ELEVENTH ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station,

OF THE

STATE COLLEGE OF KENTUCKY,

Lexington, Kentucky.

FOR THE YEAR 1898.

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Letter of Transmittal

To His Excellency, HON. WM. 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 Eleventh Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

M. A. SCOVELL, *Director.*

Agricultural and Mechanical College of Kentucky.

Board of Trustees.

List of Officers.

BOARD OF CONTROL.

HART BOSWELL, Chairman, Lexington, Ky.

J. T. GATHRIGHT, Louisville, Ky.

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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.

V. E. MUNCY, Weather Observer.

EDWARD RHORER, Secretary to Director.

Address of the 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, 1898, as per act of Congress, approved March 2, 1887 .... $15,000.00

By Salaries	$9,831	67
Labor	2,788	82
Publications	620	65
Postage and stationery	146	13
Freight and express	60	36
Heat, light and water	193	57
Chemical supplies	153	50
Seeds, plants and sundry supplies ...	149	26
Live stock	50	00
Library	352	44
Tools, implements and machinery ...	85	30
Furniture and Fixtures	80	75
Scientific apparatus	125	62
Traveling expenses	68	45
Contingent expenses	83	85
Building and repairs	209	63
	$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 the fiscal year ending June 30, 1898; 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 :

{ SEAL. }

H. BOSWELL,
J. B. KENNEDY,
Auditors.

Attest :
V. E. MUNCY, Custodian.

ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station.

FOR 1898.

Report of the Director.

The work of the Station has been limited in the main along lines marked out in previous years.

CHEMICAL DIVISION.

In the Chemical Division we have examined and analyzed 957 samples, which may be classified as follows:

Commercial fertilizers, chemicals and miscellaneous fertilizer materials	292
Waters, mineral and potable	58
Butter, in connection with churn tests of cows	139
Sugar beets	104
Sorghum juice	30
Rocks, minerals, ores, etc.	22
Coal and coke, mostly for Dept. Mech. Eng.	27
Steel and Iron, mostly for Dept. Mech. Eng.	17
Nitre earths, etc	4
Wood ashes	3
Miscellaneous (petroleum, paint, oils, soap, Paris green, distillery slop)	15
Food samples, official and others	246
Total	957

ENTOMOLOGICAL AND BOTANICAL DIVISION.

Under charge of Prof. Garman experiments have been conducted on tobacco insects; on gapes of young poultry; in reference to checking the rotting of lettuce when grown under glass; on the best and cheapest method of treating seed wheat for smut; and on the various ways of treating the disease known as potato scab. He has continued the work on forage plants and grass plots, and some work has been undertaken for the Government in growing forest trees.

Prof. Garman has under his charge the inspection of nurseries under a law enacted by the Legislature. He has visited some forty of these nurseries during the past year, and has taken steps to prevent the San Jose scale from getting a foot-hold in this State. He reports the law as working satisfactorily.

Prof. Garman has also undertaken some bacteriological work, and has taught a class in entomology in the College.

HORTICULTURAL DIVISION.

As in other years, the duties of the Horticulturist have been divided between the College and Station, and the work that Prof. Mathews has been able to give the Station has been covered in the main by routine work of correspondence and an oversight of fruit plantations which were started in previous years. The feature of the Horticultural work is an experiment vineyard, which has been increased from year to year, and now numbers about 100 varieties of grapes. In connection with the observation of varieties, a study is being made of the various methods of training, and Prof. Mathews reports that a bulletin is now in preparation upon the general topic of grape culture.

Prof. Mathews desires ten or fifteen acres of land-- ten acres for orchard fruits and five acres for other horticultural purposes. If Prof. Mathews has time to give to this work, I think we have the land which would answer his purpose.

FIELD EXPERIMENTS.

Mr. Harper had under his charge last year a number of field experiments, which may be classified as follows:

Wheat—test of varieties	20
test of fertilizers	10
Oats—test of varieties	32
Potatoes—test of fertilizers	10

Corn—test of fertilizers 20
Clover—test of fertilizers 2
Fertilizer experiments on pasture 10

DAIRY WORK.

Mr. Harper also had under his immediate supervision from ten to fifteen cows, and most of these were under test during part of the time for both milk and butter production, and some experiments were made testing bran versus corn meal. One cow was under test for a year's butter record. The amount of milk at each milking, the per cent of fat in the milk of each milking and the amount of butter given for each three or four days, with the amount of fat left in the butter-milk and skim milk were accurately kept. The cow made during the year 676.53 pounds of butter and gave 10,218.3 pounds of milk. An accurate account of her food was kept. Her butter was sold at 25 cents per pound, and on a financial basis, the records show that the cow made over and above her expense for feed, $186.71, and in the meantime dropped a bull calf, which should be worth at least $100.

OFFICE WORK.

The office work is increasing rapidly, and with the pure food work and the increased fertilizer work, it is growing to such an extent that an increased force may be necessary. The farmers are getting more acquainted and are writing freely to the Station for information as to fertilizer law and for suggestions.

PUBLICATIONS.

We have published during the year the following bulletins:

No 72, Potatoes.
" 73, Strawberries.
" 74, (1) The Chinch-Bug.
(2) Earthworms a Source of Gapes in Poultry.
" 75, Commercial Fertilizers.
" 76, Commercial Fertilizers.
" 77, Wheat.
" 78, Ginseng, Its Nature and Culture.
" 79, Commercial Fertilizers.

OUR GROWTH.

Two important measures directly bearing on the Station's growth were enacted into laws by the last Legislature. One was the enactment of a new fertilizer law; the other a pure food law. The enforcement of both these laws will materially increase the work of the Station, but the laws also provide for increased revenue. Under the old fertilizer law we received annually about $4,000. The new fertilizer law has not been in effect long enough to estimate the annual income, but it should range from $12,000 to $16,000 per year. It provides funds enough to pay expenses of analyses, inspection, and a thorough enforcement of the law.

The pure food law provides for the expenditure of only $2,500 per year out of the State treasury.

LAND.

The Station has purchased the tract of land known as the "Land Place." It contains 64½ acres, and lies nearly adjacent to the land now owned by the Station, just beyond the city limits of Lexington. Before this land can be put in proper shape for experimentation, at least $3,000 worth of improvements will be required in fencing, repairing buildings, barns, etc. This has been authorized by the Executive Committee.

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 year 1898.

Very respectfully,

A. M. PETER.

The chemical work in 1898, besides the analyses of commercial fertilizers published in Bulletins 75, 76 and 79, and the work done under the food law, included numerous analyses of butter, sugar beets, sorghum cane juice, waters both mineral and potable, fertilizer materials rocks, minerals and miscellaneous materials, many being of only transient interest. Such of these analyses as are thought to be of sufficient general interest to be worth recording are reported herewith.

The analyses of foods made under the pure food law will be incorporated in a report to be published later.

BUTTER.

The butter analyzed was that made at the Station Farm in churn tests of a number of Jersey cows.

Name of Cow.	Number of Sample.	From Milkings of	Fat Per Cent.	Water Per Cent.	Salt Per Cent.	Curd Per Cent.
Dolly's Valentine No. 105048	4234	Feb. 25-27, 1898	82.58	13.39	3.15	0.88
	35	Feb. 28-March 3	77.56	14.54	6.97	.93
	38	March 4- 6	82 04	12.76	4.05	1.15
	52	“ 7-10	82.58	13 27	3.12	1.03
	70	“ 11-13	80.93	14.82	3 47	.78
	72	“ 14-17	80.19	15.00	3.67	1.14
	75	“ 18-20	81 89	14.70	2.70	.71
	81	“ 21-24	83.16	13.44	2.57	.83
	84	“ 25-27	83.46	13.32	2.37	.85
	4301	“ 28-31	84.48	11.85	2.58	1.09
	20	April 1- 3	82.52	13.85	2.89	.73
	23	“ 4- 7	83.15	13.28	2 72	.85
	25	“ 8-10	82.77	13.61	2.77	.85
	29	“ 11-14	82.27	14.38	2.58	.77
	42	“ 15-17	82.50	14 78	2 00	.72
	43	“ 18-21	83 05	14.50	1.33	1.12
	44	“ 22-24	82.73	14.37	2.11	.79
	51	“ 25-28	81.75	14 61	2.58	1.06
	59	“ 29-May 2	81.25	14.34	2.98	1.43
	62	May 3- 5	82.50	13.86	2 76	.88
	77	“ 6- 9	82.79	14.12	2 15	.94
	78	“ 10-12	82.60	14.72	1 87	.81
	86	“ 13-16	82.16	14.35	2.43	1.06
	87	“ 17-19	80.12	14.79	4.09	1.00
	90	“ 20-23	81.82	14.65	2.65	.88
	94	“ 24-26	81.90	14 72	2.69	.69
	99	“ 27-30	80.55	14.81	3.50	1.14
	4400	“ 31-June 2	80.37	14 83	4.06	.74
	12	June 3- 6	80.38	15.21	3 65	.76
	20	“ 7- 9	79.85	15.33	3.99	.83
	25	“ 10-13	78.85	15.29	5.08	.78
	35	“ 14-16	78.98	16 43	3.71	.88
	38	“ 17-20	83.61	13.60	2.01	.78
	42	“ 21-23	82.00	14.56	2.77	.67
	52	“ 24-27	81.22	14.08	4.07	.63
	57	“ 28-30	81.54	14.65	3.00	.81
	59	July 1- 4	82.86	13.45	2.78	.91
	63	“ 5- 7	80.23	14.96	4.12	.69
	71	“ 8-11	82.26	14.00	3 00	.74
	74	“ 12-14	81.64	14.03	3.67	.66
	78	“ 15-18	82.02	14.00	3.26	.72
	81	“ 19-21	81.68	14 03	3.68	.61
	86	“ 22-24	82.44	13 64	3.37	.55
	91	“ 26-28	82.23	13.46	3.82	.49
	96	“ 29-Aug. 1	82.98	13.39	3.07	.56
	4502	Aug. 2- 4	83.57	13.26	2 59	.58
	12	“ 5- 8	83.04	13.38	2.97	.61

NAME OF COW.	Number of Sample.	From Milkings of	Fat Per Cent.	Water Per Cent.	Salt Per Cent.	Curd Per Cent
Dolly's Valentine No. 105048.	4516	Aug. 9-11 1898	82.99	13.41	3.06	.54
	23	" 12-15	81.39	14.43	3.51	.67
	26	" 16-18	83.03	14.06	2.35	.56
	45	" 19-22	80.96	15.11	3.29	.64
	46	" 23-25	82.51	13.66	3.22	.61
	72	" 26-29	81.98	14.06	3.27	.69
	4608	" 30-Sept. 1........	80.38	14.51	4.16	.95
	9	Sept. 2- 5	80.09	16.42	2.27	1.22
	10	" 6- 8	83.73	12.61	2.91	.75
	11	" 9-12	83.41	12.90	3.00	.69
	17	" 13-15	84.88	11.42	3.00	.70
	20	" 16-19	81.13	13.53	4.67	.67
	4631	" 20-22	80.90	14.11	4.16	0.83
	71	" 23-26	79.24	14.96	4.90	.90
	4708	" 27-29	79 92	14.15	5.10	.83
	25	" 30-Oct. 3.........	80.53	14.55	3.92	1.00
	32	Oct. 4- 6	81.01	13.94	4.09	.96
	43	" 7-10	80.54	14.02	4.51	.93
	70	" 11-13	82.32	12.94	3.90	.84
	83	" 14-17	83.56	12.74	2.82	.88
	91	" 18-20	80.02	15.01	3.58	1.39
	4830	" 21-24	82.00	13.15	3.68	1.17
	42	" 25-27	80.53	14.32	3.68	1.47
	49	" 28-31	80.11	14.17	4.43	1.29
	82	Nov. 1- 3	81.17	13.12	4.66	1.05
	96	" 4- 7	82.87	13.21	3.14	.78
	4929	" 8-10	82.41	12.98	3.66	.95
	36	" 11-14	81.02	12.91	4.80	1.27
	49	" 15-17	80.86	14.28	3.44	1.42
	51	" 18-21	79.25	14.60	4.88	1.27
	64	" 22-24	81.42	13.03	4.63	.92
	66	" 25-28	79.26	14.98	4.57	1.19
	76	" 29-Dec 1..........	82.97	13.12	3 09	.82
	87	Dec. 2- 5	83.05	12.35	3.52	1.08
	5000	" 6- 8	82.01	13.18	3.88	.93
	15	" 9-12	80.86	13.70	4.38	1.06
	22	" 13-15	80.97	14.47	3.76	.80
	34	" 16-19	79.88	15.84	2.54	1.74
	42	" 20-22	76.46	18.82	3.75	.97
Lydia D. Second...	4271	March 12-14	81.70	14.63	2.83	0.84
	73	" 15-18	80.67	15.71	3.10	.52
	76	" 19-21	81.97	14.55	2 96	.52
	82	" 22-25	81.60	15.04	2.62	.74
	85	" 26-28	83.73	13.40	2.14	.73
Virginia..............	4302	March 28-April 1, 1898	83.60	13.28	2 34	0.78
	21	April 2- 5	81.46	12.28	5.39	.87
	22	Same, reworked	84.19	10.34	4.75	.72
	24	April 6- 8	83.02	13.54	2.53	.91
Justa Pogis..........	4389	May 18-21 1898	78.22	16.49	4.45	0.84
	93	" 22-24	81.00	14.68	3.46	.86

NAME OF COW.	Number of Sample.	From Milkings of	Fat Per Cent.	Water Per Cent.	Salt Per Cent.	Curd Per Cent
Justa Pogis..	4397	May 25-28	81.24	15.09	2.56	1.11
	98	" 29-June 1.........	75.62	16.30	7.25	.83
	4411	June 2- 4	78.38	15.15	5.44	1.03
	19	" 5- 8	79.01	15.89	4.22	.88
	24	" 9-11	79.31	15.40	4 47	.82
	34	" 12-15	80.22	15.67	3.18	.93
	36	" 16-18	79.88	15.12	4.22	.78
	41	" 19-22	82.00	13.85	3.28	.87
Nanoonan	4448	" 24-26 1898	80.80	14.86	3.66	0.68
	56	" 27-30	80.82	14.56	3.90	.72
	60	July 1- 3	82.24	13.75	3.36	.65
	62	" 4- 7	81.96	14.12	3.38	.54
	66	" 8-10	81.93	13.73	3.44	.90
	73	" 11-14	81.15	15.28	2.76	.81
	76	" 15-17	81.17	14.75	3.46	.62
	80	" 18-21	80.38	14.67	4.20	.75
	85	" 22-24	81.08	14.41	3.75	.76
	90	" 25-28	80.68	14.18	4.47	.67
	95	" 29-31	83.61	13.67	2.17	.55
	4501	Aug. 1- 4	81.48	14.33	3.41	.78
Amelia Davenport	4453	June 25-28 1898	81.13	13.96	4.13	0.78
	58	" 29-July 1	82.04	14.64	2.55	.77
	61	July 2- 5	83.06	13.33	2.85	.76
	65	" 6- 8	81.56	13.73	3 98	.73
	72	" 9-12	82.52	13.46	3.28	.74
	75	" 13-15	80.13	15.20	3 89	.78
	79	" 16-19	81.94	14.03	3.32	.71
	84	" 20-22	83.01	13.57	2.78	.64
	87	" 23-26	82.45	13.35	3.52	.68
	93	" 27-29	83.08	13.43	2.86	.63
	98	" 30-Aug. 2	82.78	13.27	3.38	.57
Ethra K...............	4965	Nov. 23-26 1898	82.01	13 43	3.67	.89
	75	" 27-29	85.36	10.54	3.37	.73
	86	" 30-Dec. 3...... ...	79.08	16.24	3.61	1.07
	97	Dec. 4- 6	82.01	14.23	2.96	.80
	5001	" 7-10	83.04	13.12	3.00	.84
	16	" 11-13	80.60	13.92	4.35	1.13
May	4998	Dec. 4- 7 1898	83.12	12.57	3.68	.63
	5002	" 8-10	83.50	11.83	3.75	.92
	17	" 11-14	82 62	13.04	3.26	1.08
	23	" 15-17	82.94	12.83	3.47	.76
	35	" 18-21	84.06	13.25	1.72	.97
	43	" 22-24	83.08	13.05	2.58	1,29

NITRE EARTH &c.

4157.—Sent by Frank W. Watts, Oak Grove, Ky. A brown material having the appearance of soil. It was found to contain much carbonate of lime and a very notable amount of nitrate.

4207.—Sent by R. C. Brown, Cobb, Ky. Taken from a cave. Sample from 2½ feet below the surface. A chocolate-colored material like rich soil. Contains much carbonate of lime.

4219.—Sent by B. W. Nuckols, Glasgow, Ky. Sample taken from large cave in Barren Co., Ky. The material has been found to be a good fertilizer. A chocolate colored earth. Contains much carbonate of lime.

4469.—Earth from the bottom of a pond. Sent by A. R. Glascock, Maysville, Ky. The material was moist when received and lost 20 per cent. moisture by air drying.

ANALYSES OF THE AIR-DRIED MATERIALS.

	4157 Per Ct.	4207 Per Ct.	4219 Per Ct.	4469 Per Ct.
Nitrogen	0.57	0.11	1.29	2.12
Potash, soluble in water	0.23	1.36	1.71	0.14
Total phosphoric acid	1.33	0.89	1.36	0.34
Lime	n. e.	n. e.	n. e.	1.60

WOOD ASHES.

4134.—Sent by Samuel Blair, Pineville, Ky. The sample was moist when received and lost 11.8 per cent. by air-drying.

4156.—Sent by W. M. Riggin, Madisonville, Ky. Sample was moist when received and lost 19.3 per cent by air-drying.

4220.—Hickory wood ashes. Sent by G. M. Alves, Henderson, Kentucky.

ANALYSES OF AIR-DRIED MATERIALS.

	4134 Per Ct.	4156 Per Ct.	4220 Per Ct.
Potash, soluble in water	0.98	6.26	8.21
Phosphoric acid	——	——	1.16

PHOSPHATIC MATERIAL.

4328.—A soft, clay-like material stained with iron. Collected by Prof. A. M. Miller from a railroad cut near Georgetown, Ky.

The air-dry material contained 7.76 per cent. phosphoric acid.

SORGHUM CANE JUICE.

Seed from a cane of 1897, the juice of which gave by analysis 17.62 per cent sugar, 2.38 per cent reducing sugar and 20.9 degrees Brix, making the coefficient purity 84.3 (10th Ann. Report, p. xvii), was planted in Acre O in 1898 in continuation of the experiment in selection of seed. The cane produced was examined as heretofore at different times during the fall, and the analyses of the juice from some of the single canes are given below:

CANE JUICE. ACRE A. PEDIGREED SEED.

When Cut.	No. C C. of Juice.	Specific Gravity.	Degrees Brix.	Reducing Sugar. Per Cent.	Cane Sugar. Per Cent.	Coefficient of Purity.
Oct. 11, 1898..	365	1.080	19.3	1.47	11.41	74.6
" " " ..	255	1.090	21.3	.83	16.05	75.4
" " " ..	260	1.086	20.6	.92	15.72	73.6
" " " ..	275	1.083	19.95	1.43	14.45	72.4
" 15, " ..	325	1.082	19.7	1.79	14.64	74.3
" " " ..	315	1.081	19.5	2.13	14.64	75.0
" " " ..	340	1.080	19.3	1.25	13.89	72.0
" " " ..	310	1.084	21.2	1.00	15.36	76.0

SUGAR BEETS.

The sugar beets analyzed were raised from seed obtained from the U. S. Department of Agriculture and distributed to farmers in different parts of the State, who agreed to plant and cultivate the beets according to the directions furnished by Dr. Wiley. The samples for analysis were forwarded to the Station by mail. The analyses of beets raised at the Station are here also included.

In the column headed "Variety" in the table, "K" indicates the Kleinwantzlebener and "V" the Vilmorin. It will be noted that the beets are generally of very inferior quality.

ANALYSES OF SUGAR BEETS.

