat which is then weighed and the weight per bushel calculated from it. A test of this method makes our varieties

range from 53¾ to 62 pounds per bushel, whereas by the method always practiced at the Station our heaviest wheat this year weighed 66½ pounds and our lightest 57½ pounds per bushel. Some of this difference can, perhaps, be attributed to the time of weighing, our weights given below being obtained soon after harvest, while the others were obtained some time later, but it will be apparent that our method of settling the wheat in the measure by jarring will always give a greater weight than the other, other conditions being the same.

Number.	Name.	Yield Per Acre.		Weight Per bushel.
		Bush., Grain.	Lbs., Straw.	
1	Jones's Winter Fife	6.6	789	60
2	American Bronze	8.2	989	62
3	Beech-wood Hybrid	10.6	1034	64
4	Pride of Genesee	8.5	1011	62
5	Indiana Swamp	13.0	1443	66
6	Rice Wheat	13.2	1798	66
7	Jones's Bearded	7.9	1273	60
8	Pride	12.9	1267	62
9	Kansas Mortgage Lifter	14.6	1466	66½
10	Fultzo-Mediterranean	13.2	1023	64
11	Rudy	11.6	1074	62¾
12	Diamond Grit	12.	1239	64¾
13	Turkish Red	13.9	1557	66
14	Lancaster Red	11.7	1409	64
15	Fulcaster	10.1	1148	62¾
16	Harvest King	12.3	1023	64
17	Fultz	10.8	1079	66
18	Jersey Fultz	12.	1028	64½
19	Extra Early Oakley	9.3	1261	66
20	Democrat	11.8	1426	64½
21	Early White Leader	7.4	1148	60
22	Harvest Queen	8.2	1028	60½
23	Oatka Chief	5.2	801	58½
24	Longberry Amber	6.3	892	62
25	Gold Coin	6.1	716	61½
26	Early Genesee Giant	5.9	898	61½
27	Early Arcadian	4.7	761	59½
28	Bearded Winter Fife	8.9	489	64
29	Gold Coin ?	4.9	636	57½
30	White-seeded Golden Cross	4.7	966	57½
31	Jones's Longberry No. 1	6.1	898	63½
32	Long Amber	5.1	716	58
33	Dawson's Golden Chaff	5.9	761	61

3. NOTES AND DESCRIPTIONS.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Numbers 3, 5, 6, 9—11, 13, 15—17, 22, 24 and 31 have not been described and figured in bulletins from the Station. Their characters are indicated in the descriptions and figures following. All the other varieties grown this season are described, and most of them figured, in Bulletins 69 and 77, the former published in 1897 and the latter in 1898.

On the whole the new varieties make a much better showing than those which have been grown for some years on the Experiment Farm. The wheat produced by them is as a rule harder, heavier and finer in appearance. Numbers 3, 6 and 9 produced exceptionally fine wheat. Number 13, perhaps the hardest wheat of all those grown this season, is not quite as attractive in appearance, partly because of the small size of its seeds, possibly to some extent because it was not as thoroughly ripe when cut. No. 9, while not by my tests as hard as either numbers 6 or 13, produces a large, deep brown, seed of very fine appearance, and ought to prove a valuable wheat in the hands of Kentucky growers.

But while the quality of the wheat is better on an average than that of wheat grown in 1897 and 1898, the stand was not so good, and for some reason, difficult to explain, the heads or spikes are this year small. The varieties mentioned below, taken at random, show how decidedly a variety may vary with season in the size of the head and consequent number of seeds produced:

Variety.	Year.	Average number of seeds from one head.	Average length of of head in inches.
Early Genesee Giant..	1897	72.5	3.18
	1899	41.25	2.375
Diamond Grit.....	1897	60.	4.19
	1899	40.5	2.875
Jones's Bearded.....	1897	85.75	4.53
	1899	38.5	3.00

It is probable, therefore, that the size of the heads of the new varieties described below is not what it would have been if the conditions had been more nearly those under which our wheat has commonly been grown.

No. 3. Beech-wood Hybrid.

Beardless. Seeds red. Spike (head) not pubescent, tapering to the tip, at which are a few bristles one-half inch long and less. Length of spike 3 inches; diameters equal, about 0.37 inch. Color of spike umber-brown. Stem a trifle purplish. Average number of seeds from a spike, 25.25. Average weight of seeds from a spike, .975 gram. Weight of 10 cubic centimeters of seed, 7.8 grams.

Rust frequent on stem. This is a handsome wheat recognizable in the field by the rather slender brown heads, the spikelets being loosely placed on the axis. The wheat produced is among the best, the seeds being moderately hard, of a deep brown color, and rather above medium size. The variety resembles very closely our number 16 (Harvest King) and may be the same.

The seed of this variety was received from the U. S. Department of Agriculture, and was grown in Ohio.

No. 5. Indiana Swamp.

Bearded. Seeds red and large. Spike of medium size, rather slender and tapering, not pubescent, its bristles as much as 3 inches long. Length 3.05 inches; greater diameter 0.50 inch; lesser diameter 0.375 inch. Spike yellow. Stem slightly purple. Average number of seeds from a spike, 26. Average weight of seeds from a spike, 1.3 grams. Weight of 10 cubic centimeters of seeds, 7.8 grams.

Rust rare. A good wheat, with rather slender head, the chaff disposed to separate so as to show the seed in ripening. Seeds large and of good color. Seed obtained from J. A. Everitt, of Indianapolis, Indiana.

No. 6. Rice Wheat.

Beardless. Seeds red and large. Spike not pubescent, rather small, tapering, with a few short bristles at tip. Length of spike, 2.5875 inches; diameters alike, .375 inch. Color of

spike and stem, pale yellow. Seeds from a spike, 24.5. Weight of seeds from a spike, 1.3 gram. Weight of 10 cubic centimeters of seeds, 8.1 grams.

Rust rare. While lacking in showiness in the field, this variety possesses many desirable qualities, and judging by the fine appearance and quality of its seeds, I am disposed to rate it as the best wheat grown on the Experiment Farm this year. The head is somewhat insignificant in appearance, resembling in this respect Fultz and Extra Early Oakley (Nos. 17 and 19). The seed was obtained from Hon. G. V. Green, of Hopkinsville.

No. 9. Kansas Mortgage Lifter.

Bearded. Seeds red and very large. Spike slender, tapering, not pubescent; average length 3.125 inches; greater diameter, 0.50 inch; lesser diameter, 0.375 inch. Chaff yellow. Stem purplish. Seeds from a spike, 29. Weight of seeds from a spike, 1.3 gram. Weight of 10 cubic centimeters of seeds, 7.95 grams.

Rust frequent on the stems. The Mortgage Lifter is a more showy wheat than No. 6, and might sell better because of the fine appearance of its very large seeds. It is not quite as hard as No 6, and has this year been more affected with rust. It yielded more by weight than any other wheat grown on the farm.

The seed was obtained from Hon. G. V. Green, of Hopkinsville, a member of the Board of Trustees.

No. 10. Fultzo-Mediterranean.

Beardless. Seeds red. Spike short and compact, sometimes a little widened at tip, not pubescent, spikelets crowded. Length of spike 2.3125 inches; diameters 0.50 and 0.37 inch. Color or spike yellow; of stem, purple. Number of seeds from a spike, 34.75. Weight of seeds from a spike, 1.275 gram. Weight of 10 cubic centimeters of seeds, 7.7 grams.

Rust common. Seed obtained from J. A. Everitt, of Indianapolis, Indiana.

No 11. Rudy.

Strongly bearded, Seeds red and large. Spike rather large, the spikelets loosely placed, not pubescent. Length of spike 3 inches; diameters 0.50 and 0.375 inch. Color of spike and stem yellow. Seeds from a spike, 24.25. Weight of seeds from a spike, 1.125 gram. Weight of 10 cubic centimeters of seeds, 7.75 grams.

Rust frequent. This is a showy wheat, with large brown seeds, but ripened later than some of the preceding varieties. Seed obtained from J. A. Everitt, of Indianapolis.

No. 13. Turkish Red.

Strongly bearded. Seeds red, small. Spike small and tapering decidedly to the tip, not pubescent, the spikelets somewhat loosely placed. Length of spike, 2.3125 inches; diameters 0.375 and 0.25 inch. Color of spike and stem pale yellow. Average number of seeds from a spike, 22. Average weight of seeds from a spike, 0.675 gram. Weight of 10 cubic centimeters of seeds, 8.25 grams.

Rust rare. This differs from all other varieties grown on the farm in the small size of its spikes, their noticeable contraction in diameter towards the tips, and the small size and extreme hardness of the seeds. Only No. 6 approaches it in the latter quality.

The seed was obtained from the U. S. Department of Agriculture.

No. 15. Fulcaster.

Bearded. Seeds red. Spike of medium size, flattened, tapering, not pubescent. Length of spike, 3 inches; diameters 0.50 and 0.375 inch. Color of spike obscure yellow. Stem purplish. Seeds from a spike, 26.5. Weight of seeds from a spike, 1.2 gram. Weight of 10 cubic centimeters of seeds, 7.7 grams.

Rust frequent. A good wheat, of rather large size. The sample shows some evidence of mixing with No. 16, in occasional brown heads among the others.

The seed was sent to the Station by the U. S. Department of Agriculture.

No. 16. Harvest King.

Beardless. Seeds red, of medium size. Spike moderately long, but slender, flattened and tapering, not pubescent. Length of a spike 3 inches; diameter 0.50 and 0.375 inch. Color of chaff, umber-brown; of stem, yellow. Seeds from a spike, 31. Weight of seeds from a spike, 1.225 gram. Weight of 10 cubic centimeters of seeds, 7.65 grams.

Rust frequent. A rather handsome wheat, closely like No. 3 (Beech-wood Hybrid), and possibly the same. Occasional pale heads interspersed among the sample indicate some crossing with No. 15, such heads even bearing occasional long bristles. Seed obtained from J. A. Everitt, Indianapolis.

No. 17. Fultz.

Beardless. Seeds red. Spike rather small and slight, tapering, not pubescent. Average length 2.6875 inches, diameters, 0.375 and 0.375. Color of chaff and stem, yellow. Number of seeds from a spike, 33.5. Weight of seeds from a spike, 1.125 gram. Weight of 10 cubic centimeters of seeds, 8. grams.

Rust frequent. One of the best of the varieties grown, closely resembling in every respect the Rice wheat already described, but not so hard. Seed obtained from J. A. Everitt, Indianapolis.

No. 22. Harvest Queen.

Beardless. Seeds white. Spike stout, and thickened at upper end, the spikelets crowded, not pubescent. Length of spike, 2.6875 inches; diameters 0.50 and from 0.37 to 0.50. inch. Color of chaff and stem yellow. Number of seeds from a spike, 3.56. Weight of seeds from a spike, 1.2 gram. Weight of 10 cubic centimeters of seeds, 7.6 grams.

Rust rare. The short, stout, whitish yellow head of this variety is characteristic. The seeds are large, but soft. Not to be recommended for this region, if judgment may be based on our sample. Seed obtained from J. A. Everitt, Indianapolis.

No. 24. Longberry Amber.

Beardless. Seeds white. Spike rather long and stout, flat, tapering, not pubescent. Length of spike, 3.3125 inches; diameters 0.50 and 0.375 inch. Color of stem and spike yellow. Number of seeds from a spike, 36.25. Weight of seeds from a spike, 1.125 gram. Weight of 10 cubic centimeters of seeds, 7.55 grams.

Rust very rare. This wheat was not well ripened in the sample, but I can see nothing in it calculated to place it in competition with such varieties as Fultz, Harvest King, Rice wheat, and others, for this region. Seed obtained from J. A. Everitt, Indianapolis.

No. 31. Jones's Longberry, No. 1.

Strongly bearded. Seeds white. Spike rather large, not thickened at extremity, not pubescent. Length of spike, 3.1875 inches; diameters, 0.50 and 0.375 inch. Color of chaff umber-brown where exposed, pale where covered. Stem yellow. Seeds from a spike, 29.25. Weight of seeds from a spike, 1 gram. Weight of 10 cubic centimeters of seeds, 7.7 grams.

Rust rare. Perhaps the best of the three new white wheats. Seed obtained from J. A. Everitt, Indianapolis.

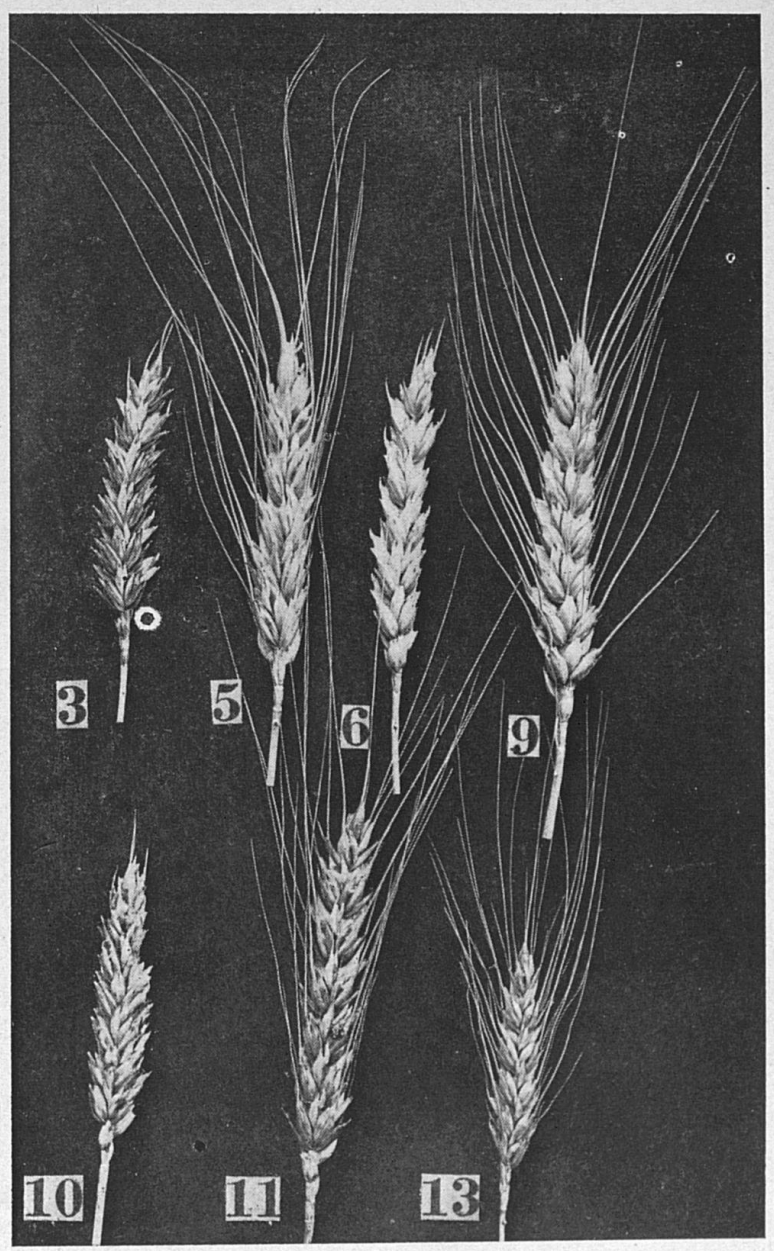


Fig. 1.— 3, Beech-wood Hybrid; 5, Indiana Swamp; 6, Rice Wheat; 9, Kansas Mortgage Lifter; 10, Fultzo-Mediterranean; 11, Rudy; 13, Turkish Red. ½ natural size. Photographed by H. Garman.

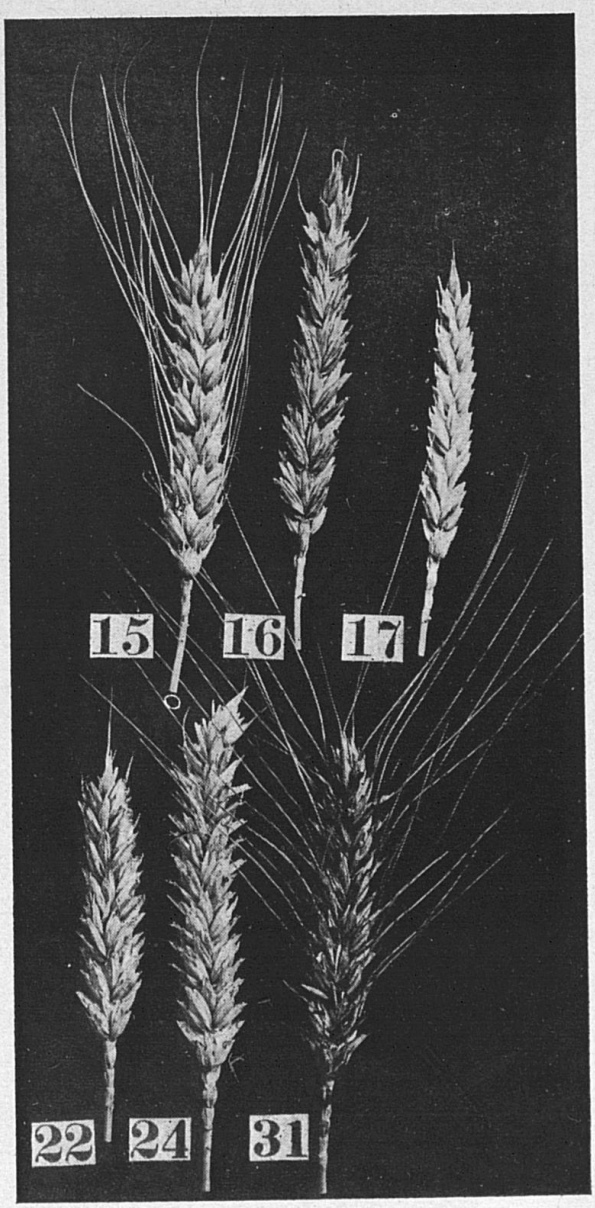


Fig. 2.— 15, Fulcaster; 16, Harvest King; 17 Fultz; 22, Harvest Queen; 24, Longberry Amber; 31, Jones's Longberry, No. 1. ½ natural size. Photographed by H. Garman.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN No. 84.

The Elms and Their Diseases.

LEXINGTON, KENTUCKY,

November, 1899.

51

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.
J. T. GATHRIGHT, Louisville, Ky.
THOS. TODD, Shelbyville, Ky.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.
A. M. PETER, H. E. CURTIS, } Chemists.
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Agriculturist.
EDWARD RHORER, Secretary to Director.

Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

Bulletin No. 84.

The Elms and Their Diseases.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Frequent complaints have appeared in our newspapers concerning the dying of elm trees in central and eastern Kentucky. In a variety of situations, along the streets of cities, about lawns, in woodland pastures, and at the edges of streams, elm trees have stood during the past summer with naked branches, when all was green around. Small and large trees are affected. It is a current notion that some little-understood epidemic, infectious disease is taking the trees, one recent writer specifying so far as to style it zymotic in character, while others have prescribed treatment suggesting that the trouble has something in common with the intermittent fever of man.

Three distinct species of elms are frequent in cultivation in Kentucky, and two others are common along some of our streams. and the mystery surrounding the death of one tree while another near by has all the appearance of health is sometimes due to a failure to recognize the difference between our white elm (*Ulmus americana*), the tree that is really dying in some parts of the State, and its relative, the red elm (*Ulmus fulva*), which holds its own in any situation. Both are beautiful trees with some general resemblances, and when young are likely to be confounded by the unscientific. The third species most commonly seen in cultivation is the English elm (*Ulmus campestris*). In some of our smaller cities this

elm predominates as a shade tree along the streets, native elms being rather scarce. In Nelson county it has been badly defoliated for several years past by the imported elm leaf-beetle (*Galerucella luteola*), and the trouble has in some instances been confounded with the white elm disease. The elm leaf-beetle does not often attack our native elms severely even when they grow near badly infested English elms, and so far as I have observed, the white elm disease does not affect either the red or the English elm.

Several additional exotic elms are in cultivation in America, among which is the Scotch or wych elm (*Ulmus montana*), very likely to be encountered in Kentucky parks, but the following are of special interest to Kentuckians from their abundance, in cultivation and out.

1. The American or white elm (*Ulmus americana*). Leaves smooth and somewhat glossy above, of medium size, with about twelve veins extending outward from the midrib on each side, not very deeply impressed, while the veinlets show scarcely at all. Twigs and buds smooth, the latter rather small and elongate in winter. No corky growth on the branches. Seed with surfaces smooth, the margin of wing fringed. Bark rather smooth in young trees, becoming rougher with age, finally grooved lengthwise of the trunk, its color dark gray. Wood moderately tough, hard, and close-grained, taking a very good polish, but checking quickly when not seasoned properly. The largest of the elms, often reaching a height of one hundred feet.

This elm is best known in America as a shade tree along the streets of cities. Its massive trunk produces a short distance above the ground numerous rather slender branches which extend outward and upward then turn outward with a long sweep and final droop, the gracefulness of which is its chief attraction. The bark is not so irregularly roughened as that of the red and cliff elms, and one can quickly distinguish this species from the others by this character alone. The wood lasts well under water, and has been used for ship building. Young trees about 25 feet high, recently examined by me, had grown at the rate of six inches in diameter of trunk in

fifteen years*. The white elm thrives in deep rich soil. It is seen at its best in valleys and along streams. On uplands it is not so common, nor so stalwart in size.

In this State it has been noted from time to time in Gallatin, Shelby, Franklin, Fayette, Jessamine, Mercer, Rockcastle, Breckinridge, Grayson, Edmonson. Warren, and Hickman counties.

2. The red or slippery elm (*Ulmus fulva*). Leaves large, oval, rough to the touch, downy beneath, with about sixteen veins on each side of the midrib, deeply impressed, as are also the veinlets, giving the surface a rough appearance. Buds large and oval in fall and winter, with a brown pubescence. Wing of seed obovate in outline, not fringed ; surface of seed only, pubescent. Bark dark in color, rough, especially in young trees where it resembles that of the hackberry. Inner bark containing a mucilaginous substance employed in medicine and giving origin to the name slippery elm.

While this tree lacks the stateliness of the white elm, it has a beauty of its own that entitles it to a place on the lawn and in the park. It does not often exceed sixty feet in height, and is disposed to send its branches out horizontally, giving the crown a very different character from that of the white elm. Many red elms are seen in cultivation in Kentucky, having, I suspect, been planted in some instances by mistake. The roughness of its leaf is a ready means of distinguishing it. Its characteristic roughness of bark, also, will enable any one familiar with elms to pick it out at a glance. The leaves are often of very large size on young trees, some of those from a tree growing near the Station building measuring eight inches in length and four inches in diameter. It is partial to rich, damp soil, and is in consequence most common in the vicinity of streams, but trees are to be encountered widely scattered in our forests.

---

*Laslett, the British authority on timbers, is surely mistaken when he says (Timber and Timber Trees, p. 179) that its wood diameter increases only about one inch in fourteen years Though he employs the name *Ulmus americana*, it seems very likely that his statement was based upon an examination of the cliff elm (*U. racemosa*), which is very slow of growth.

It has been noted by me in the following counties: Boyd, Greenup, Wolfe, Fayette, Anderson, Woodford, Jessamine, Rockcastle, Whitley, Hardin, Grayson, Edmonson, Warren, Hickman.

3. The cliff or rock elm (*Ulmus racemosa*). Leaves smooth and glossy, of medium size, with about twenty straight and nearly parallel veins on each side of the midrib; but little impressed, and only occasionally forked before reaching the margin. Winter buds not large and round-oval. Wing of seed oval in outline; not widest outwardly; everywhere downy; long-stalked. Bark light gray and rough, like some of the oaks. Branches with corky knots and irregular ridges; these not present, however, on the new growth. Wood very hard, taking a fine polish.

I have seen this tree in cultivation, but it is not handled so far as I know by local nurserymen, and is not well known in the State, except to wood-cutters in regions where the species grows. It is common along cliffs and rocky banks of the Kentucky River. The trees I have seen thus far are not large, the trunk not exceeding ten inches in diameter, and the height not above forty feet. At the North the species grows to a height of 100 feet or more. The cliff elm is well known to people residing on the banks of Kentucky River, who seem to be impressed more by the hardness of its wood than by any other character. At Brooklyn Bridge, Jessamine County, numerous young elms of this species grow up along the faces of the cliffs, the roots penetrating soil that has accumulated on ledges and in crevices. The wood is harder than that of any other elm native to the State, and is valued for uses requiring strong and durable timber, such as bridge building. Quantities of the timber have been shipped to England from the United States and Canada. A section of a small tree now before me shows eighteen annual rings with a diameter of but two and a half inches. At the same age a white elm would have had more than twice this diameter.

The handsome, glossy leaves with numerous parallel veins, together with the irregular corky growths on the branches, are the most convenient characters for distinguishing this elm.

The only other native elm with these corky growths is the next, and it is a small tree with small leaves, the corky growths of twigs generally in the form of two ridges, one on each side.

The cliff elm has been observed by me along Kentucky River, in Fayette, Jessamine and Mercer counties. Recently Dr. A. M. Peter, of the Station, has called my attention to a clump of these trees standing on the bank of North Elkhorn Creek, about seven miles north of Lexington. A partly decayed trunk observed here measured fifty-four inches in circumference, at about three and a half feet above the ground.

4. The winged elm (*Ulmus alata*). Leaves small, lanceolate; veins on each side of the midrib about 10, not strictly parallel. Buds small. Seed elongate, the wing fringed at the margin. Branches with flat, corky ridges, generally one on each side; these present even among the leaves on the young growth.

This little elm is generally less than forty feet high, and not often more than a foot in diameter of trunk. So far as I know its wood has no great value. Its distribution outside our borders is southern in general, and it has been observed by me only in the southern and western parts of the State.

It is more or less common in the following counties: Bell, Whitley, Rockcastle, Breckinridge, Grayson, Edmonson, Warren, Logan, Todd, Ohio, Christian, Hopkins, McCracken, Fulton, Hickman.

5. The English elm (*Ulmus campestris*). Leaf smooth on large trees, of medium size, broad oval in shape and disposed to be one-sided. Seed placed near the outer end of the wing. Branches (sometimes with corky growths) directed upwards and horizontally, the lower sometimes drooping so that they can be reached from the ground. Bark rough. Wood hard.

This imported elm is very different from ours in its manner of growth. The crown is compact like that of some of our oaks and throws a dense shade. It does not grow to as great a height as either the white or cliff elm. In European countries the wood is valued above that of our species. In culti-

vation the tree varies widely, and some of these variations pass as distinct species with those who are not informed as to their history.

The Scotch or wych elm (*U. montana*) has a rough leaf like our red elm, but its buds are not downy. It is the only other imported elm likely to be encountered in the State ; but it presents some puzzling variations that may lead to the impression that we have many European elms.

THE WHITE ELM DISEASE.

Beginning in 1892 and continuing with greater or less frequency ever since complaints have reached me concerning a diseased condition of elm trees in this State. As early as December, 1893, a bulletin prepared by me was issued by the Station in which (p. 44) is a discussion of the trouble, with suggestions as to remedies. Previous to 1892 there is every probability that the trouble was under way. It was observed in Massachusetts in 1847, and in Illinois in 1883.

Since the "passing" of our elms has thus continued far so long a time without reaching an end, we may hope that some of these beautiful trees will still remain at the close of another half century. But if the death rate continues as during the past two years this hope is not to be realized in Central Kentucky.

The first discernible evidence of disease is a loss of the leaves at the ends of twigs, often at the tops of the trees. As the trouble extends towards the trunk the foliage gradually drops from other parts until finally the tree stands bare. The fallen leaves may show no mark of insect work, certainly none that could cause them to let go their hold on the branches, and the only thing abnormal about them is a discoloration, sometimes present, like that due to the blight fungus of potatoes, the tips or side regions being more or less extensively black. Most of the affected twigs show no external evidence of injury, but in still living trees one may sometimes find part of them thickly covered with little red wart-like pustules, 1-25 inch and less in diameter. These represent a fungus that passes its early stages in the bark and emerges in this shape to develop its

fruit. It is perhaps not actively parasitic, but appears occasionally to invade the wood of trees enfeebled by other causes.

The twigs are sometimes scored also by the buffalo tree hopper (*Ceresa bubalus*) which deposits its eggs in the bark, and old marks of this work are likely to be found on elm trees in this region.

By cutting into the bark of the twigs one may find about the bases of lateral shoots the burrows of a beetle, the small, white, "flat-headed" grub of which eats out the inner layer of bark. It resembles very closely in shape the flat-headed apple tree borer, well known to fruit growers, and belongs to the same family of insects. I find it present in trees not yet dead, but thus far always in dead wood, so that it seems unsafe to pronounce it the cause of the dying, and in fact a tree was recently examined in which none of these twig-infesting grubs could be found. At farthest it is to be considered, like the fungus previously mentioned, a help in the destruction of the tree.

In the inner layer of bark of the trunk, anywhere from the ground up to the bases of the first branches, one will find in most, perhaps all, dying elms the grubs of a wood-boring beetle. The fact, so far as my own experience goes, is that while I have not in one or two cases found these grubs in the bark of trees examined while standing and still living, I have never made a *thorough* examination of a diseased tree, living or dead, without finding some of them.

In August, 1899, two white elm trees growing on the College grounds were dug up and examined from the roots to the tips of the branches. One was alive but showed the disease in naked twigs at the top; the other was dead. They were both about 25 feet high, had a trunk diameter of about seven inches, and appeared to be of the same age, about 18 years. The living tree, when the bark of the trunk was removed from one side, was found to have been attacked by the grubs of a small beetle,* which occurred in large numbers

*Probably *Magdalis armicollis*, a curculio known to infest elms. A part of the trunk is now sealed up in boxes to get the adult when it emerges. Until then it will be impossible to identify them positively.

in burrows made in the inner bark. With them were a few larger grubs of the well-known elm-tree borer (*Saperda tridentata*), a member of a family of wood-boring beetles. A few adults of a third bettle* were found starting burrows in the bark preparatory to placing their eggs. Only one side of the tree was occupied by the grubs, but on this side they were present from the surface of the ground up to the origin of the branches. In some of the twigs were found some of the flat-headed grubs† already mentioned, but they were not common and had evidently but recently become established there. Most of the twigs were sound, and many bore some leaves. On some of the dead ones was present some of the red nodules of the fungus mentioned in another connection. The roots were followed out from the tree to a distance of nineteen feet, and proved to be sound except that the bark when cut into was discolored, and no doubt had ceased to perform its functions some time earlier. The bark of many of the dying twigs was also found to be of a rusty color, though no other evidence of disease was apparent.