Sample Number	Variety.	County	By Whom Grown.	When Planted.	When Harvested.	Analysis of the Juice. Specific Gravity.	Total Solids from Sp. Gr.	Per Cent. Sugar.	Co-efficient of Purity.	Average Weight, Trimmed—Ozs.	Sample Number.
4709	K	Adair	B F. Cofer, Cane Valley	April 20	Sept. 28	1.046	11 4	6.9	82.6	12¼	4709
4754	K	"	John A. Coffee, Gradyville	May 12	Oct. 5	1.040	10.0	7.2	72.0	16½	4754
4738	K	Allen	M. E. Reed, Scottsville	May 13	Oct. 3	1.042	10.5	7.2	68.5	17½	4738
4735	K	Ballard	Wade Brown, Woodville	May 1	Oct. 3	1.044	10.9	7.2	66.1	5½	4735
4742	V	"	W. T. Wyatt, Woodville	May 31	Oct. 5	1.046	11.4	8.5	74.5	14¼	4742
4753	K	Barren	John T Smith, Dry Fork	May 3	Oct. 6	1.041	10.2	6.7	65.7	25.	4753
4686	V	Boyle	G. W. Breeding, Gravel Switch	May 10	Sept. 27	1.036	9.0	6.1	68.0	12.	4686
4711	K	"	John W. Crain, Brumfield	....	....	1.060	14 7	11.9	81.0	25½	4711
4952	V	"	John Clarkson, Forkland	May 28	Nov. 19	1.045	11.2	6.8	60.7	7¼	4952
4954	V	"	Elias M. Harmon, Brumfield	May 28	Nov. 18	1,048	11 9	7.8	65.5	23.	4954
4759	K	Breathitt	Chas. Terry, Terry	May 4	Oct. 1	1 050	12.35	8.75	70.8	30¼	4759
4737	K	Butler	S. H. Tanner, Little Bend	May 10	Sept. 27	1.051	12 6	10.0	79.2	12.	4737
4843	K	"	Same	May 10	....	1.043	10.7	8.7	81.3	14¼	4843
4799	V	Caldwell	W. H. White, Cable	May 10	Oct. 15	1.033	8.3	5.0	60 0	11½	4799
4739	V	Campbell	Alfred Eisen, Gubser	May 2	Oct. 3	1.048	11 9	9.1	76.5	11.	4739
4926	V	"	Same	May [illegible]	Nov 2	1.056	13.8	10.9	79.	14¼	4926
4796	K	"	Rev. H. C. Northcott, Newport	May 17	Oct. 18	1.050	12.4	8 8	71.	31.	4796
4948	K	"	Same	May 17	Nov. 15	1.062	15.2	11.5	75.7	37¼	4948
4974	K	"	Same	May 17	Nov. 19	1.058	14.3	10.2	71.3	30.	4974
4750	K	Carlisle	J. H. Lovelace, Bardwell	May 2	Oct. 1	1.043	10.7	7.2	67.3	37¾	4750
4797	K	"	Martin J. Wedding, Fancy Farm	May 5	Oct 14	1.042	10.45	6.6	63.1	16½	4797
4937	V	Carroll	M. I. Barker, Carrollton	May 5	Nov. 12	1.072	17.5	13.3	76.0	8¼	4937

4710	K	Casey	E. J. Goodby, Middleburg	April 22	Sept. 28	1.033	8.3	4.75	57.2	14½	4710
4767	V	Davies	C. L. Balee, Sorgho	May 16	Oct. 11	1.043	10.7	8.1	75.7	13¼	4767
4713	V	"	J. E. Greenwell, Owensboro........	May 4	Oct. 1	1.059	14.5	11.1	76 5	9.	4713
4836	V	"	Same	May 4	Oct. 21	1.041	10.2	7.2	70.6	18½	4836
4839	K	Estill	H. C. Witt, Rice Station	April 25	Oct. 24	1.044	10.9	7.5	68.8	19½	4839
4717	K	Fayette	Experiment Station, garden........	....	Oct. 4	1.039	9 75	6 9	71.1	19.	4717
4746	K	"	Same	....	Oct. 12	1.039	9.75	6.1	63.6	14¼	4746
4775	K	"	Same	....	Oct. 17	1.039	9.75	6 9	70.7	17¼	4775
4946	K	"	Same	....	Nov. 19	1.045	11.2	7.6	67.8	15½	4946
4718	K	"	Exp. Station, field	....	Oct. 4	1.056	13.8	12.0	87	12¼	4718
4747	K	"	Same	....	Oct. 12	1.052	12 8	10.6	82 8	7¾	4747
4773	K	"	Same	....	Oct. 17	1.056	13.8	11.6	84.0	9½	4773
4774	K	"	Same	....	Oct. 17	1.052	12.8	10.6	83.0	6½	4774
4715	V	"	Exp. Station, garden	....	Oct. 4	1.044	10.9	8.2	75.2	16	4715
4744	V	"	Same	....	Oct. 12	1 040	10.0	6.8	68 0	9¾	4744
4772	V	"	Same	....	Oct. 17	1.037	9.25	6.1	66.0	17½	4772
4945	V	"	Same	....	Nov. 19	1.032	8.05	4.3	53.4	18½	4945
4716	V	"	Exp. Station, field	....	Oct. 4	1.055	13.5	11.7	86 6	10.	4716
4745	V	"	Same	....	Oct. 12	1.048	11.9	9.4	79 0	10¼	4745
4771	V	"	Same	....	Oct. 17	1.052	12 8	10 2	80 0	7.	4771
4765	V	"	W. W. Estill, Lexington...........	May 10	Oct. 14	1.042	10.45	6.5	62 2	33¼	4765
4967	V	"	H. F. Hillenmeyer, Lexington ...	....	....	1.053	13 1	9.0	68 7	19.	4967
4684	K	"	Wm. Warfield, Lexington	....	....	1.041	10.0	7.2	72 0	27¼	4684
4712	K	Fleming........	Hiram Staggs, Sandford	April 20	Sept. 30	1.053	13 1	9.6	73.3	22¾	4712
4798	K	"	Same	May 1	Oct. 5	1.048	11.9	7.4	62.3	9¼	4798
4837	V	"	J. F. Burgess, Tilton.............	May 10	Oct. 20	1.051	12.6	9.5	75.4	21¾	4837
4924	V	"	Same	May 10	....	1.036	9 0	4.7	52.2	28¼	4924
4963	K	"	R. J. Samuel, Poplar Plains	April 26	Nov. 19	1.059	14.5	10.1	70.0	12¾	4963
4752	V	Franklin.......	T. D. Fitzgerel, Elmville	May 5	Oct. 8	1.041	10.2	6.9	67.6	23½	4752
4840	W	"	W. D. Thomas, Frankfort	March 30	Oct. 25	1.050	12.35	9.9	80.1	18¼	4840
4841	K	"	Same	May 4	Oct. —	1.037	9.25	6.1	66.0	24.	4841
4749	V	Gallatin	A. N. Slaughter, Glencoe.........	May 17	Oct. 8	1.041	10.2	7.0	68.6	18½	4749
4927	V	"	Same	May 17	Nov. 2	1.054	13.3	9.1	68.4	15½	4927

ANALYSES OF SUGAR BEETS.—*Continued.*

Sample Number.	Variety.	County.	By Whom Grown.	When Planted.	When Harvested.	Analysis of the Juice. Specific Gravity.	Total Solids from Sp. Gr.	Per Cent. Sugar.	Co-efficient of Purity.	Average Weight, Trimmed—Ozs.	Sample Number.
4720	K	Grant	E. K. Loomis, Heekin	May 2	Oct 3	1.044	10.9	8.3	76.0	21.	4720
4733	V	Green	W. H. Graham, Greensburg	May 1	Oct. 3	1.042	10.5	6.6	63.0	24¾	4733
4741	K	Hancock	R. C. Pence, Gatewood	May 20	Oct. 6	1.043	10.7	7.9	73.8	18½	4741
4685	K	Harrison	B. E. Hilen, Broadwell	May 15	Sept. 27	1.055	13.6	10.0	73.5	23½	4685
4874	K	Hickman	R. J. Bugg, Spring Hill	April 27	Nov. 1	1.030	7.55	3.5	46.0	16.	4874
4719	V	Jackson	Jerry Davidson, Welchburg	April 20	Oct. 1	1.041	10.2	8.2	80.3	19.	4719
4520	K	Jefferson	John J. Barrett, Anchorage	May 1	Aug. 15	1.045	11.2	7.75	69.0	16.	4520
4583	K	"	Same	......	......	1.044	10.9	7.35	66.8	......	4583
4584	K	"	Same	......	......	1.051	12.6	9.0	71.7	......	4584
4800	K	"	Same	May 1	Oct. 15	1.037	9.25	6.8	73.5	22¼	4800
4762	V	Jessamine	L. H. Willis, Nicholasville	May 8	Oct 11	1.044	10.9	7.1	65.0	21¾	4762
4795	K	"	H. C. Hemphill, Nicholasville	May 7	Oct 18	1.043	10.7	6.5	60.6	21.6	4795
4872	V	"	H. C. Muir, Nicholasville	April 26	Oct. 31	1.036	9.0	6.2	69.0	16¼	4872
4758	K	Johnson	Milton D. McDowell, Manila	May 10	Oct. 5	1.037	9.25	5.15	55.6	18¼	4758
4938	K	"	Same	May 10	Nov 3	1.035	8.3	5.5	66.2	18¼	4938
4763	K	Kenton	Carl Neumeister, Key West	April 27	Oct. 12	1.053	13.1	9.8	74.8	19½	4763
4755	V	Knott	G. A. Collins, Pine Top	April 20	Oct. 7	1.040	10.0	6.8	68.0	21¼	4755
4740	K	Knox	Wm. Lock, Barboursville	May 20	Oct. 6	1.031	7.8	4.7	60.2	13½	4740
4925	K	"	Same	May 20	Oct 20	1.032	8.05	3.9	48.4	15¼	4925
4734	K	Laurel	James B. McDaniel, Langnau	May 6	Oct 4	1.041	10.2	7.4	72.5	31½	4734
4838	V	"	J. B. Faris, East Bernstadt	May 1	Oct. 20	1.043	10.7	7.7	72.0	12¾	4838
4764	K	Lee	M. F. Cable, Fincastle	April 20	Oct. 9	1.046	11.4	8.3	72.8	13¾	4764

4955	V	"	Sam Eversole, Beattyville	....	....	1.052	12.8	10.3	80.5	14¼	4955
4769	K	Lewis	W. F. Garrett, Alburn	April 30	Oct. 12	1.046	11.4	8.0	70.0	21.	4769
4875	K	"	Same	April 30	Oct. 29	1.053	13.1	9.1	70.0	25.	4875
4803	K	Lincoln	J. A. McKee & Co , Kingsville	April 20	Oct. 18	1.043	10.7	7 2	67.3	27¾	4803
4953	V	"	Wm. Huser, Ottenheim	May —	Oct. —	1.032	8.05	4.4	54 6	13¼	4953
4766	K	Magoffin	G. W. Anderson, Salyersville	April 27	Oct. 4	1.053	13.1	10.4	79.4	13¼	4766
4778	V	Marion	John L. Thompson, Loretto	May 20	Oct. 12	1.054	13.3	10.0	75.0	13¼	4778
4760	V	Marshall	J. A. Cope, Glade	May 3	Oct. 8	1.029	7.3	4 7	64 4	15½	4760
4714	V	Mason	James N. Boyd, Dover	May 1	....	1.051	12.6	9.6	76.2	6.	4714
4768	K	McCracken	J. P. Brooks, Epperson	May 20	Oct. 11	1.043	10.7	7.0	65.4	19.	4768
4776	K	Montgomery	J. T. Coons, Spencer	April 29	Oct. 13	1.039	9.75	5.1	58.4	13.	4776
4801	V	"	Nick Hadden, Jr., Gilead	May 10	Oct. 14	1.042	10.45	7.6	72.5	7¼	4801
4947	V	"	Same	May 12	Nov. 14	1.043	10.7	6.4	60.0	16¾	4947
4802	K	Nelson	J. A. Sayers, Deatsville.	April 21	Oct. 19	1.043	10.7	7.8	73 0	10½	4802
4928	K	Pike	Alex. Mullins, Beatrice	May 23	Oct 28	1.044	10.9	7 1	65.1	14.	4928
4748	V	Pulaski	W. G. Wood, Science Hill	June 3	Oct. 11	1 048	11.9	9.0	75.6	6.	4748
4777	K	Shelby	J. A. Logan, Christiansburg	May 15	Oct. 14	1.039	9.75	6.0	61 5	15.	4777
4751	K	Spencer	W. Lee Van Dyke, Normandy	May 15	Oct. 10	1.034	8.5	5.2	61.2	33	4751
4873	V	"	T M Lilly, Fairfield, Nelson Co.	May 5	Oct. 31	1.043	10.7	7.2	67.3	25½	4873
4736	K	Todd	R. F. Bass, Kirkmansville	May 4	Oct. 3	1.045	11 2	7.5	67.	13½	4736
4793	K	Warren	Martin Honaker, Glenmore	May 22	Oct. 12	1.049	12.1	8.2	67.7	45¼	4793
4794	K	"	D. J. Honaker, Glenmore	May —	Oct 15	1.046	11.4	7.1	62.3	25¼	4794
4950	V	Washington	J. B. Hays, Polin	May 15	Nov. 10	1.042	10.45	7.0	67.0	18.	4950
4756	K	Whitley	S. R. Sutton, Sumner	May 11	Oct. 10	1.039	9.75	7.4	75.9	4½	4756
4757	K	Woodford	Thos W. Scott, Ducker	May 16	Oct. 6	1.045	11.2	6.5	58.0	13¼	4757
4761	K	"	Same	May 16	Oct. 6	1.047	11.65	9.1	78.1	14.	4761
4792	V	"	C. Alexander, Versailles	April 25	Oct. 20	1.041	10.2	6.8	66.7	10.	4792

LIMESTONES.

4296.—Limestone sent by Geo. A. Campbell, Elizabethtown, Hardin County, Ky., to determine its value for agricultural lime. Sample A. A gray, granular, somewhat oolitic limestone.

4297.—Sample marked B. Sent &c., same as above. Gray, compact limestone with subconchoidal fracture.

4298.—Sample marked C. Sent, &c., same as above. Similar to 4297, but more compact and fracture more decidedly conchoidal.

4299.—Sample marked D. Sent, &c., same as above. A very compact blue limestone, weathered to brown in places. Some small fossils.

4383.—Light-colored oolitic limestone from Pulaski County, Ky., on the Q. & C. R. R. Oolitic structure very distinct.

4384.—Blue oolitic limestone from same locality as 4383. Oolitic structure less distinct.

ANALYSES.

	4296	4297	4298	4299	4383	4384
Lime	52.38	52.04	48.36	44.72	55.58	53.43
Magnesia	....	....	....	....	.28	.53
Peroxide of iron	....	....	....	....	.17	.36
Carbonic acid	....	....	....	....	43.68	42.50
Silica and insoluble matter	5 02	4 37	7.10	10.88	.67	3.36
Moisture	....	....	....	....	.05	.08
					100.43	100.26
Carbonate of lime equivalent to the lime.	93.54	92.92	86.35	79.85	99.25	95.41

PETROLEUM.

4231.—Brought by John T. Geary, Lexington, Ky. A dark brown, rather thin oil.

4439.—Brought by Hon. G. W. Stone, Inspector of Mines, from James Gray, Blaine, Ky.

ANALYSIS.

	4231	4439
Specific gravity	0.855	0.897
	Per Ct	Per Ct.
Distilling from 80°–110° C	Trace.	
" " 110°–150° C (too light for burning)	10.5	1.
" " 150°–300° C (burning oils)	46.9	26.
Residue (lubricating oils, paraffin, &c.)	39.3	73.
Loss	3.3	
	100.0	100.00

4477.—Mineral collected by Prof. A. M. Miller in a cut on the Q. & C. R. R., ¾ mile north of High Bridge. Geological position Birdseye limestone. A pale green, amorphous material, soapy to the touch and easily scratched with the finger nail; lustre somewhat waxy; adheres strongly to the tongue. Before the blowpipe fuses easily.

ANALYSIS.

	Per Cent.
Water	11.26
Silica	56.13
Potash	6.85
Soda	.44
Alumina with a little oxide of iron	23.99
Lime	1.03
Magnesia	.90
	100.40

MINERAL WATERS.

4330.—Mineral water from a well 150 feet deep, owned by Messrs. E. & R. M. Gill, situated in Allensville, Todd County. Sample drawn March 25, 1898. The water when received was yellow from the presence of sulphides and had a strong smell of sulphuretted hydrogen gas and petroleum. It deposited a black sediment of sulphide of iron on standing.

ANALYSIS IN GRAINS PER GALLON.

Carbonates of iron and manganese	0.6
Carbonate of lime	5.1
Sulphate of lime	269.7
Chloride of calcium	11.2
" " magnesium	255.3
" " potassium	4.5
" " sodium	1243.7
Sulphide of sodium	37.8
Silica	0.3
Iodides, bromides, borates, and lithium and strontium compounds	Very marked
Total solid matters	1828.2

Free sulphuretted hydrogen gas..........	14.7 grains
Specific gravity	1.025

4382.—Mineral water sent by Dr. Sam E Woody, Louisville.

ANALYSIS.

The water contains 10.4 grains solid matter to the gallon, consisting mainly of the carbonates of lime, magnesia and soda, with a very notable amount of carbonate of lithia and small quantities of the sulphates, chlorides and nitrates of sodium and potassium, and a notable amount of silica.

This water resembles that of the Silurian Spring, Waukesha, Wis., though perhaps containing a larger proportion of carbonate of soda.

4402.—Mineral water, sent by N. L. McKee, Hopkinsville, Christian county, from a well 150 feet deep on the farm of Miss Mary McKee, 2¼ miles east of Hopkinsville, on the Nashville pike.

ANALYSIS.

The water contains 15.5 grains of solid matter to the gallon, consisting mainly of carbonate of lime, small quantities of chloride of sodium, sulphate of magnesium, sulphate of potassium, traces of carbonates of iron, strontia, soda and lithia, and traces of organic matter and nitrates.

The amount of mineral matter contained in this water is about the same as in our ordinary limestone waters, but its character is very similar to that of the Bethesda spring at Waukesha, Wis.

4403.—Mineral water marked "Holman," sent by N. L. McKee, Hopkinsville, with the preceding, from another well.

ANALYSIS.

The water contains 15.7 grains of solid matter per gallon, containing oxide of iron equivalent to 0.42 grain carbonate of iron. It contains also a moderate quantity of carbonate of lime and traces of the carbonates of soda and lithia and of sulphate of soda.

This water contains more iron than 4402 and is to be considered a mild chalybeate water.

4404.—Mineral water sent for analysis by J. P. Deboe, Crayneville, Ky., from a well 40 feet deep, situated 5 miles west of Marion, Crittenden Co., on the O. V. Division of the Illinois Central R. R.

ANALYSIS.

The water contains 318 3 grains of solid matter to the gallon, consisting mainly of the sulphates of lime and soda and chloride of sodium, with small quantities of the sulphates of iron, alumina and magnesia and marked trades of bromide of sodium and sulphate of lithium.

This is quite a strong alum water.

4405.—Mineral water sent by W. O. Clark, Slaughtersville, Webster Co. Mr. Clark says that the use of this water has cured several persons of rheumatism and indigestion.

ANALYSIS.

The water contains 201.4 grains of solid matter to the gallon, containing 2.83 grains protosulphate of iron, and consisting mainly of sulphate of lime, with small quantities of sulphate of magnesia, sulphate of soda and chloride of sodium and a marked trace of sulphate of lithium.

4406.—Mineral water sent by Moses Cook, Sr., Dot, Logan Co.

ANALYSIS.

The water contains 19.1 grains of solid matter to the gallon, containing oxide of iron equivalent to 0.3 grain carbonate of iron, a trace of carbonate of magnesia, a moderate amount of carbonate of lime and traces of sulphate of magnesia, chloride of sodium and sulphate of lithium.

This is a very weak chalybeate water.

4407.—Mineral water sent by E. R. VanMeter, Greensburg, Green Co.

ANALYSIS.

The water contains 65.5 grains of solid matter to the gallon, composed mainly of carbonate of lime, sulphate of lime, and chloride of sodium, with small quantities of sulphate of magnesia and sulphate of potash and marked traces of bromides and lithium compounds.

This is a weak calcic saline water.

4408.—Mineral water sent by Frank Campbell, Crofton, from a well situated in the northern part of Christian County, near the Hopkins County line. The well is 3 inch bore. Water was struck at about 18 feet and the boring continued to 26 feet, where a 4-foot bed of coal was struck. Mr. Campbell says the well is remarkable for the force of the water, rising, as it does, about 3 feet above the surface.

ANALYSIS.

The water contains 42.6 grains of solid matter to the gallon, containing oxide of iron equivalent to 0.57 grain of carbonate of iron, with small quantities of carbonate of lime, sulphate of magnesia and sulphate of soda and traces of potassium and lithium compounds and chlorides.

4409.—Mineral water sent by J. B. Rudd, Clifty, Todd Co. The water is from a spring.

ANALYSIS.

The water contains 8.61 grains solid matter to the gallon, containing oxide of iron equivalent to 0.51 grain carbonate of iron; also small quantities of carbonate of lime, carbonate of magnesia, chloride of sodium and marked traces of the sulphates or chlorides of potassium and lithium.

This is a very good chalybeate water, containing all its iron in the form of carbonate.

4410.—Mineral water brought by G. F. Bateman from a bored well 125 feet deep, situated on his farm near Donerail, about 8 miles from Lexington, on the Georgetown pike.

The water smelled strongly of petroleum, but no hydrogen sulphide could be detected.

ANALYSIS IN GRAINS PER GALLON.

Sulphate of lime	25.0 grains.
" " strontia	Very marked trace.
Chloride of calcium	211.6
" " magnesium	181.3
" " sodium	1524.0
" " potassium	17.8
" " lithium	1.3
Bromide of potassium	5.1
Total solid matters	1966.1

4612.—Mineral water from the well of H. McKenna, Fairfield. The water had a strong smell of petroleum. Its specific gravity was 1.016.

ANALYSIS.

The water contains 1318.5 grains of solid matter to the gallon, composed mainly of the chlorides of sodium, calcium and magnesium with small quantities of chloride of potassium, chloride of lithium, sulphate of lime, sulphate of strontia, the carbonates of lime, magnesia and iron, biborate of soda and bromide of sodium, and a trace of iodide of sodium. The sediment in the jug was found to contain a notable amount of oxide or carbonate of zinc.

4613.—Mineral water from a public well in Hopkinsville, Christian County, sent by F. W. Dabney, Mayor.

ANALYSIS.

The water contains 414.5 grains of solid matter to the gallon, composed mainly of chloride of sodium, with small quantities of carbonate of lime, carbonate of strontia, carbonate of iron, sulphate of lime, sulphate of magnesia, very notable quantities of bromide of sodium and chloride of lithium, and traces of borates and nitrates.

This is a weak saline water, noteworthy for the very considerable amounts of bromides and lithium salts it contains.

4614.—Mineral water sent by Mr. G. T. McIntosh, Russellville, from a well on his place.

ANALYSIS.

The water contains 133.6 grains of solid matter to the gallon, composed of the carbonates of lime, magnesia and soda, sulphates of potash and of soda, sulphide of sodium, and marked traces of carbonate of iron, carbonate of lithia, iodide bromide, and biborate of sodium. It is a good alkaline, saline, sulphur water.

4615.—Water from a bored well at Conway, Rockcastle County, brought by Hon. Jos. A. Humphries.

ANALYSIS.

The water contains 46.5 grains of solid matter to the gallon, composed mainly of carbonates of soda, lime and magnesia, with a very notable amount of carbonate of lithia, small amounts of carbonate of iron, chloride of sodium and chloride of potassium, and traces of bromide and biborate of sodium. The water contains so much free carbonic acid as to cause effervescence when the cork was removed.

This is an alkaline, carbonated water, and should be valuable.

4616.—Brine from the wells of the old Goose Creek Salt Works, Clay County. Its specific gravity was 1.0535.

ANALYSIS.

The water contained 4684.5 grains of solid matter to the gallon, consisting mainly of chloride of sodium, with much chloride of calcium and chloride of magnesium, and notable amounts of the chlorides of barium, strontium, potassium and lithium, and of bromide of sodium.

This water is remarkable for the absence of sulphates and the presence of barium and strontium chlorides, and a comparatively large amount of bromides. A quantitative analysis of a sample of this water is published in the Chemical Reports of the Kentucky Geological Survey, Vol. A, Part I, p. 231.

4933.—Mineral water sent by Geo. T. Stagg & Co., Frankfort, from a well on their premises.

ANALYSIS.

The water contains 124.2 grains of solid matter to the gallon, composed mainly of chloride of sodium, carbonate of lime and chloride of magnesium, with small quantities of sulphate of lime, chloride of potassium and chloride of lithium, and marked traces of carbonate of iron, carbonate of strontia, bromides, borates, nitrates and nitrites. The sediment in the jug contained a notable quantity of oxide of zinc.

4934.—Water from the "White Sulphur Spring" at Drennon Springs, Henry County.

ANALYSIS.

The water contains 469.6 grains of solid matter to the gallon, composed mainly of chloride of sodium and carbonate of lime, with some sulphate of magnesia, sulphate of potash, carbonate of strontia, carbonate of iron, bromides, borates, lithium compounds, and a trace of iodides. The fresh water contains hydrogen sulphide.

4935.—Water from the "Blue Sulphur Spring" at Drennon Springs, Henry County.

ANALYSIS.

The water contains 710.7 grains of solid matter to the gallon, composed mainly of chloride of sodium, sulphate of magnesia and carbonate of lime, with some sulphate of potash, carbonate of iron, carbonate of strontia, bromides, borates, lithium compounds, and traces of iodides.

Division of Entomology and Botany

M. A. SCOVELL, *Director*,

Sir : I submit herewith a report of the Entomological and Botanical Division for the year 1898 :

The entomologist and botanist was kept in the field for more than a month in the spring of 1898 engaged in inspecting nurseries. These establishments number forty at present. This was the second annual inspecting tour made for this purpose, and I have to report that no San Jose scale, yellows, or rosette has been found in any of them. Several localities in which San Jose scale is established have, however, come to light, but in all cases the infested trees proved to have been brought here from outside nurseries The infested places were in most cases located by a list obtained from one of the eastern nurseries known to have been infested some years ago. The owners of the infested Kentucky trees have all been warned of the dangerous character of the pest, and I am informed that the trees have either been destroyed or treated, as urged by me. I hope soon to be able to report the pest completely exterminated in all of the infested localities discovered. The working of the law in so far as it relates to nursery stock seems to be satisfactory. Aside from the check it puts on the dissemination of San Jose scale, against which the law is more especially aimed, its general effect is good, and I believe it will prove a help to both fruit-grower and nurseryman. Some instances on the part of nurseries in Tennessee failing to furnish certificates with their packages have been reported to me, but I believe this is due to ignorance of our law rather than to a disposition to evade its provisions. Laws similar to our own are being enacted by the States north of us, and a movement is on foot looking toward the same end in Tennessee. Such laws are a direct advantage to us by lessening our chances of receiving destructive pests from these States, and it is gratifying to witness the interest taken in the matter everywhere in the Mississippi Valley.

Owing to frequent rains, destructive insects proved less troublesome than usual during the summer of 1898. It was anticipated that the chinch-bug would injure wheat and corn in counties in which it had been abundant in 1897, unless frequent rains prevented. The rainfall was such as to prevent all trouble from the insect, and the fungus for which frequent applications were received in 1897 was not often called for, only ten applications having been received during the season. The most notable injury from insects occurred in southwestern Kentucky in the latter part of the summer, when grasshoppers appeared in swarms and damaged meadows and, to some extent, corn. Late in the fall complaints appeared in the agricultural papers, and were received occasionally at the Station, of injury from the Hessian fly among young wheat.

With the aid of an incubator, experiments were conducted in the spring of 1898 on gapes of young poultry, with special reference to the relation of the disease to earthworms, the results confirming those previously obtained and published in Bulletin 70.

Much of the space in the vivarium has been occupied from time to time with experiments having reference to checking the rotting of lettuce when grown under glass, and material for a bulletin, soon to be published, has been gathered.

Numerous experiments, both in the vivarium and in plots at the Experiment Farm, have also been made with reference to the best and cheapest method of treating seed wheat for smut, and a bulletin on this subject will be ready for printing after some tests, already started, are completed in the spring of 1899.

An acre of ground was occupied during the season with potatoes treated in several different ways for the disease known as scab. The results have been ready for printing for some time.

The forage plant plots at the Experiment Farm have been kept in very good shape by Mr. Keller, a student in the College, who acts as special assistant in the Division.

Small lots of seeds of forest trees were received in the winter from the U. S. Department of Agriculture to be used in an experiment, having for its object the testing of the relative vigor of plants produced by seeds obtained from different localities. I am not sure that it will be wise to undertake such work in the future unless we can have more assistance connected with the Division.

During the month of December the entomologist and botanist spent some time engaged in farmers' institute work in eastern Kentucky, a series of institutes having been organized by Hon. Lucas Moore, the present Commissioner of Agriculture. It is my impression that such work can be profitably done in the future by Station men, since it brings our work home to many people who otherwise receive a very imperfect notion of what we are doing and of what the Station has been established for.

The bulletins prepared during the year are the following:

Bulletin 74, containing two articles, one on the chinch-bug, which for a couple of seasons has been very destructive locally in the State, and another giving the results of experiments made in 1898 on the gape disease of poultry.

Bulletin 77 contains, together with articles by other members of the Station staff, two articles of mine, one on varieties of wheat, and the other on the disease known as red rust.

Bulletin 78 is an illustrated account of ginseng, a plant in which there is a growing interest, and gives data with reference to its value in the market, and with reference to methods of growing the roots.

An illustrated account of pests likely to be disseminated on nursery stock, is ready for the press, and, together with an article on the nursery inspection law, will constitute Bulletin 80 of the Station series.

The most notable addition to our apparatus made during the year is a complete microscopical outfit embracing a recent model biological stand, with detachable stage, objectives, 1½ inch, 1 inch, ⅔ inch and ¼ inch, with two oculars, polarizing apparatus, and micrometers, making it a very satisfactory outfit for work on foods, and for general laboratory work in other directions.

Assistance in the laboratory work at the Station building has been rendered the Division by Miss Mary L. Didlake during the school year, for half of each working day except Saturday. Mr. Keller, of the Agricultural Course in the College, has been occupied, when free from his college work, in the vivarium and at the Experiment Farm.

Respectfully submitted.

H. GARMAN,

Entomologist and Botanist.

Horticultural Division

M. A. Scovell, *Director*,

Sir: In compliance with annual custom, the following report of the Horticultural Division of the Experiment Station for the past collegiate year is respectfully submitted:

As in other years, the duties of the horticulturist have been divided between the College and Station, so that the time given to the latter has to a considerable degree been absorbed by the routine work of correspondence and the oversight of the fruit plantations made in previous years.

The feature of the work now occupying first place in our attention is the experiment vineyard, which has been increased in size from year to year and now numbers about 100 varieties, not all of which, however, have as yet fruited. In connection with the observation of varieties, a study is being made of various methods of training, and a bulletin is now in preparation upon the general topic of grape culture.

With the acquisition of another tract of land for experiment purposes, it is hoped that ample provision will be made for fruit plantations.

There are very few collections of any considerable extent, of orchard, vineyard and small fruits, within seventy-five miles of the Experiment Station, and only one near Lexington, so that there is, in my judgment, an urgent need for the best possible provision for this line of work here.

There should be ten acres for orchard fruits alone, and this would give but a moderate collection of varieties, with a small allowance for room for special experiments. If five acres could be added to this for small fruits and miscellaneous experiment work, it would give a fair allotment of land for several years to come.

To develop the work of the Division properly, there is still need of a trained assistant who could intelligently supervise the work and attend to many of the details that would be involved in the use of the increased area suggested above.

I have before proposed the separation of the work of the College and Station, and still believe that, when feasible, it will be the more satisfactory plan to both interests.

The horticulturist, in company with other Station officers, attended during the past winter a number of farmers' institutes which were conducted by the State Commissioner of Agriculture, and in all of the meetings much interest was manifested in the horticultural work of the Station.

Respectfully submitted,

C. W. MATHEWS, Horticulturist.

Division of Meteorolgy.

M. A. Scovell, *Director*,

Dear Sir:—A brief meteorological summary for the year, 1898, is herewith submitted.

Very respectfully,

V. E. Muncy, Observer.

ANNUAL METEOROLOGICAL SUMMARY FOR 1898—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	28.98	29.30	1	28 29	22	1.01
February	29.05	29.40	3	28.55	15	0.85
March	29.06	29.33	29	28.69	12	0.64
April	29.00	29.47	14	28.55	13	0.92
May	28.90	29.08	3	28.59	6	0.48
June	28.98	29.15	23	28.72	25	0 43
July..........	29.00	29.16	12	28.83	2[illegible]	0.33
August	28.98	29.15	15	28 84	3 & 9	0.31
September	29.03	29.31	11	28.73	22	0.58
October	29.01	29.25	31	28.67	17	0.58
November.	29 05	29.[illegible]7	3	28.61	18	0.77
December	29 05	29.66	9	28 33	4	1.32
....	....	Highest.	Date.	Lowest.	Date.	....
Mean	29.01	29.66	Dec. 9	28.29	Jan. 22	0.68

TEMPERATURE.

MONTHS.	Elevation of Dry Thermometer Bulb above Ground on Dec. 31, 75 Feet. — From Self-Registering Instruments.										No. of Days.		
	Mean.							Range.					
	Max	Min.	Monthly	Highest.	Date.	Lowest.	Date.	Absolute.	Mean daily.	Mean daily change	Max. below 32°	Max. above 90°	Min. below 32°
	°	°	°	°		°		°	°	°			
January	45.2	30.9	38.0	68	12	11	2	57	14.3	6.8	2	0	17
February ...	44.1	28.1	36.1	66	10	-1	3	67	16.0	6.6	6	0	20
March	56.2	41.7	49.0	72	19	26	4 & 5	46	14.5	5.7	0	0	6
April	59.2	42.2	50.7	77	17	22	5	55	17.0	5.5	0	0	5
May	74.6	56.3	65.4	85	15	33	7	52	18.3	5.7	0	0	0
June..........	84.0	64.7	74.4	93	10	57	20	36	19.3	2.6	0	2	0
July	85.5	66.9	76.2	96	2	54	11	42	18.6	3.0	0	3	0
August	85.3	66.3	75.8	92	31	60	28	32	19.1	2.8	0	4	0
September..	82.1	61.9	72.0	92	1	49	12	43	20.1	2.8	0	2	0
October	63.9	48.2	56.0	87	2	27	27	60	15.7	5.5	0	0	1
November ..	51.0	34.9	43.0	71	4	12	27	59	16.1	5.7	1	0	12
December....	41.1	24.7	32.9	63	22	1	14	64	16.8	6.5	6	0	23
....	....	....	....	Max.	Date.	Min.	Date.	....	....	....	Total 15	11	84
Mean	64.4	47.2	55.8	96	July 2	-1	Dec. 14	51	17.2	4.9	....	....	....

PRECIPITATION.

(Amount in inches and hundredths.)

ELEVATION OF TOP OF GAUGE ABOVE GROUND DEC. 31, 68 FEET.

MONTHS.	Total Amount	Greatest Amount 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).
		Amount	Date.			
	In.	*In.*				
January	9.56	2.57	22	3	16	3 to 5 27 to 29
February	2.20	0.88	19-20	0	18	24 to 27
March..........	8.18	1.19	28	1	16	3 to 10
April	3.29	0.84	10-11	0	19	6 to 9 15 to 17
May	6.13	2.61	6- 7	1	20	April 29 to May 2
June	7.94	4.45	26-27	2	20	1 to 7 19 to 24
July	5.72	1.40	25-26	2	15	1 to 3 6 to 8 10 to 12
August	2.99	1.70	8- 9	1	21	10 to 16 20 to 23
September ...	3.55	0 96	21-22	0	15	Aug. 24 to Sept. 2 8 to 12 17 to 21
October	5.27	1.93	7	2	18	8 to 10 27 to 29
November.....	2.89	1.01	9-10	0	17	1 to 4 23 to 25
December	2.80	1.29	4	1	18	8 to 11 14 to 16
Summary	60.52	....	....	13	213	....

Normal rainfall for April, 3.72 inches.
" " " May, 3.49 "
" " " June, 4.25 "
" " " July, 5.10 "
" " " Aug., 3.52 "
" " " Sept., 2.54 "

MONTHS.	Mean Cloudiness (0 to 10)			Character of Day.		
	8 a. m.	8 p. m.	Monthly	Clear.	Partly Cloudy.	Cloudy.
January	8.1	6.8	7.6	5	6	20
February	8.5	5.4	7.2	4	8	16
March.......	8.5	6.7	8.1	2	8	21
April	5.7	7.0	6.9	5	10	15
May	6.4	5.0	5.5	7	16	8
June	4 5	5.8	5.3	10	14	6
July..........	5.9	5.7	5.7	11	9	11
August	4.0	4 6	5,0	11	11	9
September................	5.6	3.8	5.3	9	13	8
October	6.7	4.8	6.2	9	7	15
November..................	6.2	5.9	6.3	8	7	15
December	4.7	4.4	5.6	10	10	11
....	....	....	....	91	119	155
Mean	6.2	55.5	6.2	....	....	....

WIND.

ELEVATION OF ANEMOMETER CUPS ABOVE GROUND DEC. 31, 102 FEET.

MONTHS	Prevailing direction.	Maximum Hourly Velocity During Month.			No. of days with Gales *	No. of Calms.
		Miles.	From	Date.		
January	S. W.	60	S. W	23	4	0
February	S. W.	60	S. W.	15	3	0
March.....	S.	44	W.	13	1	1
April	N. E.	42	S. W.	20	3	2
May	S. W.	36	N. W.	10	0	0
June	E.	46	S. W.	25	1	2
July..................... .	S. W.	44	S. W.	28	2	3
August	S. W.	40	S. W.	24	1	4
September..	S.	38	S.	4	0	0
October	S.	36	S. E.	25	0	1
November	S.	46	N. W.	5	5	0
December	S.	45	W.	4	1	0
Summary	....	....	....	....	21	13
Mean	S. W.	....	....	....	....	....

* Days with 40 miles per hour and over.

NUMBER OF DAYS.

MONTHS.	Thunder Storms.	Snow.	Hail.	Fog.
January	1	3	0	0
February	1	4	0	0
March	2	2	0	0
April	1	1	0	0
May	4	1	0	0
June	9	0	0	0
July	9	0	0	0
August	9	0	0	0
September	4	0	0	0
October	2	1	0	1
November	2	4	0	0
December	0	8	0	1
Summary	44	24	0	2

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 72.

POTATOES.

1. Experiments with Fertilizers.
2. Corrosive Sublimate and Sulphur for Potato Scab in 1896.
3. Corrosive Sublimate for Potato Scab in 1897.

LEXINGTON, KENTUCKY.

FEBRUARY, 1898.

KENTUCKY

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H. E. CURTIS, } Chemists.
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
J. N. HARPER, Dairyman.
V. E. MUNCY, Weather Observer.
MISS ALICE M. SHELBY, Stenographer.
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. 72

POTATOES.

1. *Tests with Fertilizers.*
2. *Corrosive Sublimate and Sulphur for Potato Scab in 1896.*
3. *Corrosive Sublimate for Potato Scab in 1897.*

1.—TESTS WITH FERTILIZERS.

BY M. A. SCOVELL.

The Season.

The season was unfavorable to the potato crop on account of the weather. The following table gives a summary of the rainfall, the mean temperature and the average per cent. of sunshine during the time specified :

1897. MONTH.	Rainfall. Inches.	Degrees Mean Temperature.	Per cent Sunshine.
April	5.80	53.2	37
May	4.48	59.4	47
June	4.77	72.1	41
July	4.34	75.7	40
August	3.21	73.8	54
September	.80	72.4	82
October	.38	63.9	76

THE SOIL.—The soil is derived from the Lower Silurian limestone, and is rich in phosphoric acid. The land is worn, having been in cultivation many years. The subsoil is a light-colored clay, so retentive as to make the soil deficient in natural drainage.

Explanations.—The leading elements of plant food are nitrogen, phosphoric acid and potash. Plants feed on other soil-elements besides these, and they are just as essential to plant life as these three, but generally speaking all but these ingredients are furnished to plants in abundance, and therefore in studying what to put on our soils to make them more productive, we need concern ourselves with only these three. Commercial fertilizers are manufactured and sold for the purpose of supplying nitrogen, phosphoric acid and potash, and the market prices depend upon these ingredients. Some fertilizers contain one of these ingredients, some two, and some all. Generally speaking, a commercial fertilizer is a mixture containing two of these ingredients, and sometimes all, the proportions varying greatly in the various brands and often in the same brand. It is at once seen to be a very difficult, if not an impossible task, to test all the various brands sold on a given soil in order to find out those that produce the best effect. It is an easy matter, however, to find out whether a given soil needs potash, phosphoric acid or nitrogen or any combination of these elements for a given crop. Having found out this by experiment, we have only to look to the analyses of the various fertilizers to tell which brands, if any, could be used to advantage on the soil and crop tested. If the experiment proved that potash was all that was needed on a given soil for the corn crop, all those fertilizers whose analyses show little or no potash would not produce favorable results, under whatever name sold.

The Experiments.

The potatoes used for seed were Empire State. They were immersed for ½ hour in a solution of mercuric chloride before being planted. This solution contained 4½ ounces of corrosive sublimate (mercuric chloride, or bichloride of mercury) to 30 gallons of water. After drying, the potatoes were cut and planted. (As the above solution is poisonous, the work of treating the potatoes with the solution should never be done where stock might get to the solution or the treated potatoes.)

The size of the experimental plots was 1-10 acre each.

After the ground was well prepared with plow and harrow, the rows were marked out with a small plow. The fertilizers used were scattered in the row by hand and afterwards slightly mixed with the soil by a brush being dragged along in the row.

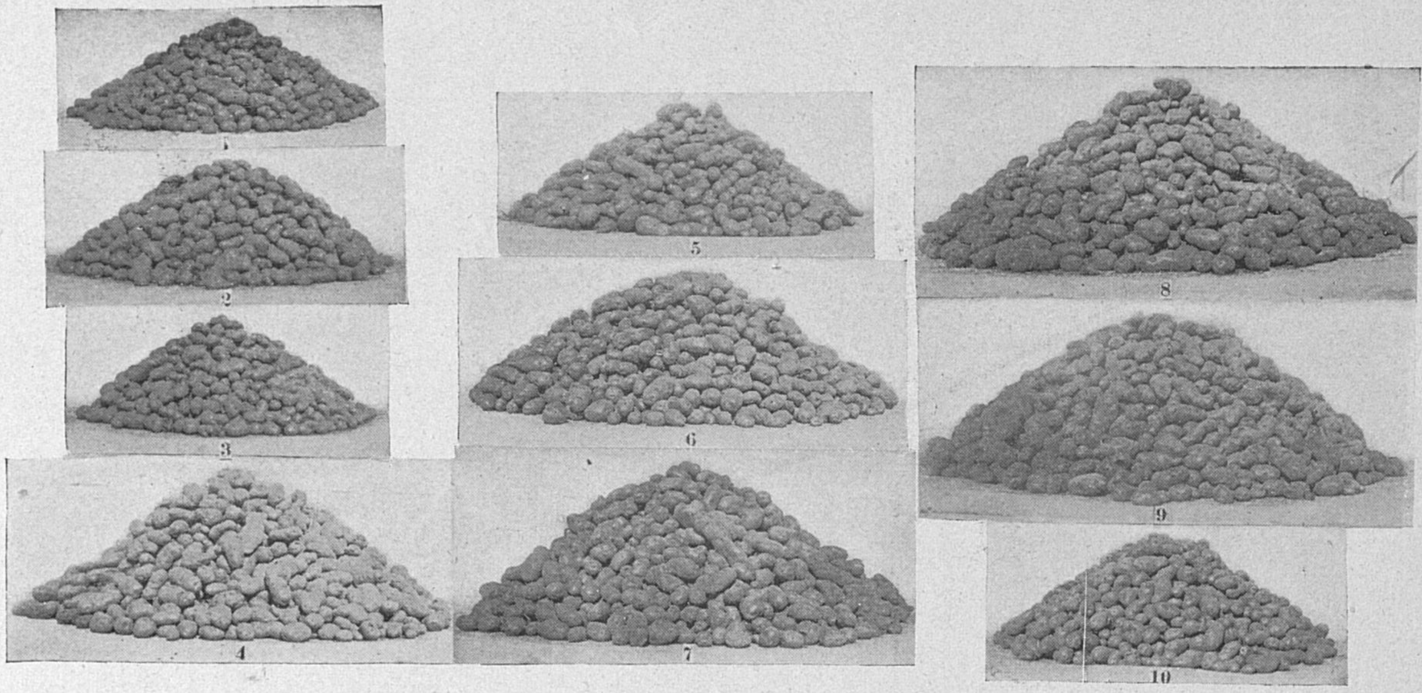
The fertilizers were applied and the potatoes planted April 24th.