The dead tree was in much the same condition as the other, except that the elm borers were here very numerous and had occupied most of the inner bark. The roots were not injured by insects, nor were the twigs mined to such an extent as to give ground for assuming that the injury had started in them. Everything, in short, pointed to the borers in the bark as the immediate cause of the dying.

But insects are not the first cause of the dying.

The white elm has a peculiar way of sending its main roots out close to the surface of the ground. Sometimes a root upon which a tree chiefly depends is covered in places with less than two inches of soil. Roots after leaving the base of the trunk actually turn toward the surface, where they extend for long distances in the rich surface soil. The trees taken up on the college grounds for examination illustrate the point very well. The living tree had three main laterally directed roots of this

*One of the Scolytidæ, *Hylesinus opaculus*.

†I have reared the adult flat-headed apple tree borer (*Chrysobothris femorata*) from diseased elm, but these small grubs are probably the young of some other beetle of the same family.

sort. They were vertically flattened for about eight inches and then contracted rather abruptly to two inches in diameter, tapering gradually from this point to their extremities. After leaving the trunk they rose toward the surface and lay for a distance of nineteen feet out from the tree among the roots of clover and grasses. Besides their main roots were a few whip-like roots of the same sort, lying even nearer the surface than the large ones. The only other roots present were eight small brace roots from one-half to one inch in diameter, which extended downward into the soil at an angle of about 45 degrees. So long as they were uncut the tree stood firmly in place, though the soil was removed for a depth of several feet. The long lateral roots were all cut and still the tree could not be moved until these little roots were severed. The second tree had more of the lateral roots, but they arose and extended outward like those of the first. The brace roots were of the same character and of about the same number.

Trees with such a root system are adapted to alluvial soils, rich and easily penetrated. A certain amount of moisture is also essential to them. Under natural conditions elms grow among other plants, interspersed with other trees. The ground, besides being rich and from situation moist, is protected during winter by a mulch of dead leaves and in summer by shade and perhaps a tangle of undergrowth. Soil so protected does not give up its moisture quickly. But let such trees be exposed to the heat of the summer sun by cutting away all other trees, or by keeping the grass browsed or mowed closely over their long roots, and they become enfeebled in time ready to succumb when any sudden and exceptionally severe drought or freeze comes. Even if the removal of our forests had no other effect than exposing the soil to the sun it is probable that such isolated trees would suffer in time. But removal of vast tracts of forest, coupled with tillage and other processes involved in peopling a country, is known to encourage drought in other ways: By favoring a rapid escape of rainfall by surface drainage, a process that is accelerated artificially by ditching, tile draining and the like, eventually leading to constant late summer droughts from which not only trees but

all other plants suffer. A tree with an extensive root system may not show the effect in one year, or two, but in the course of many years the available food supply becomes exhausted, having been in part leached away by the running waters, and no fresh humus being supplied, the inevitable result is exhaustion for lack of both food and moisture. The effect shows first by the death of tips of branches, the tree not having vitality sufficient to keep up the circulation in the extremities, and the tree becomes "stag headed," to use an imported term.

If one looks about in Bluegrass Kentucky he will see many trees in this condition, oaks, ash and maples. The trouble is of course more or less serious according to the exposure of the roots.

Not only do trees fail to show signs of suffering immediately after the surface is cleared, but it is known to experienced foresters that for a time they grow more rapidly and appear to be in better condition. This is explained as the result of an increased food supply, due to the removal of competitors, to a more rapid decomposition of humus, which results from exposure to the air, and to increased sunlight. It is only after a considerable period that the final effect of deforesting is felt by the trees and perceived by man. Such results are not restricted to this country, but are known among foresters the world over.

I take it we are now witnessing some of these effects in Kentucky, and that our elms feel the change most keenly because of their manner of rooting. The debility brought about by unfavorable conditions such as those described is taken advantage of by the elm tree borer* in some cases, which completes the ruin by girdling trees under the rough outer bark.

This explanation carries its own suggestions as to means of saving the affected trees. Possibly a mulch of humus consisting of decayed leaves and other nutrient materials could be spread on the ground under the trees to supply the food needed and to protect the soil from rapid evaporation, and from heat

*Two other beetles belonging to the same family as the elm borer, were reared by me some years ago from diseased elms, they are *Dularius brevilineus* and *Xylotrechus colonus*.

and cold. At the least, the natural mulch under trees should not be destroyed.

To prevent the injuries of the beetles the suggestion made by me in the bulletin on shade tree insects, and already referred to, must be repeated, namely, the coating of the bark with whitewash containing Paris green or arsenate of lead to prevent the placing of the eggs. The smell of carbolic acid is repulsive to insects, and a little of this might be added to advantage. The borers find rough places on the bark to place their eggs, and cutting away the corky outer layer before applying the whitewash is to be recommended, not only as rendering the surface less attractive to the egg-laying adult, but also as exposing any insects already in the bark to the sun, which is said to destroy them. Quite often the grubs get into the bark at an injured place and spread from this. Such injuries should be sought for, and when found the dead bark be cut away. In some cases the beetles themselves will be revealed and may be destroyed so as to prevent further injury. If the injured place is not extensive, by washing it with a solution of bluestone and then wrapping with stout paper for a time the bark may close over the wound. Such injuries to fruit trees are often treated in this way, and trees threatened with destruction may thus be completely restored.

It is a well known fact that wood-boring beetles spread from diseased trees to others standing near, and to this extent the elm disease may be said to be infectious. They may even be brought into a neighborhood in rough lumber. It follows that dead elm trees and those so badly injured that they cannot recover should be be burned as promptly as possible. The grubs are in the bark in winter, and this is the best time to dispose of such trees. In summer the adult beetles are abroad for a considerable period engaged in placing their eggs, and hence destroying trees at this season is not so likely to get all of the insects. The burning should not be delayed, however, on this account.

Spurious Remedies.

Whenever any disease appears, either of man, of animals, or of plants, some cure-all bobs up and is hailed by the gullible

among human kind as a great scientific discovery. The elm tree disease is not without its unfailing remedy, and more of them are probably to follow. Time and again such bogus remedies are relegated to the limbo from which they have been resurrected, only to be dragged forth again on some new occasion. The *Industrial Gazette*, of Louisville, Ky., published the following in December, 1866:

"A gentleman of Rochester [N. Y.] was lately in Saratoga County, and was there shown an apple tree in fine healthy condition, which had been ill, subjected to treatment with calomel, and thoroughly cured. This tree was afflicted with insects, which were destroying it and rendering it unproductive. A hole was bored into the body of the tree nearly through the sap, and two grains of calomel inserted. As soon as this calomel was taken up by the sap, the vermin on the tree died, and it began to bear fruit and has done so for three years, to the entire satisfaction of the owner. Sulphur may be mixed with the calomel and produce a good effect. This is a fact worth knowing."

Commenting on the above at the time, the editor of one of our entomological journals said, among other things: "I lately heard of a lady who was cured of a violent headache by her husband presenting her with a new bonnet. As soon as the bonnet was put on her head, the headache left her, and never returned for three or four years afterward." The proof of cure is just as good in one case as in the other. It is a well known fact that neither sulphur nor calomel is soluble in water and hence they are not likely to be appropriated by trees in the way supposed. It has been proved by actual test that sulphur introduced in augur holes made in fruit trees remains there intact for years, in one recorded instance until found, to the great astonishment of a wood-chopper, in the family wood-pile. After all, it must be said of such remedies that they imply in their originators a very different type of mind from that of the superstitious man of olden times who looked upon the dying of certain trees as a premonition of disaster and, thus paralized, did nothing to check the trouble.

"'Tis thought the king is dead; we will not stay,
The bay trees in our county are all withered."

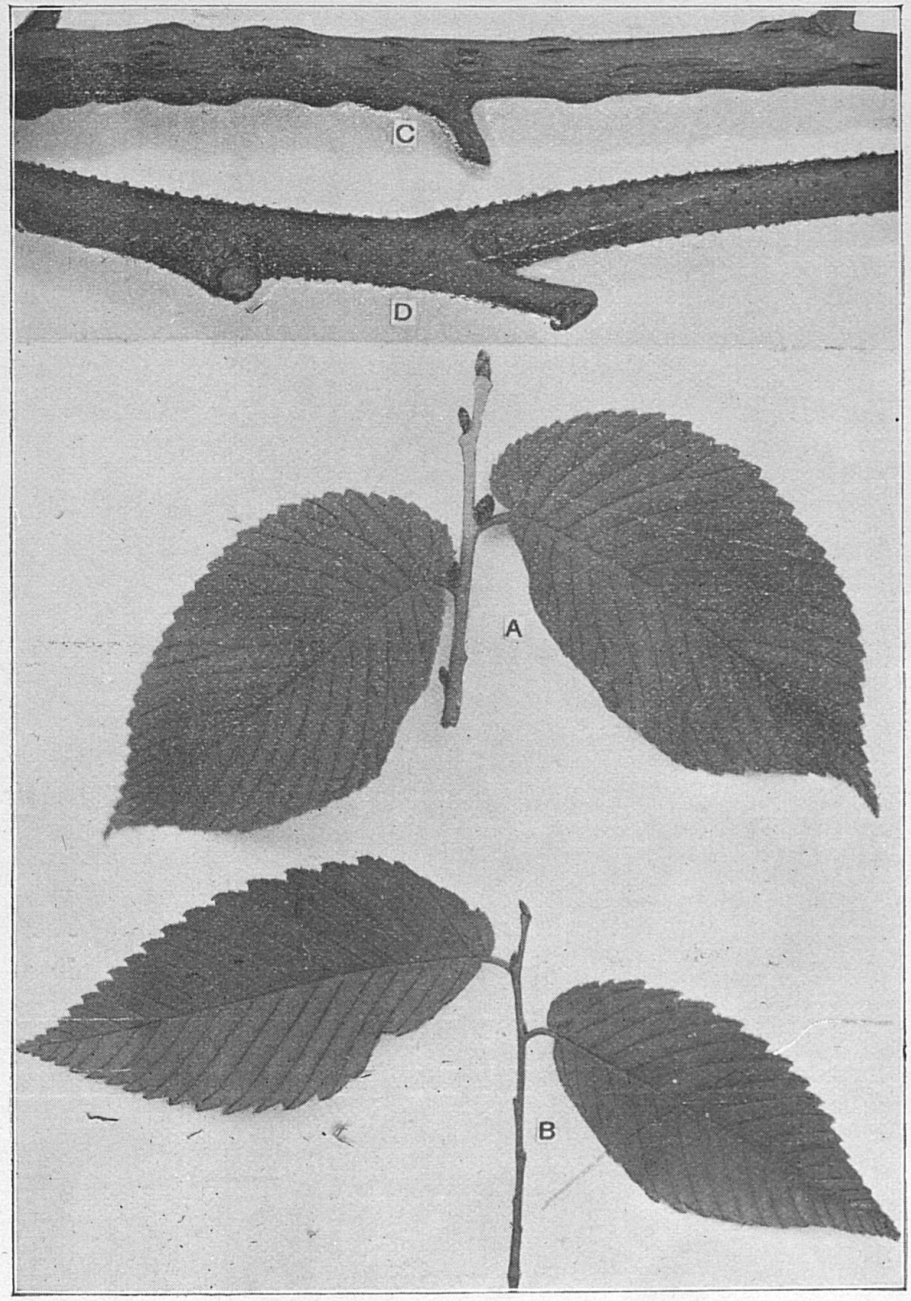


FIG. 1.—A, showing buds and leaves of red elm (*Ulmus fulva*); B, showing buds and leaves of white elm (*U. americana*); C, twig of white elm showing grooves made by the buffalo tree hopper in depositing eggs; D, red fungus (*Nectria sp.*) sometimes present on dead twigs of diseased white elms. A and B, reduced in size. C and D, natural size.

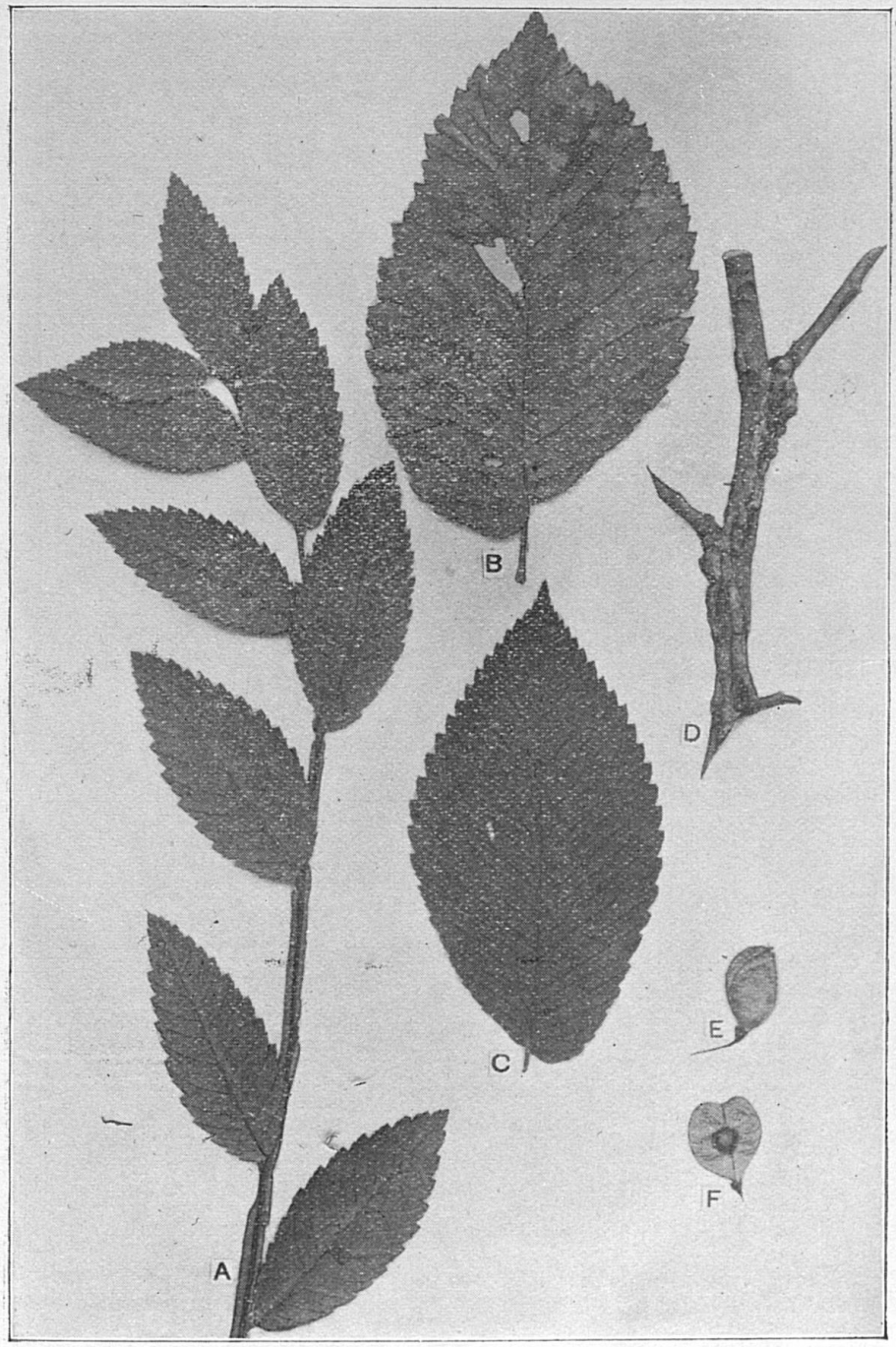


FIG. 2.—A, twig and leaves of winged elm (*Ulmus alata*); B, leaf of English elm (*U. campestris*); C, leaf of cliff elm (*U. racemosa*); D, twig of clift elm showing irregular corky growths E, seed of cliff elm; F, seed of red elm.

FIG. 3.—Stag-headed chinquepin oak (*Quercus acuminata*), growing on the Experiment Farm.

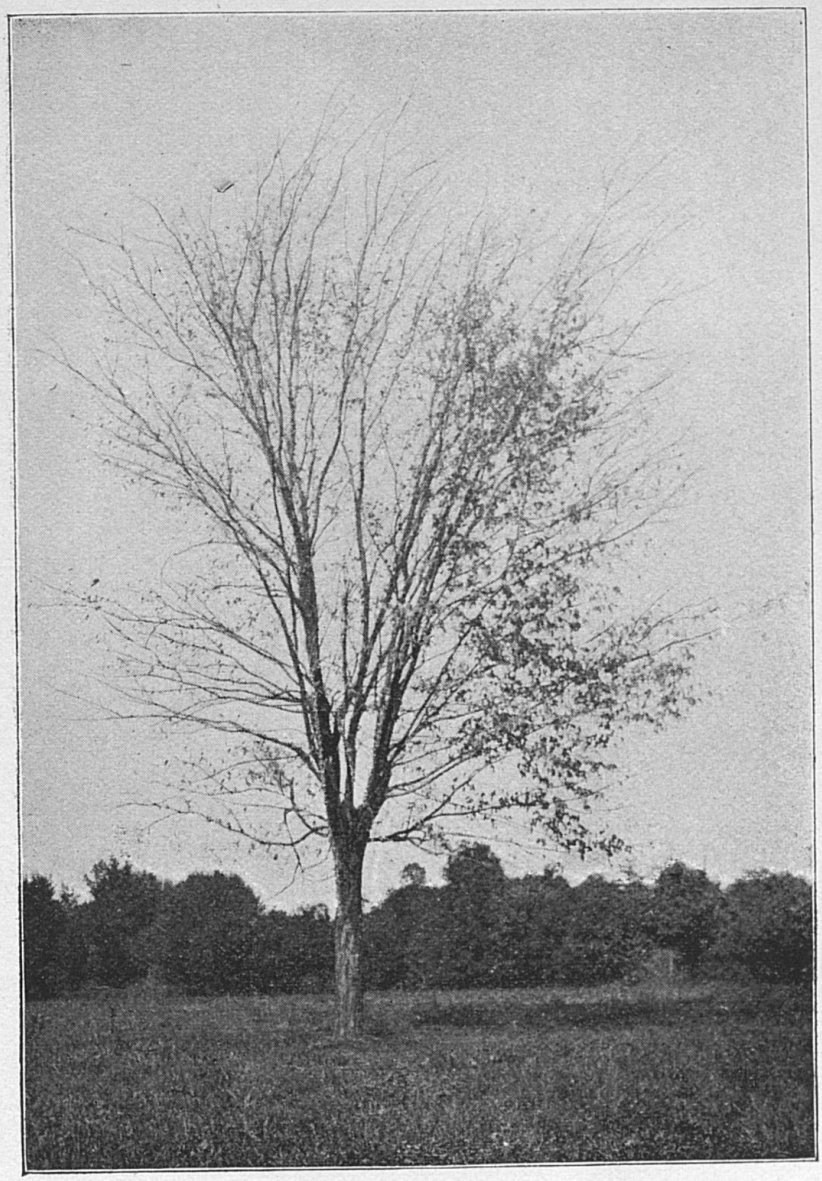


FIG. 4.—A diseased white elm (*U. americana*) growing on the State College grounds. Photographed August 28, 1899.

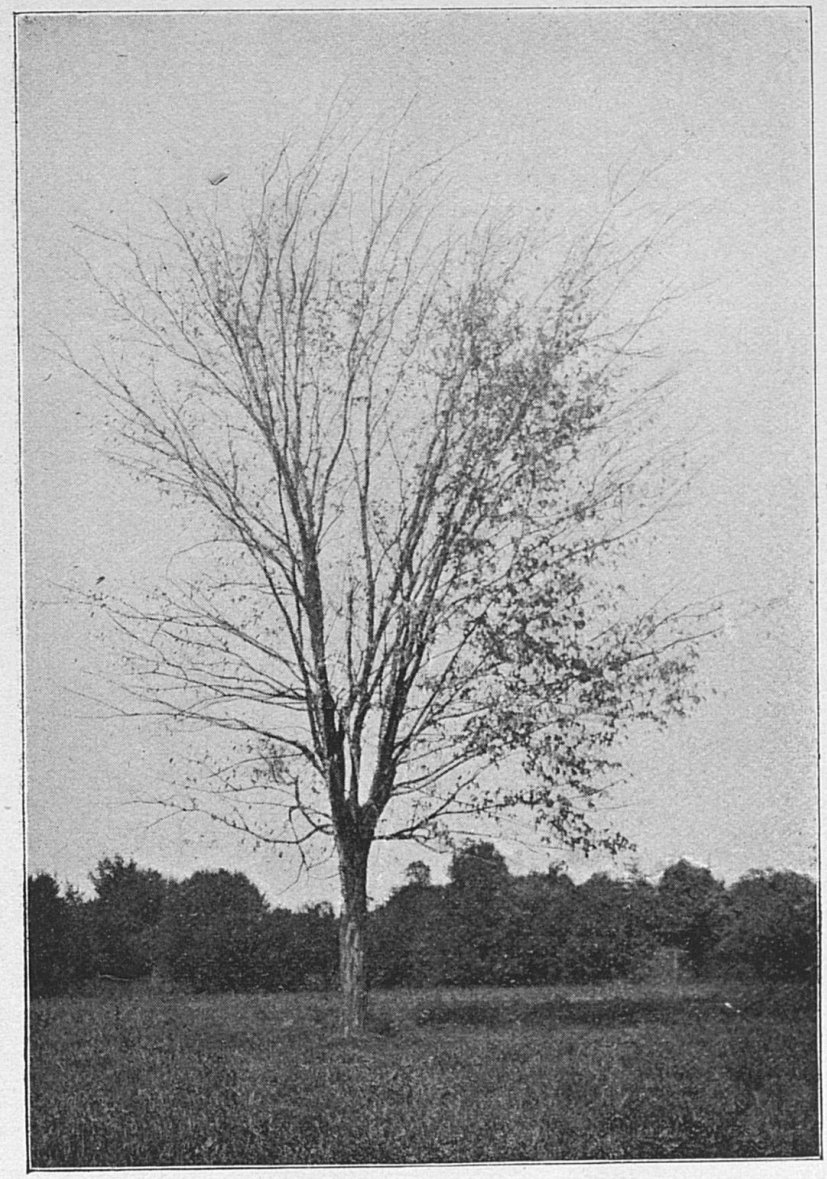


FIG. 4.—A diseased white elm (*U. americana*) growing on the State College grounds. Photographed August 28, 1899.

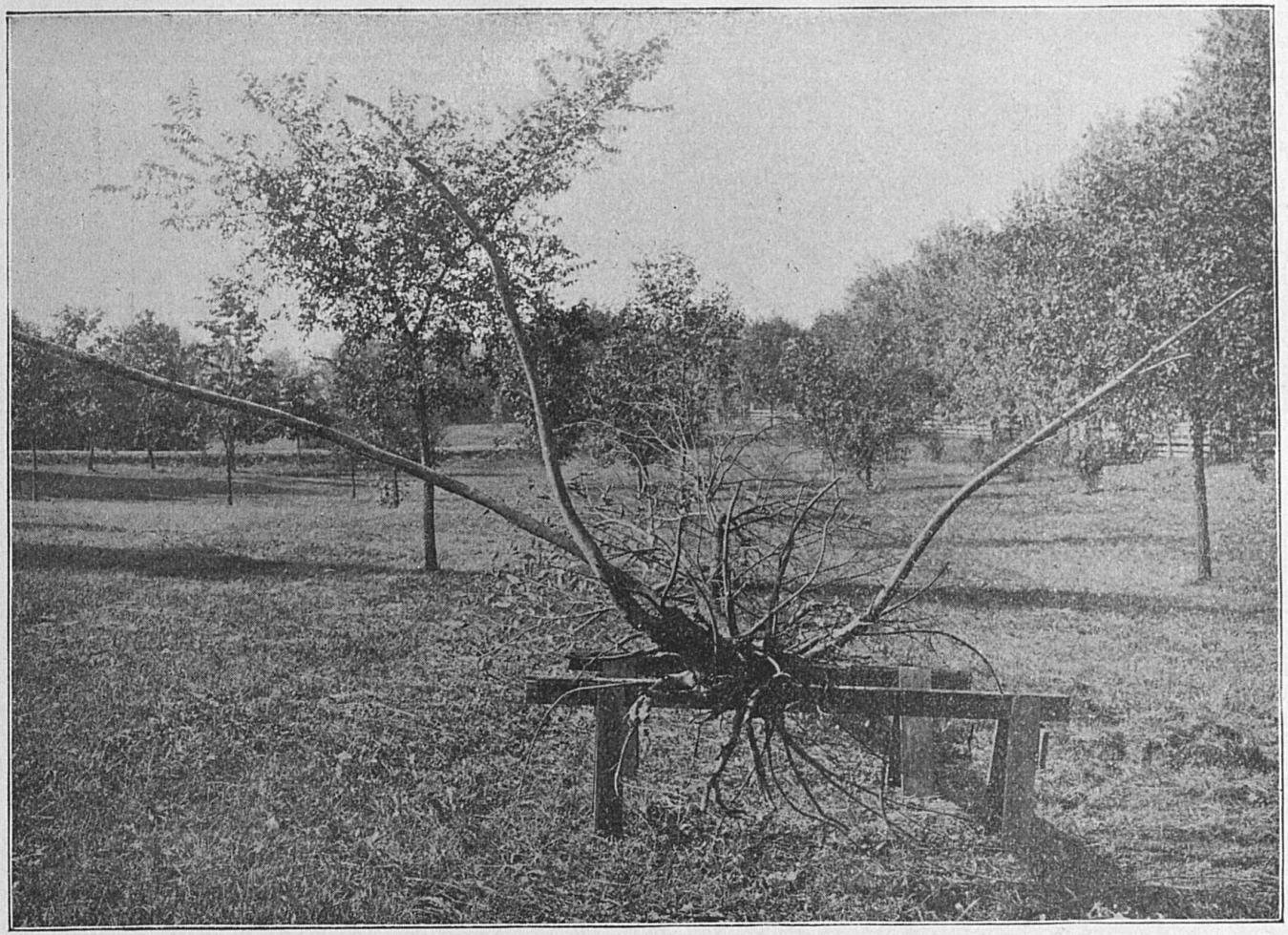


FIG. 5.—Showing the roots of a diseased white elm taken up on the State College grounds. Seen from beneath.

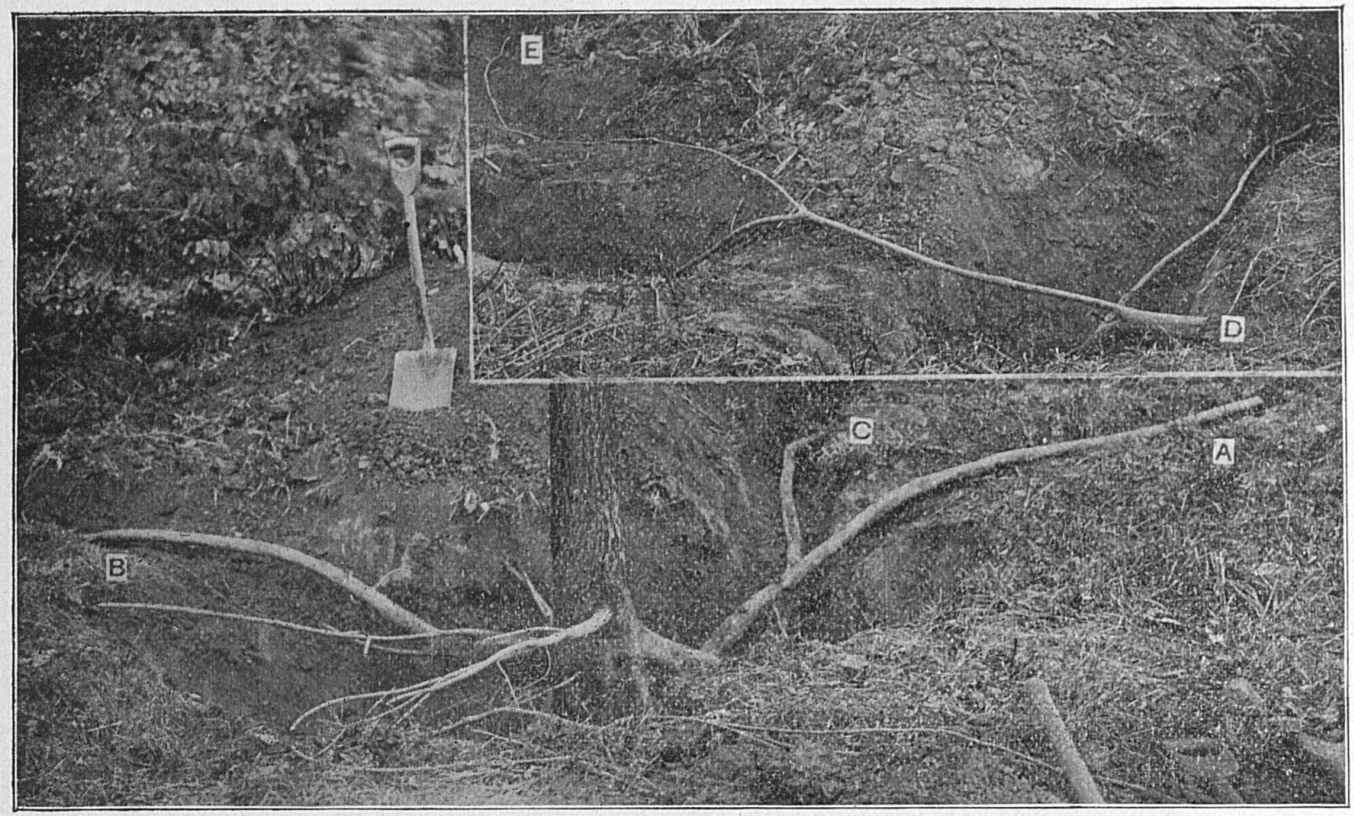


FIG. 6.—The same elm after the roots were uncovered and before it was taken out of the ground. A, B, C, the three main lateral roots; D, continuation of the root C, its extremity nineteen feet from the trunk shown at E.

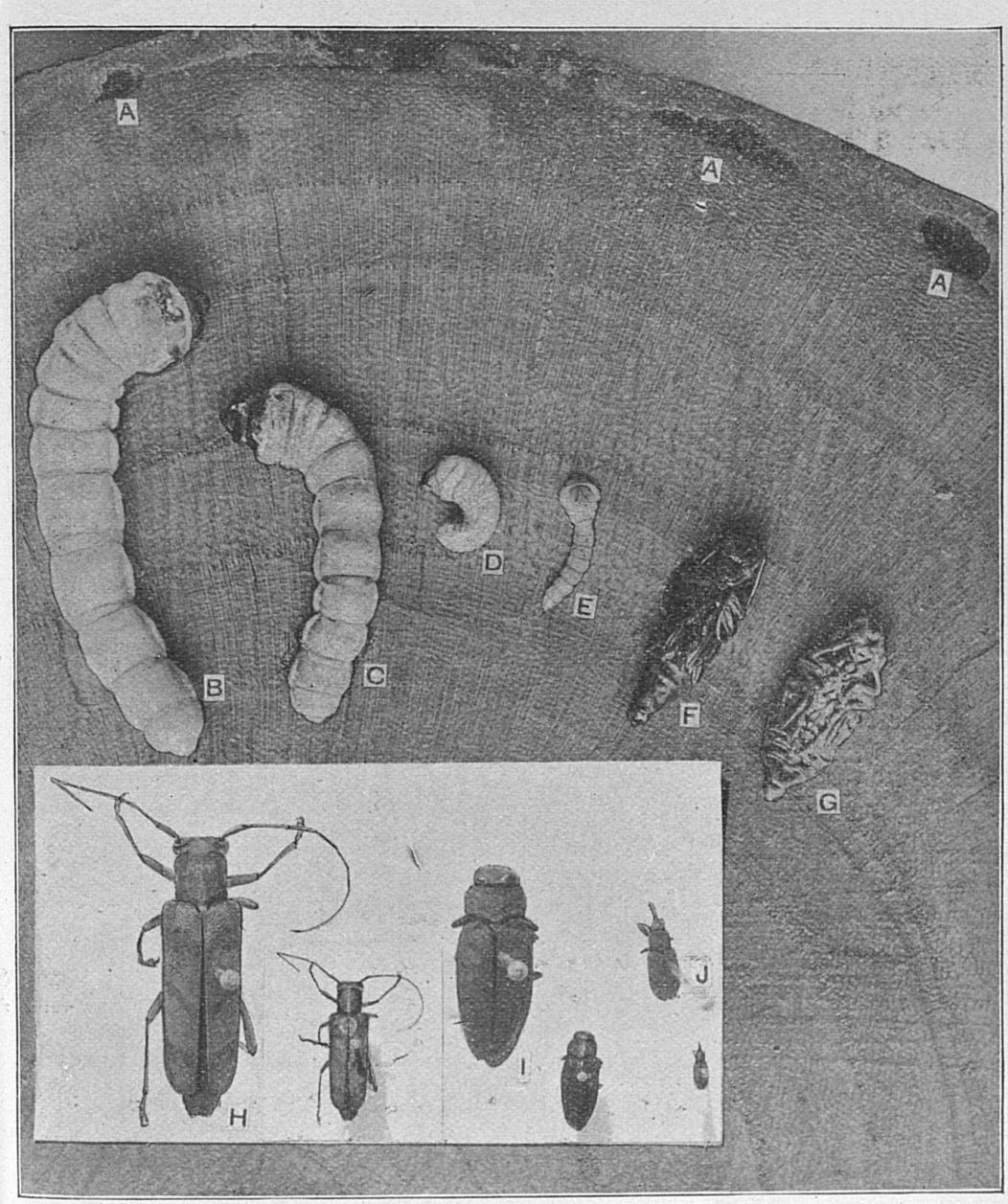


FIG. 7.—Section of the elm represented by Figs 5 and 6, showing the burrows of beetles at A, A, A, in the inner bark. B, C, grubs of elm borers; D, grub of the elm curculio (*Magdalis armicollis*); E, flat-headed grub from white elm; F, pupa of elm borer; G, pupa of flat-headed elm borer; H, adult of elm borer (*Saperda tridentata*); I, adult of flat-headed elm borer; J, elm curculio (*M. armicollis*). Everything enlarged to two diameters, except the small figure at the right of each beetle, which shows the natural size.

THE IMPORTED ELM LEAF-BEETLE.

(*Galerucella luteola.*)

A letter from one of the Sisters at Nazareth Academy, Nelson County, dated June 20, 1898, was received by me, in which the writer stated that hundreds of beautiful English elms on the Academy grounds were then being defoliated by insects, examples of which were sent me with the letter. These proved to be the above beetle. It had appeared at Nazareth three years before, having probably been brought from some eastern State. Since that time it has spread rapidly in the neighborhood, wherever English elms abound, and last June was noted by me as injuring trees along the streets of Bloomfield, at Fairfield, and at Copperas Creek. September 18th of this year I spent a few hours at Bardstown, and found the trees, of which there are numerous fine ones along the streets, badly defoliated, in some cases with only the gnawed remnants of leaves remaining. I was informed by residents of the place that this was the third time the leaves had been destroyed during the season, and examination showed that on some of the trees the leaves then present were young and tender and had not yet attained the normal size. So far as I could learn in the brief time at my disposal, nothing whatever had been done to check the injury.

The adult beetles were abundant at the time on the trunks of infested trees, on the leaves, and on the ground. Many had but recently acquired wings, as was shown by the softness of their integument and absence of the characteristic markings. They were still feeding, but it was evident that their period of activity was about over and that they would soon scatter and find concealment for the winter months. A few of the grubs also remained about the leaves, while at the bases of some of the trees were masses of the insects in all three stages, grub, pupa and adult, the latter consisting of many bodies of spent and dead individuals, with some just transformed, and still others with markings denoting complete maturity. Only the eggs were at this time lacking to represent all the stages in the life-history of the insect.

Nature of the Injury.

The injury to these English elms is very simple and easily understood, being entirely different from that suffered by our native white elm. The grub of the beetle is provided with jaws and gnaws away and devours the leaves, eating at first only the green portion and thus producing numerous whitish spots, as shown in the illustration. The adult beetle also eats the leaves and does a good deal of the mischief. As already stated, the insect does not attack American elms to such an extent as to be the occasion of anxiety for them. Examples of these, standing near badly infested English elms at Bardstown, were noticed to be entirely free from attack. Experience with the pest in other parts of the country is to the same effect, though in some observed instances our elms have been resorted to by broods of beetles that were starved to it by exhausting the foliage on European elms.

Description.

The Adult. Length about ¼ inch ; greatest width about ⅛ inch ; somewhat flattened from above downward, but the back convex. General color obscure yellowish brown. Head immersed in the thorax, marked with a transverse black spot above the bases of the antennæ, which may or may not be connected with a triangular black spot on the occiput ; a broad black spot behind each eye, sometimes concealed ; antennæ short, about half the length of the body ; pale, edged with black. Thorax short and wide, deeply indented each side of the middle, with a black spot on each side near the outer margin, and a third of smaller size before the middle of the hind margin, this latter spot extending forward toward the front and sometimes terminating in a slightly expanded tip. Legs short, pale, often with a black dot above on each femur, generally with one below on the two hind pairs ; tibiæ with a line of black behind. Triangular plate (scutellum) at base of wing covers with a transverse central black spot. Wing covers with a stripe of black extending from the front margin and gradually expanding to terminate without reaching the hind margin. A narrow line extends backward from the

front edge of each wing cover, inside the large stripe, and terminates rather abruptly about 1-6 the distance to the hind extremity. Body beneath pale at the margins; dark centrally.

The colors vary a good deal in individuals, some being very dark with the markings scarcely discernible while others present the ground color and black stripes and spots in sharp contrast. The beetle resembles in general shape the well known striped cucumber beetle, is in fact a member of the same family.

The Pupa. Length rather less than ¼ inch, owing to the front and hind parts of the body being bent downward; width about ⅛ inch; back arched, under side incurved. White, without evident markings, but under a hand magnifier seen to be marked above with regularly arranged black dots, from each of which arises a short black bristle. Margins of three abdominal segments with flattened, plate-like projections, each with a short black tooth. Head, legs, and wing-pads folded close against the breast.

The Larva or Grub. Length about ⅓ inch; diameter about 1-10 inch; rather blunt at extremities. Skin roughened with small tubercles bearing short hairs, those forming two series on the lower part of each side being larger and more conspicuous. General color brown, young being lighter, older ones nearly black, with a wide band of black along each side, formed of closely placed black spots. Head and legs black.

The Egg. About 1–25 inch in height, being conical and pointed at the free end, the attached end being broadest. Yellow, or dull whitish in color if empty. Attached to the under sides of leaves in elongate clusters of from 15 to 30 eggs.

On the approach of cold weather the beetles leave the elm trees and scatter about in search of hiding places for the winter. These they find in all sorts of crevices about outbuildings, fences, and refuse of various sorts, and here they lie dormant until the following spring, when the warmth of the sun stirs them to activity again. They resort to the trees and begin to feed on the young leaves as soon as the latter

appear, eating round holes in them and often riddling them badly. At the same time they place the clusters of eggs on the under sides of the young leaves, producing in all as many as six hundred, but scattering them about in small clusters, so that the young may not suffer from being over crowded. They may be present about the trees for three weeks or a month. When the young larvæ hatch they feed on the green substance of the leaves, gnawing it away from the under side and leaving translucent patches which look like holes when the foliage is between one and the light. All of the green substance may be thus gnawed away, leaving only the brown skeleton. The length of time passed as a grub is about two weeks, when they creep down the trunk of the tree and change to pupæ under rubbish commonly, but sometimes completely exposed on the ground at the base. They pass about two weeks in this quiescent stage, when the skin is moulted, and the adult beetle emerges. It is at first white, like the pupæ, but gradually the skin becomes firmer and darker in hue, the black spots and stripes finally becoming more or less distinct. These beetles resort to the leaves again to lay eggs for a second brood, and thus the injury is kept going all summer; for with the long time required by the female to place all her eggs there is a wide difference in the times of hatching of individuals of the same brood, consequently the broods overlap and there is no time until October when most of the stages of the insect may not be found about the trees. A third brood probably develops at this latitude.

Its Means of Spreading.

The imported elm leaf-beetle was known in eastern states sixty years ago, but appears to have spread slowly, and has not been known in the interior until during the past three years. Its slowness in reaching this State has not been due to any deficiency in its organs of locomotion. The larva creeps rather slowly, having only short legs, and is evidently not the stage chiefly concerned in disseminating the species. The jointed legs of the adult too are rather short, but it can travel well, though slowly, and by their use can easily find its way from tree to tree, when these are not widely separated. But

its relatively large membranous wings are of most importance to it as means of finding new feeding grounds, and there is no reason why it should not, with their use, fly long distances. I suspect it is somewhat handicapped in this country by the fact that it is pretty closely restricted to the English and Scotch elms, and as these are not very generally grown, wandering beetles stand a good chance of starving before finding appropriate food. It seems altogether probable that they were brought to Nazareth with plants of some sort, possibly as eggs on the leaves of young elms, possibly as beetles hibernating among material used as packing.

Treatment.

Gnawing insects such as this can generally be best dealt with by applying poisonous substances to their food This is easily enough done when the plants to be treated are small, but becomes more difficult with trees because of the trouble involved in reaching the tops of large ones. It requires a good strong force pump, and sufficient strongly made hose to allow the one who handles the spray nozzle to climb up a ladder into the tree. For trees from 60 to 75 feet high, fifty feet of hose, together with the brass extension furnished with same pumps, would probably be sufficient. Trees of eastern cities are now sprayed with such appliances every year, and the cost of treatment has been so far reduced that there is no reason why every city with trees as badly infested as these at Bardstown should not make provision for checking the ravages of the insects. It can be done either by giving the contract of treating all infested trees to some person who will provide apparatus, materials and labor, or by the city itself buying the necessary pumps, hose, etc., and taking charge of the work.

The cost of treating trees varies of course with the size and the number of applications necessary. It is claimed that a contractor can make a profit by spraying trees of all sorts several times for a season at one dollar apiece. The actual cost of treatment has been in some instances reduced to as little as fifteen cents per tree. Few people are willing to part with a fine elm for many times the cost of treating it, yet it is to

be feared that many trees in Nelson County will be destroyed before owners are aroused to the necessity for spraying.

In a recent bulletin the State Entomologist of New York, writing of a Daimler gasoline motor (See figure 13), made under the direction of Dr. E. B. Southwick, of the department of public parks, New York City, says that it is perhaps the best apparatus yet designed for spraying trees:

"It consists of a Daimler gasoline motor operating a Gould force pump—the motor and pump weighing but 300 pounds can be placed in the bottom of a spring wagon along with the 100-gallon tank containing the poisonous mixture. This motor has the advantage of being almost noiseless in operation, and is scarcely noticed by passing horses. It is very inexpensive to operate, as a gallon of gasoline is sufficient for a day, and it requires so little attention that a tyro can run it. The smallest size Gould 3-piston pump is the one used with the motor, although Dr. Southwick now recommends a larger one in order to utilize the power more fully. The motor costs $250 and the pump about $50. They can easily supply four lines of hose, although not more than two can be used to advantage in most places."

One of the most charming features of Bardstown is the number of fine elms that line its streets. The citizens of the place could well afford to spend the above amount rather than have them removed, or continually made unsightly by myriads of gnawing insects.

The poison most commonly employed for spraying is Paris green, and water in proportions varying with the plant to be sprayed, some being much more tender than others. About one pound of the poison in 100 gallons of water may be used on elms, but the addition of a pound of slaked lime is recommended by those who have had experience in the East, as a precaution against burning the leaves, and also as a means of making the poison adhere longer. Arsenate of lead and other compounds not soluble in water are now being employed to some extent in place of Paris green, the advantage in their favor being that they can be used in much greater quantities without burning foliage. Arsenate of lead has been used

in the proportion of twenty pounds in 150 gallons of water. This insecticide can now be bought for about 10 cents per pound. It remains in suspension better than Paris green, and contains no particles to clog the nozzle used in spraying.

Time to Spray.

The proper time to spray is early spring, as soon as the leaves unfold and the beetles begin to lay their eggs. A thorough application made at this time should greatly lessen the mischief for the season by destroying both the adults and any young that might subsequently hatch from their eggs. A second application may be required for the young worms if rains follow the first. Where nothing has been done to check the injury, it is probable several additional sprayings will be required. These should be so timed as to get the greatest possible number of insects, and are calculated to do most good when a new brood is appearing. If properly timed and the rainfall is not very great, three sprayings should be sufficient.

Other Treatment.

In addition to spraying, much good can be done by destroying all the worms and pupæ that accumulate just at the bases of the trees. One often sees these so numerous that they can be gathered up by handfuls. While there it is a simple matter to destroy them by the use of a little kerosene emulsion or even hot water.

Enemies.

Several insects have proved valuable friends to us by their onslaughts upon the elm leaf beetle, and their presence about infested elms has sometimes been misunderstood. One of these most likely to attract attention is the praying mantis figured on one of my plates (Fig. 9). It was observed at Bardstown creeping about the infested elms. Another insect noticed feeding on the immature leaf beetles at Bardstown is known as the spined soldier bug (*Podisus spinosus*). Its young was common about the trees. The body is rather flat and about ⅜ inch long, of a brown color, marked with black. It impales the young beetle on its slender beak and sucks its blood. The

same insect is known in potato patches from its destruction of the young Colorado potato beetle. No doubt many other insects gather about the trees to prey upon the helpless pupæ and in course of time it is to be hoped will appreciably reduce the numbers of the leaf beetles. At present they are not numerous enough, and if the trees are to be saved they must be sprayed.

THE ELM LEAF-SKELETONIZER.

(*Canarsia ulmiarrosorella.*)

The leaves of the white elm are sometimes badly gnawed by a native insect whose work is not unlikely to be mistaken for that of the beetle just described. It is a member of a different order of insects, one of the small moths of the family Tineidæ, a group containing many species with similar leaf-skeletonizing or mining traits. This one eats long holes in the leaf between the veins, working from the upper side, where it spins a slight web for its protection. The very young simply gnaw away the green substance, but as they grow older eat through the leaf as stated. I have seen scattered trees on lawns and in pastures that were severely damaged for a season or two, in one case a tree in my own yard having been attacked. It seems to be held in check by parasites, or enemies of other sorts, to such an extent that its depredations never become general. But its injuries are sometimes not less serious to the trees attacked than those of the imported beetle.

The active stage is the larva or worm, which is green, with a black dot on each side of the head above the cluster of simple eyes, and with a larger dot on each side of the first and second divisions of the body following the head. The jointed legs are pale, or in large examples slightly brownish, while the ten soft false legs are black at the tips. Scattered pale hairs arise from the body, those on the hindmost division being noticeable because of their length. Length of an alcoholic specimen, one-half inch. Young worms are paler, and the head is larger relatively, but the black dots on head and body divisions are as described, though the tips of the false legs are not black.

Worms kept in breeding cages at the Station pupated in

some instances about the leaves, while other examples concealed themselves in earth. The adults emerge early in spring during the latter part of March and in April.

The moth is dull gray in general, with a wing expanse of about five-eighths of an inch, the front wings marked at about the middle with a zig-zag line of black, edged imperfectly within and without with white; outside this is a black central spot, followed by another obscure zig-zag pale line edged with black; the outer edge of the wing narrowly black, the wide fringe gray. Hind wings pale gray, translucent, the margin with the fringe narrowly dusky, then pale. Body gray, the edges of abdominal segments paler.

Treatment.

The same treatment is to be recommended for this insect as for the imported leaf beetle, namely, spraying the leaves with either Paris green or arsenate of lead in water. The winter is probably spent among leaves and other rubbish on the ground, which suggests the advisability of raking up and burning for a few seasons material of this sort accumulating under the infested trees.

THE ELM BARK-BEETLE.

(*Hylesinus opaculus.*)

In all the diseased elms examined by me this season, whether dead or not, was found the work of a small, short, thick beetle, quite different from the larger elm borer and also from the elm curcalio (*Magdalis armicollis*). In some of the trees adult beetles were just making their way into the bark, starting either on the trunk or at rough places at the bases of twigs. In other trees extensive systems of burrows were present, like that figured, and in small cavities made at the ends of individual burrows were grubs, pupæ and occasional recently transformed adults. These latter emerged from time to time during the fall in confinement at the Station, the first coming out September 14, and others scattering along until Oct. 15.

The burrows made by the female of this insect and her own offspring are so different from those of other beetles

mentioned in this bulletin that they would be pronounced to be the work of a different insect by almost any one who might encounter them. The mother beetle bores straight into the bark, selecting a point of entrance in a groove of the rough outer bark where the opening will not readily be perceived. Once in the inner bark next to the wood she makes a straight or slightly curved burrow as wide as her body and an inch or thereabouts long, placing her eggs along its sides. When they hatch, the young grubs bore out from the mother's burrow at right angles, or nearly so, each little grub cutting a channel of its own and gradually extending it until it is an inch and three-quarters or two inches long. It is gradually enlarged towards the outer end, and at the extremity is made the cavity where the grub changes to a pupa, and finally to a winged beetle.

While this small beetle is common here and seems to be a constant attendant of dying and dead elms, it appears to be attracted to them only when they are in the last stages of disease, and has in no case been observed by me making its way into living bark. Its singular burrows sometimes attract the attention of people disposed to investigate the elm disease, and have on several occasions been pointed out to me as probably the cause of the whole trouble. The insect and its work are described here to note the differences between it and the elm borer (*Saperda tridentata*), which is a much larger insect, of entirely different shape, making burrows of larger size and of different character.

Should more extended observations show that the insect makes trouble at times by invading the living parts of trees the same treatment is recommended as for the elm borer.

The opaque brownish black beetle is about 0.08 inch long, of compact build, cylindrical, the surface of head and prothorax roughened with closely placed and rather coarse punctures, the wing covers punctured in lines, with the intervals roughened. Entire body with short and stiff hairs. Antennæ short, with a large balloon-shaped firstjoint (the scape), followed by seven small joints (the funicle), which together about equal the first,

these in turn followed by a compact oval terminal club composed of five additional joints. Scutellum rather large but below the level of surrounding parts. Bases of wing covers elevated and forming a ridge. Legs short, the tibiæ flattened and dentate.

A related insect (*Scolytus destructor*) was known years ago as very destructive to elms in the parks and public gardens of London. Westwood, one of the fathers of Entomology, wrote of it in 1839 that it was annually destroying numerous elms about London and that the mischief was spreading into the neighboring country owing to the "inattention or ignorance of those whose duty it is, or ought to be, to adopt decided measures for stopping the mischief." This pest is fortunately not present in the United States, and as noted above, our own most closely related elm-infesting insect has not thus far shown the same aggressive disposition.

FIG. 8.—Showing English elms near the Court-house at Bardstown, stripped of their leaves by the imported elm leaf-beetle (*Galerucella luteola*). A, two adult beetles; B, pupa, seen from beneath; C, larva or grub; the insects all enlarged to two diameters.

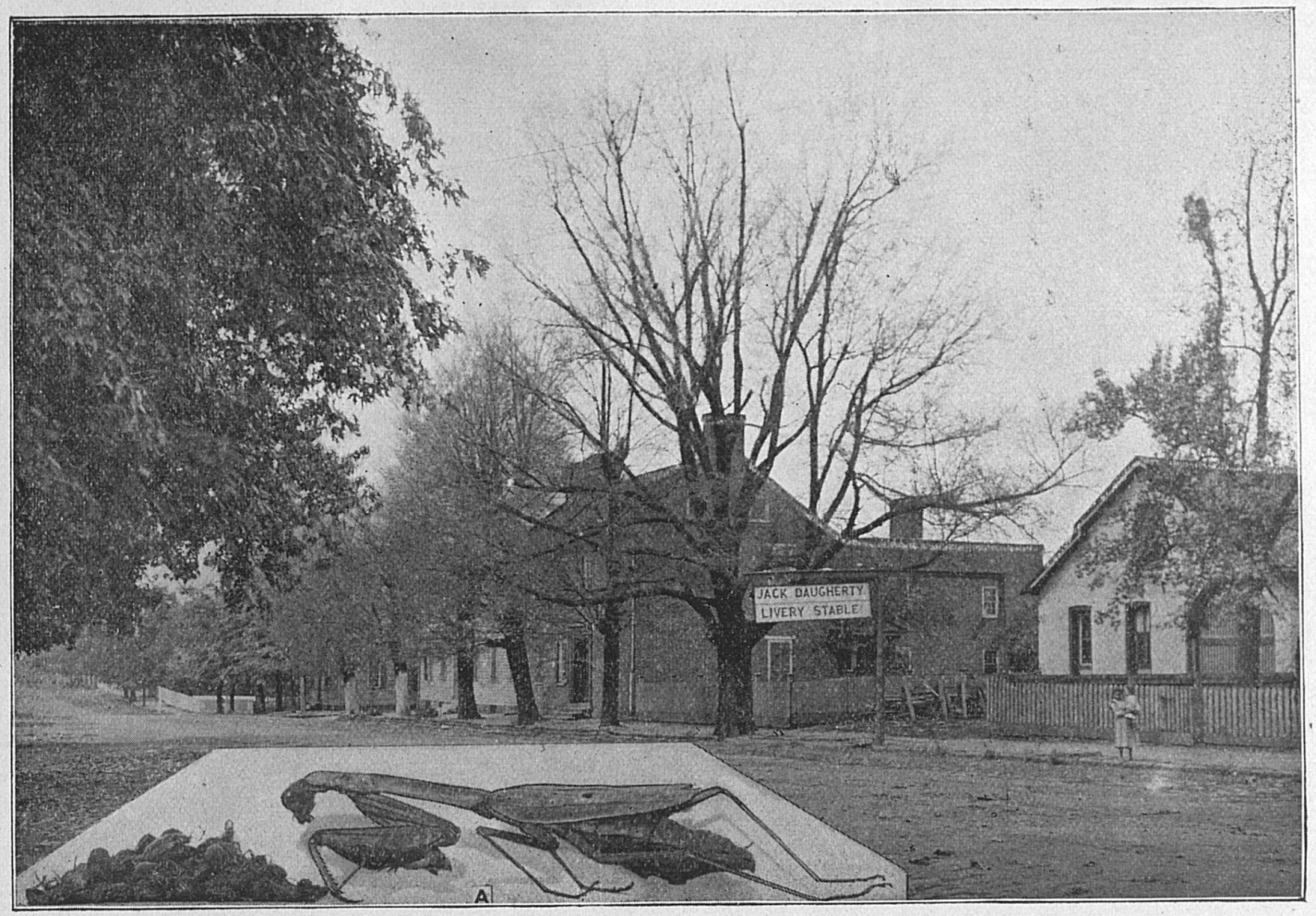


FIG. 9.—English elms along same street, looking in the opposite direction. A, preying mantis taken from the trunk of one of these trees; represented of natural size.

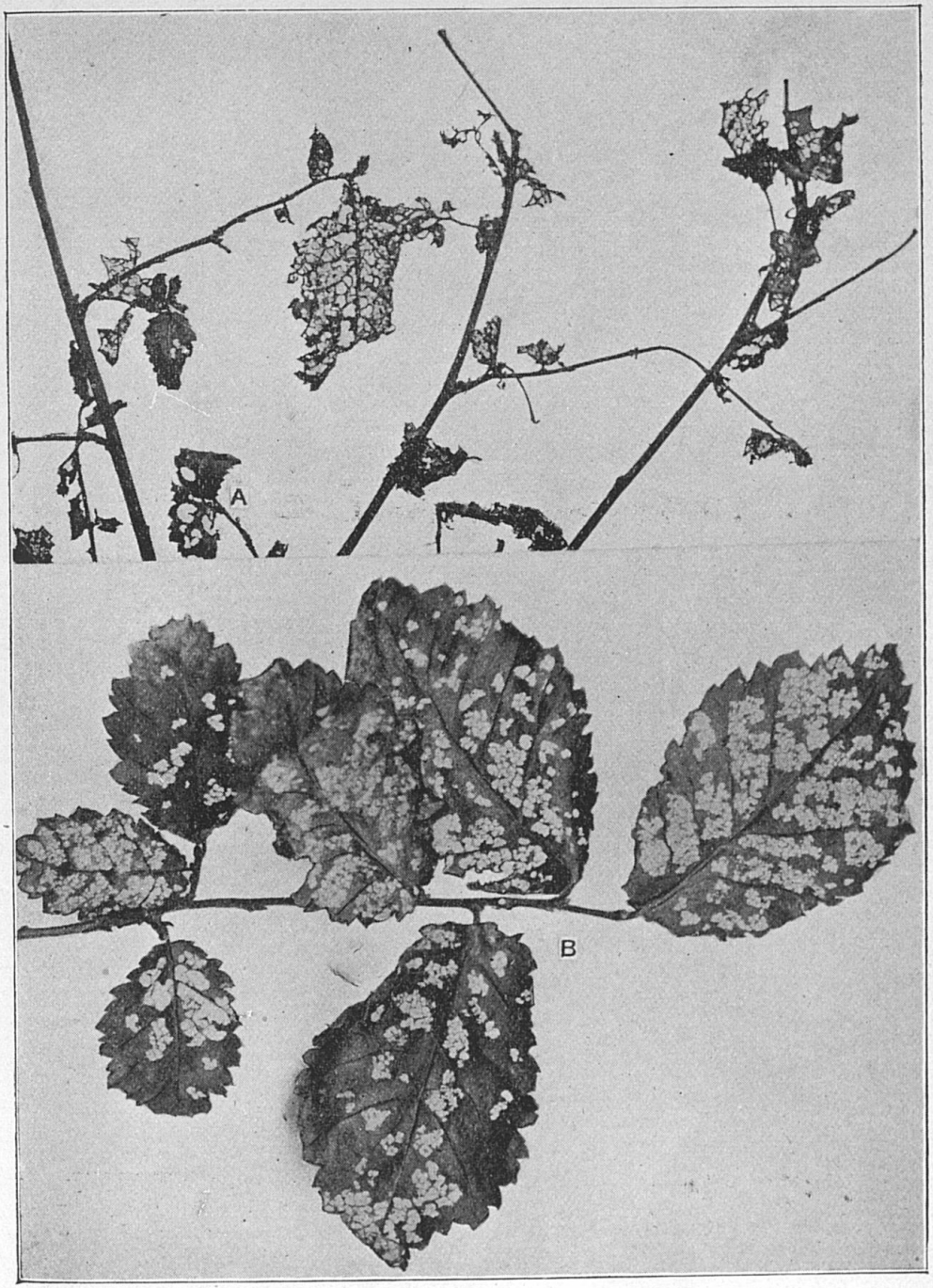


FIG. 10.—Showing leaves of English elms injured by the elm leaf-beetle; A, work of adult beetle (elsewhere the same twigs are injured largely by the larvæ); B, work of larvæ.