The following table shows the kind of fertilizers applied to the various plots, their amount calculated per acre, the number of pounds of leading elements of plant food applied per acre, and the per cent. of these elements in the various fertilizers:

TABLE I—Showing fertilizers applied and per cent. of ingredients.

NUMBER.	FERTILIZERS USED.	No. of Pounds.	Number of pounds of the leading elements of plant food.			Per cent of the leading elements of plant food in fertilizers used.		
			Phosphoric Acid.	Potash.	Nitrogen.	Phosphoric Acid.	Potash.	Nitrogen.
1	No Fertilizer							
2	Nitrate of Soda	160	0	0	25.6	0	0	5.5
3	Acid Phosphate	140	57	0	0	12.4	0	0
4	Muriate of Potash	160	0	80	0	0	17.	0
5	No Fertilizer							
6	Acid Phosphate Nitrate of Soda	140 160	57	0	25.6	12.4	0	5.5
7	Muriate of Potash Nitrate of Soda	160 160	0	80	25.6	0	17.	5.5
8	Acid Phosphate Muriate of Potash	140 160	57	80	0	12.4	17.	0
9	Acid Phosphate Muriate of Potash Nitrate of Soda	140 160 160	57	80	25.6	12.4	17.	5.5
10	No Fertilizer							

The following table gives the name and amount of fertilizer used and the yield of potatoes, calculated to the acre, for each plot :



1. No fertilizer.
2. Nitrogen.
3. Phosphoric acid.
4. Potash.
5. No fertilizer
6. Nitrogen and phosphoric acid.
7. Nitrogen and potash.
8. Potash and phosphoric acid.
9. Potash, phosphoric acid and nitrogen.
10. No fertilizer.

TABLE 2—Showing Results of Fertilizers on Potatoes.

No. of Plot.	FERTILIZER USED.	Amount per acre, pounds.	Yield per acre, bushels.	Comparative Scale.
1	No Fertilizer.....	.....	31.0	
2	Nitrate of Soda....	160	39.0	
3	Acid Phosphate...	140	27.2	
4	Muriate of Potash.	160	77.8	
5	No Fertilizer......	.....	35.8	
6	Nitrate of Soda... Acid Phosphate...	160 140	56.6	
7	Nitrate of Soda... Muriate of Potash..	160 160	83.6	
8	Acid Phosphate... Muriate of Potash..	140 160	109.4	
9	Nitrate of Soda... Acid Phosphate... Muriate of Potash.	160 140 160	109.6	
10	No Fertilizer......	.....	35.3	

The accompanying plate is an exact reproduction of a photograph taken of the potatoes grown on each plot. Each pile was exactly the same distance from the camera when photographed, and therefore the difference in size of each pile is owing to the difference in yield.

Financial Results.

The financial results obtained by the use of the fertilizers in various combinations may be seen in the following table. The acid phosphate costs at the rate of $3.30 per acre, the muriate of potash $3.60, and nitrate of soda $3.60. In these estimates the potatoes are rated at 50 cents per bushel, including the small potatoes:

TABLE 3—Showing Financial Results.

	FERTILIZERS USED.	Cost of Fertilizer used per Acre.	Value Potatoes per Acre.	Value of Increased Yield of Potatoes per Acre.	Profit or Loss.
1	No Fertilizer	....	$15.50	....	......
2	Nitrate of Soda	$ 3.60	19.50	$ 2.48	$1.12*
3	Acid Phosphate	3.30	13.60	....	3.30*
4	Muriate of Potash	3.60	38.90	21.88	18.28
5	No Fertilizer	....	17.90	....	......
6	Nitrate of Soda Acid Phosphate	6.90	28.30	11.28	4.38
7	Muriate of Potash Nitrate of Soda	7.20	41.80	24.78	17.58
8	Muriate of Potash Acid Phosphate	6.90	54.70	37.68	30.78
9	Nitrate of Soda Acid Phosphate Muriate of Potash	10.50	54.80	37.78	27.28
10	No Fertilizer	....	17.65	....	......

* Loss.

From results obtained it would appear that both potash and nitrogen are needed on our soil, for potatoes ; that potash alone greatly increases the yield ; that nitrogen does to some extent, but that the best results are obtained by a combination of the two. Trials for eight years have shown that potash greatly increases the yield of potatoes, when applied to our soil.

2.—CORROSIVE SUBLIMATE AND FLOUR OF SULPHUR FOR POTATO SCAB. EXPERIMENTS MADE IN 1896.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

To what extent the scabbing of potatoes is the work of a fungus introduced into soil with seed potatoes and what proportion is the work of organisms which live, for a longer or shorter time, in soil where no potatoes are grown, are questions of much importance to the grower of this crop. The first question is now pretty definitely answered, but the question how long the scab fungus, or fungi, persist in soil is yet to be settled. The experiments immediately following were made in the Vivarium of my Division with a view to getting light on the first question—Is the scab really transferred to soil on seed potatoes?

May 13, 1896, a scabbed potato was planted in each of six 10-inch flower pots, the soil in all having been previously baked for several hours over a fire. They were subsequently kept on a slate-topped table. There was very little difference in the growth of plants in different pots.

No. 1. The potato to be planted was first rolled thoroughly in flour of sulphur. The tubers were taken up and examined August 21. In this pot they were twelve in number. Nine were more or less scabbed, three of them badly so, the rest not enough to injure them. Weight of scabbed potatoes 8½ ounces; weight of not scabbed potatoes 1¾ ounces.

No. 2 (check on No. 1). The tuber planted in this pot was not treated. August 21 fifteen potatoes were taken from the soil; twelve of them weighing 8 ounces were scabbed, seven badly so. The three potatoes not scabbed weighed 2¾ ounce.

No. 3. The potato used for this was first soaked one hour in corrosive sublimate solution (4½ ounces in 30 gallons of water). Eight potatoes developed, six of which weighing 6 ounces were not scabbed, while two weighing 3¼ ounces were scabbed.

No. 4 (check on No. 3). Potato not treated. On August 21 five tubers were taken from the pot every one more or less scabbed. Weight 5¼ ounces.

No. 5. Potato soaked one hour in corrosive sublimate solution (4½ ounces in 30 gallons). Eight potatoes, weighing 6½ ounces, developed, none of them scabbed.

No. 6 (check on No. 5). Potato not treated. Twelve potatoes were obtained from this, six of them, weighing 4½ ounces, scabbed, while the remaining six, weighing 3 ounces, were not.

A single test of the flour of sulphur treatment is perhaps not sufficient as a basis for judgment on the effectiveness of this substance in checking the growth of the scab fungus, but as far as one test can decide the matter, this test indicates that sulphur does not check the scab very decidedly; for the percentage of scabbed potatoes to not scabbed is but slightly less in the treated number (75 per cent.) than in its untreated check (80 per cent.) However, there was a smaller percentage of *badly* scabbed potatoes in the treated number, these constituting 25 per cent. of the whole as against 47 per cent. in the untreated number.

The corrosive sublimate on the contrary proved very decidedly effective in both of the tests. Including the potatoes of both treated numbers (3 and 5) only 12.5 per cent. was scabbed, while the two checks (4 and 6) averaged 64.7 per cent. scabbed. The absence of scab on the treated numbers is so marked, that, taken in connection with the fact that in every one of the three checks from 50 per cent. to 100 per cent. was scabbed, we cannot consider it the result of accident. That any scab at all occurred on the treated numbers was probably due to the fact that some portions of the fungus on the original potatoes was so deeply imbedded in the tissue that the corrosive sublimate did not reach it. A stronger solution (say 5 ounces to 30 gallons of water), or a more prolonged soaking, might be expected to exterminate the fungus more completely. But the adoption of either of these alternatives increases the danger of injuring the seed. I believe, however, from observation on the effects of the solution used in these tests (4½ ounces in 30 gallons) that potatoes can be safely soaked in it longer than they were immersed by me, say for an hour and a half, or possibly two hours.

Field Experiments With Corrosive Sublimate and Flour of Sulphur.

The same acre of ground used for potato scab experiments in 1895 was used in 1896. It was planted in 10 plots of about 1-10 acre each, eight rows, planted in the usual way, in each tenth. The eastern half of each plot was planted with treated seed, the western half being with untreated seed constituting a check. Early Rose potatoes were used, the seed being obtained in the local market. It was not first-class, the tubers feeling somewhat soft in the hand, though otherwise of good appearance. Since the object of the experiments was to learn the effect of the fungicides, the quality of the seed was not regarded as a matter of prime importance. The potatoes were only moderately scabby, not so much so as was desired. They were planted April 11.

The first four rows of Plots 1 to 5, inclusive, were planted with seed that had been immersed for one hour in a solution made by dissolving 4½ ounces of corrosive sublimate in two quarts of boiling water, then adding this to thirty gallons of water in a barrel. These plots are therefore duplicates as far as treatment goes.

The first four rows of Plots 6 to 8, inclusive, were treated with 7½ pounds of flour of sulphur to each plot, the sulphur being dusted in the furrows before the seed was dropped.

The first four rows of Plots 9 and 10 were also treated with sulphur, but each plot received 9 pounds.

PLOTS 1 to 5.

Since these plots received the same treatment they may be conveniently considered together. On May 22, the plants were noted as having come up only fairly well, but in every plot the four treated rows were best in appearance and in regularity of stand. I tested on this point men on the farm who did not know the plan of the experiment and this was the invariable verdict. The corrosive sublimate must therefore have had a preservative effect on the seed, perhaps checking incipient rot, or destroying such insects as may have been disposed to injure the pieces in the soil. This seems the more likely because the weather for a time after planting was unfavorable to a prompt growth of the seed potatoes.

The same difference was observable throughout the season. The potatoes were dug September 19. In every case the treated half of a plot yielded more potatoes, by weight, than the untreated half, the five treated halves having the advantage by 401 pounds over the five untreated halves. This is a result which was not anticipated, since it was hardly to be expected that such a substance as corrosive sublimate would do more than check the scab. I am disposed to attribute it to the preservative effect of the poison on the seed after the latter was planted. More than once while examining the potatoes during the season I was struck with the soundness of such cut pieces as were unearthed, and it seems likely from the better stand obtained from treated seed that the seed of these rows was preserved from rotting, as has already been suggested.

In getting the percentage of scab, 100 potatoes were examined from each row, making for the five plots 4000 in all, 2000 treated and 2000 not. In every plot the treated half showed the lowest per cent. of scab, there being from 2 to 2½ times more in the untreated than in the treated plots. The difference is more marked still when the badly scabbed potatoes are considered alone, the untreated rows of one of the plots having more than 20 times as much scab as the treated rows of the same plot. The differences are so constant and decided that there can be but one conclusion with reference to the treatment with corrosive sublimate, namely that it had a decided beneficial effect in checking the development of scab upon the potatoes. The effectiveness of the treatment might possibly be increased by allowing the seed potatoes to remain for a longer time in the solution, or else by increasing the strength of the solution. Our experiments prove that 4½ ounces of corrosive sublimate in 30 gallons of water has not the slightest injurious effect upon the seed potatoes, in fact, it appears that it has a beneficial effect by preserving the seed from rotting in the ground.

PLOTS 6 TO 8.

The arrangement of rows treated with sulphur was the same as in the case of those treated with corrosive sublimate. In these plots 7½ pounds of sulphur were used on four rows of each plot, the other four rows being left without treatment, and serving as a check upon the former. The potatoes did not come up as well as in the case of those treated with corrosive sublimate. The stand in the rows not treated was not as good as in the treated rows, a fact which may be attributed to a preservative action of the sulphur, similar to that exerted by the corrosive sublimate. In every case the weight of potatoes taken from the treated rows was greater than in the untreated rows, but when we come to consider the scab, we get the surprising result that the untreated potatoes were less affected on the average than the treated, the treated rows of the three plots, having 54.42 per cent. marred by the fungus, while the untreated rows of these plots averaged only 43.42 per cent. injured. When we consider the badly scabbed potatoes alone of the three plots, the result is to some extent reversed, the treated rows having a per cent. of 10.83 injury, while the untreated rows have 11.75 per cent. a trifle more. It is just possible that in the examination of the potatoes from treated seed, we mistook in some cases corrosive effects of the sulphur upon the skins of the potatoes for the scab, but we had this in mind at the time of examination, and I believe the results indicate that the sulphur was not effective in checking the scab.

PLOTS 9 TO 10.

The treatment of these plots was the same as that given the three preceding, excepting that four rows of each received nine pounds of sulphur instead of 7½. The plants of treated and untreated halves of plots showed no special difference that could be attributed to treatment. In plot 10, especially, they were quite uniform throughout the plot with the exception of the outside row which was not treated. This latter appeared to be injuriously affected by its position next a roadway. The yield of potatoes was greater from the two treated halves than from the two untreated, but the result as to scabbing agrees very closely with that obtained from plots 6 to 8. The per cent. for the treated halves of the two plots is 48.28. Of the potatoes from the two untreated halves, only 37 per cent. was scabbed. Of the badly scabbed potatoes of these two plots the per cent. was a trifle higher for the untreated halves than for the treated, but the difference is so slight as not to indicate any advantage for treatment.

SUMMARY OF RESULTS.

The conclusion to be drawn from these experiments with reference to corrosive sublimate is that it is a very useful agent for checking scabbing of potatoes. The results agree with those obtained by others, and we have confidence in commending the use of this substance to those who may be troubled with this disease of potatoes. Our practice was to dissolve the corrosive sublimate first in a small quantity of hot water, then transfer this to the larger quantity in a kerosene, or alcohol barrel. The seed potatoes in bags were immersed in the barrel, a bag at a time, afterwards were taken out, the potatoes spread upon the ground until dry, and then cut into pieces according to the usual practice. With reference to the sulphur treatment it must be said that our results do not indicate any especial advantage from treatment with this substance. The results were a surprise to us, because others who have experimented with it have commended it very highly, claiming that it is even superior to corrosive sublimate as a check upon scab. Possibly further experiments will reverse our present opinion as to its usefulness.

The light total yield obtained from the whole acre was, I believe, the result of the use of wilted seed. The soil was in excellent condition at the time of planting and, thanks to the efficient oversight of Dr. Spurr, the plants had throughout the summer the best of care bestowed upon them. The season, too, was a good one in the main and some exceptionally fine crops of potatoes were raised in the neighborhood. The invariably better stand, and greater final yield, of treated plants as compared with those not treated is conclusive proof that neither of the fungicides used is chargeable with the light total weight of potatoes harvested.

The fungus causing the scab is the one observed in other parts of the country and described some years ago by Dr. R. Thaxter as *Oospora scabies.* A specimen from a home-grown potato was submitted to Dr. Thaxter last summer and was pronounced by him to be his species.

Showing Results of Treating Seed Potatoes With Corrosive Sublimate and Sulphur.

Plot.	Treatment.	Weight of potatoes in pounds.	Per cent. scabbed.	Per cent. badly scabbed.	Total weight of treated potatoes in pounds.	Total weight of untreated potatoes in pounds.	Per cent. scabbed of all treated rows.	Per cent. scabbed of all untreated rows.	Per cent. badly scabbed of all treated rows.	Per cent. badly scabbed of all untreated rows.
1	Corrosive Sublimate.	303	39.	4.						
	None......	210	70.	15.75						
2	Corrosive Sublimate.	234	27.	1.75						
	None......	216½	60.25	15.25						
3	Corrosive Sublimate.	225	24.25	2.						
	None.....	135½	46.25	10.50						
4	Corrosive Sublimate.	216½	19.50	0.50						
	None......	126½	51.25	9.						
5	Corrosive Sublimate.	252½	14.50	0.50						
	None.....	141½	53.25	10.75						
1–5	Corrosive Sublimate	....	....	....	1231	....	24.85	....	1 75	
	None.....	....	....	....	....	830	....	56.20	....	12.25
6	7½ lbs. Sulphur..	184¼	57.50	11.						
	None......	147½	45.50	14.50						
7	7½ lbs. Sulphur..	155½	60.50	13.75						
	None......	145	47.25	13.						
8	7½ lbs. Sulphur .	111¼	45.25	7.75						
	None......	88	38 91	8.09						
6–8	7½ lbs. Sulphur..	......	....	....	451	....	54.42	....	10.83	
	None....	....	....	....	....	380½	....	43.42	....	11.75

Showing Results of Treating Seed Potatoes With Corrosive Sublimate and Sulphur.—(Continued.)

Plot.	Treatment.	Weight of potatoes in pounds.	Per cent. scabbed.	Per cent. badly scabbed.	Total weight of of treated potatoes in pounds	Total weight of untreated potatoes in pounds.	Per cent. scabbed of all treated rows.	Per cent. scabbed of all untreated rows.	Per cent. badly scabbed of all treated rows.	Per cent. badly scabbed of all untreated rows.
9	9 lbs. Sulphur.	108½	58.59	15.88						
	None.....	63½	42.87	11.04						
10	9 lbs. Sulphur.	247¼	38.25	5.						
	None.....	171	30.	8.						
9–10	9 lbs. Sulphur.	....	....	....	382¾	....	48.21	....	9.05	
	None.....	....	....	....	....	234½	....	37.	....	9.32

3.—THE USE OF CORROSIVE SUBLIMATE FOR POTATO SCAB IN 1897.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

To learn what strength of corrosive sublimate solutions may safely be used on seed potatoes and what length of time potatoes will bear immersion in such solutions the following tests were made in 1897 on an acre of land that had for several years been planted in corn and hemp. Whether or not it had ever been in potatoes before I am unable to say. All the seed was planted April 24. The plants came up well and evenly on both treated and untreated rows, there being no perceptible difference in growth. They continued good for some time, but died prematurely either from the effects of drought or as the result of an application of a prepared fungicide and insecticide combination known as Laurel green, it was impossible to say which. The early decline of the plants shortened the crop very much, but the results as far as checking scab were concerned were striking, so much so that one could while walking over the field when the potatoes were being harvested tell at a glance the heaps gathered from treated rows, by their freedom from scab.

Plot 1. One half (4 rows) of this plot was planted with seed potatoes that were soaked 1 hour in corrosive sublimate solution, consisting of 4½ ounces of the sublimate dissolved in 30 gallons of water. The potatoes were afterward dried and cut in the usual manner before planting.

The remaining half (4 rows) of the plot was planted with untreated seed to serve as a check on the four treated rows.

The potatoes from the treated rows were examined September 21. The total weight was 138 pounds. 51 per cent. was very slightly scabbed, none badly. Considering the season it was a very fair lot of potatoes.

The potatoes from the four check rows of this plot weighed 126½ pounds, and 93 per cent. was scabbed, many potatoes being badly injured and the whole lot was of inferior quality.

Plot 2. This is a duplicate of Plot 1 and the results are not very different. From the treated rows 140¾ pounds of potatoes were obtained, of which 35 per cent. was scabbed, none badly, and the lot averaging of good quality.

The four untreated rows of Plot 2 yielded 113 pounds of potatoes, 95 per cent. of which was scabbed, most of them being very badly injured by the disease.

Plots 1 and 2. Since these two plots are alike in the matter of treatment an average of the results will give a fairer idea of the benefit resulting from treatment than will the plots when considered separately. The eight treated rows yielded 278¾ pounds of potatoes, with 43 per cent. scabbed. The eight untreated rows yielded 239½ pounds of which 94 per cent was scabbed. The difference in weight is in favor of the treated potatoes and amounts to 38½ pounds. Scab was reduced 51 per cent. But this last statement does not convey a fair idea of the result, for every scabbed potato, however slightly affected with the disease, was counted. The scab on the treated lot was often scarcely perceptible and was never very bad, so that the market value of the potatoes was not affected by it. The potatoes of the untreated lot were on the contrary badly scabbed and if offered for sale side by side with the others would not have sold as readily, or for as good a price.

Plot 3. The arrangement of this plot and of those following was the same as in Nos. 1 and 2, but the treated rows in this case were planted with seed that had been soaked one hour in a solution consisting of 5 ounces of corrosive sublimate in 30 gallons of water.

The weight of the potatoes from the four treated rows was in this plot 137¼ pounds, with 34 per cent. of them marked with scab, none badly, however.

The four untreated rows furnished 158½ pounds, with 93 per cent. scabbed, many of them being badly injured and some completely worthless.

Plot 4. This is a repetition of the test made in plot 3, the proportion of corrosive sublimate and water being 5 ounces to 30 gallons, the seed remaining in this solution one hour.

The treated rows yielded 145¾ pounds with 12 per cent. scabbed, while the untreated rows produced 172¾ pounds of which 94 per cent. was scabbed.

Plots 3 and 4. Taking these plots together, as was done in the case of Nos. 1 and 2, it will be seen that the difference in weight between the yield of treated and untreated rows is in favor of the latter and amounts to 48¼ pounds. In the matter of scab the showing is more decidedly in favor of treatment than in the case of Nos. 1 and 2. Only 23 per cent. showed scab in the treated lot, and these were but lightly touched, while the eight untreated rows yielded 93.5 per cent. of scabbed potatoes. The treatment thus saved 70.5 per cent. from the disease.

Plot 5. The result here is in favor of the treatment both as regards scab and with reference to yield by weight. The treated rows were planted with seed that was soaked one hour in a solution consisting of 6 ounces of corrosive sublimate and

30 gallons of water. The treated rows yielded 159½ pounds, of which 31 per cent. was slightly scabbed, most of them very badly.

Plot 6. This repeats the test made in Plot 5, with the result with reference to scab in favor of the treatment, but with the weight of potatoes from the untreated rows greater than from the others.

107½ pounds were obtained from the treated seed, with 32 per cent. scabbed.

142¾ pounds were produced by the untreated rows, of which 94 per cent. was affected with the disease.

Plots 5 and 6. Taken together these plots give as a result an advantage by weight of 26½ pounds to the eight untreated rows, but the advantage with reference to scab is still with the treated parts of the plots, by 66.5 per cent.

Plot 7. The treated potatoes of this and the following plots were soaked only half an hour in the sublimate solution. In this case 7 ounces of corrosive sublimate were dissolved in 30 gallons of water. The weight of potatoes from the treated seed was 185¾ pounds, while the percentage scabbed was only 18. The untreated rows yielded 141½ pounds, with 97 per cent. scabbed, many of them very bady.

Plot 8. This is a duplicate of Plot 7, and gave similar results, although the percentage of scabbed potatoes from treated rows was higher. The treated rows yielded 156½ pounds, as against 113¼ pounds from the four untreated rows; 35 per cent. of the potatoes from treated rows was scabbed, while 95 per cent. of the potatoes from the untreated rows showed the disease.

Plots 7 and 8. An average of the results from these two plots points the same way as averages made from the preceding numbers. By weight the result is in favor of the eight treated rows, these rows producing 87½ pounds more than the eight untreated rows. In the matter of scab the result is much the same as when the potatoes were soaked longer in weaker solutions, the percentage scabbed from treated rows being 26.5, while from untreated rows it was 96.

Plot 9. 8 ounces of corrosive sublimate dissolved in 30 gallons of water were used for half of the seed potatoes of this plot and they were soaked one-half hour. By weight the advantage is with the untreated rows this time, the four treated rows yielding 93½ pounds, to 112 pounds from those which received no treatment. Only 26 per cent. of the potatoes from the treated rows was scabbed, while 88 per cent of the untreated lot was affected.

Plot 10. This repeats the work done in Plot 9. The advantage by weight lies with the treated rows, however, by 43¼ pounds; 23 per cent. of the treated potatoes was scabbed; 81 per cent. of the check lot was scabbed.

Plots 9 and 10. On averaging results from these two plots it is found that the advantage lies with the treatment, both by weight and by percentage of scab. The treated rows have a larger yield by 24¾ pounds, and 60 per cent. more potatoes of the untreated lot was scabbed.

Summary of Results.

1. The scab was greatly reduced by treatment in every case, the percentage scabbed from treated seed ranging from 12 to 51 (averaging 29.7), while seed of untreated rows furnished from 81 to 100 (averaging 93) per cent. scabbed potatoes.

2. In no case were the potatoes from treated seed badly scabbed, the affected spots being small as a rule, and not affecting the value of the potatoes for the market.

3. The percentage of scab diminishes with increase in strength of the solution used on seed potatoes. The treated potatoes of the first four plots averaging 33 per cent. scabbed, while the average from plots 5 and 6 is 31 per cent. and from 7 to 10, inclusive, only 25.5 per cent.

4. Short exposure of seed potatoes to strong solutions of corrosive sublimate checks the scab as effectually as long exposures to weaker solutions. Thus the average per cent. of scabbed potatoes from seed soaked one hour in solutions containing from 4½ ounces of sublimate to 6 ounces is 32.5, while the average from seed soaked only one-half hour in solutions containing 7 to 8 ounces of corrosive sublimate is 25.5

per cent., the advantage being in favor of the short exposure.

5. Judging by the weight of potatoes obtained from the different plots there is some indication of an injury to the seed and a consequent reduction of yield from treatment with very strong solutions when the exposure is prolonged. Thus in plots 1 and 2, where only 4½ ounces of sublimate was used, the weight from treated rows was greater than from untreated rows, but in plots 3 to 6, inclusive, where from 5 to 6 ounces of corrosive sublimate was used, the exposure being the same, the reverse is true, the untreated rows having an advantage by weight. In plots 7 to 10, however, where the exposure was only half as long but the solution stronger, the treated rows yielded more by weight than their untreated checks.

That the strong solutions and prolonged immersion were to some extent responsible for the reduced yield of treated rows is rendered more probable by the fact that in 1896 when only 4½ ounces of sublimate in 30 gallons were used the treated seed in every case yielded more than the untreated.

Conclusion.

Soaking seed potatoes for an hour in a solution consisting of 4½ ounces of corrosive sublimate in 30 gallons is an effective treatment for the fungus disease known as scab.

Stronger solutions used for the same length of time may injure the seed.

Stronger solutions (7 to 8 ounces of sublimate in 30 gallons of water) may be used with as good effect as weaker ones, provided the seed remains in them for only a short time (½ hour, or possibly less.)

NOTE.—When bought of druggists corrosive sublimate costs about $1.00 per pound. One of the foremost dealers in chemical supplies in the country gives a list price of 85 cents per pound.

Corrosive sublimate is a deadly poison, and both the solutions and the soaked potatoes must be kept where stock cannot reach them.

Table Giving Result of Treatment with Corrosive Sublimate in 1897.

Plot.	Treatment of Seed.	Weight of Potatoes in pounds.	Per cent. Scabbed.	Badly Scabbed
1	1 hr. 4½ oz. sublimate. 30 gals water...	138	51	None.
	None...	126½	93	Many.
2	1 hr. 4½ oz. sublimate. 30 gals water...	140¾	35	None.
	None......	113	95	Most.
3	1 hr. 5 oz. sublimate. 30 gals water.....	137¼	34	None.
	None.........	158½	93	Many.
4	1 hr. 5 oz. sublimate. 30 gals water......	145¾	12	None.
	None...........	172¾	94	Many.
5	1 hr. 6 oz. sublimate. 30 gals water......	159½	31	None.
	None...	150¾	100	Most.
6	1 hr. 6 oz. sublimate. 30 gals water......	107½	32	None
	None..	142¾	94	Many.
7	½ hr. 7 oz. sublimate. 30 gals water.....	185¾	18	None.
	None..	141½	97	Many.
8	½ hr. 7 oz. sublimate. 30 gals water......	156½	35	A few.
	None.........	113¼	95	Many.
9	½ hr. 8 oz. sublimate. 30 gals water....	93½	26	A few.
	None..	112	88	Many.
10	½ hr. 8 oz. sublimate. 30 gals water.....	121½	23	A few.
	None... .	78¼	81	Many.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN No. 73.

STRAWBERRIES.

LEXINGTON, KENTUCKY.

FEBRUARY, 1898.

KENTUCKY

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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.

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KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

BULLETIN No. 73.

STRAWBERRY RESULTS IN 1897.

BY C. W. MATHEWS, HORTICULTURIST.

A report upon the varieties of strawberries grown upon the Experiment Station farm in 1895 was issued two years ago as Bulletin No. 62 of this station. The following year (1896) was a very unfavorable season for the strawberry in this locality, so that no reliable estimate could be made of the relative value of the varieties under cultivation during that year.

The past season, however, was quite favorable to the crop, both in this vicinity, and as our reports show, in most parts of the state.

As in our previous strawberry report, we have again called upon the growers throughout the state to give us their experience with methods of cultivation and varieties. In response to our inquiries we have been fortunate in securing valuable data from one hundred and thirty of the largest and most progressive strawberry growers in the state, and the writer takes this opportunity of expressing his appreciation of the valued assistance they have rendered.

It is believed that a report of this kind will have a far greater value to the farmers of Kentucky when obtained from the records of growers all over the state than it could possibly have if it included only the results of our own observations upon our limited plots, representing but a single combination of soil, climate, and other conditions.

That the reports from our correspondents are fairly representative of the conditions existing in Kentucky may be seen from the fact that they include all parts of the state, thirty-two counties being represented, from Fulton to Lawrence and from Boone to Bell. Among the seventy-five growers who have stated the area devoted to this crop, there are three hundred and twenty-five acres in strawberries, an average of four and one-third acres each.

While this represents of course but a fraction of the acreage in the state, it is nevertheless ample to show the prevailing methods of culture and the average opinion concerning varieties.

Interest in the strawberry, both as an adjunct to the farmer's garden and as a market crop, is undoubtedly on the increase. The large and growing cities upon our northern border afford a good market for early berries, which the fruit growers of Kentucky are in just the position to profit by. Nor should the smaller towns be overlooked when the strawberry grower is seeking a market. Experience has shown over and over again that in shipping to large cities the farmer and gardener often neglect a near but smaller market, which, with some attention could be made to return much larger profits, at least for limited quantities, than do the large city markets, which receive such enormous quantities of perishable products that they must sometimes be sold at a loss.

The importance of cultivating the smaller cities and towns as fruit markets is further very emphatically shown by the replies of our correspondents. Those who have sold their crops in smaller markets have as a rule received two or three cents per quart more than those who have shipped to the large markets of Cincinnati, Louisville and Chicago.

Growers who have many acres in this crop cannot, it is true, hope to dispose of their entire crop in small towns, although many of this class do sell a considerable amount of fruit in the smaller markets, only shipping to the large cities when the home market has been completely supplied, but the difference in price enforces the importance of studying the demand in the home market; a demand that can often be greatly increased by properly supplying it.

CULTURAL METHODS.

THE SOIL AND ITS PREPARATION.

The strawberry will thrive upon nearly all kinds of soils, as the great variety of soils mentioned by our correspondents would indicate. But the soil should be good and well drained. The majority prefer a "clay loam" or "sandy loam" on somewhat elevated land to escape late frosts, with a gentle slope to the southeast or north, according as the grower desires to reach an early or late market.

Whenever the "cutworm" is prevalent, growers find it safer to use land that has been in some cultivated crop for a year or two rather than sod ground. Many growers, in parts of the state where it is practicable, find that they secure their best results with "new" or "virgin" land, but recently cleared of its timber. Such land, if suitable in quality, generally contains an abundance of all the needed elements of plant fertility from the decaying organic matter and ashes usually left in large quantities upon such land.

Some of the most thorough cultivators plow the ground deeply in the fall, leaving it rough through the winter, plow again as early in the spring as possible, and work it very thoroughly with harrows and other implements, according to the character of the soil, until it is in the most perfect tilth possible, before setting the plants.

MANURES AND FERTILIZERS.

The manures and fertilizers used vary greatly, as would be expected upon widely different kinds of soil. No rule of general application can be given as to whether manures or commercial fertilizers are needed upon a soil for the strawberry crop, and the individual must use his judgment, based upon experiment and observation upon his own or nearby lands to determine whether the use of any manure will yield a profit.

Of one fact, however, there can be no question; the soil must be either naturally fertile or made so artificially. The strawberry, of all crops, will nowhere yield satisfactory returns upon a poor and unfertilized soil.

Upon some virgin lands, our correspondents find that they can secure abundant crops without manures of any kind, and in our "Blue Grass" soils others find that the application of commercial fertilizers will not produce any paying results for the strawberry.

The most generally used source of plant food in the state is barnyard or stable manure. When commercial fertilizers are applied at all, as they are by perhaps one-fourth or one-fifth of our correspondents, wood ashes and ground bone seem to be used more than all other kinds put together.

Stable manure should be well rotted or applied the year previous to setting the plants. Many find it profitable, particularly on the lighter soils, to turn under a green crop such as clover or cow peas the previous year, thus furnishing an abundant supply of decaying vegetable matter or humus to the soil, as well as supplying the nitrogenous element of plant food.

Bone dust and wood ashes are best applied in the spring just before setting the plants, in most cases broadcasting giving best results, and they should be thoroughly worked into the surface layers of the soil.

Too much attention cannot be given to thoroughly pulverizing the soil before setting the plants; as one grower expresses it, he "continues working it until no clod larger than a hen's egg can be found either under or on top of the ground." With lighter soil than this man possesses, it would be a good rule to allow no clod even of this size.

SETTING THE PLANTS.

Among Kentucky strawberry growers, as in most parts of the country, the "matted row" system of growing the crop has been very generally adopted, as giving the largest and most profitable yield of fruit for the average grower. The large growers set the plants in rows from three and one-half to four feet apart, the plants in the rows being set from one to three feet apart, according to the ability of the variety to produce runners and plants. We believe the latter distance (3 feet) to be by far too great under most circumstances, as it is difficult to avoid a poor "stand" of plants, if, on account of cutworms or other causes, a portion of the first setting of plants is lost. Distances of fourteen to twenty inches apart, according to soil and variety, appear to be safer limits, except for the strongest growing varieties. The greater of these distances is sometimes adopted to enable the grower to cultivate both ways until the plants begin to run considerably.

Each grower has his favorite plan of setting the plants. One very careful and apparently successful cultivator in central western Kentucky gives the following as his method of procedure: "A boy has the plants in a pail about one-third full of water, and the plants are dropped just as needed by the planter. The planter uses a concave trowel, the plant roots are spread fan-shaped in the hole, and the soil is pressed firmly all around except just at the crown." Many growers prefer instead of the concave trowel, a flat dibber, such as is used by nurserymen, and others a common sharp spade for making a narrow, wedge-shaped opening in which the roots can be spread out fan-shaped in the direction of the row.

AFTER-CULTURE.

As soon as the plants are set, cultivation should begin and should be continued unceasingly until late in the fall. Some of the most careful growers in our state cultivate their strawberry fields regularly once a week except when interfered with by storms. It should be remembered that the best cultivation, as now understood, does not mean simply the destruction of weeds and keeping the land clean. Careful experiment and observation have shown beyond question, that in most cases, an object of nearly or quite equal importance is the saving of soil moisture, that is effected by a constant stirring of the surface soil, which acts like a blanket to prevent the rapid evaporation of the water beneath the surface. The importance of moisture to the strawberry crop, and the losses occasioned by drouth, are too well known to every grower of experience. No other crop grown is more exacting in its demands for a sufficient supply of soil moisture, and no effort should be spared to jealously guard every avenue by which the moisture can be lost.

In regard to the practice of cutting the runners from newly set plants, opinions differ, as was expected. A large majority do not favor cutting them at all, believing that the first formed plants are the most fruitful ones of the succeeding season. Those who practice cutting the runners usually do so until the middle of June or the first of July, after which time the stored up energies of the parent are able to produce a large number of young plants if the weather is favorable. If, on the other hand, one of our frequent summer drouths begins about this time the chances for a good "stand" of plants are greatly diminished.

A number of careful growers follow an alternative plan which has much to commend it. They allow the runners to grow, but late in the season carefully thin out the plants in the matted rows, removing all the smaller ones and leaving an even stand of plants not nearer than six or eight inches apart. Every plant is thus relieved from crowding, the winter mulch will settle about it to keep the future berries clean, and each is thus in the best condition for an abundant fruitage.

On account of its ready availability the most commonly used mulch is wheat straw, which is generally applied lightly in December, or after the first freeze, and remains in place until after the crop is marketed in order to keep the berries clean. If the mulch is heavy enough over the plants to prevent them from coming through freely when growth starts in the spring, it should be partly raked off into the alleys between the rows. Here, like the soil mulch of the preceding years, it serves to check the escape of moisture from the soil by evaporation.

It is the usual practice among Kentucky growers to take two or three crops, often more, of berries from a bed before turning it under. Like most other practices its advisability depends upon the conditions surrounding the individual grower. In many parts of the country the practice of turning under the plants as soon as the first crop is secured, meets with much favor. It is argued by those who follow this practice that it is less expensive to set a new bed each year than to clean and keep clean the old one; that some quick growing crop can be matured before winter upon the same land that produced a crop of berries, and finally that the first crop of fruit meets with a readier sale on account of the larger size and greater attractiveness of the berries.

PICKING, MARKETING, YIELD AND PRICES.

In this state the pickers who are employed to gather the berries are of all kinds, men, women and children, both white and colored. They are for the most part paid by the quart, although a few growers prefer to pay by the day. The price ranges in general from 1 cent to 2 cents per quart, although in a few cases the prices run above or below this rate, the average being 1½ cents per quart. In counties adjacent to the Cincinnati market, the price paid is usually 1 cent or 1¼ cents per quart; around Louisville the price appears to range slightly higher, while in the extreme western part of the state the usual price paid by those reporting is 2 cents per quart. This variation in price is due in part to the different class of berries produced in different sections. In the extreme west the Crescent type is the favorite, being shipped to distant northern markets like Chicago, while in the vicinity of Louisville and Cincinnati the shorter transportation permits a greater proportion of the larger varieties like the Bubach to be grown, with a consequent saving in the cost of picking.

In keeping tally with the pickers the common plan is still the use of checks of different denominations, which are handed to the pickers as fast as a picking stand of four to six quarts is passed in to the superintendent, these checks being redeemable in cash at the end of the week or picking season.

As these checks are frequently lost, and found by others than the owners, giving rise to more or less dispute and dissatisfaction, many growers have adopted the plan of using tickets to be punched, on which are printed different denominations of money or numbers of baskets. These tickets are not transferable, and as fast as berries are gathered the amount due the picker is punched from the numbers on this card, the punch used for this purpose being carefully kept of course in the owner's possession, the settlements being made just as in the check system.

The practice of branding each crate of fruit with the grower's name and the variety of fruit in some neat design, is an excellent idea that has been adopted by a few growers. This is an inexpensive form of advertising that helps to create a demand for a grower's product if his fruit is uniformly good and carefully picked, and has a reactionary effect upon the grower himself, stimulating him to greater efforts in the growing of choice fruit and putting that fruit upon the market in the most attractive shape.

From general reports, the past season seems to have been one of the most favorable for the strawberry crop for several years. An attempt was made to secure data as to the yield of fruit, and the average prices received. As the figures given were not all estimated upon the same basis, it is not possible to give results with exactness. The average yield for 1897, of all the growers who gave definite figures, appears to be about 3400 quarts or a little over 100 bushels per acre, the average gross price, 6¼ cents per quart, and the average net price, after deducting cost of picking, shipping and commissions, to be 4½ cents per quart, or in round numbers, $150 per acre.

Many growers have, of course, exceeded these figures, but the estimate made above, including only one or two growers who are cultivating less than one acre, and including sales in smaller markets as well as the large cities, is believed to be a close approximation to the truth.

Several growers, whom we have every reason to believe to be thoroughly reliable, have reported crops nearly or quite twice as large as the yield mentioned above. A significant fact noticed in several instances is, that those growers who have produced the large yields per acre have also frequently secured prices considerably higher than the average. While, of course, much depends upon a man's conditions and markets, these facts possibly suggest that the same energy and painstaking care that enables one to produce a large crop, will also lead him to give such attention to its condition and attractiveness in the market that its ready sale at a good price is assured.

MOST POPULAR VARIETIES.

The varieties first in popular favor remain about the same as they were two years ago, Bubach still easily holding first place among growers for market, followed by Haverland, Gandy, Crescent, Michel and Warfield.

It is interesting to note that in an inquiry regarding best market varieties, that was sent out four years ago, the returns gave Creseent first place as the favorite. This seems to indicate,—what we should expect,—that consumers are becoming better educated and more critical in their purchases of strawberries, so that where a berry of the Crescent class would once sell freely, the buyers now demand the larger and better berries represented by the Bubach.

The Michel, while not very much esteemed in the eastern part of the State, is generally of considerable value in western Kentucky for shipment, because the entire crop can be ripened and gotten to market before the glut of later berries arrives, so that, although not a very productive variety, it fills a very important place in their crop.

Of the varieties recommended as pollinators of such standard varieties as Bubach and Haverland, the varieties most frequently mentioned and in their order are: Gandy, Michel, Lovett, Enhance and Woolverton.

One grower suggests removing the mulch from Bubach and Haverland at a later period than from the Gandy, thus bringing their blooming period into closer conformity.

NOTES ON VARIETIES.

(The varieties marked P. are pistillate or imperfect flowered kinds.)

It should be remembered that these notes are made chiefly under such conditions as surround the average grower for market. The culture given is such as prevails upon farms where several acres of strawberries are grown. It is doubtless true that some of the varieties which are unpopular under such field culture, would, in small gardens under high culture, yield good crops and give complete satisfaction.

Upon our own grounds, while the conditions are perhaps somewhat more favorable than in the fields of the average market grower, they are no better than are provided by a number of our correspondents who grow several acres of berries each, and no excessive "coddling" is given to either old or new varieties.