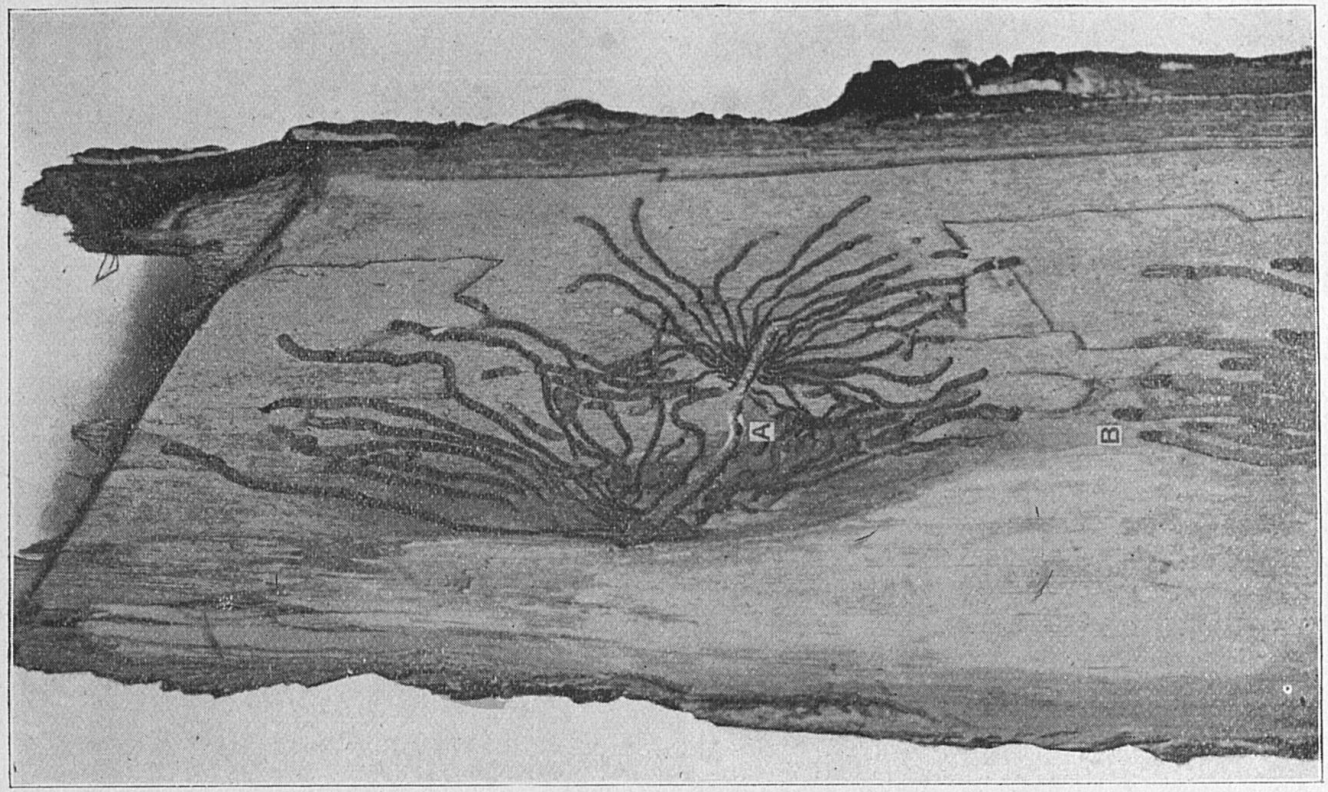


FIG. 11.—Showing the burrows made by the elm bark-beetle (*Hylesinus opaculus*) A, the opening by which the adult beetle entered, her burrow extending obliquely across the bark, while those of the grubs hatching from her eggs run, in the main, lengthwise of the bark; B, extremities of larval burrows of another colony, showing the cavities in which the pupæ are formed. Of natural size.

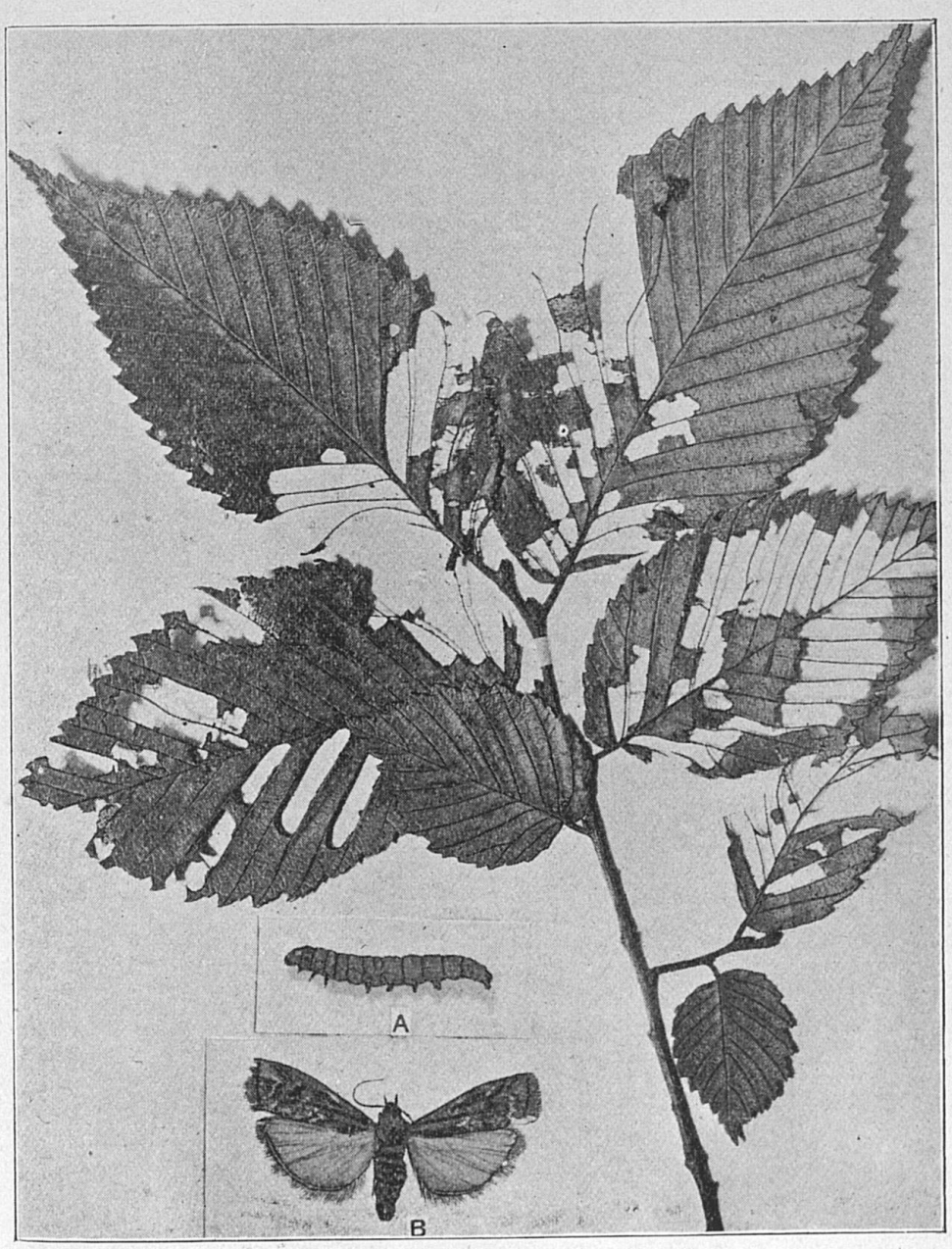


FIG. 12.—Leaves of white elm injured by the elm leaf-skeletonizer (*Canarsia ulmiarrosorella*); of natural size. A, the larva which gnaws the leaves; B, the adult reared from it; both enlarged to two diameters.

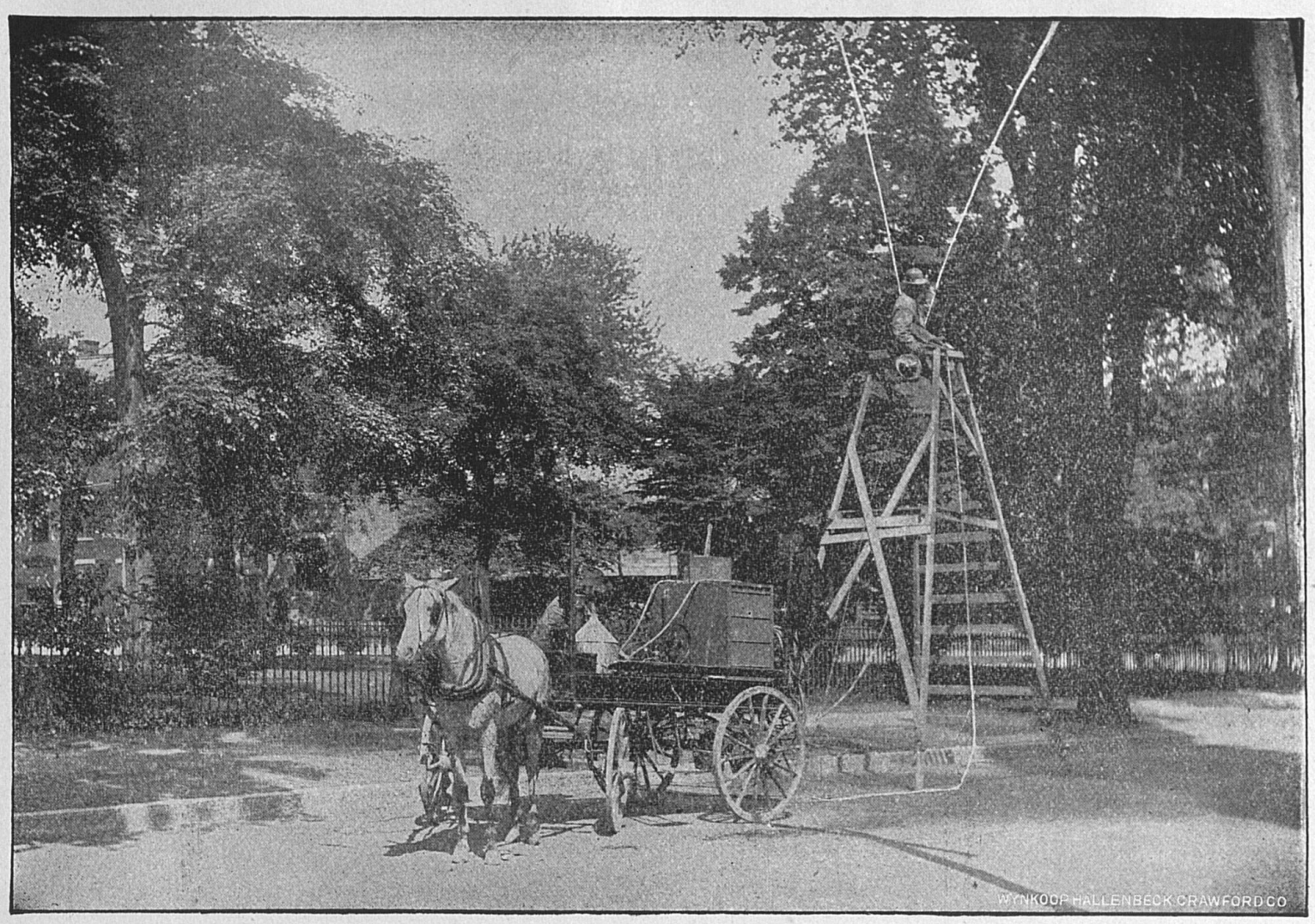


FIG. 13.—A Daimler gasoline motor in operation on the streets of Albany. (From E. P. Felt, Bulletin 20, Vol. 5, New York State Museum.)

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 85.

COMMERCIAL FERTILIZERS,

LEXINGTON, KENTUCKY,
December, 1899.

77

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.
J. T. GATHRIGHT, Louisville, Ky.
THOS. TODD, Shelbyville, Ky.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.
A. M. PETER, H. E. CURTIS, } Chemists.
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Agriculturist.
EDWARD RHORER, Secretary to Director.
W. H. SCHERFFIUS, W. A. BEATTY, } Ass't. Chemists.

Address of the Station—LEXINGTON, KY.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Station for that purpose.

Correspondents will please notify the Director of changes in their post-office address, or of any failure to receive the Bulletins.

ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

BULLETIN NO. 85.

Analyses of Commercial Fertilizers.

1. Number of Brands. There were 208 different brands of commercial fertilizers registered during the year 1899, representing thirty-eight firms. Of these different brands, 120 were complete fertilizers, or fertilizers containing all three of the essential elements, namely: phosphoric acid, nitrogen and potash; 18 were acid phosphates, or superphosphates; 12 contained a mixture of acid phosphate and nitrogen compounds only; 23 acid phosphates and potash salts only; and 35 were classed as bones or tankage.

2. Samples Collected and Analyzed. Three hundred and thirty-four samples were collected by deputy inspectors in various parts of the State; 21 were sent in for analysis by farmers; 213 samples were those sent in by the firms as the official samples. Of these samples, 406 were analyzed by the Station.

3. Results of the Analyses. The results of the analyses show that of the 406 samples analyzed, 94, representing 56 brands and 24 firms, fell so far below the guaranteed analyses of the manufacturers in phosphoric acid, nitrogen or potash, or any two, or all three of these constituents, as to be unaccounted for by variations in sampling or analysis. In most cases these variations come undoubtedly in hurried or careless mixing at the factories, or careless mistakes in shipping one brand for another, but in some few instances the results indicate a desire on the part of the manufacturer to guarantee a higher percent-

age of the essential ingredients than goods sold in the State contain. Notably is this true of A. B. Mayer Manfg. Co., of St. Louis, Mo. Of the ten samples of their goods analyzed by this Station, eight fell below their minimum guarantee on phosphoric acid, after allowing a reasonable variation, in the opinion of the Director, for variations in samples and analysis; seven were likewise under the guaranteed minimum percentage of nitrogen, and the potash fell below in every instance in the six fertilizer samples containing potash. Even in estimated values, which is not a safe guide to rely upon, eight of the ten samples are deficient. It matters little whether these low results were brought about by lack of proper facilities for mixing, by repeated mistakes and carelessness, or ignorance of the true composition of the ingredients of which these fertilizers were made, or a desire to economize in those costly ingredients, for the consumer suffers alike, whatever the cause. Until this firm establishes a reputation in this State of furnishing fertilizers up to the guaranteed analysis, it would be best for buyers of their fertilizers to purchase with an understanding that the price should depend upon the analysis of a sample taken from the goods at the time purchased.

A few other firms should use more caution in having their goods come up to their guarantee in all cases, and especially take more care in mixing. The great majority of manufacturers, however, have furnished in most instances, fertilizers fully up to or above guarantee.

The following table gives the names of all manufacturers legally selling fertilizers in this State during the year, and the number of samples analyzed of each firm's fertilizers taken from various places in the State or furnished by the manufacturers.

The table also shows in how many of these samples there was a serious deficiency of either phosphoric acid, nitrogen or potash, and in how many the percentages of these constituents are such as to be considered acceptable, from the point of view of the buyer, either because they equal or exceed the percentage guaranteed by the manufacturer, or because a slight deficiency in one constituent is, in the Director's judgment,

fully made up by an excess in one or both of the others. Under the heading, "Relative Value Per Ton," is shown in how many instances the "estimated value per ton," calculated from our analysis, equals or exceeds the value calculated from the manufacturer's minimum guaranteed analysis, and in how many it is too low, reasonable allowance having been made for unavoidable variations. This table should be carefully studied. It concisely reviews each firm, showing how the samples of fertilizers taken from various places in the State compare with what was guaranteed. In order, however, to see the amount of variations from the guaranteed analyses, this table should be studied in connection with the table of results of analyses, which follows this introduction. This table can be easily referred to, as the names of the firms are arranged in alphabetical order.

Name of Manufacturer.	No. of Samples Analyzed.	Phosphoric Acid.		Nitrogen.		Potash.		Relative Value Per Ton.	
		No. Acceptable.	No. too low.	No. Acceptable.	No. too low.	No. Acceptable.	No. too low.	No. Acceptable.	No. too low.
The Abbott & Martin Rendering Co	1	1	0	1	0	1	0	1	0
The Armour Fertilizer Works	16	16	0	14	0	9	0	16	0
Peter Backer & Son	6	4	2	6	0	2	2	6	0
Geo. S. Bartlett	5	3	2	5	0	3	2	5	0
A. Button & Son	1	1	0	1	0	0	0	1	0
The Chicago Fertilizer Co	11	6	5	6	0	5	2	8	3
The Cleveland Dryer Co	14	13	1	10	1	8	0	13	1
Continental Fertilizer Co	7	6	1	3	0	5	1	6	1
Crocker Fertilizer & Chemical Co	2	2	0	2	0	2	0	2	0
The Currie Fertilizer Co	20	20	0	17	2	15	0	20	0
Furman Farm Improvement Co	4	4	0	3	0	4	0	4	0
Globe Fertilizer Co	31	31	0	28	1	22	3	31	0
The Hardy Packing Co	2	2	0	2	0	1	1	2	0

R. H. Hoskins	1	1	0	1	0	0	0	1	0
The Jarecki Chemical Co	4	3	1	3	0	3	0	4	0
J. B. Jones	10	8	2	10	0	4	2	9	1
The Jones Fertilizing Co	19	16	3	18	0	11	0	19	0
The Loudenback Fertilizer Co	1	1	0	0	1	1	0	1	0
Louisville Fertilizer Works	20	18	2	12	2	9	3	19	1
A. B. Mayer Mfg. Co	10	2	8	3	7	0	6	2	8
Meridian Fertilizer Factory	3	2	1	3	0	3	0	3	0
Michigan Carbon Works	18	18	0	15	0	12	0	18	0
National Fertilizer Co	21	21	0	15	0	14	3	21	0
North-Western Fertilizing Co	32	29	3	28	0	17	6	30	2
The Ohio Farmers Fertilizer Co	26	17	9	12	5	12	3	20	6
Queen City Fertilizer Co	1	1	0	0	0	1	0	1	0
The E. Rauh & Sons Fertilizer Co	2	2	0	1	1	0	0	1	1
Read Phosphate Co	28	19	9	18	0	24	2	23	5
John S. Reese & Co	2	2	0	2	0	2	0	2	0
The J. & F. Schroth Packing Co	2	2	0	2	0	2	0	2	0

Name of Manufacturer.	No. of Samples Analyzed.	Phosphoric Acid.		Nitrogen.		Potash.		Relative Value Per Ton.	
		No. Acceptable.	No. too low.	No. Acceptable.	No. too low.	No. Acceptable.	No. too low	No. Acceptable.	No. too low
J. F. & W. H. Singer	4	4	0	3	1	1	1	4	0
Southern Fertilizer Co	4	4	0	1	0	3	0	4	0
Standard Guano and Chemical Manufacturing Co	4	4	0	4	0	2	0	4	0
Swift & Company	19	18	1	15	0	10	0	19	0
Tennessee Chemical Co	18	13	5	9	1	14	0	17	1
S. W. Travers & Co	15	15	0	9	0	13	0	15	0
White Fertilizer Co	1	0	1	0	0	0	0	0	1
Wood & Stubbs	5	5	0	4	0	5	0	5	0

It is evident from the preceding table that while most of the fertilizers examined ran above the minimum guarantee, yet a thorough and careful inspection seems essential. It is hoped that farmers will generally take advantage of Section 8 of the fertilizer law, and when they purchase fertilizers, at least in quantity, that they take a sample in accordance with Section 8 and send it to the Station for free analysis.

The essentials in taking a sample are: 1. Take it at the time of purchase, and if possible, in the presence of agent or seller. 2. Take a sample from not less than two bags, and from one additional bag for every ten purchased; mix these samples carefully and take at least a pint of this mixed sample, put it into a fruit jar, seal, box and express to M. A. Scovell, Director, Lexington, Ky. 3. Take the sample in the presence of at least one witness, and have the witness sign the required certificate. 4. The certificate for free analysis to be sent *by mail* and should be in accordance with the law as given in Section 8.

If the sample is taken in accordance with the above directions it may be sent by express and the charges will be paid by the Station.

A good form of certificate is the following, and blank certificates will be sent free to any farmer requesting the same.

CERTIFICATE FOR FREE ANALYSIS.

.....190

M. A. SCOVELL, Director, Lexington, Ky.:

This is to certify that I am not a dealer in, or agent for the sale of any fertilizer, and that the fertilizer, a sample of which I have sent by express to you for free analysis was purchased by me for my own use and not for sale.

I further certify that the sample was taken at the time of purchase from at least 10 per cent. of the sacks or other packages comprising the whole lot purchased, that the sacks or other packages were tagged with tags bearing the facsimile signa-

ture of the Director, and that it was taken as provided in Section 8 of the fertilizer law in the following described manner, to-wit:.....

.....

.....

.....

.....

.....

.....

Upon receipt of the analysis from you, I agree to furnish you with a tag taken from one of the sacks sampled, the name and address of the firm or agent of whom the fertilizer was purchased, and the amount purchased.

(Signature).....

(P. O. Address).....

Signatures of witnesses:

.....

.....

Should, however, any farmer desire to take a sample and not have a blank certificate at hand, he may write one in full like the form above given, or take the sample in presence of seller and witness and so mark it that he can identify it subsequently in a certificate, and send it at once to the Experiment Station with the request that the Station furnish form of certificate, such certificate to be filled out upon receipt covering the sample and properly signed by sender and witnesses and sent by return mail to the Station.

SECTION PROVIDING FOR FREE ANALYSIS.—The section of the Fertilizer Law, providing for the taking of samples for free analysis is as follows:

SEC. 8. Any person not a dealer in, or agent for the sale of any fertilizer who may purchase any commercial fertilizer in this State for his own use and not for sale, may take a sample of the same for analysis, which analysis shall be made by the said Experiment Station free of charge. Such samples for free analysis shall be taken by the purchaser in presence of the person, company or agent selling the fertilizer, from at least ten (10) per cent. of the sacks or other packages comprising the whole lot purchased, and shall be thoroughly mixed and at least one pound of the material after mixing must be put into a jar or can, securely sealed and marked in such a way as to surely identify the sample and show by whom it was sent, without giving the name of the fertilizer or the person from whom it was purchased, and must be forwarded to the Director of the Kentucky Agricultural Experiment Station, Lexington, Ky. The purchaser shall also send with the sample a certificate signed by himself and witness, or by two witnesses, stating that the sender has purchased the fertilizer for his own use and not for sale, and that the sample was taken in the manner prescribed in this Section. Provided, however, that if the person, company or agent shall refuse to witness the taking of the sample, then the sample may be taken at the time of the purchase in the manner already described in the presence of two witnesses who shall certify to the manner of taking the sample. The purchaser shall preserve the official label from one of the bags or other packages sampled to be sent to the Director after having received the report of analysis of the sample, and at the same time he shall furnish to the Director the name and address of the firm of whom the fertilizer was purchased and the amount purchased; and any person having sent a sample for free analysis, under the provisions of this Section, who shall, after having received the report of analysis of the same, refuse to furnish the required information, shall thereafter forfeit the privilege of free analysis of fertilizers under this Section. But if any sample shall have been submitted for free analysis without all the requirements of this Section having been complied with, the Director shall inquire into the case and may accept the sample for free analysis if he believes that it is a fair sample of the fertilizer as it was delivered to the purchaser.

DESCRIPTION OF SAMPLES IN TABLE OF ANALYSES.

THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.

No. 5624—Bone Meal, collected by deputy inspector from stock of Forbes & Bro., Hopkinsville, Ky. (Spring shipment).

No. 6012—Same brand, etc., from fall shipment.

No. 5598—Grain Grower, collected by deputy inspector from stock of Joplin Implement Co., Elizabethtown, Ky.

No. 5578—Ammoniated Bone with Potash, collected by deputy inspector from stock of R. O. Dorsey, St. Matthews, Ky.

No. 5622—Tobacco Grower, collected by deputy inspector from lot purchased by R. C. Gary, Hopkinsville, Ky.

No. 5623—Bone, Blood and Potash, collected by deputy inspector from lot purchased by C. Gregory, Church Hill, Ky.

No. 5898—Star Phosphate, collected by deputy inspector from stock of Irvington Milling Co., Irvington, Ky.

PETER BACKER & SON, TROY, IND.

No. 5896—Grower No. 7, collected by deputy inspector from stock of Lee Rhodes, Rhodelia, Ky.

THE CHICAGO FERTILIZER CO., CHICAGO, ILL.

No. 5948—No. 2 Acid Phosphate, collected by deputy inspector from stock of John M. Vick, Central City, Ky.

No. 5911—Western Bone and Potash, collected by deputy inspector from stock of Bland & Lyons, Jolly Station, Ky.

No. 5949—Same brand, etc., from John M. Vick, Central City, Ky.

No. 5912—Bone, Blood and Potash, collected by deputy inspector from stock of Bland & Lyons. Jolly Station, Ky,

No. 5950—Same brand, etc., from John M. Vick, Central City, Ky.

No. 5913—Chicago Bone Meal, collected by deputy inspector from stock of Kinkade Bros., Sonora, Ky.

THE CLEVELAND DRYER CO., CLEVELAND, O.

No. 5956—Phospho Bone, collected by deputy inspector from stock of R. W. Newman, Lewisburg, Ky.

No. 5957—XXX Phosphate, collected by deputy inspector from stock of R. W. Newman, Lewisburg, Ky.

No. 5575—White Burley Tobacco Fertilizer, sent by F. L. Harmon, Germantown, Ky.

CONTINENTAL FERTILIZER CO., NASHVILLE, TENN.

No. 5952—Bear Beef, Blood and Bone, collected by deputy inspector from stock of Tom Huffaker, Monticello, Ky.

No. 5953—Bear Special Wheat and Corn Guano, collected by deputy inspector from stock of Tom Huffaker, Monticello, Ky.

No. 6013—Same brand, etc., from Hill & Helsley, Central City, Ky.

THE CURRIE FERTILIZER CO., LOUISVILLE, KY.

No. 5924—Currie's Soluble Bone, collected by deputy inspector from lot purchased by John Sandmyar, Cane Valley, Ky.

No. 6021—Same brand, etc., from stock of Young, Waller & Young, Morganfield, Ky.

No. 5925—Currie's Corn and Wheat Special, collected by deputy inspector from stock of C. W. Quiggins, Elizabethtown, Ky.

No. 6022—Same brand, etc., from Hughes, Coffey & Hunter, Gradyville, Ky.

No. 5926—Currie's Butchertown Raw Bone Meal, collected by deputy inspector from stock of C. W. Quiggins, Elizabethtown, Ky.

No. 5739—Currie's Raw Bone Meal, collected by deputy inspector from stock of George S. Dick & Bro., Mill Springs, Ky.

No. 5927—Same brand, etc., from C. W. Quiggins, Elizabethtown, Ky.

GLOBE FERTILIZER CO., LOUISVILLE, KY.

No. 5590—Kentucky Standard Tobacco Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5646—Same brand, etc., from lot purchased by J. A. Browning, Church Hill, Ky.

No. 5503—Globe Special Tobacco Grower, sent by Peter Gemmell, Geneva, Ky.

No. 5573—Same brand, sent by F. L. Harmon, Germantown, Ky.

No. 5615—Same brand, collected by deputy inspector from Gus Young, Hopkinsville, Ky.

No. 5577—Globe Potato Grower, collected by deputy inspector from stock of A. Button & Son, Louisville, Ky.

No. 5589—Eagle Corn and Wheat Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5986—Same brand, etc., from C. E. Owen, Madisonville, Ky.

No. 6006—Same brand, etc., from Ray & Green, Fredonia, Ky.

No. 5588—Big Four Tobacco Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5987—Golden Harvest Bone Meal, collected by deputy inspector from stock of J. M. Tindell, Ekron, Ky.

No. 5587—Progress Wheat and Corn Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5613—Same brand, etc., from J. M. Francis, Gracey, Ky.

No. 5614—Same brand, etc., from Smith Bros., Princeton, Ky.

No. 5988—Globe Wheat Grower, collected by deputy inspector from stock of Hunt & Crutcher, Vine Grove, Ky.

No. 5568—Bone & Potash, collected by deputy inspector from stock of A. Button & Son, Louisville, Ky.

No. 5591—Globe Bone Dust, collected by deputy inspector from stock of D. E. Patterson, Hodgenville, Ky.

No. 5567—Globe Soluble Vegetable Manure, collected by deputy inspector from stock of A. Button & Son, Louisville, Ky.

No. 5592—Globe Bone Meal, collected by deputy inspector from stock of J. T. Harris & Bro., Franklin, Ky.

J. B. JONES, LOUISVILLE, KY.

No. 5607—Corn Grower, collected by deputy inspector from stock of John Heinz & Co., Louisville, Ky.

No. 5608—Tobacco and Potato Grower, same as above.

No. 5937—Ammoniated Bone Meal, collected by deputy inspector from stock of I. K. Miller, Campbellsville, Ky.

No. 5938—Wheat Grower, same as above.

THE JONES FERTILIZING CO., CINCINNATI, OHIO.

No. 5916—Bone Meal, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5917—Ammoniated Bone, collected by deputy inspector from stock of Lewis & Co., Glendale, Ky.

No. 5617—Bone and Potash, collected by deputy inspector from lot purchased by Walter Foard, Church Hill, Ky.

No. 5918—Same brand, etc., from stock of W. T. Kirkman, Elkton, Ky.

No. 5616—Tobacco and Potato Grower, collected by deputy inspector from lot purchased by Gus Goodwin, Julien, Ky.

No. 5625—Same brand, etc., from stock of A. S. White, Hopkinsville, Ky.

No. 5618—Miami Valley, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky.

No. 5919—Jones' Reliable, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5920—Jewel Phosphate, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

LOUISVILLE FERTILIZER WORKS, LOUISVILLE, KY.

No. 5939—Corn and Wheat Grower, collected by deputy inspector from stock of Albert Blair, Columbia, Ky.

No. 5596—Potato and Tobacco Grower, collected by deputy inspector from stock of L. S. Brough, Bowling Green, Ky.

No. 5597—Soluble Bone and Potash, collected by deputy inspector from stock of L. S. Brough, Bowling Green, Ky.

No. 5940—Wheat Grower, collected by deputy inspector from lot purchased by J. F. West, Mill Springs, Ky.

No. 5951—Same brand, sent by Steven Everin, Avoca, Ky.

No. 6000—Same brand, collected by deputy inspector from stock of D. L. Sandifer, Beaver Dam, Ky.

No. 5941—Bone Meal, collected by deputy inspector from lot purchased by S. & M. Shearer, Shearer Valley, Ky.

No. 5954—Same brand, etc., from stock of Gregory & Co. Cloverport, Ky.

No. 5955—Same brand, etc., from W. T. Kirkman, Elkton, Ky.