ANNIE LAURIE. Eight out of nine who mention it describe it as worthless and unproductive, which accords with our experience.

AROMA. Upon our grounds we had but a very few plants of this. It seemed fairly productive, of fair size and will be tried again. Two growers in Warren county speak in very high terms of this as a late variety.

AUBURN. P. A medium sized berry of good quality and handsome appearance, but only moderately productive here and elsewhere so far as heard from.

BANQUET. P. Showed no indications of special value upon our grounds.

BARTON. P. While still cultivated as a market variety in some localities on account of its productiveness, it is no longer a popular variety owing in part to its susceptibility to rust.

BEDER WOOD. Generally discarded throughout the state, although still grown for market in northern Kentucky near Cincinnati.

BEECHER. Has been generally discarded on account of unproductiveness.

BEVERLY. Does not seem to grow in popularity; of good quality, but not productive enough.

BISEL. P. Gave a good yield of medium sized berries on our land, but generally reported as valueless.

BOYNTON. P. Not generally liked as well as Crescent, which it closely resembles.

BRANDYWINE. Receives about an equal number of favorable and unfavorable comments; its praises are moderate in tone and it does not seem likely to become very popular; not very productive.

BRUNETTE. Of medium size, quite productive, and of superior quality on our grounds, but the majority of reports are unfavorable.

BUBACH. P. Still by far the most popular variety in Kentucky either for market or home use.

CHAIRS. Discarded as valueless by all who have reported upon it.

CHILDS. Favorably commented upon by a few growers and discarded by others. A pale berry, of medium size and rather attractive in appearance, but not productive on our grounds.

CRESCENT. P. Continues to be one of the favorites for market in Kentucky, particularly with those who ship long distances. Some of the latter still find it their best paying variety.

CYCLONE. A rather small berry, bright in color and of good flavor, but not productive enough; not generally valuable.

DOWNING. Not very generally grown for market now; not productive and suffers much from rust. Still a favorite with some for home use.

EDGAR QUEEN. P. Generally discarded, although favorably spoken of in Jefferson county; moderately productive here, but rather irregular in shape; others are more valuable.

ELEANOR. One of the recent varieties, which meets but little favor in Kentucky; on our grounds it was small and not productive.

ENHANCE. Not very generally esteemed, although several in Kenton county give a favorable opinion of it; as grown here not very productive and is unattractive in appearance.

ENORMOUS. P. Of large size and attractive in appearance; quality good and productive upon our grounds; will be tried further.

EPPING. P. Has not proved of value on our grounds; will not be grown further.

EQUINOX. Does not appear valuable on our grounds: rather small and unproductive. The majority of those reporting pronounce unfavorably upon it; one however finds it worthy of further trial.

FAR WEST. A recently introduced variety of the Crescent type that exhibits no valuable qualities here.

FOUNTAIN. Small and unproductive; discarded.

GANDY. One of the trio of Kentucky's favorite varieties; best late market berry almost everywhere in the state; equally good for the home garden; somewhat lacking in productiveness, but on most ground has nearly every other good quality.

GARDNER. A strong vigorous grower and quite productive on our ground; berry of good size and appearance. The only comment upon it from our correspondents is favorable.

GREENVILLE. P. Reports upon this variety are in most cases favorable; handsome in appearance and productive here as in most places in the state.

HAVERLAND. P. Too well known to need any description; a favorite all over the state as a market variety and for home use, although only fair in quality.

IOWA BEAUTY. A fairly productive variety, of good quality and medium size. Growers elsewhere do not praise it; badly rusted here.

IVANHOE. Medium to large in size, of excellent quality and fairly productive. Comments from other parts of the state, though few, are favorable to it.

JAY GOULD. P. Generally discarded.

LEADER. Not very generally grown in Kentucky. One grower speaks in high terms of it. Upon our ground it was large bnt irregular in shape and not productive enough.

LOVETT. One of our most productive varieties and largely used for pollinating imperfect varieties. Of medium size and fair quality. Quite largely grown for market, especially in Northern Kentucky.

MARSHALL. A large and handsome fruit but not productive, and although a considerable number of growers have tested it, scarcely a single favorable report has been received concerning it.

MAY KING. Reports are not favorable. Much complaint of rust.

MARGARET. A new variety that has been quite extensively advertised. Upon the few plants on our grounds it was quite productive of large and attractive berries. We shall try it further.

MEEK'S EARLY. P. Upon our grounds a small dark colored berry. Discarded by other growers who have tested it.

MEXICAN. Unproductive and rusted badly. Discarded.

MICHEL. Not productive but ripens its entire crop early so that when the chief object is to reach the market early, this variety sometimes proves quite desirable. Not generally esteemed in this part of the State, but growers in southern and western Kentucky speak in high terms of it and find it their best paying berry, because they can get it into market before the glut of later berries arrives.

MIDDLEFIELD. P. Large and handsome berries, but unproductive and generally discarded.

MINER. All reports are unfavorable. Generally discarded.

MRS. CLEVELAND. Of several reports received all are unfavorable, and it is generally discarded.

MOUNT VERNON. While favorably commented upon by some for a home berry, this variety has been generally discarded as a market variety, on account of its softness and because badly affected by rust.

MUSKINGUM. Of the few reports made in regard to this berry, most are unfavorable except from this part of the state. Upon our grounds this variety is large, smooth and handsome, and of superior quality. Plants very free from rust.

NOBLE. Of the few reports received all are unfavorable.

NO NAME. Fairly productive and of pleasing appearance on our grounds, but reports from other parts of the State are uniformly unfavorable.

PARKER EARLE. Generally discarded. Only does well on rich soil with an abundant supply of moisture.

PREMIUM. P. Berries few and of poor quality on the few plants that we grew in our plot.

PRINCESS. P. Of the seven correspondents who refer to this variety only one calls it good; the remaining reports are unfavorable. Upon our ground it yielded a fair crop of berries of good appearance and flavor.

PRINCETON CHIEF. P. General reports unfavorable. Yielded here a generous crop of small to medium berries which were rather sour.

REIHL'S NO. 5. A productive variety of medium size and good quality. Quite free from rust. We shall try it further.

RIO. A variety that, like Michel, ripens the bulk of its crop early, and is reported upon quite favorably from the counties along the Ohio River and in the extreme western part of Kentucky as an early market variety. In this part of the State it is not commended. Upon our grounds this variety has produced a moderate yield of handsome berries of good size, and very early. Plants healthy.

SHARPLESS. This old variety, though cultivated to some extent, has been generally discarded throughout the state. As several growers suggest, it "has seen its day."

SNOWBALL. Of no pronounced value here. Rusts badly.

SPARTA. Small to medium in size. Not productive and rusts badly here.

SPLENDID. Reports from nearly all points in the State are unfavorable. Rusts badly here.

STAPLES. Reports are unfavorable. Of no decided merit here.

SWINDLE. P. One of the most productive varieties upon our grounds during the past two seasons. Of good size, but dull in color and rather unattractive in appearance.

TENNESSEE PROLIFIC. Reports divided in opinion as to its value. Majority favorable. Moderately productive here, but not attractive in appearance.

TIMBRELL. P. Of good quality, but so unsightly in appearance that it has been generally discarded.

TUBBS. Not very productive here and rusts badly, but one prominent grower finds it worthy of further trial.

WARFIELD. P. Not generally found valuable except in the northern counties along the Ohio River, where it is still considered by most of the growers a standard market variety.

WILLIAM BELT. Moderately productive of large and attractive berries. Reports are divided as to its merits, the majority being unfavorable on account of its lack of productiveness and its susceptibility to rust.

SUMMARY.

THE SOIL FOR STRAWBERRIES SHOULD BE RICH AND MOIST, BUT WELL DRAINED.

SOMEWHAT ELEVATED LANDS PREFERABLE TO AVOID LATE FROSTS.

THE SOIL SHOULD BE THOROUGHLY AND DEEPLY PULVERIZED BEFORE SETTING PLANTS.

BARNYARD MANURE THE MOST GENERALLY USED SOURCE OF PLANT FOOD. BONE DUST AND WOOD ASHES FOUND PARTICULARLY VALUABLE BY MANY GROWERS.

THE MATTED ROW SYSTEM OF GROWING THE CROP ALMOST UNIVERSALLY USED IN KENTUCKY.

CONTINUOUS AND FREQUENT CULTIVATION SHOULD BE GIVEN THE CROP, WHETHER WEEDY OR NOT, FROM THE TIME OF SETTING UNTIL LATE FALL.

MOST KENTUCKY GROWERS FIND IT PROFITABLE TO FRUIT THEIR BEDS FOR TWO OR THREE YEARS.

THE USE OF TICKETS SUITABLE FOR PUNCHING IS THE MOST GENERALLY SATISFACTORY METHOD OF KEEPING TALLY WITH THE PICKERS.

THE AVERAGE YIELD IN KENTUCKY IS 3400 QUARTS PER ACRE. ARE YOU HELPING TO RAISE OR LOWER THAT AVERAGE?

THE AVERAGE GROSS PRICE IS 6 1-4 CENTS PER QUART.

THE FAVORITE MARKET VARIETIES IN KENTUCKY IN THEIR ORDER ARE: BUBACH, HAVERLAND, GANDY, CRESCENT, MICHEL AND WARFIELD.

THE FAVORITE VARIETIES FOR HOME USE NOW VARY BUT SLIGHTLY FROM THE MARKET LIST.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 74.

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1. The Chinch-bug.
2. Earthworms a Source of Gapes in Poultry.

LEXINGTON, KENTUCKY.

MAY, 1898.

KENTUCKY

Agricultural Experiment Station.

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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. 74

1. THE CHINCH-BUG.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Kentuckians have not, until within the two years just past, been disposed to admit that the chinch-bug is to be feared as an enemy of growing crops in this State. Eight years ago careful men might have been heard to declare that it never does serious mischief in Kentucky. To many of our farmers it was, and is yet in some localities, absolutely unknown. But the insect has been present in this State, to my personal knowledge, all the time since 1889. On the Experiment Farm at Lexington a few individuals can be found at almost any time during the summer. Flying individuals are not infrequently encountered as one travels along the pikes in blue-grass Kentucky. In short all the evidence we have indicates that it is never entirely absent from this region.

Why then should it not be destructive in Kentucky as it is in Illinois and Iowa? In a general way our farmers are right in the belief that the climate is unfavorable to the chinch-bug. Much of the State has been, and a large portion of it is still covered with forest. The retention of moisture brought about by such natural growths encourages the development of the fungus enemies of the chinch-bug, to which from its habit of gathering together in large numbers it is especially subject. Moisture is well known as an enemy of the insect in States where most of its mischief is done. Our own farmers have not been slow to learn the beneficial effect in checking injury of a few good showers of rain in summer. Quite often packages of chinch-bug fungus sent out from the Station are reported "not used," the reason given being that opportune rains "scattered" the bugs before the fungus could be set at work.

It is quite probable, from all we know of the effect of moisture on this insect, that its abundance here during 1896 and 1897 was the result of the unimpeded multiplication of the bugs permitted by the exceptionally dry summers of several years preceding. A couple of wet summers may be expected to reduce their numbers again. This is what the history of the insect in other States teaches, for with few exceptions in Illinois, Iowa and Kansas notable outbreaks have followed a succession of dry seasons, or have taken place while drought prevailed. Not only this, but the early writers on the injuries in the South Atlantic States complain of the dry weather prevailing during outbreaks. A gentleman named Sidney Weller, resident at Brinckleyville, Halifax County, North Carolina, wrote in 1840 after a very severe drought:*

"Our fears were disappointed and our hopes exceeded as to this pest, by the hand of an overruling Providence. The season turned off wet and very propitious to crops of all kinds, and the ravages of this bug were arrested. Even fields of wheat that had been greatly injured, suddenly revived and produced tolerable crops; and the corn, which last season in places here was ruined, escaped uninjured."

The chinch-bug is a native American insect. Before the settlement of the country by whites, it probably subsisted on native grasses, just as it does to some extent now. As an injurious insect it appeared first in wheat fields of the South Atlantic States about 1783, and was called Hessian fly under the mistaken impression that it was the same pest that had appeared in wheat fields farther north. At this time it was a much more serious pest in the Carolinas than it is now, and in some sections, we are told, farmers were compelled to give up growing wheat for several years. Subsequently it appeared in the upper Mississippi valley, and since 1840 has been a constant menace to wheat and corn throughout much of the very best wheat and corn sections of the United States. For some unexplained reason it does not do much damage in New

*As quoted by Dr. Asa Fitch in his second report on the noxious insects of New York.

York or the New England States. Writing in 1885 of an instance of its occurring abundantly in New York, Dr. J. A. Lintner used the following words:

"The insects being submitted to me by Secretary Harison, of the State Agricultural Society, they were at once, greatly to my surprise, recognized as the notorious chinch-bug of the Southern and Western States. It was the first instance of a New York specimen of the species coming under my observation, nor had I knowledge of its occurrence within the State, beyond the record of Dr. Fitch of his having met with three individuals of it. Dr. Harris had seen one specimen in Massachusetts."

Distribution and Injury in Kentucky.

It appears that the insect is distributed over much of the Eastern United States, but that its injuries are confined largely to those Middle States in which most of our wheat and corn is grown. Illinois, Iowa, Kansas and Missouri embrace within their limits much of the territory in which the chinch-bug is at present seriously destructive. Kentucky is at the border of this region, and, generally, complaints of damage come from counties along the Ohio river. So far as we have information on the subject, outbreaks in Kentucky occur about the same time as those in the upper part of the valley, but are less marked even in the upper counties, and sometimes do not attract general attention. In 1887 when, according to J. R. Dodge, Statistician of the Department of Agriculture,* the states Kentucky, Ohio, Indiana, Illinois, Wisconsin, Minnesota and Kansas, together lost $60,000,000 from chinch-bug injury; this State as her share lost on her corn and wheat crop, $569,813. Yet the injury was restricted to the counties Bracken, Pendleton, Carroll, Estill, Mercer, Union, Marshall and Ballard. The insect, as already stated, did not again attract attention in the State until 1896, when it became locally troublesome, showing a disposition to occupy the interior counties and did mischief at isolated places even in

*See Bulletin 17, Division of Entomology, U. S. Department Agriculture, by L. O. Howard.

Tennessee. The complaint of severe injury in Kentucky came from two widely separate localities. Kenton County, immediately opposite Cincinnati, seemed to be the center of greatest abundance in Eastern Kentucky. Another isolated center occurred in the western part of the State, near the mouth of the Tennessee River, the injury being greatest in Marshall County. From most of the counties between these two widely separated centers few complaints of injury were received. The only intermediate counties from which complaints came were Shelby, Mercer and Marion, all three away from the Ohio River, and constituting a third center, though not far removed from the group of counties opposite Cincinnati. In this last region but little injury was done, only five complaints being received from the three counties. In 1897 the centers of injury were shifted to some extent. The Kenton County center appeared to have moved eastward along the Ohio River, the largest number of complaints being from Lewis County, not far from the eastern limit of the State. The same eastward shifting appears to have taken place in western Kentucky, no complaint at all coming from Marshall County, while from McLean County more were received than from any other in this part of Kentucky, and injury was observed in all the neighboring counties along the Ohio River, except Hancock, from Livingston to Meade, inclusive. The insects became especially abundant and troublesome in Marion, Washington and Nelson counties, more complaints being received from this region than have been received before from any part of the State. This is very near the center of Kentucky, and the prevalence of the insect here and its presence in small numbers in Clark, Russell, Warren, Simpson, Graves and other isolated counties, shows that it is capable of doing mischief in any part of the State where wheat and corn are grown. In truth the chinch-bug was in 1897 distributed throughout crop-growing Kentucky.

An interesting feature of its injuries in 1897, as compared with those in 1896, is the fact that in 1897 no injury of consequence was suffered in the counties in which the greatest destruction was wrought in 1896. In the latter year more complaints came from Kenton than from any other county, while in 1897 only one complaint came from this county. Marshall County in 1896 was, next to Kenton County, the seat of greatest injury, but in 1897 not a single complaint came from Marshall County. To what extent the distribution of the chinch-bug fungus in these counties contributed to this result it is impossible to say, yet that it did contribute in some measure is altogether probable, and with this feature of the subject in view it will be interesting to note in 1898 the condition of the chinch-bug injury in the counties that received most of the fungus in 1897. The study of the chinch-bug in the State indicates that it is spreading from the west towards the east and south, and unless the weather of 1898 continues damp, we are likely to witness its injuries more widespread than they have yet been. The promise at present is for a wet season, yet it is not well to depend on anything so uncertain as the weather, and it is with this thought in mind that the present account of the chinch-bug has been drawn up.

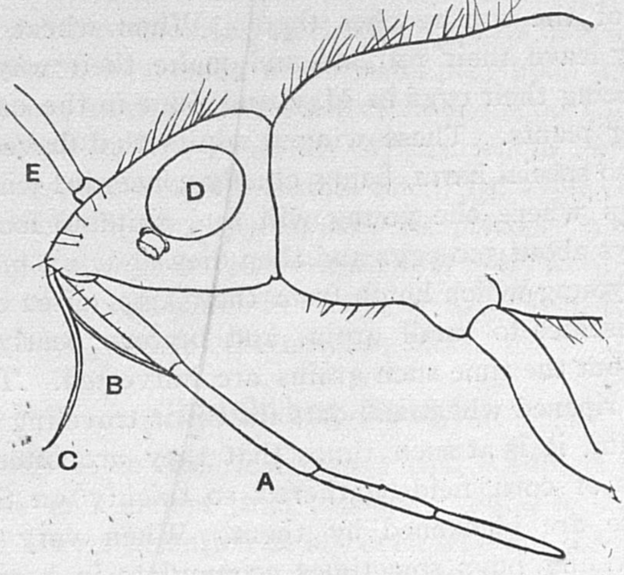

FIG. 1.—A side view of head and part of thorax of chinch-bug, as seen through the microscope. A, jointed beak; B, the slender mouth parts used in puncturing plants, partly withdrawn from groove on dorsal side of jointed beak; C, the slender upper lip, or labrum; D, the eye; E, base of antenna.

What It Is Like.

The adult bug is about 3-16 inch long and 1-16 inch wide; black in general, with white wings lying flat on the back, each with a black dot at the middle of the outer margin. The legs and bases of the feelers are red. The young without wings are more or less red in color. Very young have a cross-band of pale yellow. Older examples with rudiments of wings are largely black in front, approaching in this respect the adult insect.

The chinch-bug feeds at all times after it leaves the egg. It is provided with a beak and takes only the sap of plants for food.

Habits.

The winter is spent as an adult under boards, logs, leaves and the like at the edges of cultivated fields. The bugs do not remain *in* the fields as a rule at this season. As long as cold weather continues the hibernating individuals lie torpid, but with the first warm spring days they begin to stir, and may then be found close under boards and stones, where the warmth of the sun reaches them. When wheat begins to grow they leave their retreats and make their way into the fields, placing their eggs in May and June in the earth about the young plants. These winged adults that have wintered over do no special harm, being chiefly concerned with placing their eggs where the young will find suitable food. Each female lays about 500 eggs and then dies.

The young which hatch from their eggs often do a great deal of mischief to small grain, and become nearly or quite grown about the time such grains are harvested. They then leave the ripened wheat and oats for corn, traveling along the ground, and it is at such times that they are often seen at the edges of corn fields gathered so thickly on the stalks that these are blackened by them. When very abundant these traveling bugs sometimes accumulate in heaps several inches deep on the ground. The brood matures on corn, when not already matured, and places the eggs for a second brood under the enfolding parts (boots) of the lower blades, as well as in the ground. The second brood may either remain upon corn, or when very abundant, sometimes leaves cornfields for fall wheat. There is evidence of the development of a third brood at this latitude, but the injury is done by the two broods above mentioned.

The chinch-bug may be recognized by the peculiar pungent buggy odor given off when it is handled, or when suddenly exposed in its retreats between the husks of corn ears. When thus uncovered, it quickly conceals itself again, often dropping to the ground and hurriedly getting out of sight under clods. Its expertness in making its way through crevices and small openings is truly remarkable, and enables it not only to avoid its enemies, but to reach the inner tender parts of the plants upon which it feeds.

Its Enemies.

Probably no American insect has fewer natural enemies. Very few birds prey upon it because of its repulsive smell and taste. It is questionable if any of them are fond of it, and it is certain that none feed upon it to such an extent that they are worth considering as checks upon its increase. Several lady beetles have been observed to prey upon it, yet seem never to have an appreciable effect in reducing its numbers during an outbreak. From its disposition to devour foul-smelling bugs, the common toad is calculated to be very useful during chinch-bug outbreaks, and its presence about grain fields should always be encouraged. A good word must also be said for the quail, which is known to eat chinch-bugs, occasionally at least, and for the meadow lark.

Chinch-bug Fungi.

Yet there is no American insect that is subject to greater fluctuations in numbers than this one. For a series of years it may not attract attention at all, even where it is best known and most destructive. Then an outbreak comes that means almost total ruin to the wheat and oats of some sections, and serious reduction of yield throughout the greater part of our wheat-growing area. If the chinch-bug were attacked by small ichneumon flies, as is the grain louse, we might suppose it was the work of such parasites; but the chinch-bug has no enemies of this kind, as far as known; and as stated, is not much hampered by insect enemies of other kinds.

The periods of exceptional abundance come almost invariably during dry seasons. But why should this be? Is moisture directly hurtful to the bugs, and do they simply multiply without check when drought and sunshine prevail? The quickness with which they disappear after a couple of heavy showers in midsummer, gives some ground for the belief that a drenching rain actually kills them. But after witnessing the manner in which they endure drenching and even immersion in water when kept in confinement, one is compelled to abandon this belief. Furthermore, there is evidence gathered from field observations showing that the chinch-bug will endure as much soaking with water as most other insects. In the account by Dr. Lintner, referred to above, of its depredations in New York, it is stated that it multiplied in spite of persistent rainy weather. He says:

"The past year and the present have both been years of excessive rainfall in St. Lawrence county; spring, summer and autumn have been exceptionally wet. In the spring heavy and continued rains flooded meadows now showing the chinch-bug attack. At haying time, when the bugs were young, and according to all statements hitherto made, readily killed by wet, the rains were so frequent and severe that the grass cut could only be secured with difficulty. Upon Mr. King's farm much of it was drawn in, upon favorable days, by improving the opportunity of extending the labor into nightfall. At the present time grass is lying in fields in stacks, which could not be gathered, owing to continued rain, and fields of oats are still unharvested."

Dr. Lintner suggests in explanation of this immunity that it was a recent introduction into the State, and that it followed the rule with such recent importations in becoming more destructive in its newly invaded territory than it was in regions where it had been long established. It is a fact that insects not especially injurious in their original home often become exceedingly destructive and difficult to deal with when by some chance they reach a foreign country. The notorious San Jose scale is an example. The cottony cushion scale of citrus fruits is still another. The reason why they are more destructive when transplanted is not far to seek. In the case of the cottony cushion scale, it appears that it was brought to our western orchards without its natural checks, and when they were sought out and imported also this insect was no longer to be greatly feared. Unfortunately, we do not yet know positively the native land of the San Jose scale, but it is very probable that we shall yet find its natural check when we have learned more of it in foreign countries.

Now, in the Middle States, the chinch-bug is attacked by several parasitic fungi, which appear to be very generally scattered ready to destroy the bug when the weather conditions are proper for their growth. They are here in Kentucky, in Illinois, in Kansas, and other States of the Ohio and Mississippi valleys. They are dependent on moisture, and when rains come they get their opportunity. But in New York, where the chinch-bug is commonly very rare, these parasites, we may suppose, were not common in cultivated fields, and hence, the bugs, once started, had, for a time, everything their own way.

Two of these plant parasites are known to be particularly effective in destroying chinch-bugs. They are fungi, somewhat more highly organized than the microbes so often mentioned as causing epidemic diseases, but seem to act in much the same way, getting into the bodies of insects through the breathing pores, and by their growth in the interior, destroying the life of the attacked bugs, and then pushing through to the outside, where the fruit or spores are developed. The small growing threads are too small to be discerned with the unaided eye, and hence, the only way to get a knowledge of the structure and manner of fruiting is by the use of the compound microscope. The presence of these fungi is to be known by the white or gray powdery coats formed on the backs, and often completely covering the dead bugs. The most common and active species has received the name

"Chinch-bug Fungus."* It is pure white as commonly seen on the bodies of insects, but, when old, becomes of a light cream-yellow color. When it is grown in large masses, this change is especially marked.

The second fungus† is not so common as the other, and has not, as far as I know, been grown artificially for distribution. It appears on bugs in the field at times, and the *Sporotrichum*, mentioned above, has sometimes received credit for good work done by this species. It produces a gray coat on the bodies of dead bugs.

But chinch-bugs sometimes die in large numbers, and present none of the symptoms of attack by either of the above fungi. The fluids of these bugs examined under the microscope are often swarming with a micro-organism, which received, many years ago, the name "*Bacillus insectorum.*" It is one of the microbes such as we find associated with certain infectious human diseases, and although it is easily grown artificially in beef broth and in nutrient gelatine, it has not, thus far, in experiment, proved of value in destroying the chinch-bug in the field.

These are the enemies most useful to us, it is thought, from their destruction of chinch-bugs. The chinch-bug fungus (Sporotrichum) has been quite extensively grown artificially in several of the Middle States, and thousands of farmers have used it in their fields. In Kansas it has been more extensively used than elsewhere, and the testimony of farmers there has been at times strongly in favor of its effectiveness as a remedy for chinch-bug injury. The testimony of those who have been chiefly concerned in its culture and distribution is, however, somewhat less positive, owing,

*The botanical name is *Sporotrichum globuliferum*. It attacks many insects of several different orders; in fact, will probably attack, spontaneously, most of those that live in such a way as to give it an opportunity. It is especially destructive in Kentucky to the false chinch-bug (*Nysius angustatus*). The harlequin cabbage bug, the tobacco worms, the cabbage Plusia, and the bird grasshopper (*Schistocerca americana*) have proved especially liable to its attacks when confined in the Vivarium of my Division.

†*Entomophthora aphidis.*

partly, to unquestionable failure of the fungus to catch under some circumstances, and partly to the fact that the fungus appears spontaneously in fields, making it impossible to say, under any ordinary field test, that it was actually introduced artificially. In Kentucky the fungus has been cultivated and distributed now for two summers to all farmers who applied for it. Not all who received packages have reported to me, but the majority of those reporting to date, who actually used the fungus, assert that it cleared their fields of the bugs. Some were in doubt, not being sure but that the disappearance of the bugs was caused directly by rainy weather. But in view of all chances of error, the outlook in the direction of destroying this and other pests with artificially grown parasites does not seem to me discouraging. I know from my own experience that an enclosed area of 900 square feet can be so thoroughly infected with the chinch-bug fungus, that not only the chinch-bug, but the harlequin cabbage bug and the bird grasshopper are not safe from it. This area is under glass, it is true, and the moisture and warmth no doubt furnish conditions calculated to preserve the fungus and encourage its activity. But I can see no practical difficulty in cultivating the fungus on so large a scale that a whole county, or even a State, could be thoroughly sown with the spores so that the bugs would be in constant danger from them. It is largely a question of money. Illinois is estimated to have lost in a single year $73,000,000 from chinch-bug injury, a sum which could be made to establish and maintain laboratories that would furnish quantities of the fungus at any time to all who applied. But, it will be urged, you cannot control weather conditions, and what is the use of sending out parasitic fungi when the drought is such that they will not attack the insects? In reply it may be said that the spores of the fungus retain their vitality in soil for a considerable period, and one of the purposes of such laboratories should be to keep the parasite alive in chinch-bug infested regions in such quantities that it would quickly do its work as soon as the weather admitted. The experience with the insect in New York during rainy weather illustrates the importance of having the fungus at hand at all times.

Can fields be kept stocked with the fungus? I believe they can. It is well known that certain bacteria become established in rooms so that it is extremely difficult to keep them out of any fluid or nutritious matter suitable for their growth. Certain yeasts* causing so-called "diseases" in alcoholic beverages, are sometimes in similar manner established in distilleries where they become exceedingly troublesome; and one of the reforms introduced by recent scientific method is the suppression of the disease-producing yeasts, and the isolation in pure cultures, the cultivation and introduction into such beverages of the micro-organism known to produce the aroma desired. If injurious micro-organisms may become established and prevalent because of simple neglect, in the nature of the case it should be practicable to establish useful ones by design. It is true the difficulties become greater when one leaves the laboratory, the dairy, and distillery for the grain field, where conditions cannot be controlled. But where so much is at stake, difficulties should not stand in the way of a thorough test of a remedy in any degree promising.

The Method of Using the Fungus.

In Kentucky we have thus far adopted the practice originally recommended by Prof. Snow, and detailed in a circular which we send out with each package of the fungus. The central idea of this method is to infect the bugs by confining them for a time in a box with some of the fungus, and then set them free to carry the contagion to their comrades out of doors. The box can be made of any lumber, but must be so constructed that the bugs cannot escape. It is not so easy to make such a box as might be supposed, because the bugs get through very small crevices and persist in getting away, no matter how inviting the box is made. A layer of damp earth is spread over the bottom of the box, and fresh food in the shape of young oats or corn is kept constantly in the box. When the bugs begin to die, a part of them are taken to the field where bugs are abundant, and set free, and other

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***Saccharomyces pastorianus*, for example.

healthy bugs are substituted for them in the box. By repeating this from time to time, the box is made a source from which a steady supply of diseased bugs can be obtained.

The method has defects that stand in the way of its success. The quantity of the fungus sent out is small in the first place, commonly not exceeding half an ounce, and the confined chinch-bugs may not contract the disease in less than five days or a week, during which time the mischief is going on out doors, or else the bugs become scattered to carry on their work in the neighborhood the following season. Then again, it is often not possible in Kentucky to collect the bugs in sufficient quantities to carry out the directions given in the circular, yet, at the same time, they are abundant enough to do a great deal of harm, and in any case are a threat for the future. Some method must be developed, if possible, that will enable the farmers to set the fungus at work as soon as the bugs appear, and before they become abundant.

It is my personal opinion, though, that the sending out of small packages of the fungus is to be commended, even though the benefit is not at once apparent, and reports received are in the main unfavorable. These small packages contain millions of spores, and the chances are very good indeed that some one of these would destroy a bug or two, and thus introduce the parasite where it was not before present. If the one receiving the package did no more than empty the small box in his infested field, there would still be a chance that the fungus would obtain a foothold and do future effective work. If this is haphazard practice, so, it may be replied, is the sowing of bluegrass, crimson clover, and even wheat during a dry fall. The seeds of these crops fail to catch under much the same conditions that prevent the catching of the chinch-bug fungus.

A Suggestion as to Practice.

When the spores of the chinch-bug fungus have been as systematically sown in our fields for a series of years as are the seeds of clover or wheat and the result carefully observed and recorded we shall be in a position to say whether or not the treatment is a success. And I wish here to offer a suggestion as to practice which I hope to employ myself when opportunity comes. Briefly told, it is this: Moisten seed wheat and dust it thoroughly with the fungus before sowing.

The hot water treatment for smut in wheat seems destined to be very generally adopted by growers of the crop. It is a very simple matter to suspend wheat in a barrel of water heated to 131-132° F. for fifteen minutes, and when it is spread out to dry it will take but a few minutes more to dust it with the fungus, just as it is dusted with lime after it has been soaked in bluestone. The fungus can easily be grown by the quart, with a little outlay of money, and I should judge that this quantity would be sufficient to charge all the seed wheat commonly planted by one farmer.

How to Grow the Fungus.

The methods of growing the fungus have no practical interest for the farmer, since he cannot be expected soon to grow it for his own use, no matter how effective it may prove to be; but as explaining the nature of the fungus some observations on methods of handling it may be worth giving. My own practice is based upon methods in use everywhere in bacteriological laboratories. The fungus is obtained from an insect that is covered with the white growth by the use of a platinum needle (a piece of wire two inches long) in the end of a glass rod and a dozen or more test tubes containing sterilized potato, or gelatine charged with meat infusion and peptone, the tubes, of course, being kept carefully plugged with sterilized cotton. By simply touching the needle to the white powder on the dead bug and then introducing it up into a tube and drawing it over the surface of the potato, or gelatine, the spores for a culture are sown. In the majority of such tubes several different organisms, moulds and bacteria, appear, often growing so promptly and rapidly that the fungus wanted is crowded out, but when a number of cultures are started, some one or more will very likely show, *on the third day*, the characteristic white cottony growth, which may, a little later, be transferred pure to other tubes. The potato used is cut in the form of a cylinder by a cork cutter, and afterward each piece is sliced so as to give a large oblique surface. By cutting under water, then putting in test tubes at once and sterilizing with steam, the potato does not blacken.

One trouble the beginner must be warned against. When other work is pressing he is likely to let his cultures dry out, and if left too long in this condition the fungus dies, when it is necessary to get a fresh start, not an easy thing to do at a moment's notice and at any season of the year. I have kept the fungus alive by starting pure cultures in several large flasks, stopped with sterilized cotton and partly filled with nutrient gelatine. The quantity of gelatine is so great that it will not dry out if kept several months. Flasks of this sort should be placed where the temperature does not range widely. The fungus will not grow at a temperature of 103°F., as I find by testing it in an incubator. I prefer to start fresh cultures each spring from fungus found growing spontaneously out of doors, for the reason that continued cultivation seems to weaken the vitality of the fungus.

Gelatine is not convenient as a medium on which to grow the fungus in large quantities sufficient for distribution. Corn meal charged with meat infusion is used instead. The meal, dampened with meat infusion, is put in shallow glass dishes, known as Petri dishes, or in a large culture dish ten inches in diameter, and sterilized with steam, being heated for an hour on each of three or four successive days. The spores are introduced from the pure culture in a test tube by using the platinum needle. I have sometimes sterilized the meal by a single heating in the hot-air sterilizer, and then quickly lifting the lid of the culture dish, poured from a flask over the dry meal sterilized beef broth containing the spores. The method practiced by Prof. Snow has also been followed to some extent, namely, using Mason fruit jars with perforated screw caps, though the opening in the cap *is not indispensable, provided the culture medium has been thoroughly sterilized*, but the fungus requires air to grow well, and my cultures on a large exposed surface have been better, as a rule, than those made in jars. Slightly crushed and steamed wheat makes a rather better medium than corn meal, because the air penetrates the mass more readily. Hominy, after steaming an hour or two for several days, is an excellent medium.

With the best management, moulds and bacteria will sometimes be accidentally introduced into the meal and take possession of it. Bacteria of fermentation are especially troublesome in hot weather, and soon convert the meal into an offensive sour mass, upon which the Sporotrichum will not grow. Once these organisms get a start in a dish before the fungus appears, it is useless to waste further time with it, and the only thing to do is to have it washed out thoroughly, sterilize it in the hot-air sterilizer, and start again. To avoid loss of time occasioned by such failures, it is well to start a dozen or two cultures at one time. Then a few failures are not of so much consequence. Quite often a green mould will appear on the meal at one or two places, spores floating in the air having fallen on the surface when the cover of the dish was lifted. With a broad blade of a sterilized scalpel, or spatula, one can often remove such growths before they have spread much, and thus preserve the culture of Sporotrichum from further contamination. The culture must be allowed to dry somewhat before being put in tin boxes for distribution; otherwise, the moulds and bacteria take possession. Of course, drying in the sun is not to be thought of, and drying for too long a time anywhere is sure to destroy the spores.

The most important thing to keep in mind in growing the fungus is thorough sterilization of everything used in starting cultures. It is not safe to hurry the process. The medium used *must* be sterile, otherwise, it is useless to sow the spores of Sporotrichum on it. When introducing the spores into dishes or jars, shut all windows and lock all doors. Do the work at night, if possible.

Other Treatment.

Numerous other ways of fighting the chinch-bug have been advocated from time to time in the northwest. Some are utterly valueless, while others are of very limited application, and cannot be expected to have much effect on the general abundance of the insect. One of them has been proved in practice effective in preventing injury. It is the use of barriers.

Barriers. When small grain ripens, the chinch-bugs are driven to other plants in the vicinity, and even when the wings are developed, prefer to creep along the ground. Corn or oats adjoining infested wheat suffers severely about the time of cutting wheat, because of the inroads of these migrating bugs. For at least thirty years farmers in the Middle States have been accustomed to plow furrows along the edges of fields liable to invasion, and at intervals of two rods, or thereabouts, dig holes, like a post hole, in which the bugs will accumulate and where they may be destroyed with coal oil. Sometimes, several such furrows, parallel with each other, are made. When tar can be conveniently obtained, fence boards are set on edge in the ground end to end, and the upper edge painted with this substance, which is offensive to the bugs and prevents their passing over. Sometimes the tar alone is used as a barrier, a strip of ground at the edge of the threatened field being smoothed off and the tar poured from the spout of a kettle in a narrow line in the midst of the smooth area. The strip must be worked from time to time to keep the soil pulverized, The bugs will not pass over such a line of tar as long as it is fresh, but it hardens in time and must be renewed. However, if the bugs can be kept out of the field for about ten days, the barrier will have accomplished its purpose, since what bugs are not actually destroyed will have scattered in other directions. Instead of digging holes along the barriers, it is customary in some localities to sink cans or pails in the ground and keep them partly full of coal oil.

A barrier used in Kansas and recommended by Prof. Snow in one of his reports consists of a ridge of earth made by plowing two furrows so that the turned earth falls together, and then smooth this by dragging over it a heavy drag with concave under side. Along the top of the ridge is poured a line of tar, petroleum, or salt and coal oil. On the side of this barrier, next the field from which the bugs come, post holes are dug about one hundred feet apart, and the bugs falling in them are killed by using a little coal oil from time to time. Writing of the use of this barrier, Prof. Snow says: "Notwithstanding the success reported in former years by a large percentage of farmers using the white fungus infection, there have been enough failures to teach us not to put entire dependence on this, but to supplement the infection by a method that will succeed where the infection fails. The barrier method just described has succeeded admirably in our experience."

Prof. S. A. Forbes, State Entomologist of Illinois, corroborates the testimony of Prof. Snow as to the effectiveness of the barrier method. In his report for the years 1895 and 1896 (published this year) he writes:

"The great importance of making widely known to farmers the ascertained facts concerning the utility of this most valuable and reliable of all known measures of contest with the chinch-bug, and of substantiating the statements concerning it by detailed accounts of practical experiments, will justify still further discussion of it in the light of our latest experience." And then after giving in detail the result of work done in Effingham County, Illinois, 1895, where a dusty furrow was made by plowing a strip and then dragging a piece of heavy timber back and forth, he continues: "The general effect of the Effingham procedure, above described, was to protect the corn and other crops adjacent to the field of wheat (itself so badly infested as to have been completely destroyed,) except so far as the corn was entered before the beginning of the experiment, and at the time of the heavy rain of June 12, when the tar was not at hand for use. Even these infested portions of the field were saved by the kerosene emulsion, as described. By selecting an average part of a furrow around the field, and carefully collecting and measuring all the chinch-bugs accumulated in it, it was determined that the entire mass of bugs killed in this ten days' contest would measure not less than twelve bushels. * * *In short, the success of this field enperiment, tried under very difficult conditions, was substantially complete, and the value of* *this method of contest with the chinch-bug seems established beyond controversy.*" The italics are Prof. Forbes'.

To give the words quoted above the weight with Kentucky farmers that they are entitled to, I need only add that Professors Forbes and Snow have given more time in study and experiment to the chinch-bug problem than any one else in the country. Their conclusion with respect to the barrier method is to be accepted as the very best information we have ou the subject.

The Use of Coal Oil. Under some circumstances coal oil is to be recommended for use against the bugs in preference to other treatment. When it happens that they have already collected on the outer rows of corn, having been driven there from ripening wheat or oats near by, spraying with oil is about the only thing to be done. It can be used to advantage also to supplement the barrier method, when the barrier becomes defective from the effect of rain, for example. Very dilute preparations of the oil are destructive to the bugs, hence it is possible to apply the oil to corn in an emulsion* without injury to the plants. The application must be made promptly, while the bugs are on the outer rows, since they soon scatter into the interior of the field where it is not easy to reach them. The cost of spraying the outer rows of corn is not great, amounting to about $3.00 per acre for materials.

The Use of Steam. Steam generated in the field in a boiler hauled about by horses, has been recommended as a bug exterminator. Carefully made tests have shown it to be too destructive to vegetation to be safely used.

Deep Plowing. It has sometimes been suggested that the chinch-bug in badly infested wheat be plowed under when

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*The emulsion has been repeatedly described, but for convenience may be given here. Dissolve one-half pound of whale oil or laundry soap in one gallon of hot water. Add to it while still hot two gallons of coal oil, then churn it vigorously for ten minutes by passing it through a garden force pump. The oil mixes with the soap solution, forming an emulsion, looking somewhat like thick cream. It can be bottled and kept until wanted in this condition. When ready to use, dilute the three gallons with water, so as to make thirty gallons in all. It must be applied with a force pump and spray nozzle.

there is no hope of saving the grain. This, too, proves to be impracticable. The bugs, as already stated, are capable of making their way through crevices that would thwart most other insects, and readily make their way out of loose soil.

Early Planting. The first brood of bugs is the one which injures small grains. The eggs for these are placed in wheat fields in May and June. If, when threatened, the grain can be given an early start, by the time the bulk of bugs are hatched it will be better able to withstand attack.

Fertilizers. Chinch-bugs do most harm to crops on poor land. The plants succumb to the attacks of their enemies the more quickly because feeble, just as the weak and ill-fed among human kind perish, as a rule, quickest in the presence of disease. The use of a stimulant in the shape of fertilizers has been employed with complete success in the case of chinch-bug injury to wheat. The plants are being drained of their fluids by innumerable beaks, and are tided over the trouble by a good supply of nourishing food.

Planting Timothy with Wheat. This practice has been claimed to be a good means of preventing injury to wheat. Just why it should serve this purpose is not very clear, unless it be that the moisture retained by the double growth encourages the fungus parasites of the bugs. A very satisfactory instance of benefit from the practice was reported some years ago to the Illinois State Entomologist by Mr. E. E. Chester, a thoroughly reliable and successful farmer of Champaign County, Illinois. Mr. Chester wrote: "A field of 28 acres was sown to wheat in the fall of 1874, when the chinch-bugs were innumerable throughout this region; twenty acres with timothy and the remaining eight without, timothy being sown on the latter in the spring. This eight acre plot, like the rest in every respect except that mentioned, was overwhelmingly infested with chinch-bug, the grain at harvest yielding only seven bushels per acre, while the twenty acres bearing a thrifty growth of fall timothy, remained wholly unaffected, except for a short distance adjoining the other plot, and yielded an average of twenty bushels to the acre."