No. 5942—Raw Bone Meal, collected by deputy inspector from stock of Nat Meguiar, Franklin, Ky.

No. 5991—Same brand sent by Geo. W. Dant, Dant, Ky.

A. B. MAYER, M'F'G CO., ST. LOUIS, MO.

No. 5621—Anchor Brand Corn and Wheat Grower, collected by deputy inspector from stock of Smith Bros., Princeton, Ky.

No. 5894—Same brand, etc., from McClanahan Bros., Franklin, Ky.

No. 5909—Same brand, etc., from Brashear & Co., Sonora, Ky.

No. 5946—Same brand. etc., from Smith Bros., Princeton, Ky. (Fall shipment).

No. 5895—Anchor Brand Pure Bone Meal, collected by deputy inspector from stock of Brasher & Co., Sonora, Ky.

No. 5910—Same brand, etc., from McClanahan Bros., Franklin, Ky.

No. 5947—Same brand, etc., from W. M. Lovell, Greenville, Ky.

MERIDIAN FERTILIZER FACTORY, MERIDIAN, MISS.

No. 5897—Meridian Home Mixture, collected by deputy inspector from stock of Goodwin & Waddle, Somerset, Ky.

MICHIGAN CARBON WORKS, DETROIT, MICH.

No. 5982—Homestead Corn and Wheat Grower, collected by deputy inspector from stock of J. R. Davis & Bro., Campbellsville, Ky.

No. 6014—Same brand, etc., from D. Childres, Auburn, Ky.

No. 5595—Homestead Tobacco Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5593—Desiccated Bone, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5983—Acid Phosphate, collected by deputy inspector from stock of L. J. Bryan, Stithton, Ky.

No. 5594—Red Line Complete Manure, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5984—Red Line Crop Grower, collected by deputy inspector from stock of J. H. Thurman, Somerset, Ky.

No. 5985—Red Line Ammoniated Phosphate, collected by deputy inspector from stock of J. D. Jackson, Scottsburg, Ky.

NATIONAL FERTILIZER CO., NASHVILLE, TENN.

No. 5581—Corn Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5579—Tobacco Grower, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5647—Same brand, etc., from lot purchased by W. L. Caudle, Herndon, Ky.

No. 6002—Same brand, etc., from stock of W. S. Knight, Jamestown, Ky.

No. 5583—Acid Phosphate, collected by deputy inspector from stock of Wood & Mueller, Glasgow, Ky.

No. 5580—Sadler's Formula, collected by deputy inspector from stock of Wells, Miller & Perkins, Elkton, Ky.

No. 5584—Pure Bone Meal, collected by deputy inspector from stock of Wood & Mueller, Glasgow, Ky.

No. 5582—National Dissolved Bone, collected by deputy inspector from stock of Hill & McElroy, Bowling Green, Ky.

No. 6003—Twentieth Century Guano, collected by deputy inspector from stock of W. S. Knight, Jamestown, Ky.

No. 6004—Wheat Grower, collected by deputy inspecter from stock of Wilson Bros., Adairville, Ky.

NORTH-WESTERN FERTILIZING CO., CHICAGO, ILL.

No. 5605—Horse Shoe Brand Fine Raw Bone, collected by deputy inspector from stock of H. C. Smith, Mgr., Louisville, Ky.

No. 6008—H. S. B. Pure Ground Bone, collected by deputy inspector from stock of Alex Hendry, Webster, Ky.

No. 5602—H. S. B. Raw Bone and Superphosphate Mixture, collected by deputy inspector from stock of H. C. Smith, Mgr., Louisville, Ky.

No. 5554—H. S. B. Tobacco Grower, collected by deputy inspector from stock of H. C. Smith, Mgr., Louisville, Ky.

No. 5574—Same brand, sent by F. L. Harmon, Germantown, Ky.

No. 5630—Same brand, collected by deputy inspector from stock of Alvin Richey & Co., Princeton, Ky.

No. 5555—H. S. B. Ky. Tobacco Grower, collected by deputy inspector from stock of H. C. Smith, Mgr., Louisville, Ky.

No. 5553—H. S. B. Challenge Corn Grower, collected by deputy inspector from stock of W. P. Hall, Jeffersontown, Ky.

No. 5552—H. S. B. Potato Grower, collected by deputy inspector from stock of W. P. Hall, Jeffersontown, Ky.

No. 5603—H. S. B. Corn and Wheat Grower, collected by deputy inspector from stock of H. C. Smith, Manager, Louisville, Ky.

No. 6009—H. S. B. Acidulated Bone and Potash, collected by deputy inspector from stock of J. J. Carr, Science Hill, Ky.

No. 6023—Same brand, etc., from Bryan & Clayton, Edmonton, Ky.

No. 6031—Same brand. etc., from Ross Rogers, Hopkinsville, Ky.

No. 5556—H. S. B. Bone and Potash, collected by deputy inspector from stock of H. C. Smith, Manager, Louisville, Ky,

No. 5604—H. S. B. Acidulated Bone, collected by deputy inspector from stock of H. C. Smith, Manager, Louisville, Ky.

No. 6010—H. S. B. Quick Acting Phosphate, collected by deputy inspector from stock of J. J. Carr, Science Hill, Ky.

No. 5629—H. S. B. Special High Grade Tobacco Grower, collected by deputy inspector from lot purchased by J. F. Garnett, The Square, Ky.

THE OHIO FARMERS' FERTILIZER CO., COLUMBUS, O.

No. 5888—Acid Phosphate, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5900—Same brand, etc., from A. Weatherford & Son, Harned, Ky.

No. 5611—Soluble Bone and Potash, collected by deputy inspector from stock of Watkins & Edwards, Hopkinsville, Ky.

No. 5889—Same brand, etc., from A. Weatherford & Son, Harned, Ky.

No. 5901—Same brand, etc., from Buchanan & Sanders, Campbellsville, Ky.

No. 5999—Same brand, etc., from J. W. Kelly, Leitchfield, Ky.

No. 5610—Corn, Oats and Wheat Fish Guano, collected by deputy inspector from Watkins & Edwards, Hopkinsville, Ky.

No. 5884—Same brand, sent by Arthur Goodman, Harned, Ky.

No. 5890—Same brand, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5902—Same brand, etc., from J. W. Pate, Jolly Station, Ky.

No. 5903—Same brand, etc., from Goodwin & Hollinsworth, Hopkinsville, Ky.

No. 5609—Tobacco Special, collected by deputy inspector from lot purchased by L. H. Smithson, Church Hill, Ky.

No. 5619—Same brand, etc., from stock of Watkins & Edwards, Hopkinsville, Ky.

No. 5891—Fine Ground Bone Meal, collected by deputy inspector from stock of J. W. Pate, Jolly Station, Ky.

No. 5892—Imperial Raw Bone, collected by deputy inspector from stock of A. Weatherford & Son, Harned, Ky.

No. 5904—Same brand, etc., from Goodwin & Hollinsworth, Hopkinsville, Ky.

No. 5893—Desiccated Bone Meal, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5905—Same brand, etc., from A. Weatherford & Son, Harned, Ky.

READ PHOSPHATE CO., NASHVILLE, TENN.

No. 5600—High Grade Tobacco Grower, collected by deputy inspector from stock of Wood & Mueller, Glasgow, Ky.

No. 5626—Blood and Bone No. 1, collected by deputy inspector from stock of A. A. and M. F. Winfree, Casky, Ky.

No. 5992—Same brand, etc., from R. M. Gill, Allensville, Ky,

No. 5928—Alkaline Bone, sent by J. M. Stamp, Bonnieville, Ky.

No. 5989—Same brand, collected by deputy inspector from stock of Hines, Swope & Co., Science Hill, Ky.

No. 6001—Same brand, etc., from Bearce & Co., Bowling Green, Ky.

No. 6015—Same brand, etc.. from J. McClain Stanley, Henderson, Ky.

No. 6032—Same brand, etc., from B. F. Beard, Dillon & Co., Hardinsburg, Ky.

No. 6140—Same brand, etc., from J. McClain Stanley, Henderson, Ky. (Last shipment).

No. 5993—Farmers' Special Manure, collected by deputy inspector from stock of W. H. Bland, Sonora, Ky.

No. 6007—Same brand, etc.. from R. M. Gill, Allensville, Ky.

No. 6024—Same brand, etc., from Bearce & Co., Bowling Green, Ky.

No. 6033—Same brand, etc., from J. McClain Stanley, Henderson, Ky.

No. 5990—XXX Dissolved Bone, collected by deputy inspector from stock of I. K. Miller, Campbellsville, Ky.

No. 5971—Vegetable, Fruit and Vine Fertilizer, sent by Peter Gemmell, Geneva, Ky.

No. 5994—Read's Wheat and Clover Grower, collected by deputy inspector from stock of J. H. Thurman, Somerset, Ky.

No. 5914—Read's Wheat Grower, sent by E. G. Clark, Jr., Auburn, Ky.

No. 5929—Same brand, sent by L. C. Summers, Ferguson, Ky.

No. 5995—Same brand, collected by deputy inspector from stock of W. P. Mote, Russellville, Ky.

JOHN S. REESE & CO., AGTS., BALTIMORE, MD.

No 5960—Reese's Pacific Guano, collected by deputy inspector from stock of J. A. Small, Owensboro, Ky.

J. F. & W. H. SINGER, NASHVILLE, TENN.

No. 5961—Standard Bone Meal, collected by deputy inspector from stock of Franklin Hardware Co., Franklin, Ky.

No. 5962—Singer's No. 2 Wheat Grower, collected by deputy inspector from stock of Franklin Hardware Co., Franklin, Ky.

SOUTHERN FERTILIZER CO., ATLANTA, GA.

No. 5981—Greer's Compound Fertilizer, collected by deputy inspector from stock of J. W. Munsey, Somerset, Ky.

STANDARD GUANO & CHEMICAL MFG. CO., NEW ORLEANS, LA.

No. 5963—Pure Raw Ground Bone, collected by deputy inspector from stock of D. K. Mason, Adairville, Ky.

No. 5964—Standard Raw Bone Wheat Grower, collected by deputy inspector from stock of Franklin Hardware Co., Franklin, Ky.

SWIFT & CO., CHICAGO, ILL.

No. 5974—Raw Bone Meal, collected by deputy inspector from stock of W. H. Jernigan & Co., Pembroke, Ky.

No. 5975—Ground Steamed Bone, collected by deputy inspector from stock of W. H. Jernigan & Co., Pembroke, Ky.

No. 5976—Superphosphate, collected by deputy inspector from stock of Woodson Lewis, Greensburg, Ky.

No. 5620—Potato and Tobacco Grower, collected by deputy inspector from lot purchased by J. T. Garnett, Casky, Ky.

No. 5977—Bone Tankage, collected by deputy inspector from stock of J. M. Wright, Temperance, Ky.

No. 5978—Complete Fertilizer, collected by deputy inspector from stock of Woodson Lewis, Greensburg, Ky.

No. 5979—Diamond [S] Phosphate, collected by deputy inspector from stock of Woodson Lewis, Greensburg, Ky.

TENNESSEE CHEMICAL CO., NASHVILLE, TENN.

No. 5627—Ox Alkaline Bone, collected by deputy inspector from stock of Gus Young, Hopkinsville, Ky.

No. 5966—Same brand, etc., from Depp, Hughes & Holman, Glasgow, Ky.

No. 5980—Same brand, etc., from H. B. Phillips & Co., Owensboro, Ky.

No. 6025—Same brand, etc., from Tandy & Young, Hopkinsville, Ky.

No. 5601—Ox Special Tobacco Guano, collected by deputy inspector from stock of C. E. Haddox, Allensville, Ky.

No. 6005—Ox High Grade Dissolved Bone, collected by deputy inspector from lot purchased by J. W. Riley, Newstead, Ky.

No. 5967—Ox Special Wheat and Corn Guano, collected by deputy inspector from stock of Tom Huffaker, Monticello, Ky.

No. 5899—Ox Ammoniated Bone, sent by G. W. Pottinger, Auburn, Ky.

No. 5921—Same brand, sent by J. Guthrie Coke, Jr., Auburn, Ky.

No. 5968—Bone Meal, collected by deputy inspector from stock of Tom Huffaker, Monticello, Ky.

S. W. TRAVERS & CO., BRANCH, RICHMOND, VA.

No. 5565—Beef, Blood and Bone Fertilizer, collected by deputy inspector from stock of R. S. Bandy, Irvington, Ky.

No. 6026—Same brand, etc., from stock of J. M. Rose & Co., Pembroke, Ky.

No. 5355—National Tobacco Fertilizer, sent by Joe J. Lyddane, Rome, Ky.

No. 5564—Same brand, collected by deputy inspector from stock of R. S. Bandy, Irvington, Ky.

No. 5563—Capital Bone Potash Compound, collected by deputy inspector from stock of R. S. Bandy, Irvington, Ky.

No. 5628—Same brand, etc., from W. R. Wood, Trenton, Ky.

No. 5969—Same brand, etc., from Buchanan & Sanders, Campbellsville, Ky.

No. 5970—Capital Dissolved S. C. Bone, collected by deputy inspector from stock of Buchanan & Sanders, Campbellsville, Ky.

No. 5566—Champion Corn Grower, collected by deputy inspector from stock of R. S. Bandy, Irvington, Ky.

Values Used.

In calculating the relative value per ton, the same values have been used as were used in our last bulletins, namely:

Soluble and reverted phosphoric acid in mixed fertilizers ..... 7¢ per lb.
Soluble and reverted phosphoric acid in plain acid and unacidulated phosphates ..... 5¢ per lb.
Insoluble phosphoric acid in mixed fertilizers .... 2½¢ per lb.
Insoluble phosphoric acid in plain acid phosphates ..... 0 per lb.
Phosphoric acid in fine bone ..... 4¢ per lb.
Phosphoric acid in medium bone ..... 3¢ per lb.

Fine bone is all that passes through a sieve with meshes one-twenty-fifth inch square. Medium bone passes through a sieve with meshes one-sixth inch square, but does not include fine bone.

Nitrogen in all fertilizers ..... 17½¢ per lb.
Potash in all fertilizers, from Sulphate ..... 7¢ per lb.
Potash in all fertilizers, from muriate ..... 6¢ per lb.

The term "Potash, from Muriate" does not indicate necessarily that the manufacturers used muriate of potash in furnishing the potash; they may have used sulphate of potash, or other salts of potash, but in all fertilizers where the term "Potash from Muriate" is used there is enough chlorine present to combine with the potash, either from salt in the tankage used, or the potash salts used, as muriate, kainit, carnallite, etc. As the objection to the use of muriate of potash arises from the chlorine present in this salt, it likewise follows that chlorine in a fertilizer is objectionable, whether put in with the potash or otherwise. The using of sulphate of potash where there is chlorine present in other ingredients of the fertilizer will not obviate the injurious effect of the chlorine, and therefore we take this method of showing chlorine present by designating the potash as "from muriate."

Explanations of the Table.

In the table of analyses we have given in bold-faced type the guaranteed analyses of all brands entered in the State for the year 1899. These analyses will be found following the name of the brand and opposite the word "guaranteed" in the column headed "Analysis", and next, under the guaranteed analysis will be found the analysis of the sample that was furnished by the manufacturer at the time the fertilizer was entered for sale, and which was accompanied by an affidavit giving the guaranteed analysis. This is the analysis that is marked "found" in the table of analyses in the colum headed "Analysis." All other analyses in the table are those made of samples taken by deputy inspectors or of samples sent by farmers, which have all been described under the head "Description of Samples." The figures in the table which are set in italics are those results which, in the judgment of the Director, were too low to be acceptable. Where samples of bone have been marked with (*) it indicates that the bone contains soluble phosphoric acid. This soluble phosphoric acid is an indication of either the addition of acid phosphate to the bone, (in which case it would not be a pure raw bone), or else that the bone containing this soluble phosphoric acid was not strictly a pure or high grade bone, but contained trashy materials, which carried with them the soluble phosphoric acid.

The names of the manufacturers are arranged in alphabetical order, and all the analyses of the same brand have been grouped together.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5742	The Abbott & Martin Rendering Co., Columbus, Ohio.	Peerless Bone and Potash.	Guaranteed. Found.
	A. D. Adair & McCarty Bros., Atlanta, Ga.	See Furman Farm Improvement Co.	
5113	The Armour Fertilizer Works, Chicago, Ill.	Bone Meal.	Guaranteed. Found. Hopkinsville.
5624 6012			Hopkinsville.
5114	Same.	Acidulated Bone Meal.	Guaranteed. Found.
5115	Same.	Raw Bone Meal.	Guaranteed. Found.
5116	Same.	Grain Grower.	Guaranteed. Found.
5598			Elizabethtown.
5117	Same.	Ammoniated Bone with Potash.	Guaranteed. Found.
5578			St. Matthews.
5118	Same.	Tobacco Grower.	Guaranteed. Found.
5622			Hopkinsville.
5119	Same.	Bone, Blood and Potash.	Guaranteed. Found.
5623			Church Hill.
5120	Same.	Star Phosphate.	Guaranteed. Found.
5898			Irvington.
5365	Same.	White Burley and Black Tobacco.	Guaranteed. Found.
5743	Peter Backer & Son, Troy, Ind.	Grower No. 2.	Guaranteed. Found.
5744	Same.	Grower No. 3.	Guaranteed. Found.
5745	Same.	Grower No. 1.	Guaranteed. Found.
5746	Same.	Grower No. 8.	Guaranteed. Found.
5747	Same.	Grower No. 7.	Guaranteed. Found.
5896			Rhodelia.
5274	Geo. S. Bartlett, successor to the Cin'ti Desiccating Co., Cin'ti, O.	Indian Brand Tobacco and Potato Fertilizer.	Guaranteed. Found.
5275	Same.	Indian Brand Ohio Valley Phosphate.	Guaranteed. Found.

TABLE OF ANALYSES.

Pounds in the Hundred.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	....	.....	..	8.00	...	9 00	0 41	0.50	....	2.50	$16.64	5742
.....	..	.....	.....	7.29	3. 28	10.57	0. 75	0. 91	3. 97	....	19.24	
.....	....	.....	....	.....	..	....	...	...	...	.....	.....	
.....	..	....	.	.....	...	....	.....	...	.....		.....	
.....	..	.....	....	.....	...	24.00	2 47	3. 00	....	....	23.05	5113
20.05	4.46	.....	....	.....	....	24.51	3. 90	4. 73	.....	.....	32.37	
19.58	4.39	.....	.....	....	....	23.97	3. 34	4. 05	...	.....	29.98	5624
21.17	4.03	.....	...	.....	...	25.20	2. 88	3. 50	...	....	29.44	6012
.....	....	....	...	11 00		18 00	1. 65	2. 00	.....	.....	24.68	5114
..	...	..	..	17.31	5. 33	22.64	2. 93	3. 56	....	..	37.16	
.....	....		...	.....	.....	22 00	3. 71	4. 50	....	....	26. 19	5115
16.47	9.19	.....	...	...	...	25.66	3. 92	4.76	....	...	32.41	
.....	....	6.00	2. 00	8.00	...	10.00	1. 65	2. 00	2. 00		20.38	5116
.....	....	.....	....	8.84	4. 03	12.87	2. 26	2. 74	1. 20	1. 47	25.81	
...	.....	.....	...	8.22	4. 62	12.84	2. 32	2. 82	..	3. 08	26.25	5598
.....	..	4 00	2. 00	6.00	...	8.00	2. 47	3. 00	....	2. 00	20.85	5117
.....	.....	.....	.	8.77	3. 08	11.85	3 22	3. 91	....	2. 33	28.35	
.....	..	.....	..	7.18	5. 25	12.43	3. 22	3. 91	.....	3. 46	28.79	5578
.....	.....	6.00	2. 00	8.00	..	10.00	1. 65	2. 00	...	5. 00	24.98	5118
.. ..	....	.....	.....	9.42	2. 38	11 80	1. 95	2. 37	....	5. 06	28.29	
....	..	.....	.....	9.89	3. 30	13.19	1. 73	2. 10	...	4. 56	27.94	5622
.....	.....	6.00	2. 00	8.00	...	10.00	4. 12	5. 00	.....	7. 00	36.42	5119
.....	...	....	....	9.29	2. 15	11.44	3. 91	4. 75	....	8. 09	39.11	
.....	...	.....		9.34	1. 94	11.28	4. 44	5. 39	.....	7. 01	39.40	5623
.....	.....	9.00	3 00	12.00	.....	16.00	....	....	....	....	12.00	5120
.....	.....	.....	...	16.52	1. 98	18.50	....	.....	...	....	16.52	
.. ..	.....	.....	...	13.14	2. 37	15.51	....	.....	..	...	13.14	5898
....	...	2.00	6 00	8.00		10.00	2. 88	3. 50	.....	4. 00	27. 88	5365
...				9.37	2. 21	11.58	3. 44	4. 18	...	5. 45	33.90	
.....	..	5.00	2. 00	7.00		10.00	2. 00	2. 43	3. 00	....	21.90	5743
...	.....			*5.74*	3. 22	8.96	2 80	3. 40	11.29	..	33.00	
.....	...	4.00	2. 00	6.00		9.00	2. 00	2. 43	5. 00	...	22.90	5744
.....	....	..	.....	5.70	2. 67	8.37	2. 40	2. 91	14.78	....	35.46	
.....	..	4.00	2. 00	6.00	....	9.00	2. 00	2. 43	.....	....	16.90	5745
.....			.....	8.67	2. 20	10.87	2. 65	3. 22	.....		22.52	
.....	...		.....	.....		15.00	3. 00	3. 64	.....	....	19.50	5746
9.37	5 27	...	.....			14.64	4. 36	5. 29	.....	.....	25.92	
..	...	.....	.....	....	....	15.00	3 00	3. 64	2. 50	...	22.50	5747
9.46	4. 25	.....	..	.....	..	*13.71*	4. 32	5. 24	*2. 09*	.....	27.75	
13.50	4.03		..	...	..	17.53	3. 11	3. 78	*1. 16*	..	25.50	5896
.....	...	....	....	9.00	....	11.00	3. 29	4. 00	....	5. 00	32.12	5274
.....	...	.....	.....	8.10	5. 54	13.64	3. 71	4. 50	...	7. 66	37.82	
.....	....	.....	....	8.00	...	11.00	1. 65	2. 00	2. 00	.....	20.88	5275
.....	....	.....	....	8.17	1. 42	9.59	1. 84	2. 23	*0. 80*	*0. 77*	20.63	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	ANALYSIS.
5367	George S. Bartlett.	Indian Brand Pure Gilead Phosphate	Guaranteed. Found.
5368	Same.	Indian Brand Phoenix Phosphate.	Guaranteed. Found.
5390	Same.	Indian Brand Ky. & Tenn. Tob. Grower.	Guaranteed. Found.
5722	A. Button & Son, Louisville, Ky.	Invincible Raw Bone Meal.	Guaranteed. Found.
	Wm. Casler, Louisville, Ky.	See R. H. Hoskins.	
5180 5948	The Chicago Fertilizer Co., Chicago, Ill.	No. 2 Acid Phosphate	Guaranteed. Found. Central City.
5181 5911 5949	Same.	Western Bone & Potash	Guaranteed. Found. Jolly Stat'n. Central City.
5182 5912 5950	Same.	Bone, Blood and Potash.	Guaranteed. Found. Jolly Stat'n. Central City.
5183	Same.	Standard Truck Fertilizer.	Guaranteed. Found.
5719 5913	Same.	Chicago Bone Meal.	Guaranteed. Found. Sonora.
5301	The Cleveland Dryer Co., Cleveland, O.	Ohio Seed Maker.	Guaranteed. Found.
5302	Same.	Ohio Seed Maker with Potash.	Guaranteed. Found.
5303 5956	Same.	Phospho Bone.	Guaranteed. Found. Lewisburg.
5304	Same.	Horsehead Phosphate.	Guaranteed. Found.
5371	Same.	Buckeye Ammoniated Bone Superphosphate.	Guaranteed. Found.
5372 5957	Same.	XXX Phosphate.	Guaranteed. Found. Lewisburg.
5373 5575	Same.	White Burley Tobacco Fertilizer.	Guaranteed. Found. Germantown
5374	Same.	Kentucky Tobacco Grower.	Guaranteed. Found.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate		
.....	....	.....	...	**9.00**	...	**11.00**	**2.47**	**3.00**	**2.00**	....	$**24.65**	5367
.....	....	.....	.....	9.84	3.95	13.79	3.44	4.18	2.23	...	30.48	
.....	....	.....	....	**7.00**	..	**10.00**	**1.65**	**2.00**	**1.00**	....	**18.28**	5368
.....	.	.....	...	*6.55*	1.33	*7.88*	1.93	2.34	*0.71*	....	17.45	
.....	....	.....	..	**8.00**	....	**10.00**	**1.65**	**2.00**	**3.00**	...	**21.58**	5390
.....	....		..	*7.33*	1.97	*9.30*	2.21	2.68	2.76	.....	22.30	
...	.....	.....	....	.....	....	**21.98**	**3.29**	**4.00**	....	.....	**24.71**	5722
21.13	....	....	...	.....	....	21.13	3.70	4.49	....		29.85	
.....	....	....	.....	.....	....	.....	....	... ..	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	
.....	....	.....	....	**9.00**	.....	**10.00**	..	.....	.....	....	**9.00**	5180
.....	....	.....	....	9.56	4.68	14.24	.....	....	....	....	9.56	
.....	....	.....	.....	*7.14*	3.45	10.59	....	....	....	.....	*7.14*	5948
.....	....	.....	....	**12.00**	....	**13.00**	....	....	**1.00**	...	**18.50**	5181
.....	.....	.....	....	11.73	5.51	17.24	.. .	....	1.33	....	20.78	
.....	....	....	...	*9.71*	4.46	14.17	....	....	*0.38*	....	*16.28*	5911
.....	....	....		*10.62*	3.29	13.91	....	.....	0.92		17.62	5949
.....	....	.....	....	**9.00**	....	**10.00**	**1.23**	**1.50**	...	**2.00**	**20 21**	5182
.....	....	.....	.....	10.49	11.25	21 74	1.50	1.82	1.16	2.82	30.91	
.....	....	.....	....	*7.55*	4.07	11.62	1.36	1.65	3.89	.....	22.04	5912
.....	.....	.....	....	*7.06*	3.02	10.08	1.06	1.29	*1.32*	.....	*16.68*	5930
.....	....	.....	.....	**8.00**	...	**9.00**	**2.47**	**3.00**	....	**4.00**	**25.95**	5183
.....	.....	.....	...	8.82	6.22	15.04	3.21	3.90	1.56	3.39	33.32	
.....	....	.....	....	.....	....	**20.00**	**1.65**	**2.00**	....	..	**17.78**	5719
18.58	2.30	.....	.....	.....	....	20.88	1.79	2.17	....	....	22.51	
18.95	2.11	.....	.....	.....		21.06	1.99	2.42	...	....	23.40	5913
.....	....	.....	...	**10.00**	.....	**15.00**	**1.65**	**2 00**	...	....	**22.28**	5301
. .	....	.....	...	10.22	3.67	13.89	1.71	2.08	...	....	22.14	
.....	....	.....	.....	**10.00**	...	**15.00**	**1.65**	**2.00**	**2.00**	...	**24.68**	5302
.....	..	....		10.21	3.88	14.09	1.58	1.92	2.54	.....	24.81	
.....	..	.....	.....	**10.00**	...	.....	**0.82**	**1.00**	**1.00**	....	**18.07**	5303
....	.....	.....	.....	9.84	2.02	11.86	1.05	1.27	1.41	....	20.16	
....	.....	.....	..	9.78	3.83	13.61	1.01	1.23	0.98	....	20.33	5956
.....	...	.....	...	**10.00**	..	**12.00**	.....	...	....	....	**10.00**	5304
...	...	.....	. .	11.74	1.88	13.62	...	...	.....	....	11.74	
.....	....	.....	.....	**9.00**	....	**11.00**	**2.47**	**3.00**	**1.00**	....	**23.45**	5371
	...	.....	..	9.32	3.56	12.88	2.61	3.17	1.09	...	25.28	
.....	...	.....	....	**13.00**	.....	**15.00**	.....	....	.....	.....	**13.00**	5372
...	...	.....	.....	13.81	2.76	16.57	...	....	....	.....	13.81	
.....	....	....	....	14 17	1.69	15.86	...	. .	...	....	14.17	5957
.....	..	.....	....	**9.00**	.....	**11.00**	**2.47**	**3.00**	**1.00**	**1.00**	**24.85**	5373
.....	....	.....	....	8.54	3.95	12.49	2.59	3.14	2.71	...	26.26	
.....	....	.....	....	*7.59*	3.13	10.72	*2.12*	2.57	2.49	..	*22.61*	5575
.....	.....	.....	....	**10.00**	..	**12.00**	**1.65**	**2.00**	**1.00**	**1.00**	**23.38**	5374
.....	....	.....	.....	10.03	4.03	14.06	1.60	1.94	2.65	.....	24.84	

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5375	The Cleveland Dryer Co.	Potato, Tobacco and Gen'l Crop Fert.	Guaranteed. Found.
5376	Same.	Square Bone.	Guaranteed. Found.
5377	Same.	Superior Bone Meal	Guaranteed. Found.
5168	Continental Fertilizer Co., Nashville, Tenn.	Bear Beef, Blood and Bone.	Guaranteed. Found.
5952			Monticello.
5169	Same.	Bear High Grade Dissolved Bone.	Guaranteed. Found.
5170	Same.	Bear Specal Tobacco Guano.	Guaranteed. Found.
5171	Same.	Bear Special Wheat and Corn Guano.	Guaranteed. Found.
5953			Monticello.
6013			Central City.
5344	Crocker Fert. & Chemical Co , Buffalo, N. Y.	Crocker's Ammoniated Prac. Phosphate.	Guaranteed. Found.
5345	Same.	Crocker's Ky. Tobacco Phosphate.	Guaranteed. Found
5280	The Currie Fertilizer Co., Louisville, Ky.	Currie's Soluble Bone.	Guaranteed. Found.
5924			Cane Valley.
6021			Morganfield.
5281	Same.	Currie's Clm'x Tobac. and Potato Grower.	Guaranteed. Found.
5282	Same.	Curries Gl'dn Lf. Tob. and Potato Grower.	Guaranteed. Found.
5283	Same.	Currie's Corn and Wheat Special.	Guaranteed. Found.
5925			El'z'b'htown
6022			Gradyville.
5284	Same.	Currie's Corn Grower.	Guaranteed. Found.
5285	Same	Currie's Corn and Oats Special.	Guaranteed. Found.
5286	Same.	Currie's Acid Phosphate.	Guaranteed. Found.
5287	Same.	Currie's Tobacco and Potato Grower.	Guaranteed. Found.
5650	Same.	Currie's Wheat Grower.	Guaranteed. Found.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.			
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Relative Value Per Ton.	Station Number.
.....	..	.....	.....	**10.00**		**11.00**	**1.03**	**1.25**	**6.00**	.....	$**25.31**	5375
.....	.....	.....	.....	10.00	2.60	12.60	0.94	1.14	5.95	..	25.73	
.....	....	.....	....	**6.00**		**20.00**	**2.06**	**2.50**	..	...	**22.61**	5376
.....	.....		. ..	13.43	9.39	22.82	2.38	2.89	...	.....	31.83	
.....	.....	.....	.....	.....	..	**22.00**	**3.29**	**4.00**	.....	.	**24 72**	5377
12.88	9.79	.....		.....		22.67	3.53	4.29		.....	28.53	
.....	....	**8.00**	**2.00**	**10.00**	.....	**11.00**	**1.65**	**2.00**	**2.00**	..	**22.68**	5168
.....	....	.....	....	13.12	1.23	14.35	1.91	2.32	2.20	.....	28.32	
.....	.....	.....	...	10.48	1.39	11.87	1.62	1.97		2.05	23.91	5952
.....	...	**8.00**	**6 00**	**14.00**		**15.00**	...	.	.....	....	**14.00**	5169
.....	..	.....	.....	15.65	1.45	17.10	.....	.....	.	.....	15.65	
.....	.....	**8.00**	**2.00**	**10.00**	.....	**11.00**	**1.65**	**2.00**	**2.00**	.....	**22.68**	5170
.....	..	....		12.62	1.47	14.09	1.93	2.34	2.25		27.87	
.....	....	**8.00**	**3.00**	**11.00**		**12.00**		....	**2.00**	....	**18.30**	5171
.....		....	....	11.27	1.48	12.75	....	....	*1.13*	....	17.88	
.....	.....	.....	....	10.50	1.37	11.87	....	...	..	1.84	17.97	5953
.....	.....	.....	....	*9.81*	1.47	11.28	....	....	2.33	.....	*17.27*	6013
.....		**6.00**	**2.00**	**8.00**		**9.00**	**0.82**	**1.00**	**1.08**	....	**15.87**	5344
.....	....	.....	.....	9.20	1.51	10.71	1.34	1.63	1.22	.	19.79	
.....	.....	**8.00**	**2.00**	**10.00**	.....	**11.00**	**2.06**	**2.50**	**3.24**	.....	**25.60**	5345
.....		.....	.....	10.30	1.25	11.55	2.31	2 80	3.41		27.23	
.....	..	.....	..	**9 50**	.....	**11.25**	**0.82**	**1.00**	**1.00**	...	**18.25**	5280
.....	.....	.....	....	10.36	2.55	12.91	1.41	1.71	..	1.87	23.34	
.....	...	.....	....	10.57	3.02	13.59	0.82	1.00	..	1.56	21.36	5924
.....	.....	.....	.....	11.17	3.17	14.34	0.89	1.08	.....	1.41	22.32	6021
.....	...	.....	....	**9 50**	.....	**11.25**	**0.82**	**1.00**	**1.00**	.....	**18.25**	5281
.....	.....	....	...	10.08	2.60	12.68	1.42	1.72	...	1.94	23.10	
.....	....	.....	....	**8.00**	.....	**10.50**	**1 23**	**1 50**	**3.00**		**20.36**	5282
.....	.....	.....	...	9.97	1.74	11.71	1.45	1.76	...	3.76	25.17	
.....	.....	...	.....	**9.50**	...	**11.00**	**0.41**	**0 50**	...	**0.50**	**16.19**	5283
.....	....	.....	....	11.45	3.53	14.98	0.74	0.90	1.26	.....	21.90	
.....	....	.....	....	12.07	2.80	14.87	0.52	0.63	1.20	...	21.56	5925
.....	....	.....	.....	10.49	4.34	14.83	0.62	0.75	....	1.09	20.56	6022
.....	....	.....	.....	**9.50**	....	**11.00**	**0.82**	**1.00**	....	**1.00**	**18.32**	5284
.....	.....		.....	10.39	2.65	13.04	1.44	1.75	..	2.17	23.96	
.....	..	....	....	**7.00**		**8.50**	**0.82**	**1.00**	....	**2.50**	**16.92**	5285
.....	. .	.....	.....	7.63	2.43	10.06	1.53	1.86	4.04		22.11	
.....	.....	.....	....	**12.00**	.....	**14.00**	.....	....	.....	....	**12.00**	5286
.....	..	....		15.41	2.47	17.88	.....	..	.....		15.41	
.....	...	.....	.....	**7.00**		**9.00**	**1.65**	**2.00**	.....	**7.50**	**27.08**	5287
.....	...	.....	....	6.96	2.37	9.33	1.57	1.91	.....	9.79	30.14	
.....	.....	.....	....	**10.00**	...	**12.00**	**1.23**	**1.50**	....	**4.50**	**21.41**	5650
.....	....	.....	....	12.12	2.67	14.79	1.07	1.30	...	1.22	23.77	

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5651 5926	The Currie Fertilizer Co.	Currie's Butchertown Raw Bone Meal.	Guaranteed. Found. Elizabethtown.
5652	Same.	Currie's Fine Ground Raw Bone Meal.	Guaranteed. Found.
5653 5739	Same.	Currie's Raw Bone Meal.	Guaranteed. Found. Mill Springs.
4509 5927	Same.	Same.	Guaranteed. Elizabethtown.
5750	Same.	Currie's Kentucky Phosphate.	Guaranteed. Found.
5341	Furman Farm Imp. Co., Atlanta, Ga.	Furman High Grade Fertilizer.	Guaranteed. Found.
5342	Same.	Farish Furman Formula.	Guaranteed. Found.
5343	Same.	Furman Soluble Bone with Am. & Potash.	Guaranteed. Found.
5856	Same.	Buffalo Bone Fertilizer.	Guaranteed. Found.
5134 5590 5646	Globe Fertilizer Co., Louisville, Ky.	Kentucky Standard Tobacco Grower.	Guaranteed. Found. Elkton. Church Hill.
5212 5503 5573 5615	Same.	Globe Special Tobacco Grower.	Guaranteed. Found. Geneva. Germantown. Hopkinsville.
5213 5577	Same.	Globe Potato Grower.	Guaranteed. Found. Louisville.
5259 5589 5986 6006	Same.	Eagle Corn and Wheat Grower.	Guaranteed. Found. Elkton. Madisonville. Fredonia.
5260 5588	Same.	Big Four Tobacco Grower.	Guaranteed. Found. Elkton.
5261 5987	Same.	Golden Harvest Bone Meal.	Guaranteed. Found. Ekron.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	.....	.....	**10.00**	.....	**15.50**	**1.85**	**2.25**	...	**1.25**	**$24.98**	5651
.....	...	.....	...	12.83	6.23	19.06	*0.63*	0.76	..	1.08	24.80	
.....	.....	.....	.....	13.31	6.37	19.68	*0.66*	0.80		1.10	25.67	5926
.....	...	.....	.....	.....	....	**18.00**	**1.23**	**1.50**	....	.....	**15.11**	5652
12.33	5.04	.....	.....	....	....	* 17.37	2.66	3.23	....	.....	22.19	
.....	...	.....	...	.....	...	**20.50**	**3.29**	**4.00**	....	....	**23.82**	5653
10.21	12.48	.....	....	.....	...	22.69	3.82	4.64	.....	....	29.03	
12.18	7.47	.....	...		...	19.65	3.45	4.19	....	....	26.30	5739
.....	.....	.....	....	.....	....	**22.00**	**3.71**	**4.50**	.....	....	**26.19**	4509
10.95	11.39	.....	....	....	.....	22.34	3.80	4.61	....	...	28.89	5927
.....	....	.....	.....	**10.00**	..	**12.00**	**1.23**	**1.50**	....	**1.50**	**21.41**	5750
.....	....	....	.....	10.55	3.02	13.57	1.10	1.34		1.22	21.84	
.....	....	**7.00**	**3.00**	**10.00**	.....	.....	**1.65**	**2.00**	**2.00**	..	**22.18**	5341
.....	....		.....	10.53	2.28	12.81	1.77	2.15	1.71	....	24.13	
.....	....	**7.00**	**3.00**	**10.00**	.....	.....	....	..	**2.00**	....	**16.40**	5342
.....	.....	.....	...	10.28	0.77	11.05			1.98	.....	17.16	
.....	....	**7.00**	**3.00**	**10.00**	...	....	**0.82**	**1.00**	**2.00**	.....	**19.27**	5343
.....	.....	...	..	10.98	1.38	12.36	0.95	1.15	2.09	....	21.90	
.....	.....	.....	....	**8.00**	..	....	**1.65**	**2.00**	**2.00**	....	**19.38**	5856
.....	..	.....	...	9.90	1.73	11.63	1.82	2.21	2.34	.....	23.91	
.....	.....	.....	....	**8.00**	.....	**10.00**	**2.47**	**3.00**	.....	**3.00**	**25.05**	5134
.....	....	....	.....	10.67	1.04	11.71	3.19	3.87	....	3.54	31.59	
.....	.....	.....	.....	9.83	4.78	14.61	2.34	2.84	...	3.29	28.95	5590
.....	....	...	....	9.77	3.75	13.52	2.57	3.12	....	2.95	28.69	5646
.....	....	.....	.....	**8.00**	....	**9.00**	**2.47**	**3.00**	..	**10.00**	**34.35**	5212
.....	....	.....	....	8.72	1.00	9.72	2.88	3.50	.....	10.60	37.63	
.....	.....	.....	....	8.44	2.92	11.36	2.56	3.11	....	*9.09*	34.97	5503
.....	.....	.....	.....	9.45	1.45	10.90	2.79	3.39	...	*9.18*	36.58	5573
.....	....	.....	....	10.79	1.30	12.09	2.58	3.13	....	10.14	38.99	5615
.....	....	.....	....	**8.00**	....	**9.00**	**3.29**	**4.00**	....	**4.00**	**28.82**	5213
.....	....	.....	....	9.35	0.83	10.18	3.90	4.73	....	4.87	33.98	
.....	.....	.....	....	8.68	5.92	14.60	*2.73*	3.31	.....	4.16	30.49	5577
.....	....	.....	....	**9.00**	.....	**11.00**	**2.06**	**2.50**	....	**2.00**	**23.61**	5259
.....	....	.....	.....	10.72	1.57	12.29	2.23	2.71	.....	2.90	27.67	
.....	.....	.....	.....	11.12	3.84	14.96	1.82	2.21	....	*1.55*	26.03	5589
.....	.....	.....	....	10.86	1.61	12.47	2.13	2.59	2.85	..	26.89	5986
.....	....	....	....	11.11	1.45	12.56	2.02	2.45	2.74	.....	26.64	6006
.....	....	.....	...	**8.00**	...	**10.00**	**1.65**	**2.00**	.....	**2.00**	**20.78**	5260
.....	.....	.....	.....	10.66	2.64	13.30	2.11	2.56	.....	2.63	27.31	
.....	....	....	....	9.85	5.08	14.93	2.06	2.50	.....	2.55	27.11	5588
.....	....	.....	....	**10.00**	.....	**12.00**	**2.47**	**3.00**	.....	....	**23.65**	5261
.....	....	.....	.....	10.58	1.94	12.52	3.14	3.81	...	.....	26.77	
.....	.....	...	...	11.46	2.24	13.70	2.90	3.52	....	...	27.31	5987

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5262	Globe Fertilizer Co.	Progress Wheat and Corn Grower.	Guaranteed. Found. Elkton. Gracey. Princeton.
5587 5613 5614			
5263	Same.	Globe Wheat Grower.	Guaranteed. Found. Vine Grove.
5988			
5264	Same.	Bone and Potash.	Guaranteed. Found. Louisville.
5568			
5265	Same.	Globe Bone Dust.	Guaranteed. Found. Hodgenville.
5591			
5266	Same.	Globe Soluble Vegetable Manure.	Guaranteed. Found. Louisville.
5567			
5649	Same.	Globe Bone Meal.	Guaranteed. Found. Franklin.
5592			
	Greer Machinery Co., Knoxville, Tenn.	See Southern Fertilizer Co.	.....
5748	The Hardy Packing Co., Chicago, Ill.	Hardy's Wheat Grower.	Guaranteed. Found.
5749	Same.	Hardy's Tobacco Special.	Guaranteed. Found.
5686	R. H. Hoskins, Louisville, Ky.	Champion Raw Bone Meal.	Guaranteed. Found.
5383	The Jarecki Chemical Co., Sandusky, O.	Lake Erie Fish Guano.	Guaranteed. Found.
5384	Same.	C. O. D. Phosphate.	Guaranteed. Found.
5549	Same.	Fish and Potash Tobacco & Potato Food.	Guaranteed. Found.
5550	Same.	Number One Fish Guano.	Guaranteed. Found.
5159	J. B. Jones, Louisville, Ky.	Corn Grower.	Guaranteed. Found. Louisville.
5607			
5160	Same.	Tobacco and Potato Grower.	Guaranteed. Found. Louisville.
5608			
5269	Same.	Jones' Bone Meal.	Guaranteed. Found.

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	....	...	....	**9.00**	...	**10.00**	**1.65**	**2.00**	.....	**1.00**	**$20.28**	5262
.....	.....	.....	....	10.16	2.25	12.41	2.31	2.80	.....	0.77	24.52	
.....	....	.....	..	10.53	4.78	15.31	2.54	3.08	.....	1.77	28.50	5587
.....	....	....	.....	9.97	5.87	15.84	1.92	2.33	....	0.94	24.94	5613
.....	..		....	10.59	4.67	15.26	2.37	2.88	....	1.32	27.32	5614
.....	...	.....	....	**9.00**	.....	**11.00**	**2.06**	**2.50**	...	**2 00**	**23.61**	5263
.....	..	.....	....	10.65	1.38	12.03	2.14	2.60	..	2.66	26.81	
....	..	.....	.....	11.23	4.45	15.68	1.98	2.40	...	2.14	27.88	5988
.....	...	.....	.....	**11.00**	.	.....	...	....	....	**1.00**	**16.80**	5264
.....	....	.....	....	12.49	1.13	13.62	.....	.....	.....	0.91	19.33	
.....	.....		....	11.53	1.05	12.58	0.83	1.01		1.16	21.20	5568
.....	....	.....	....	**9.00**	....	**11.00**	**1.23**	**1.50**	.....	....	**17.91**	5265
.....	....	.....	....	10.41	5.44	15.85	1.77	2.15	.....	....	23.49	
....	..		...	11.22	4.13	15.35	1.52	1.85		1.67	25.44	5591
.....	...	.....	.....	**8.00**	....	**10.00**	**2.47**	**3.00**	..	**3.00**	**25.05**	5266
.....	.....	....	.....	10.49	1.09	11.58	3.21	3.90	..	3.54	31.44	
....		.....	...	11.73	1.97	13.70	3.03	3.68	..	3.65	33.13	5567
..	....	....	....	.....	....	**20.00**	**3.29**	**4.00**	..	....	**23.52**	5649
13.95	11.51	.....	....	....	....	25.46	3.68	4.47	..	....	30.95	
9.56	10.91	..	....	.....	...	20.47	3.47	4.21	.	..	26.35	5592
.....	.....	.....	...	.....	..	.....	....	....	....	....	.....	
.....		.....		.....	....	.....	....	....	..	.....		
.....	...	.....	....	**8.00**	...	**9.00**	**0.41**	**0.50**	..	**2.50**	**16.64**	5748
.....	.....	.....	....	9.95	1.93	11.88	0.52	0.63	*2.10*	.....	19.66	
.....	..	.....	.....	**8.00**	..	**9.00**	**2.47**	**3.00**	...	**4.00**	**25.95**	5749
... ..	....	.. ..	.....	9.51	2.00	11.51	3.45	4.19	1.48	3.95	33.70	
.....		.....	.....	.....	..	**22.00**	**3.29**	**4.00**	.....	...	**24.72**	5686
22.72	.....	....	...	.....	....	22.72	3.39	4.12	....	.....	30.05	
.....	....	.....	....	**10.00**	.....	**11.00**	**1.65**	**2.00**	**0.50**	**0.50**	**21.58**	5383
....	...	..	.....	9.61	2.48	12.09	1.60	1.94	1.94	....	22.62	
.....	....	.....	....	**14.00**	.....	**15.00**		....	....	....	**14.00**	5384
.....	.....	.....	.....	15.46	1.71	17.17	..	...	....	.....	15.46	
.....	....	.....	....	**9.00**	....	**10.00**	**0.82**	**1.00**	**4.00**	..	**20.77**	5549
.....	.....		.....	9.62	2.57	12.19	1.13	1.37	4.01	...	23.53	
.....	....	.....	...	**10.00**	....	**11.00**	**0.82**	**1.00**	**1.00**	....	**18.57**	5550
.....	...	.	.....	*9.21*	3.88	13.09	1.11	1.35	1.04	....	19.97	
.....	....	.....	...	**9 00**	.....	**11.00**	**2.47**	**3.00**	..	**1.50**	**24.35**	5159
.....	....	.....	.....	8.74	3.63	12.37	2.49	3.02	...	1.65	25.09	
.....	..	.....	.....	*8.06*	2.93	10.99	2.52	3.06	.....	1.43	23.57	5607
.....	.....	.....	..	**10.00**	...	**12.00**	**2.88**	**3.50**	....	**6 50**	**34.18**	5160
.....	..	.....	....	10.22	2.41	12.63	3.18	3.86	.....	*5.63*	34.53	
.....	.....	.....	.....	9.41	1.92	11.33	3.20	3.88	.....	*4.96*	*32.27*	5608
.....	...	.....	...	.....		**20.00**	**2.47**	**3.00**	....	.....	**20.65**	5269
15.04	6.35	....	...	.....		*21.39	2.45	2.97	...	...	24.42	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5270	J. B. Jones, Louisville, Ky.	Ammoniated Bone Meal.	Guaranteed. Found. Campbellsville.
5937			
5380	Same.	Raw Bone Meal.	Guaranteed. Found.
5381	Same.	Wheat Grower.	Guaranteed. Found. Campbellsville.
5938			
5125	The Jones Fertilizing Co., Cincinnati, O.	Bone Meal.	Guaranteed. Found. Campbellsville.
5916			
5126	Same.	Acidulated Bone Meal.	Guaranteed. Found.
5127	Same.	Ammoniated Bone.	Guaranteed. Found. Glendale.
5917			
5128	Same.	Bone and Potash.	Guaranteed. Found. Church Hill. Elkton.
5617			
5918			
5129	Same.	Tobacco and Potato Grower.	Guaranteed. Found. Julien. Hopkinsville.
5616			
5625			
5130	Same.	Miami Valley.	Guaranteed. Found. Hopkinsville.
5618			
5131	Same.	Jones Reliable.	Guaranteed. Found. Campbellsville.
5919			
5132	Same.	Jewel Phosphate.	Guaranteed. Found. Campbellsville.
5920			
5133	Same.	Acid Phosphate.	Guaranteed. Found.
5334	Same.	Kentucky Tobacco Grower.	Guaranteed Found.
5377	The Loudenback Fert Co., Urbana, O.	Urbana Bone Phosphate and Potash.	Guaranteed. Found.
5189	Louisville Fertilizer Works, Louisville, Ky.	Corn and Wheat Grower.	Guaranteed. Found. Columbia.
5939			
5190	Same.	Special Tobacco and Corn Grower.	Guaranteed. Found.

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	....	.....	.....	.....	.....	**15.00**	**2.06**	**2.50**	....	.....	**$16.21**	5270
14.25	1.82	.....	....	....	.....	*16.07	2.23	2.71	.....	....	20.30	
10.08	1.51	.....	..	...		*11.59	2.57	3.12	.	.....	17.97	5937
.....	....	.....	....	.....	....	**21.50**	**3.50**	**4.25**	....	....	**25.15**	5380
13.90	8.59	.....	.....	.....	....	22.49	3.80	4.61	..	.....	29.57	
.....	....	.....	....	**9.00**	..	**11.00**	**1.70**	**2.06**	...	**2.00**	**22.35**	5381
.....	....	.....	....	9.04	2.90	11.94	1.68	2.04	....	2.32	23.24	
.....	.....	.....	.....	9.07	2.41	11.48	1.95	2.37	....	2.10	23.68	5938
.....	....	.....	....	.....	...	**20.00**	**3.30**	**4.00**	....	.....	**23.55**	5125
17.68	5.07	.....	....	.....	....	*22.75	3.40	4.13	....	....	29.08	
18.67	3.82	.....	....	....	....	*22.49	3.09	3.75	....	....	28.05	5916
.....	.....	.....	....	**7.00**	....	**14.50**	**3.30**	**4.00**	.....	....	**25.10**	5126
.....	.....	.....	....	9.50	6.31	15.81	3.80	4.61		....	29.76	
.....	.....	.....	....	.....	....	**15.00**	**4.12**	**5.00**	.....	. ...	**23.42**	5127
12.78	2.75	.....	....	.....	....	*15.53	4.08	4.95	.....	....	26.15	
14.36	1.78	.....	....	.....	.....	*16.14	4.55	5.52	.....	....	28.49	5917
.....	....	.....	.....	**8.00**	.....	**10.00**	**1.65**	**2.00**	....	**4.00**	**23.58**	5128
.....	.....	.....	.....	7.56	3.24	10.80	1.66	2.02	....	4.31	24.04	
.....	...	.....	....	7.41	3.90	11.31	1.91	2.32	....	3.75	24.26	5617
.....	....	.....	....	8.08	3.28	11.36	1.95	2.37	....	4.29	25.79	5918
.....	....	.....	....	**10.00**		**12.00**	**3.71**	**4.50**	...	**5.00**	**34.99**	5129
.....	....	.....	.....	*7.84*	5.46	13.30	3.80	4.61	....	6.09	35.54	
.....	.....	.. ..	.....	*7.85*	4.84	12.69	4.34	5.27	....	4.63	35.08	5616
.....	.....	.....	.....	*7.24*	5.48	12.72	4.09	4.97	...	5.65	35.11	5625
.....	....	....	.....	**9.00**	.	**13.00**	**2.47**	**3.00**	....	**2.75**	**27.10**	5130
.....	.....	....	....	9.63	4.31	13.94	2.57	3.12	....	3.35	29.33	
.....	....	...	.....	8.58	6.00	14.58	3.65	4.43	.....	2.70	31.57	5618
.....	....	.....	....	**8.50**	...	**10.00**	**1.23**	**1.50**	...	**1.25**	**18.71**	5131
.....	....	.....	.....	8.03	3.13	11.16	1.38	1.68	...	1.83	20.20	
.....	....	.....	....	8.33	2.94	11.27	1.96	2.38	....	1.51	22.10	5919
.....	...	.....	...	**8.00**	...	**10.00**	**0.82**	**1.00**	....	.....	**15.07**	5132
.....	....	.....	.....	9.10	2.06	11.16	0.68	0.83	...	.....	16.15	
.....	.....	....	.....	10.05	2.69	12.74	1.36	1.65	.....	..	20.18	5920
.....	...	.....	.....	**8.00**	....	**10.00**	.....	.....	.....	..	**8.00**	5133
.....	...	.....		8.78	1.30	10.08	....	....	....	.	8.78	
.....	.....	.....	....	**8.00**	....	**10.00**	**1.65**	**2.00**	.	**4.00**	**23.58**	5334
.....	.....	.....	.....	7.73	3.13	10.86	1.75	2.12	.....	4.24	24.46	
.....	...	.....	....	**9.00**	..		**1.23**	**1.50**	**2.00**	.....	**19.31**	5177
...	....	....	....	11.04	1.33	12.37	*0.70*	0.85	3.46	.	22.73	
.....	.....	.....	.....	**10.00**	...	**11.00**	**0.21**	**0.25**	**0.25**	....	**15.54**	5189
.....	....	....	.....	11.18	1.11	12.29	0.50	0.61	0.40	....	18.44	
...	...	..	.....	10.50	1.73	12.23	0.23	0.28	0.09	.....	16.49	5939
.....	.....	....	....	**8.00**	...	**9.00**	**0.82**	**1.00**	....	**1.50**	**16.67**	5190
.....	.....			8.35	1.73	10.08	0.94	1.14	....	1.96	18.59	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5191	Louisville Fertilizer Works.	Potato and Tobacco Grower.	Guaranteed. Found. Bowling Green.
5596			
5218	Same.	Soluble Bone and Potash.	Guaranteed. Found. Bowling Green.
5597			
5268	Same.	Corn Grower.	Guaranteed. Found.
5358	Same.	Dissolved Bone.	Guaranteed. Found.
5688	Same.	Wheat Grower.	Guaranteed. Found. Mill Springs. Avoca. Beaver Dam.
5940			
5951			
6000			
5689	Same.	Bone Meal.	Guaranteed. Found. Shearer Valley. Cloverport. Elkton.
5941			
5954			
5955			
5695	Same.	Raw Bone Meal.	Guaranteed. Found. Franklin. Dant.
5942			
5991			
5495	A. B. Mayer M'f'g Co., St. Louis, Mo.	Anchor Brand Complete Fertilizer.	Guaranteed. Found.
5496	Same.	Anchor Brand Corn and Wheat Grower.	Guaranteed. Found. Princeton. Franklin. Sonora. Princeton.
5621			
5894			
5909			
5946			
5497	Same.	Anchor Brand Pure Bone Meal.	Guaranteed. Found. Sonora. Franklin. Greenville.
5895			
5910			
5947			
5222	Meridian Fertilizer Fac., Meridian, Miss.	Meridian Home Mixture.	Guaranteed. Found. Somerset.
5897			
5223	Same.	Meridian Corn and Wheat Grower.	Guaranteed. Found.
5194	Michigan Carbon Works, Detroit, Mich.	Homestead Corn and Wheat Grower.	Guaranteed. Found. Campbellsville. Auburn.
5982			
6014			

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	..	.....	.....	**7.00**		**10.00**	**1.65**	**2.00**	....	**4.00**	**$22.68**	5191
.....	.....	.....	...	7.52	2.02	9.54	2.18	2.65	...	4.87	25.99	
.....	....	.....	..	10.18	0.87	11.05	1.55	1.88	....	*3.27*	24.70	5596
.....	....	.....	.....	**8.00**	...	**9.00**	**0.82**	**1.00**	....	**1.50**	**16.67**	5218
.....	..	.....	...	8.15	1.85	10.00	0.93	1.13	....	1.98	18.37	
.. ...	.....	...	.	12.17	0.84	13.01	0.78	0.95	...	2.74	24.03	5597
.....	.....	.....	...	**10.00**	..	**11.00**	...	.....	**2.00**	..	**16.90**	5268
....	....	..	.....	11.82	1.02	12.84	..		2.64	.....	20.23	
.....	....	.....	...	**10.00**		**11.00**	...	...	.....	....	**10.00**	5358
.....	..	.....	..	11.76	1.28	13.04	...	..	.....	.....	11.76	
.....	.....	.....	....	**10.00**	...	**11.00**	.....	....	**2.00**	.....	**16.90**	5688
.....	....	.....	....	*8.48*	1.11	9.59	.....	...	1.86	.....	*14.66*	
.....	....	.....	....	10.40	1.80	12.20	....	....	*0.60*	..	16.18	5940
.....	....	.....	.....	10.77	1.98	12.75	....	.....	*0.91*	.....	17.16	5951
.....	...	....	....	9.62	1.70	11.32	..	.....	1.96	.....	16.67	6000
.....	...	.....	.....	.....	....	**18.00**	**1.65**	**2.00**	.....	....	**16.58**	5689
						*22.06	1.86	2.26	....	.....	22.88	
15.66	6.40	.....	.....	.....	....	*26.81	*0.68*	0.83	....	.....	22.06	5941
17.96	8.85	.....	....	.....	....	*23.00	2.44	2.96	....	....	24.83	5954
12.42	10.58	.....	...	.....	....	*26.07	*0.76*	0.92	.....	.....	22.16	5955
19.29	6.78	....	....	.... ..	.....							
.....	.....	.....	....	.....	....	**20.00**	**2.88**	**3.50**	....	..	**22.08**	5695
						*21.52	2.69	3.27	....	....	25.22	
14.42	7.10	.....	....	.....	.....	*21.26	3.07	3.73	....	...	26.31	5942
14.03	7.23	.....	....	.....	.....	*18.41	3.56	4.32	.	.....	25.90	5991
11.97	6.44	.....	....	.....								
.....	..	**4.00**	**4.00**	**8.00**	....	**12.00**	**2.88**	**3.50**	...	**3.50**	**28.18**	5495
.....	.....	...	....	*6.52*	4.00	10.52	2.85	3.46	*2.52*	.....	*24.13*	
.....	.....	**4.00**	**5.00**	**9.00**	.....	**12.00**	**3.29**	**4.00**	.....	**2.50**	**29.12**	5496
.....	....	...	.....	*6.39*	6.24	12.63	*1.91*	2.32	....	*0.52*	*19.49*	
.....	....	.....	....	*6.57*	6.06	12.63	*2.29*	2.78	.....	*0.66*	*21.17*	5621
.....	....	.....	.....	*6.36*	7.80	14.16	*2.37*	2.88	....	*0.69*	*22.07*	5894
.....	....	.....	....	8.60	6.10	14.70	*2.32*	2.82	....	*0.59*	*24.04*	5909
.....	....	.....	....	9.29	4.53	13.82	*2.45*	2.97	....	*0.57*	*24.66*	5946
.....	.....	.....	.....	.....	....	**22.00**	**3.71**	**4.50**	.....	.....	**26.19**	5497
						19.42	3.50	4.25	.....	.....	26.55	
13.21	6.21	.....	..	.....	....	*20.62*	3.64	4.42	.....	.....	27.95	5895
14.23	6.39	.....	.....	.....	....	*17.22*	*3.02*	3.67	.....	.....	*23.62*	5910
13.60	3.62	.....	...	.....	.....	*20.65	*2.75*	3.34	.....	.....	*24.91*	5947
14.45	6.20	.....	....	.....								
.....	....	**7.00**	**2.00**	**9.00**		**10.00**	**2.25**	**2.73**	**2.25**	.....	**23.68**	5222
.....	....	.....	..	11.01	1.73	12.74	2.51	3.05	2.90	.....	28.55	
.....	....	.....	.....	*6.40*	1.14	*7.54*	3.36	4.08	2.14	1.26	25.62	5897
.....	....	**7.00**	**2.00**	**9.00**	...	**10.00**	**2.25**	**2.73**	**2.25**	... .	**23.68**	5223
.....	....	.....	...	11.11	1.70	12.81	2.46	2.99	2.86	.....	28.44	
.....	.....	.....	...	**9.00**	....	....	**2.26**	**2.75**	**1.75**	.....	**22.61**	5194
.....	...	.....	....	9.73	1.20	10.93	2.38	2.89	2.30	.....	25.31	
.....	.....	.....	....	9.42	0.65	10.07	2.75	3.34	1.68	.....	25.17	5982
.....	....	.....	...	10.33	0.72	11.05	2.30	2.79	1.57	....	24.75	6014

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5195 5595	Michigan Carbon Works, Detroit, Mich.	Homestead Tobacco Grower.	Guaranteed. Found. Elkton.
5196 5593	Same.	Desiccated Bone.	Guaranteed. Found. Elkton.
5197 5983	Same.	Acid Phosphate.	Guaranteed. Found. Stithton.
5198	Same.	Red Line Phosphate with Potash.	Guaranteed. Found.
5199 5594	Same.	Red Line Complete Manure.	Guaranteed. Found. Elkton.
5200 5984	Same.	Red Line Crop Grower.	Guaranteed. Found. Somerset.
5279 5985	Same.	Red Line Ammoniated Phosphate.	Guaranteed. Found. Scottsburg.
5290	Same.	Homestead Potato Grower.	Guaranteed. Found.
5357	Same.	Jarves Drill Phosphate.	Guaranteed. Found.
5276 5581	National Fertilizer Co., Nashville, Tenn.	Corn Grower.	Guaranteed. Found. Elkton.
5278 5579 5647 6002	Same.	Tobacco Grower.	Guaranteed. Found. Elkton. Herndon. Jamestown.
5352 5583	Same.	Acid Phosphate.	Guaranteed. Found. Glasgow.
5353 5580	Same.	Sadler's Formula.	Guaranteed. Found. Elkton.
5476	Same.	Tobacco Fertilizer.	Guaranteed. Found.
5486 5584	Same.	Bone Meal.	Guaranteed. Found. Glasgow.

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	..	.....	...	**10.00**	....	.....	**2.88**	**3.50**	**3.50**	....	**$28.28**	5195
.....	.....	.....	....	10.05	0.63	10.68	3.33	4.04	4.97	....	32.01	
.....	.....	.....	...	10.33	0.28	10.61	3.76	4.56	3.71	....	32.21	5595
.....	...	.....	....	.....	....	**25.00**	**1.23**	**1.50**	....	...	**19.31**	5196
27.55	5.05	.....	....	.....	...	32.60	1.62	1.97	...	....	30.74	
23.29	9.46	...	....	.....	.....	32.75	1.45	1.76	..	..	29.39	5593
.....	.....	.....	....	**14.00**	...	**15.00**	....	.....	...		**14.00**	5197
.....	....	.....	....	13.94	3.30	17.24	....	....	....	.....	13.94	
.....	.....	.....	....	14.88	0.96	15.84	....	...	.		14.88	5983
.....	....	.....	.....	**10.00**	..	**12.00**	.....	....	**3.00**	....	**18.60**	5198
.....	....	.....	...	10.82	2.32	13.14	....	....	3.29	..	20.26	
.....	.....	.....	....	**8.00**	....	**9.00**	**1.03**	**1.25**	**1.50**	....	**17.11**	5199
.....	....	.....	....	8.93	1.65	10.58	1.45	1.76	1.70	....	20.45	
.....	...	.....	....	9.47	1.66	11.13	1.13	1.37	1.54	....	19.90	5594
.....	.....	.....	..	**8.00**	.....	**9.00**	**1.65**	**2.00**	**2.00**	....	**19.88**	5200
.....	....	.....	....	8.11	2.00	10.11	1.78	2.16	2.41	....	21.47	
.....	...	.. .	.....	8.25	1.47	9.72	1.80	2.19	2.49	....	21.58	5984
.....	....	.....	...	**8.00**	....	**9.00**	**1.65**	**2.00**	.....	....	**17.48**	5279
.....	.....	.....	....	8.93	1.87	10.80	2.01	2.44	....	....	20.48	
.....	.	.....	.....	9.46	1.27	10.73	1.89	2.29	...	....	20.50	5985
.....	....		....	**8.50**	..	**10.00**	**1.94**	**2.35**	**5.00**	.....	**25.44**	5290
....	.....	....	.....	9.69	0.77	10.46	2.36	2.87	5.73	....	29.10	
.....	...	....	....	**8.00**	...	**10.00**	**1.03**	**1.25**	**0.75**	....	**16.71**	5357
.....	.....	...	...	8.65	1.41	10.06	1.06	1.29	1.38	....	18.19	
.....	....	....	....	**12.00**	....	.....	**0.82**	**1.00**	**1.00**	..	**20.87**	5276
.....	....	.....	....	14.63	0.45	15.08	0.89	1.08	1.00	....	25.03	
.....	...		....	14.92	1.22	16.14	0.99	1.20	1.39	....	26.64	5581
.....	.....	.....	.....	**10.00**	..	.....	**1.65**	**2.00**	**2.00**	....	**22.18**	5278
.....	...	.....	.....	12.87	0.96	13.83	2.02	2.45	1.72	.....	27.63	
.....	.....	....	....	14.13	1.20	15.33	1.37	1.66	1.77	....	27.30	5579
.....	....	.....	....	11.60	1.42	13.02	2.04	2.48	*1.38*	....	25.75	5647
.....	....	.....	...	11.64	0.68	12.32	2.02	2.45	1.67	....	25.71	6002
.....	.....	.....	....	**15.00**	.....	.....	..	....	....	.. .	**15.00**	5352
.....	....	.....	....	16.34	0.55	16.89	....	.....	...	.....	16.34	
.....	...	....	.....	16.86	2.05	18.91	...	...	.....	.	16.86	5583
.....	.....	....	..	**12.00**	..	....	.....	....	**2.00**	...	**19.20**	5353
.....	....	.....	....	14.54	1.73	16.27	....	.....	3.02	....	24.85	
.....	...	.....		14.32	0.40	14.72	..	....	4.55	....	25.71	5580
.....	....	.. ...	....	**10.00**	.....	..	**2.06**	**2.50**	**3.00**	...	**24.81**	5476
.....	...	.....	...	11.41	1.45	12.86	2.21	2.68	*2.40*	....	27.32	
.....	...	.....	....	.....	....	**20.00**	**2.47**	**3.00**	..	....	**20.65**	5486
6.86	16.55	.....	....	.....	.....	23.41	3.89	4.72	..	.....	29.04	
14.46	10.00	.....	....	.....	....	24.46	3.96	4.81	....	....	31.43	5584

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5487	National Fertilizer Co.	National Dissolved Bone.	Guaranteed. Found. Bowling Green.
5582			
5505	Same.	Tennessee Guano.	Guaranteed. Found.
5506	Same.	Twentieth Century Guano.	Guaranteed. Found. Jamestown.
6003			
5507	Same.	Vegetable Grower.	Guaranteed. Found.
5857	Same.	Wheat Grower.	Guaranteed. Found. Adairville.
6004			
5143	North-Western Fertilizing Co., Chicago, Ill.	Horse Shoe Brand Fine Raw Bone.	Guaranteed. Found. Louisville.
5605			
5144	Same.	H. S. B. Pure Ground Bone.	Guaranteed. Found. Webster.
6008			
5145	Same.	H. S. B. Raw Bone and Super-Phosphate Mixture.	Guaranteed. Found. Louisville.
5602			
5146	Same.	H. S. B. Tobacco Grower.	Guaranteed. Found. Louisville. Germantown. Princeton.
5554			
5574			
5630			
5147	Same.	H. S. B. Kentucky Tobacco Grower.	Guaranteed. Found. Louisville.
5555			
5148	Same.	H. S. B. Challenge Corn Grower.	Guaranteed. Found. Jeffersontown.
5553			
5149	Same.	H. S. B. Potato Grower.	Guaranteed. Found. Jeffersontown.
5552			
5150	Same.	H. S. B. Corn and Wheat Grower.	Guaranteed. Found. Louisville.
5603			
5151	Same.	H. S. B. Acidulated Bone and Potash.	Guaranteed. Found. Science Hill. Edmonton. Hopkinsville.
6009			
6023			
6031			

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	.....	.....	**12.00**	.....	.....	**0.82**	**1.00**	**1.00**	.....	**$20.87**	5487
.....	.....	.....	.....	14.43	0.36	14.79	0.86	1.04	0.63	.....	24.15	
.....	.....	.....	.....	14.26	0.50	14.76	0.94	1.14	0.92	.....	24.60	5582
.....	.....	.....	.....	**10.00**	.....	.....	**1.65**	**2.00**	**2.00**	.....	**22.18**	5505
.....	.....	.....	.....	13.18	0.74	13.92	1.71	2.08	1.70	.....	26.85	
.....	.....	.....	.....	**12.00**	.....	.....	.....	.....	**4.00**	.....	**21.60**	5506
.....	.....	.....	.....	14.15	0.40	14.55	.....	.....	3.62	.....	24.35	
.....	.....	.....	.....	12.94	0.77	13.71	.....	.....	*3.13*	.....	22.27	6003
.....	.....	.....	.....	**10.00**	.....	.....	**2.47**	**3.00**	**2.00**	.....	**25.05**	5507
.....	.....	.....	.....	11.63	1.39	13.02	2.87	3.48	1.58	.....	28.93	
.....	.....	.....	.....	**10.00**	.....	.....	**1.65**	**2.00**	**2.00**	.....	**22.18**	5857
.....	.....	.....	.....	13.84	1.51	15.35	1.89	2.29	3.37	.....	30.80	
.....	.....	.....	.....	11.96	1.36	13.32	1.81	2.20	2.13	.....	26.32	6004
.....	.....	.....	.....	.....	.....	**22.00**	**3.29**	**4.00**	.....	.....	**24.72**	5143
.....	.....	.....	.....	.....	.....	22.82	4.01	4.87	.....	.....	29.56	
9.11	13.71	.....	.....	.....	.....	24.08	3.33	4.04	.....	.....	29.11	5605
15.03	9.05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	**18.00**	**2.47**	**3.00**	.....	.....	**19.45**	5144
.....	.....	.....	.....	.....	.....	18.52	2.70	3.28	.....	.....	23.37	
14.04	4.48	.....	.....	.....	.....	*21.34	2.57	3.12	.....	.....	25.77	6008
19.85	1.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	**4.00**	**3.00**	**7.00**	.....	**13.00**	**2.47**	**3.00**	.....	**0.50**	**22.15**	5145
.....	.....	.....	.....	10.44	6.09	16.53	2.87	3.37	.....	0.55	28.17	
.....	.....	.....	.....	9.15	4.53	13.68	3.05	3.70	.....	0.53	26.50	5602
.....	.....	**5.00**	**3.00**	**8.00**	.....	**10.00**	**3.29**	**4.00**	.....	**2.50**	**27.22**	5146
.....	.....	.....	.....	9.64	1.16	10.80	3.35	4.07	.....	3.05	30.08	
.....	.....	.....	.....	7.56	2.43	9.99	3.84	4.66	.....	3.52	30.17	5554
.....	.....	.....	.....	8.14	2.55	10.69	3.46	4.20	.....	*1.83*	27.35	5574
.....	.....	.....	.....	8.52	2.51	11.03	3.57	4.33	.....	2.59	29.32	5630
.....	.....	**4.00**	**2.00**	**6.00**	.....	**8.00**	**2.47**	**3.00**	.....	**1.50**	**20.15**	5147
.....	.....	.....	.....	7.99	1.16	9.15	2.72	3.30	.....	2.04	24.15	
.....	.....	.....	.....	8.67	2.11	10.78	2.56	3.11	.....	2.31	25.39	5555
.....	.....	**5.00**	**3.00**	**8.00**	.....	**10.00**	**2.47**	**3.00**	.....	**1.50**	**22.95**	5148
.....	.....	.....	.....	9.12	1.43	10.55	2.76	3.35	.....	1.98	25.92	
.....	.....	.....	.....	8.10	2.06	10.16	3.02	3.67	.....	2.91	27.01	5553
.....	.....	**4.00**	**4.00**	**8.00**	.....	**10.00**	**3.29**	**4.00**	.....	**3.50**	**28.62**	5149
.....	.....	.....	.....	9.21	2.09	11.30	3.77	4.58	.....	6.90	36.80	
.....	.....	.....	.....	*6.91*	1.97	*8.88*	4.20	5.10	.....	3.06	29.64	5552
.....	.....	**7.00**	**3.00**	**10.00**	.....	**12.00**	**2.06**	**2.50**	.....	**1.00**	**23.61**	5150
.....	.....	.....	.....	10.51	2.81	13.32	2.37	2.88	.....	1.06	25.90	
.....	.....	.....	.....	10.03	2.88	12.91	2.50	3.04	.....	1 03	25.67	5603
.....	.....	**7.00**	**3.00**	**10.00**	.....	**12.00**	**0.82**	**1.00**	.....	**1.50**	**19.97**	5151
.....	.....	.....	.....	9.96	3.15	13.11	1.59	1.93	.....	*1.01*	22.50	
.....	.....	.....	.....	10.16	2.52	12.68	0.97	1.18	.....	*1.12*	20.45	6009
.....	.....	.....	.....	11.08	1.98	13.06	1.07	1.30	.....	*1.02*	21.68	6023
.....	.....	.....	.....	11.19	2.70	13.89	0.85	1.03	.....	*0.92*	21.29	6031

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5152 5556	North-Western Fertilizing Co.	H. S. B. Bone and Potash.	Guaranteed. Found. Louisville.
5153 5604	Same.	H. S. B. Acidulated Bone.	Guaranteed. Found. Louisville.
5154	Same.	H. S. B. Dissolved Bone Phosphate.	Guaranteed. Found.
5155 6010	Same.	H. S. B. Quick Acting Phosphate.	Guaranteed. Found. Science Hill.
5156	Same.	H. S. B. Prairie Phosphate.	Guaranteed. Found.
5157 5629	Same.	H. S. B. Special High Grade Tobacco Grower.	Guaranteed. Found. The Square.
5044 5888 5900	The Ohio Farmers Fertilizer Co., Columbus, O.	Acid Phosphate.	Guaranteed. Found. Campbellsville. Harned.
5045 5611 5889 5901 5999	Same.	Soluble Bone and Potash.	Guaranteed. Found. Hopkinsville. Harned. Campbellsville. Leitchfield.
5046	Same.	Grain and Grass.	Guaranteed. Found.
5047 5610 5884 5890 5902 5993	Same.	Corn, Oats and Wheat Fish Guano.	Guaranteed. Found. Hopkinsville. Harned. Campbellsville. Jolly Station. Hopkinsville.
5048 5609 5619	Same.	Tobacco Special.	Guaranteed. Found. Church Hill. Hopkinsville.
5049 5891	Same.	Fine Ground Bone Meal.	Guaranteed. Found. Jolly Station.
5684 5892 5904	Same.	Imperial Raw Bone.	Guaranteed. Found. Harned. Hopkinsville.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	**8.00**	**2.00**	**10.00**	.....	**12.00**	.....	.....	.....	**1.25**	**$16.75**	5152
.....	.....	.....	.....	10.95	3.35	14.30	.....	.....	.....	1.06	18.49	
.....	.....	.....	.....	10.17	2.00	12.17	0.30	0.36	.....	1.29	18.10	5556
.....	.....	**7.00**	**3.00**	**10.00**	.....	**12.00**	**0.82**	**1.00**	.....	.....	**17.87**	5153
.....	.....	.....	.....	10.11	3.95	14.06	1.56	1.89	.....	.....	21.59	
.....	.....	.....	.....	10.24	2.99	13.23	1.04	1.26	.....	.....	19.48	5604
.....	.....	**8.00**	**3.00**	**11.00**	.....	**13.00**	**1.23**	**1.50**	.....	.....	**20.71**	5154
.....	.....	.....	.....	11.13	3.03	14.16	1.58	1.92	.....	.....	22.63	
.....	.....	**9.00**	**4.00**	**13.00**	.....	**15.00**	.....	.....	.....	.....	**13.00**	5155
.....	.....	.....	.....	14.10	1.74	15.84	.....	.....	.....	.....	14.10	
.....	See	foot	n'te	*10.26*	3.94	14.20	.....	.....	.....	.....	*10.26*	6010
.....	.....	**4.00**	**2.00**	**6.00**	.....	**9.00**	**1.65**	**2.00**	.....	**1.00**	**17.08**	5156
.....	.....	.....	.....	7.23	1.30	8.53	1.86	2.26	.....	1.42	19.27	
.....	.....	**5.00**	**4.00**	**9.00**	.....	**11.00**	**3.29**	**4.00**	.....	**10.00**	**39.12**	5157
.....	.....	.....	.....	9.87	0.91	10.78	3.91	4.75	.....	10.25	42.32	
.....	.....	.....	.....	*5.82*	2.00	*7.82*	4.47	5.43	.....	*7.87*	*35.82*	5629
.....	.....	.....	.....	**9.00**	.....	**10.00**	.....	.....	.....	.....	**9.00**	5044
.....	.....	.....	.....	9.21	4.68	13.89	.....	.....	.....	.....	9.21	
.....	.....	.....	.....	8.41	4.75	13.16	.....	.....	.....	.....	8.41	5888
.....	.....	.....	.....	9.23	2.41	11.64	.....	.....	.....	.....	9.23	5900
.....	.....	.....	.....	**12.00**	.....	**13.00**	.....	.....	.....	**1.00**	**18.70**	5045
.....	.....	.....	.....	*10.64*	6.32	16.96	.....	.....	1.38	.....	19.72	
.....	.....	.....	.....	12.28	2.10	14.38	.....	.....	0.86	.....	19.27	5611
.....	.....	.....	.....	*10.23*	4.03	14.26	.....	.....	*0.56*	.....	*17.01*	5889
.....	.....	.....	.....	*11.17*	3.49	14.66	.....	.....	0.86	.....	18.42	5901
.....	.....	.....	.....	*9.20*	2.03	11.23	.....	.....	1.15	.....	*15.28*	5999
.....	.....	.....	.....	**12.00**	.....	**13.00**	.....	.....	.....	**1.00**	**18.70**	5046
.....	.....	.....	.....	*11.01*	5.97	16.98	.....	.....	1.36	.....	20.03	
.....	.....	.....	.....	**9.00**	.....	**10.00**	**1.24**	**1.50**	.....	**2.00**	**20.24**	5047
.....	.....	.....	.....	10.32	10.20	20.52	1.76	2.14	3.03	.....	29.35	
.....	.....	.....	.....	*8.24*	2.53	10.77	1.28	1.55	*1.35*	.....	*18.91*	5610
.....	.....	.....	.....	*7.38*	3.98	11.36	*0.91*	1.10	1.82	.....	*17.69*	5884
.....	.....	.....	.....	*8.43*	2.94	11.37	1.03	1.25	2.25	.....	19.58	5890
.....	.....	.....	.....	11.00	3.30	14.30	1.07	1.30	3.11	.....	24.53	5902
.....	.....	.....	.....	8.67	1.94	10.61	1.16	1.41	2.08	.....	19.67	5903
.....	.....	.....	.....	**8.00**	.....	**9.00**	**2.47**	**3.00**	.....	**4.00**	**25.95**	5048
.....	.....	.....	.....	8.70	5.50	14.20	3.15	3.82	5.12	.....	32.10	
.....	.....	.....	.....	*6.62*	1.80	8.42	2.41	2.93	.....	3.87	*24.03*	5609
.....	.....	.....	.....	8.73	2.00	10.73	*1.29*	1.57	.....	*2.87*	*21.76*	5619
.....	.....	.....	.....	.....	.....	**20.00**	**1.65**	**2.00**	.....	.....	**17.78**	5049
17.73	5.48	.....	.....	.....	.....	23.21	1.75	2.12	.....	.....	23.60	
25.00	4.07	.....	.....	.....	.....	29.07	1.61	1.95	.....	.....	28.08	5891
.....	.....	.....	.....	.....	.....	**16.00**	**3.29**	**4.00**	.....	.....	**21.12**	5684
9.11	6.88	.....	.....	.....	.....	15.99	*2.71*	3.29	.....	.....	20.91	
11.19	5.03	.....	.....	.....	.....	16.22	*2.79*	3.39	.....	.....	21.74	5892
10.69	8.06	.....	.....	.....	.....	18.75	3.17	3.85	.....	.....	24.47	5904

NOTE.—By mistake the wrong goods were shipped, and the manufacturers stated that they would do what they could to make it right.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5685	The Ohio Farmers Fertilizer Co.	Desiccated Bone Meal	Guaranteed.
			Found.
5893			Campbellsville.
5905			Harned.
5214	Queen City Fertilizer Co., Cincinnati, O.	High Grade Corn and Wheat Grower with Potash.	Guaranteed.
			Found.
5800	The E. Rauh & Sons Fert. Co., Indianapolis, Ind.	Half Pure Raw Bone and Half Pure Bone Phosphate.	Guaranteed.
			Found.
5801	Same.	Pure Raw Bone.	Guaranteed.
			Found.
5207	Read Phosphate Co., Nashville, Tenn.	High Grade Tobacco Grower.	Guaranteed.
			Found.
5600			Glasgow.
5208	Same.	Blood and Bone No. 1	Guaranteed.
			Found.
5626			Caskey.
5992			Allensville.
5209	Same.	Alkaline Bone.	Guaranteed.
			Found.
5928			Bonnieville.
5989			Science Hill.
6001			Bowling Green.
6015			Henderson.
6032			Hardinsburg.
6140			Henderson.
5210	Same.	Farmers Special Manure.	Guaranteed.
			Found.
5993			Sonora.
6007			Allensville.
6024			Bowling Green.
6033			Henderson.
5211	Same.	XXX Dissolved Bone.	Guaranteed.
			Found.
5990			Campbellsville.
5382	Same.	Vegetable, Fruit and Vine Fertilizer.	Guaranteed.
			Found.
5971			Geneva.
5677	Same.	Read's Wheat and Clover Grower.	Guaranteed.
			Found.
5994			Somerset.
5741	Same.	Special Potash Mixture.	Guaranteed.
			Found.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
....	....	.....	...	.....	...	**21.00**	**1.65**	**2.00**	....	....	**$18.38**	5685
18.87	2.57	.....	.....	.....	.....	21.44*	1.79	2.17	.....	....	22.91	
16.95	3.47	....	...	.....	...	20.42*	1.49	1.81	.....	....	20.86	5893
17.18	3.77	....		.....	..	20.95*	*1.18*	1.43		...	20.13	5905
.....	....	**8.00**	**3.00**	**11.00**	....	**12.00**	....	.....	**2.00**	..	**18.30**	5214
.....	....	.....	....	11.80	1.36	13.16	.....	...	2.24	.....	19.89	
.....	.....	**4.00**	**7.00**	**11.00**	...	**23.00**	**3.29**	**4.00**	.....	.....	**32.92**	5800
.....	....	.....	....	15.16	6.59	21.75	*1.51*	1.83	.....	...	*29.81*	
.....	....	....	.....	.....	....	**22.00**	**3.29**	**4.00**	....	.....	**24.72**	5801
16.37	7.02	.....	.....		.....	23.39	3.89	4.72	.....		30.93	
.....	....	.....	....	**8.00**	.....	**9.00**	**1.65**	**2.00**	**4.00**	...	**22.28**	5207
.....	....	.....	...	8.50	2.37	10.87	2.37	2.88	4.17	...	26.39	
.....	....	.....	.....	8.30	3.03	11.33	1.73	2.10	4.09	.....	24.11	5600
.....	....	.....	....	**8.00**	...	**9.00**	**1.65**	**2.00**	**2.00**	..	**19.88**	5208
.....	....	.....	....	8.56	2.67	11.23	2.40	2.91	2.15	....	24.30	
.....	.....	.....	....	7.64	2.47	10.11	1.83	2.22	1.98	...	20.73	5626
.....	.	.....	..	7.85	1.83	9.68	1.83	2.22	2.36		21.15	5992
.....	....	.....		**10.00**	....	**11.00**	..	....	**2.00**	.....	**16.90**	5209
.....	....	.....	....	9.70	2.56	12.26	....	..	1.72	.....	16.92	
.....	....	.....	.....	*8.61*	2.19	10.80	....	....	2.15	..	*15.73*	5928
.....	....	.....	....	*8.67*	2.06	10.73	....	.....	2 20	..	*15.81*	5989
.....	.....	.....	....	*8.51*	2.38	10.89	...	.....	1.82	...	*15.28*	6001
.....	....	.....	.....	*8.56*	2.29	10.85	...	....	1.94	....	*15.46*	6015
.....	.....	.....	...	10.75	2.23	12.98	....	...	1.67	....	18.17	6032
.....	...	.....	....	10.48	11.46	21.94		....	2.40	.....	23.28	6140
.....	....	.....	.....	**10.00**	.....	**11.00**	**0.82**	**1.00**	**3.00**	....	**20.97**	5210
.....	....	.....	....	10.76	2.34	13.10	1.18	1.43	3.32	....	24.34	
.....	....	.....	...	*8.90*	1.22	10.12	1.14	1.38	3.50	..	21.26	5993
.....	....	.....	...	9.73	1.66	11.39	1.09	1.32	*2.35*	.....	21.09	6007
.....	....	.....	....	*9.20*	1.46	10.66	1.06	1.29	....	3.93	22.82	6024
	.....	.....	....	*8.51*	2.35	10.86	0.93	1.13	3.33	.....	20.35	6033
.....	.....	.....	.....	**13.00**	....	**14.00**	.....	....	...	...	**13.00**	5211
.....	...	.....	...	12.59	3.31	15.90	.....	....	....	....	12.59	
.....	...	.....	....	13.15	1.77	14.92	...	.....	.....	....	13.15	5990
.....	....	.....	.....	**6.00**	....	....	**1.65**	**2.00**	**8.00**	....	**23.78**	5382
....	....	.....	.....	*5.10*	1.51	6.61	1.58	1.92	7.50	.	*22.43*	
.....	...	.....	....	7.21	2.24	9.45	1.77	2.15	7.59	..	26.52	5971
.....	...	.....	...	**10.00**	.....	**12.00**	**0.82**	**1.00**	**2.00**	...	**20.27**	5677
.....	....	.....	..	11.32	1.68	13.00	1.05	1.27	1.99	.....	22.76	
.....	....	.....	.....	10 94	1.37	12.31	0.72	0.87	*1.46*	.....	20.28	5994
.....	....	**7.00**	**3.00**	**10.00**	.....	**11.00**	....		**4.00**	....	**19.30**	5741
.....	....	.....	..	9.39	1.64	11.03	...	.....	5.28	..	20.31	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5855	Read Phosphate Co.,	Read's Wheat Grower.	Guaranteed.
			Found.
5914			Auburn.
5929			Ferguson.
5995			Russellville.
5386	John S. Reese & Co., Agts., Baltimore, Md.	Reese's Pacific Guano.	Guaranteed.
			Found.
5960			Owensboro.
5369	The J. & F. Schroth Packing Co., Cin., O.	Corn and Wheat Grower.	Guaranteed.
			Found.
5370	Same.	Schroth's Special Phosphate.	Guaranteed.
			Found.
5754	J. F. & W. H. Singer, Nashville, Tenn.	Standard Bone Meal.	Guaranteed.
			Found.
5961			Franklin.
5755	Same.	Singer's No. 2 Wheat Grower.	Guaranteed.
			Found.
5962			Franklin.
5307	Southern Fertilizer Co., Atlanta, Ga.	Greer's Compound Fertilizer.	Guaranteed.
			Found.
5981			Somerset.
5308	Same.	Greer's Challenge Fertilizer.	Guaranteed.
			Found.
5854	Same.	Greer's Dissolved Bone.	Guaranteed.
			Found.
5756	Standard Guano and Chemical M'f'g Co., New Orleans, La.	Pure Raw Ground Bone.	Guaranteed.
			Found.
5963			Adairville.
5757	Same.	Standard Raw Bone Wheat Grower.	Guaranteed.
			Found.
5964			Franklin.
5247	Swift & Company, Chicago, Ill.	Raw Bone Meal.	Guaranteed.
			Found.
5974			Pembroke.
5248	Same.	Ground Steamed Bone.	Guaranteed.
			Found.
5975			Pembroke.
5249	Same.	Bone and Potash 3 per cent.	Guaranteed.
			Found.
5250	Same.	Superphosphate.	Guaranteed.
			Found.
5976			Greensburg.

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	.....	.....	**10.00**	.....	**11.00**	**1.65**	**2.00**	**2.00**	.....	**$22.68**	5855
.....	.....	.....	.....	9.43	2.26	11.69	1.64	1.99	2.53	.....	23.11	
.....	.....	.....	.....	9.83	1.98	11.81	1.54	1.87	1.99	.....	22.53	5914
.....	.....	.....	.....	9.83	4.17	14.00	1.97	2.39	2.25	.....	25.45	5929
.....	.....	.....	.....	*9.22*	4.35	13.57	1.83	2.22	2.56	.....	24.57	5995
.....	.....	**3.50**	**5.00**	**8.50**	.....	**10.50**	**1.85**	**2.25**	**1.20**	.....	**20.82**	5386
.....	.....	.....	.....	8.81	0.84	9.65	2.22	2.70	0.86	1.68	23.90	
.....	.....	.....	.....	10.02	0.41	10.43	2.35	2.85	.....	2.42	25.86	5960
.....	.....	.....	.....	**9.00**	.....	**11.00**	**3.29**	**4.00**	**4.00**	.....	**29.92**	5369
.....	.....	.....	.....	8.83	2.84	11.67	3.30	4.01	4.74	.....	31.02	
.....	.....	.....	.....	**7.00**	.....	**10.00**	**1.65**	**2.00**	**1.00**	.....	**18.28**	5370
.....	.....	.....	.....	7.31	4.96	12.27	2.44	2.96	1.42	.....	22.95	
.....	.....	.....	.....	.....	.....	**20.61**	**3.29**	**4.00**	.....	.....	**23.89**	5754
14.34	8.07	.....	.....	.....	.....	22.41	3.47	4.21	.....	.....	28.46	
14.05	7.57	.....	.....	.....	.....	21.62	3.73	4.53	.....	.....	28.84	5961
.....	.....	.....	.....	**6.76**	.....	**12.93**	**2.06**	**2.50**	.....	**3.25**	**24.31**	5755
.....	.....	.....	.....	9.68	7.45	17.13	*1.50*	1.82	.....	3.74	27.77	
.....	.....	.....	.....	7.88	9.12	17.00	2.11	2.56	.....	*1.53*	25.12	5962
.....	.....	**9.00**	**3.00**	**12.00**	.....	**14.00**	.....	.....	**2.00**	.....	**20.20**	5307
.....	.....	.....	.....	13.09	2.17	15.26	.....	.....	2.16	.....	22.01	
.....	.....	.....	.....	12.45	1.29	13.74	.....	.....	1.79	.....	20.23	5981
.....	.....	**7.50**	**2.50**	**10.00**	.....	**12.00**	**1.65**	**2.00**	**2.00**	.....	**23.18**	5308
.....	.....	.....	.....	10.21	2.02	12.23	2.15	2.61	2.83	.....	26.23	
.....	.....	**11.00**	**3.00**	**14.00**	.....	**16.00**	.....	.....	.....	.....	**14.00**	5854
.....	.....	.....	.....	15.29	0.70	15.99	.....	.....	.....	.....	15.29	
.....	.....	.....	.....	.....	.....	**20.00**	**3.09**	**3.75**	.....	.....	**22.82**	5756
18.19	5.43	.....	.....	.....	.....	23.62	3.65	4.43	.....	.....	30.59	
22.11	.....	.....	.....	.....	.....	22.11	3.51	4.26	.....	.....	29.98	5963
.....	.....	.....	.....	**8.00**	.....	**9.00**	**1.65**	**2.00**	**2.00**	.....	**19.88**	5757
.....	.....	.....	.....	9.20	0.42	9.62	2.30	2.79	2.27	.....	23.86	
.....	.....	.....	.....	8.60	0.74	9.34	2.20	2.67	2.23	.....	22.79	5964
.....	.....	.....	.....	.....	.....	**23.00**	**3.71**	**4.50**	.....	.....	**26.79**	5247
20.00	5.13	.....	.....	.....	.....	25.13	4.17	5.06	.....	.....	33.68	
13.41	11.43	.....	.....	.....	.....	24.84	3.99	4.84	.....	.....	31.56	5974
.....	.....	.....	.....	.....	.....	**25.00**	**2.47**	**3.00**	.....	.....	**23.65**	5248
26.29	1.27	.....	.....	.....	.....	27.56	2.74	3.33	.....	.....	31.38	
25.88	1.65	.....	.....	.....	.....	27.53	2.69	3.27	.....	.....	31.11	5975
.....	.....	.....	.....	.....	.....	**23.50**	**2.47**	**3.00**	.....	**3.00**	**26.95**	5249
24.29	1.14	.....	.....	.....	.....	25.43	2.60	3.16	.....	3.08	33.52	
.....	.....	**6.00**	**2.00**	**8.00**	.....	**12.00**	**2.47**	**3.00**	.....	**2.00**	**24.65**	5250
.....	.....	.....	.....	9.82	5.65	15.47	2.94	3.57	.....	1.99	29.66	
.....	.....	.....	.....	7.99	4.11	12.10	2.67	3.24	1.40	0.77	25.36	5976

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	ANALYSIS.
5251	Swift & Co., Chicago, Ill.	Potato and Tobacco Grower.	Guaranteed. Found. Casky.
5620			
5252	Same.	Bone Tankage.	Guaranteed. Found. Temperance.
5977			
5253	Same.	Acid Phosphate.	Guaranteed. Found.
5254	Same.	Bone Tankage and Potash 3 per cent.	Guaranteed. Found.
5255	Same.	Complete Fertilizer.	Guaranteed. Found. Greensburg.
5978			
5256	Same.	Phosphate and Potash.	Guaranteed. Found.
5257	Same.	Diamond [S] Phosphate.	Guaranteed. Found. Greensburg.
5979			
5258	Same.	Vegetable Grower.	Guaranteed. Found.
5139	Tennessee Chemical Co., Nashville, Tenn.	Ox Alkaline Bone.	Guaranteed. Found. Hopkinsville. Glasgow. Owensboro. Hopkinsville.
5627			
5966			
5980			
6025			
5140	Same.	Ox Special Tobacco Guano.	Guaranteed. Found. Allensville.
5601			
5141	Same.	Ox Bone and Potash.	Guaranteed. Found.
5142	Same.	Ox High Grade Dissolved Bone.	Guaranteed. Found. Newstead.
6005			
5192	Same.	Ox Bone with Ammonia and Potash.	Guaranteed. Found.
5317	Same.	Ox Special Wheat and Corn Guano.	Guaranteed. Found. Monticello.
5967			
5858	Same.	Ox Ammoniated Bone.	Guaranteed. Found. Auburn. Auburn.
5899			
5921			

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	**8.00**	**2.00**	**10.00**	.....	**11.00**	**3.29**	**4.00**	.....	**5.00**	**$33.02**	5251
.....	.....	.....	.....	9.85	1.33	11.18	3.88	4.71	.....	5.95	36.37	
.....	.....	.....	.....	*8.80*	2.05	10.85	4.69	5.69	.....	5.22	37.08	5620
.....	.....	.....	.....	.....	.....	**17.00**	**4.94**	**6.00**	.....	.....	**27.49**	5252
15.70	2.06	.....	.....	.....	.....	17.76	5.32	6.46	.....	.....	32.42	
14.89	4.20	.....	.....	.....	.....	19.09	5.13	6.23	.....	.....	32.39	5977
.....	.....	**10.00**	**6.00**	**16.00**	.....	**17.00**	.....	.....	.....	.....	**16.00**	5253
.....	.....	.....	.....	16.92	1.83	18.75	.....	.....	.....	.....	16.92	
.....	.....	.....	.....	.....	.....	**16.00**	**4.74**	**5.75**	.....	**3.00**	**30.39**	5254
14.25	2.51	.....	.....	.....	.....	16.76	4.84	5.88	.....	3.26	34.41	
.....	.....	**6.00**	**2.00**	**8.00**	.....	**11.00**	**1.03**	**1.25**	.....	**1.00**	**17.71**	5255
.....	.....	.....	.....	9.07	3.76	12.83	1.40	1.70	.....	1.54	21.64	
.....	.....	.....	.....	9.24	3.74	12.98	1.21	1.47	.....	1.13	20.63	5978
.....	.....	**8.00**	**4.00**	**12.00**	.....	**13.00**	.....	.....	.....	**2.00**	**20.10**	5256
.....	.....	.....	.....	11.80	1.84	13.64	.....	.....	.....	2.42	20.83	
.....	.....	**7.00**	**3.00**	**10.00**	.....	**11.00**	.....	.....	.....	.....	**10.00**	5257
.....	.....	.....	.....	11.08	1.50	12.58	.....	.....	.....	.....	11.08	
.....	.....	.....	.....	9.54	2.29	11.83	.....	.....	.....	.....	9.54	5979
.....	.....	**6.00**	**3.00**	**9.00**	.....	**10.00**	**3.29**	**4.00**	.....	10.00	**38.62**	5258
.....	.....	.....	.....	8.92	1.11	10.03	3.45	4.19	.....	10.04	39.19	
.....	.....	**9.00**	**3.00**	**12.00**	.....	**13.00**	.....	.....	**2.00**	.....	**19.70**	5139
.....	.....	.....	.....	*11.32*	2.05	13.37	.....	.....	1.69	.....	18.91	
.....	.....	.....	.....	*11.48*	1.24	12.72	.....	.....	.....	1.91	19.36	5627
.....	.....	.....	.....	12.25	1.36	13.61	.....	.....	.....	1.51	19.94	5966
.....	.....	.....	.....	13.15	0.92	14.07	.....	.....	2.06	.....	21.34	5980
.....	.....	.....	.....	12.36	1.19	13.55	.....	.....	1.96	.....	20.25	6025
.....	.....	**8.00**	**2.00**	**10.00**	.....	**11.00**	**1.65**	**2.00**	**2.00**	.....	**22.68**	5140
.....	.....	.....	.....	12.81	1.59	14.40	1.90	2.31	2.16	.....	27.97	
.....	.....	.....	.....	11.19	1.37	12.56	1.79	2.17	2.12	.....	25.17	5601
.....	.....	**7.00**	**5.00**	**12.00**	.....	**13.00**	.....	.....	**1.00**	.....	**18.50**	5141
.....	.....	.....	.....	12.61	1.46	14.07	.....	.....	1.00	.....	19.58	
.....	.....	**8.00**	**6.00**	**14.00**	.....	**15.00**	.....	.....	.....	.....	**14.00**	5142
.....	.....	.....	.....	16.26	1.16	17.42	.....	.....	.....	.....	16.26	
.....	.....	.....	.....	*12.86*	2.52	15.38	.....	.....	.....	.....	*12.86*	6005
.....	.....	**6.00**	**4.00**	**10.00**	.....	**11.00**	**0.82**	**1.00**	**1.00**	.....	**18.57**	5192
.....	.....	.....	.....	12.35	1.33	13.68	1.21	1.47	1.31	.....	23.77	
.....	.....	**9.00**	**3.00**	**12.00**	.....	**13.00**	**0.82**	**1.00**	**1.00**	.....	**21 37**	5317
.....	.....	.....	.....	12.91	1.18	14.09	0.88	1.07	1.12	.....	23.08	
.....	.....	.....	.....	12.63	1.57	14.20	1.19	1.44	.....	1.50	24.74	5967
.....	.....	**6.00**	**4.00**	**10.00**	.....	**11.00**	**1.65**	**2.00**	.....	**2.00**	**23.08**	5858
.....	.....	.....	.....	*9.48*	1.91	11.39	1.68	2.04	2.58	.....	23.21	
.....	.....	.....	.....	9.74	1.79	11.53	1.74	2.11	2.26	.....	23.34	5899
.....	.....	.....	.....	*9.32*	2.00	11.32	1.56	1.89	2.50	.....	22.51	5921

TABLE OF ANALYSES.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
5859	Tennessee Chemical Co., Nashville, Tenn.	Bone Meal.	Guaranteed. Found.
4660 5968	Same.	Same.	Guaranteed. Monticello.
5104	S. W. Travers & Co., Branch, Richmond, Va.	Beef, Blood and Bone Fertilizer.	Guaranteed. Found.
5565			Irvington.
6026			Pembroke.
5105	Same.	National Tobacco Fertilizer.	Guaranteed. Found.
5355			Rome.
5564			Irvington.
5106	Same.	Capital Truck Fertilizer.	Guaranteed. Found.
5107	Same.	Capital Bone-Potash Compound.	Guaranteed. Found.
5563			Irvington.
5628			Trenton.
5969			Campbellsville.
5108	Same.	Capital Dissolved S. C. Bone.	Guaranteed. Found.
5970			Campbellsville.
5158	Same.	Champion Corn Grower.	Guaranteed. Found.
5566			Irvington.
5723	White Fertilizer Co., Nashville, Tenn.	White's Slaughter Dissolved Bone.	Guaranteed. Found.
5690	Wood & Stubbs, Louisville, Ky.	Acme Brand Wheat and Corn.	Guaranteed. Found.
5691	Same.	Acme Brand Potato and Tobacco.	Guaranteed. Found.
5692	Same.	Acme Brand High Grade Vegetable.	Guaranteed. Found.
5693	Same.	Acme Brand B. B. P. Bone, Blood & Potash	Guaranteed. Found.
5694	Same.	Acme Brand Soluble Bone and Potash.	Guaranteed. Found.

TABLE OF ANALYSES.

Pounds in the Hundred.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Relative Value Per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
.....	.....	.....	.....	.....	.....	**23.00**	**2.06**	**2.50**	.....	.....	**$21.01**	5859
28.73	1.51	.....	.....	.....	.....	30.24	1.94	2.36	.....	.....	30.68	
.....	.....	.....	.....	.....	.....	**23.00**	**2.47**	**3.00**	.....	.....	**22.45**	4660
22.00	3.87	.....	.....	.....	.....	*25.87	*1.60*	1.94	.....	.....	25.52	5968
.....	.....	**5.00**	**2.00**	**7.00**	.....	**8.00**	**1.65**	**2.00**	.....	**2.00**	**18.88**	5104
.....	.....	.....	.....	9.18	2.09	11.27	1.89	2.29	2.28	.....	23.26	
.....	.....	.....	.....	7.91	1.54	9.45	2.43	2.95	2.32	.....	23.13	5565
.....	.....	.....	.....	8.26	1.59	9.85	1.85	2.25	2.12	.....	21.38	6026
.....	.....	**5.00**	**2.00**	**7.00**	.....	**8.00**	**1.85**	**2.25**	....	**4.00**	**22.38**	5105
.....	.....	.....	.....	8.44	1.39	9.83	1.74	2.11	4.26	.....	23.72	
.....	.....	.....	.....	8.05	1.52	9.57	1.62	1.97	4.14	.....	22.67	5355
.....	.....	.....	.....	8.01	1.47	9.48	1.78	2.16	4.68	.....	23.80	5564
.....	.....	**6.00**	**2.00**	**8.00**	.....	**9.00**	**3.30**	**4.00**	.....	**3.00**	**27.45**	5106
.....	.....	.....	.....	8.40	1.87	10.27	3.60	4.37	3.20	.....	29.14	
.....	.....	**8.00**	**2.00**	**10.00**	.....	**11.00**	.....	.....	..	**2.00**	**17.30**	5107
.....	.....	.....	.....	9.89	1.83	11.72	.....	.....	2.03	.....	17.21	
.....	.....	.....	.....	10.12	1.36	11.48	.....	.....	1.92	.....	17.15	5563
.....	.....	.....	.....	10.43	1.43	11.86	.....	.....	1.56	.....	17.19	5628
.....	.....	.....	.....	10.36	1.68	12.04	.....	.....	1.90	.....	17.62	5969
.....	.....	**9.00**	**3.00**	**12.00**	.....	.....	.....	.....	.....	.....	**12.00**	5108
.....	.....	.....	.....	12.80	1.22	14.02	.....	.....	.....	.....	12.80	
.....	.....	.....	.....	11.74	2.29	14.03	.....	.....	.....	.....	11.74	5970
.....	.....	**6.00**	**2.00**	**8.00**	.....	**9.00**	**0.82**	**1.00**	.....	**2.00**	**17.37**	5158
.....	.....	.....	.....	9.12	1.10	10.22	1.08	1.31	2.16	.....	19.69	
.....	.....	.....	.....	8.48	1.61	10.09	1.06	1.29	2.30	.....	19.15	5566
.....	.....	**8.00**	**4.00**	**12.00**	.....	**13.00**	.....	.....	.....	.....	**12.00**	5723
.....	.....	.....	.....	*10.61*	1.80	12.41	.....	.....	.....	.....	*10.61*	
.....	.....	.....	.....	**10.00**	.....	...	**0.82**	**1.00**	**2.00**	...	**19.27**	5690
.....	.....	.....	.....	11.71	0.84	12.55	1.05	1.27	.....	2.15	23.50	
.....	.....	.....	.....	**8.00**	.....	.....	**2.47**	**3.00**	.....	**5.00**	**26.85**	5691
.....	.....	.....	.....	10.74	1.87	12.61	2.76	3.35	.....	4.96	32.58	
.....	.....	.....	.....	**10.00**	.....	.....	**3.29**	**4.00**	.....	**4.00**	**31.12**	5692
.....	.....	.....	.....	11.71	1.15	12.86	2.90	3.52	.....	5.49	34.81	
.....	.....	.....	.....	**10.00**	.....	.....	**1.65**	**2.00**	**2.00**	.....	**22.18**	5693
.....	.....	.....	.....	10.86	1.34	12.20	1.58	1.92	.....	2.12	24.37	
.....	.....	.....	.....	**10.00**	.....		.....	.....	**2.00**	.....	**16.40**	5694
.....	.....	.....	.....	11.52	0.84	12.36	.....	.....	.....	1.74	18.99	

*Contains Soluble Phosphoric Acid.

December 30th, 1899.

M. A. Scovell, Director.
A. M. Peter, } Chemists.
H. E. Curtis, }

INDEX

Alfalfa, analyses of ..... xiv, xxvi
Alsike clover, analyses of ..... xxv, xxviii
American Elm 54
Ambrosia trifida, analyses of ..... xxiii, xxvi
Analyses of alfalfa ..... xxiv, xxvi
alsike clover ..... xxv, xxviii
black medick ..... xxiv, xxvi
butter ..... xii, xiii
crimson clover ..... xxv, xxviii
fenugreek ..... xxiii, xxvi
ferment for ripening cream xix
ferruginous sandstone xviii
field peas ..... xxiv, xxv, xxvi, xxviii
fertilizers 20-32, 102-129
Florida beggar weed ..... xxiii, xxvi
forage plants and grasses ..... xxiii, xxix
horse weed ..... xxiii, xxvi
Japanese bush clover ..... xxiv, xxvi
Kentucky asphalt rock xxviii
kidney vetch ..... xxiii, xxvi
low hop clover ..... xxv, xxviii
mammoth clover ..... xxv, xxviii
mineral waters ..... xix-xxiii
native bush clover ..... xxiv, xxvi
sorghum cane juice ..... xiii, xiv
per algretta xvii
petroleum xviii
rape ..... xxv, xxviii
Rostow sugar pea ..... xxv, xxviii
Russian field pea ..... xxv, xxviii
Russian vetch ..... xxv, xxviii
serradella ..... xxiv, xxviii
soils ..... xiv, xv
sulphate of potash xvi
sweet clover ..... xxiv, xxvi, xxviii
tobacco stems xvi
wood ashes xvi
Anthyllis vulneraria, analyses of ..... xxiii, xxvi

Anthrax of fruit trees 247
Aphelinus mytilaspidis 220
Aphis lanigera 214
mali 222
persicae-niger 238
Arsenate of lead, how to make 206
Apple aphis 222
remedial treatment 223
leaf-crumpler 225
leaf-skeletonizer 224
remedial treatment 224
leaf-rust 230
distribution of 231
remedial treatment 231
scab 228
distribution of 229
remedial treatment 229
Apple tree tent-caterpillar 225
remedial treatment 227
Apples, varieties resistent to woolly aphis 214-217
woolly aphis of 208
Aspidiotis perniciosus 207
Austin, E. G., experiments with fertilizers 38
Beatty, W. A. ..... v, viii
Bedford, L. M xxii
Beetles, prevention of injuries to trees by 63
Bettie Oldham, butter of xiii
Bichloride of mercury on potato scab 7
Bingham, J. C., experiment with fertilizers 41
Bisulphide of carbon 207
for woolly aphis 213
Bag worm 232
remedial treatment 233
Blackberry anthracnose 258
cane rust 258
Black knot 250
law to prevent the spread of 254
remedial treatment 253
Black peach aphis 238
remedial treatment 240
Black spot 244
Black medick, analyses of ..... xxiv, xxvi
Bluegrass Tobacco Co., tobacco stems from xvi
Bluster's Queen, butter of xii
Board of Control v

Board of Trustees of the College iv
Bordeaux mixture, how to make 205
Boswell, Hart ..... iv, v, vii
Bradley, Gov. W. O ..... iii, iv
Buell, Gen. D. C iv
Buck, J. M xx
Butter, analyses of xii
Butter Jean, butter of xiii
Bulletin No. 80 Pests of Nurseries and Nursery Inspection .. 201
No. 81 Lettuce Rot and Potato Scab 3
No. 82 Commercial Fertilizers 15
No. 83 Wheat 35
No. 84 Elms and their Diseases 53
No. 85 Commercial Fertilizers 79
Canarsia hammondi 224
ulmiarrosorella 72
Carter County, asphalt rock from xviii
Cedar apple 230
Ceresa bubalus 59
Certificate of inspection of nurseries 267, 268
Cherry leaf-spot 234
distribution of 235
remedial treatment 235
scab 244
tree aphis 234
remedial treatment 234
Chionaspis furfurus 220
Chrysobothris femorata 60
Cliff elm 56
Clisiocampa americana 225
Corrosive sublimate on potato scab 7
Crandall, W. J 218
Creel, Dr. M. P xx
Crimson clover, analyses of ..... xxv, xxviii
Crittenden County, supposed gold ore from xix
Currie, Chas. E xix
Currant leaf-spot 236
rust 236
Curtis, H. E v
Desmodium torulosum, see meiboma torulosa
Division of Chemistry, report of the xi
Entomology and Botany, report of the xxx
Horticulture, report of the xxxiii
Meteorology, report of the xxxv

Dolly's Valentine, butter of xii
Double Oonan, butter of xii
Downy mildew 237
Dularius brevilineus 62
Dwarf Essex rape, analyses of ..... xxv, xxviii
Egg preservative, analyses of xvii
Elms and their diseases 53
Elm, English 57
bark-beetle 73
leaf-skeletonizer 72
remedial treatment 73
Exhausted tobacco stems as cattle food xvi
Experiments on potato scab, objects of 6
with formol, etc 6
with corrosive sublimate or bichloride of mercury 7
Fayette County, mineral waters from ..... xxii, xxiii
fenugreek, analyses of ..... xxiii, xxvi
Ferruginous sandstone, analyses of xix
Fertilizers, commercial, analyses of 20-32, 102-129
bulletins on 15, 79
brands below guarantee 79
certificate for free analysis 17, 85
description of samples 88
free analyses of 15, 86
importance to carefully sample 16
law regulating sale of 15
names of manufacturers of 82
number of brands 79
provision for free analyses 17
results of analyses 79
samples collected and analyzed 79
proper selection of 16, 18
sampling, essentials in 85
tables of analyses 20, 102
explanation of 101
values used 100
Field notes on potato scab 8
wheat 41
Field peas, analyses of ..... xxiv, xxv, xxvi, xxviii
Financial statement vi
Fleming County, petroleum from xviii
Florida beggar weed, analyses of ..... xxiii, xxvi
Flournoy, J. C iv

Formaldehyde, formol, etc, used in potato scab experiments 6
Form of certificate for free analysis of fertilizers 16
Frazee, D. F iv
Frozen sap blight 247
Gaither, Mrs. E. H., butter sent by xiii
Galerucella luteola 54, 65
Garman, H. ..... v, viii, ix
Bulletin No. 80 by 201
No. 81 by 3
No. 84 by 53
report of xxx
Gas lime for woolly aphis 212
Gathright, J. T ..... iv, v
Gladys Yakna, butter of xii
Gloystein, Friederich, sulphate of potash sent by xvi
tobacco stems sent by xvi
Gooding, A. P iv
Graham, J. B., wood ashes sent by xvi
Grape mildew 237
remedial treatment for 238
Green River Tobacco Co., tobacco stems from xvi
Greenwell, Chas. J ..... xix, xxi, xxii
Gun-shot peach-leaf blight 244
Harper, J. N ..... v, ix
Hawkins, Dr. J. E xxiii
Hind, C. B xix
Hillenmeyer, H. F., on woolly aphis 216, 217
Hobson, Gen. E. H iv
Holt, Wm. H iv
Horse weed, analyses of ..... xxiii, xxvi
Hot water for woolly aphis 213
Hylesinus opaculus 60, 73
Imported elm leaf-beetle 65
description of 66
means of spreading 68
remedial treatment 69
Inspection of nurseries 266, 268
Japanese bush clover, analyses of ..... xxiv, xxvi
Kennedy, J. B ..... iv, xxii
Kerosene emulsion, how to make 203
Kidney vetch, analyses of ..... xxiii, xxvi
Landes, J. I iv
Larue, L. M xvii

Lespedeza polystachia, analysis of ..... xxiv, xxvi
striata, analysis of ..... xxiv, xxvi
Letter of transmittal..... iii
Lettuce mold..... 3
rot 3
Low hop clover, analyses of..... xxv, xxviii
Magdalis armicollis 59, 73
Mammoth clover, analyses of ..... xxv, xxviii
Marcum, J. B..... iv
Mathews, C. W v
report of xxxiii
John G..... iv
McElroy, C. W..... iv
Meade County, soils from ..... xiv, xvi
Medicago sativa, analyses of ..... xxiv, xxvi
lupulina, analyses of..... xxiv, xxvi
Meiboma torulosa, analyses of ..... xxiii, xxvi
Mercuric chloride on potato scab..... 7
Meteorological summaries..... xxxv-xl
Methods of avoiding lettuce rot..... 3
Mineola indigenella..... 225
Monroe County, mineral water from..... xx
Muhlenburg County, mineral water from xx
Muncy, V. E. ..... iv, v, vii
report of..... xxxv
Mytilaspis pomorum 217
Myzus cerasi..... 234
Native bush clover, analyses of..... xxiv, xxvi
Nelson County, mineral water from..... xix, xxi, xxii
Northup, Col. J. H..... xxiv
Nurseries inspected in 1898..... 272
pests likely to be disseminated from..... 201
inspection law 266, 269
Nursery stock, treatment for woolly aphis..... 213
Oyster shell bark-louse, distribution of..... 219, 217
injuries by..... 219
remedial treatment..... 220
Officers of the Station v
Oidium tuckeri..... 238
Orchard rust..... 230
Orgyia leucostigma 227
Ornithopous sativus, analyses of..... xxiv, xxviii
Patterson, Jas. K ..... iv, v
Peach freckle 244

Peach fruit spot 244
distribution of 245
remedial treatment of 245
leaf-blister mite 245
injury by 247
remedial treatment 247
Peach rosette 241
distribution of 241
remedial treatment 241
yellows 242
distribution of 243
remedial treatment 243
Peak, W. F iv
Pear blight 247
distribution of 247
remedial treatment 247
fruit spot 256
leaf spot disease 256
scab 249
Peralgretta, analyses of xvii
Pests likely to be disseminated from nurseries 201
Peter, A. M ..... v, xxxii, 57
report of xi
Petroleum, analyses of xviii
Phytoptus pyri 245
Plowrightia morbosa 251
Plum scab 244
Podisus spinosus 71
Potato scab experiments 5
Potter, W. J xvi
Powdery mildew 238
Price, J. F xxii
Publications of the Station x
Quince leaf-spot 256
distribution of 257
remedial treatment 257
fruit-spot 256
Rape, analyses of ..... xxv, xxviii
Raspberry anthracnose 258
bordeaux mixture for 261
distribution of 259
remedial treatment 259
cane rust 258
Red rust of apple 230

Reid, H. M., soil sent by xiv
Report of the Auditing Committee vi
Director viii
Division of Chemistry xi
Division of Entomology and Botany xxx
Division of Horticulture xxxiii
Division of Meteorology xxxv
Rhorer, Ed v
Rives, F. O 218
Rock elm 56
Rostow sugar pea, analyses of ..... xxv, xxviii
Russian field pea, analyses of ..... xxv, xxvii
vetch, analyses of ..... xxv, xxviii
San Jose Scale 207
Saperda tridentata 60, 70
Scherffius, W. H ..... v, viii
Schizomeura lanigera 208
Scotch elm 58
Scolytus destructor 75
Scovell, M. A v
letter of transmittal iii
Scurfy bark louse 220
remedial treatment 222
Season, character of 41
Serradella, analyses of ..... xxiv, xxviii
Slippery elm 55
Smith, G. W., soil sent by xv
Soils, analyses of xiv
Some pests likely to be disseminated from nurseries 201
Sorghum cane juice, analyses of xiii
Spraying machinery 202
Stoll, R. C iv
Strawberry crown borer 261
remedial treatment 262
leaf blight 263
remedial treatment 264
leaf spot 263
rust 263
Sulphate of potash from tobacco stems xvi
Sweet clover, analyses of ..... xxiv, xxvi, xxviii
Thryidopteryx expemeraeformis 232
Tobacco stems as cattle food xvi
potash salts from xvi
Todd, Thomas ..... iv, v, vii

Trifolium hybridum, analyses of ..... xxv, xxviii
incarnatum, analyses of ..... xxv, xxviii
medium, analyses of ..... xxv, xxviii
procumbens, analyses of ..... xxv, xviii
Trustees of the College iv
Twig blight 247
Tyloderma fragariae 261
Ulmus alata 57
Americana 53, 54
campestris 53, 57
fulva 53, 55
montana 54, 58
racemosa 55, 56
Unicinula necator 238
U. S. Salix Co xvii
Vicia villosa, analyses of ..... xxv, xxviii
Warren County, mineral water from xxi
Wayne County, mineral water from xx
Weir, Dr. A. S xx
Whale oil soap 203
Wheat, Bulletin No. 83 on 35
experiments with fertilizers on 35, 38
description of varieties 45–50
notes on 41
results of experiments 36, 39
varieties tested 40
yield 43, 45
White elm disease 58
White-marked tussock moth 227
Whippoorwill pea, analyses of ..... xxv, xxviii
Winged elm 57
Wood ashes, analysis of xvi
Woolly aphis of apple, character of injury by 208
description of 209
distribution of 209
remedial treatment 211-214
varieties of apples resistent to 214-217
Xylotrechus colonus 62
Zoffman's ferment for ripening cream xix