The Use of Fire. Burning grass, leaves, weeds, and rubbish along fences at the edges of infested fields has always been a favorite "remedy" for chinch-bug injury with writers ever since the insect became troublesome in the Middle States. Dr. Fitch, of New York (second report, 1896, p. 295) mentions it; Walsh (Insect Injuries to Vegetation in Illinois, 1861, p. 14) recommends it; Riley (Practical Entomologist, 1866, p. 48) endorses it; and so on down the list to the present time. It is a well known fact that the bug does not remain in cultivated fields, but searches out more secure retreats from winter weather in neighboring woods and at the edges of fields. Of course, the destruction of even a single bug is something accomplished, since one female, as suggested by Walsh, may become the parent of 50,000 descendants during a season. To be effective, however, the fire must burn very closely, and from the habit of the insect in winter to go under bark of logs, under stones, etc., most of them are likely to escape fire that simply burns off the grass and leaves. Even in warm weather it has been found by actual test that bugs may escape a very well managed fire. Fires must be managed with intelligence. First, determine by search whether the bugs are hibernating on the land, and in what situations they are most abundant. Stumps, logs, boards and stones should be overhauled, and the fire given a chance to reach the bugs. Any green growths should have special attention if the burning is done in the fall of the year, and an extra supply of dry material be scattered over them to make sure that the heat will penetrate to concealed bugs.

The insects often migrate in fall some distance from cultivated fields, and since they fly readily in spring, are likely to invade fields to some extent in infested localities whether the growths along fences are burned out or not, yet the practice, if it should be general in a region, would very probably do good. It is only fair to state that there is some difference of opinion even on this point, and Le Baron, one of the most careful economic entomologists this country has produced, wrote in 1872 (Second Annual Report on the Noxious Insects of Illinois, p. 149): "My own observations have led me to the conclusion that this remedy, also, in the way that it would be likely to be generally put in practice, can be of but little avail."

The Literature of the Chinch-bug.

The papers of the following list contain much of what is valuable on the history, habits, and injuries of the chinch-bug. Many articles of more or less worth have appeared also in agricultural papers, those from Le Baron and others in the early issues of the Prairie Farmer having a special interest and value.

1831. Thomas Say, Descriptions of New Species of Heteropterous Hemiptera of North America. This pamphlet was published at New Harmony, Indiana, and contained the original scientific description of the insect, to which Mr. Say gave the name of *Lygæus leucopterus*, since changed in conformity with the recognized rules in scientific nomenclature to *Blissus leucopterus*. The original publication has long been out of print, but in Say's collected papers it is re-published. (Complete Writings, vol. 1, p. 329).

1856. Asa Fitch, Report on the Noxious, Beneficial and Other Insects of the State of New York, 2, p. 277. Dr. Fitch gives an exhaustive account of the chinch-bug, detailing its history as an injurious insect, its habits, and the nature of its injuries. The author had little personal experience with the pest, and his paper is drawn very largely from statements that had appeared up to that time in agricultural papers.

1861. B. D. Walsh, Insects Injurious to Vegetation in Illinois, 1, p. 14. This is a brief paper, in which the use of fire is recommended, and attention is called to four lady beetles believed to prey upon chinch-bugs.

1866. B. D. Walsh, The Practical Entomologist, 1, p. 95. The Prairie Farmer is quoted with reference to the use of tarred fence boards for barriers. A detailed account is given of the use of such a barrier in Ogle county, Illinois, where the bugs were stopped and led into post holes. According to the writer, thirty or forty bushels were collected in a day, and one hundred acres of corn "were completely protected and yielded bountifully." Walsh endorses the statements made.

1868. Henry Shimer, Proceedings of the Academy of Natural Sciences of Philadelphia, 19, p. 75. In this paper Dr. Shimer states his belief that the chinch-bug was destroyed in

1865 by an epidemic disease, and although this explanation of their sudden disappearance met the usual fate of new and strange truth, it has since been quite generally accepted as well founded. Walsh's unfortunate attitude toward Shimer's work has, however, retarded its acceptance at its real value.

1869. B. D. Walsh and C. V. Riley, The American Entomologist, 1, pp. 179 and 194. This is an extended account of the chinch-bug, giving the experience of western farmers with it, its life history, the effect of weather on its numbers, and remedies.

1872. William Le Baron, Second Annual Report on the Noxious Insects of the State of Illinois, p. 142. This is a general account of the life history and habits of the insect, together with a discussion of the different remedies that have been advocated.

1880, Cyrus Thomas, The American Entomologist, 3, p. 240. The relation of temperature and rainfall to chinch-bug outbreaks is here discussed, and a diagram given showing a pretty constant relation between rainfall and chinch-bug injury in Illinois. Data relating to rainfall and outbreaks in this state were collected for a period extending from 1840 to 1877, inclusive. He shows conclusively that where the rainfall is great and the mean temperature below the average, that chinch-bugs are not destructive, and that their outbreaks have occurred at intervals of about seven years. The same subject is discussed by this writer in the 10th report of the Illinois State Entomologist (1881), p. 47.

1883, S. A. Forbes, 12th Report of the State Entomologist of Illinois, p. 32. This paper marks an advance in the study of the chinch-bug, giving, as it does, positive evidence of the presence of epidemic disease among the chinch-bugs, and describing a micro-organism (*Bacillus insectorum*) that is constantly associated with the disease. It may be considered the starting point for the work that has since developed along the line of preventing injury by the use of artificially grown parasites of the chinch-bug. Brief notices of his results were, it is true, printed elsewhere somewhat earlier, but the substance of Forbes' study of the bacterial disease of the chinch-bug will be found in the above report.

1885, J. A. Lintner, 2nd Report on the Injurious and Other Insects of the State of New York, p. 148. This is a general account intended for the information of the farmers of New York. It is of special interest as the record of an outbreak in a locality where the insect is commonly very rare.

1888, L. O. Howard, Bulletin 17, Division of Entomology, U. S. Department of Agriculture. This is a summary of the results obtained by a study of the chinch-bug up to that time. Interesting matter on the distribution and injuries is given, especially with reference to the year 1887.

1892, F. H. Snow, 1st Annual Report of the Experiment Station of the University of Kansas. This is an extended illustrated report of 230 pages, giving the results of growing and sending to farmers the chinch-bug Sporotrichum during the year 1891. A total of 1,400 packages was sent out, and the reports received indicated that 76.5 per cent was successful; 13.0 per cent was unsuccessful, and 10.5 per cent was doubtful.

1895, Otto Lugger, Bulletin 37, Minnesota Agricultural Experiment Station. The habits of the chinch-bug are given at length, and remedies are suggested. The author thinks that the distribution of packages of the fungus parasite is calculated to do good, but deprecates sensational articles, sometimes published, which lead farmers to believe that the disease can be introduced without labor. "Many farmers actually expected that by throwing a pinch of the diseased bugs in a large field infested with bugs, these would—presto!—be found dead next day. They did not realize that the introduction of a disease requires very careful work," etc.

1895, F. H. Snow, 4th Annual Report of the Experiment Station of the University of Kansas. The results of field tests of the fungus are given for 1894, the percentage of successful trials being, however, but slightly greater than the unsuccessful. Thus, in Kansas, 875 farmers reported success, while

741 reported failure. The reports obtained from other states give 196 successes and 185 failures.

1896, F. H. Snow, 5th Annual Report of the Experiment Station of the University of Kansas. This report is a continuation of those above cited, and gives results of laboratory and field experiments with the fungus in 1895. The author states that the evidence from field tests was unsatisfactory, and not conclusive as to benefit. The total number of packages sent out was 7,271.

1896. H. Garman, Eighth Annual Report of the Kentucky Agricultural Experiment Station, for the year 1895, p. LIV. A few complaints of injury in Kentucky were received at the Station in 1895, at which time the outbreak of 1896 and 1897 had its beginning. In the report cited is given a brief notice of its occurrence in the State, of methods of growing the fungus, and attention is called to the fact that the Station will furnish packages of the chinch-bug fungus for experiment. Figures of well and diseased bugs are given.

1896. S. A. Forbes, Nineteenth Report of the State Entomologist of Illinois. One hundred and eighty-nine pages of this report are given up to a record and discussion of laboratory and other experiments with several chinch-bug fungi, a list of papers on the parasitic fungi of insects, and some experiments on the effect of water on chinch-bugs. The author thinks that the white fungus serves to hasten the beneficial effect of wet weather, but is not sure about the exact part it takes in lessening the numbers of the bugs. It is plain, at any rate, from the experiments recorded, that immersing chinch-bugs in water has no effect on them sufficient to account for their rapid disappearance after heavy rains.

1896. Otto Lugger, Bulletin 43 Minnesota Agricultural Experiment Station. The general subject of insect disease is discussed, and then the chinch-bug fungi are taken up and some laboratory and field experiments with them are described. The Station furnished 1941 farmers with the fungus in 1895.

1898. S. A. Forbes, Twentieth Annual Report of the State

Entomologist of Illinois. Considerable space is given in this report also to the discussion of chinch-bug fungi, and to the effects of heat, moist and dry, on the insect. The author strongly recommends the use of dusty furrows or strips along the edges of threatened fields, with a line of tar to make them more effective.

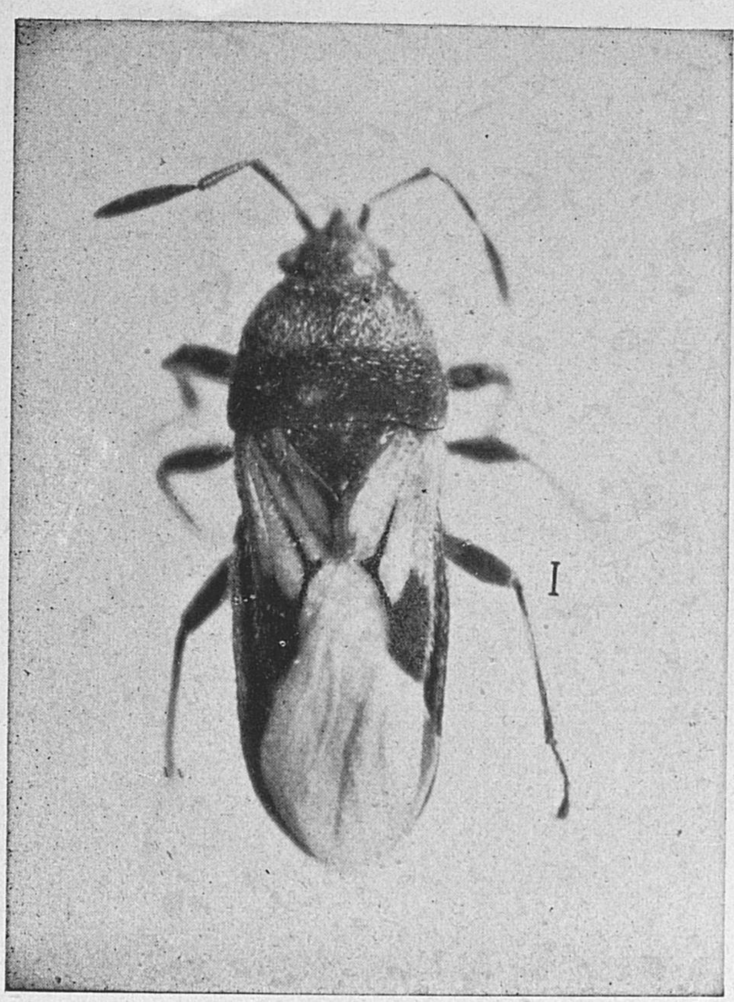

FIG. 2.—The adult chinch-bug, the line at the right of figure denoting the natural size. From a photo-micrograph made by H. Garman.

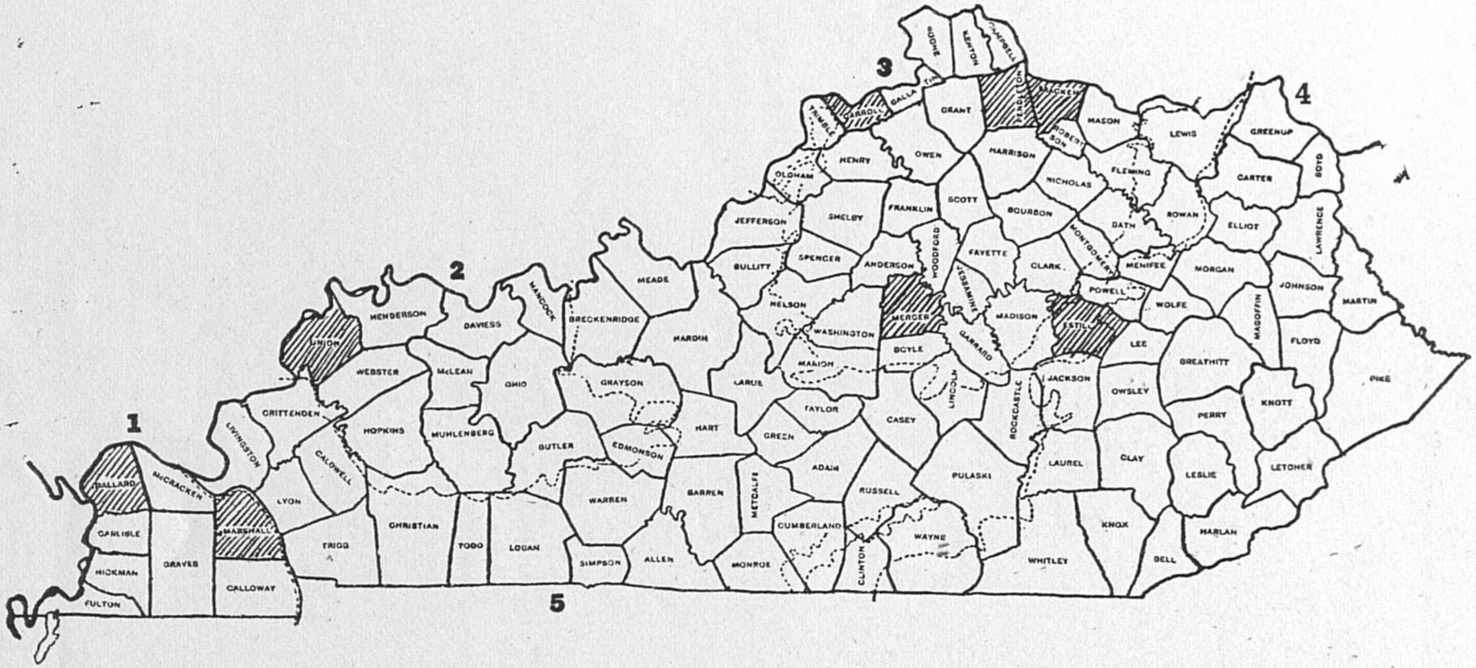

FIG. 3.—The counties marked with lines infested with the chinch-bug in 1887, according to the statistician of the U. S. Department of Agriculture.

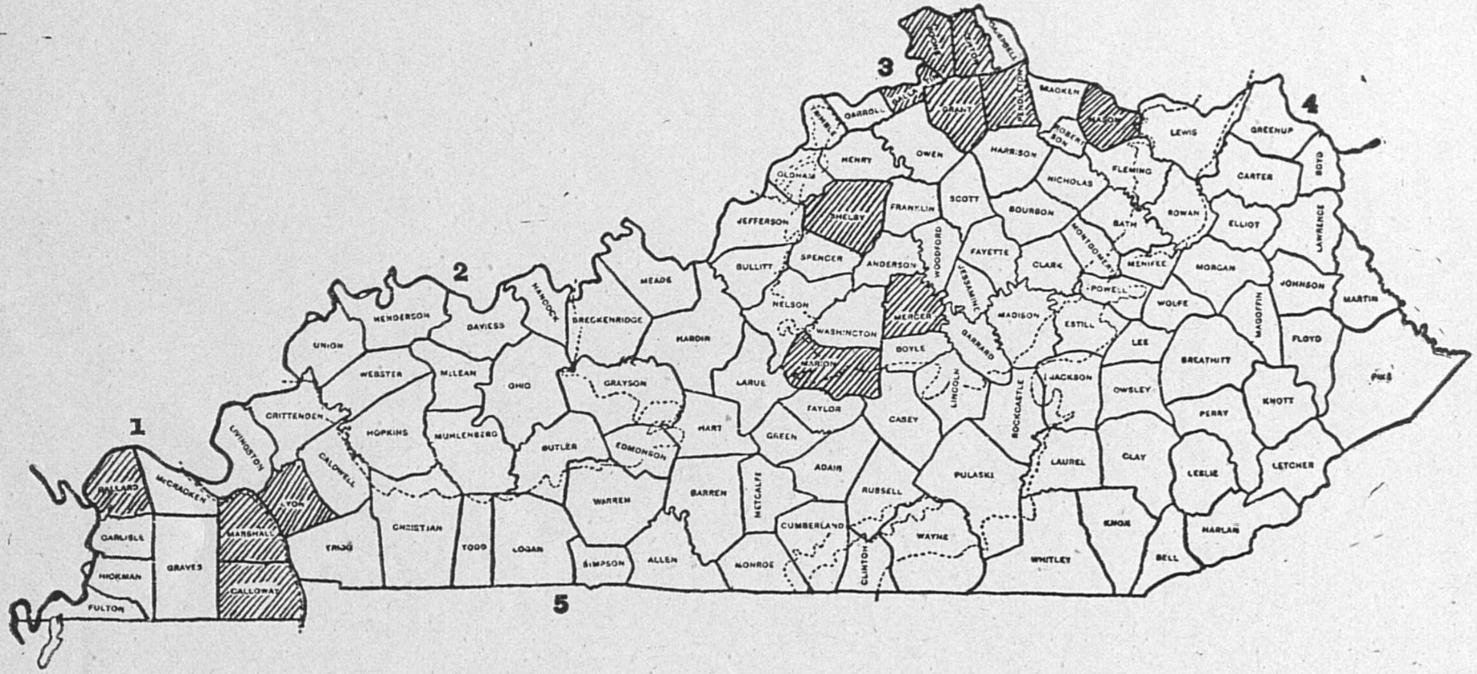

FIG. 4.—The chinch-bug injurious in 1896 in the counties marked by cross lines.

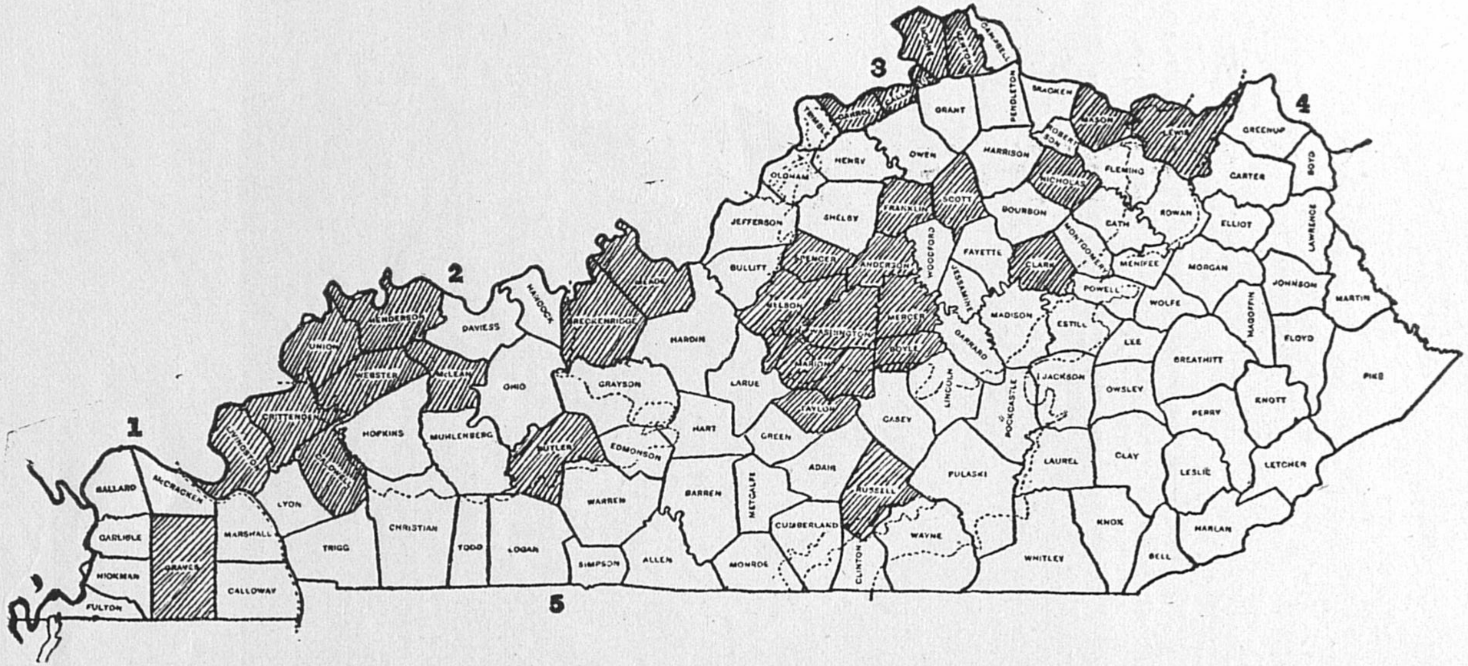

FIG. 5.—The chinch-bug injurious in 1897 in the counties marked by cross lines.

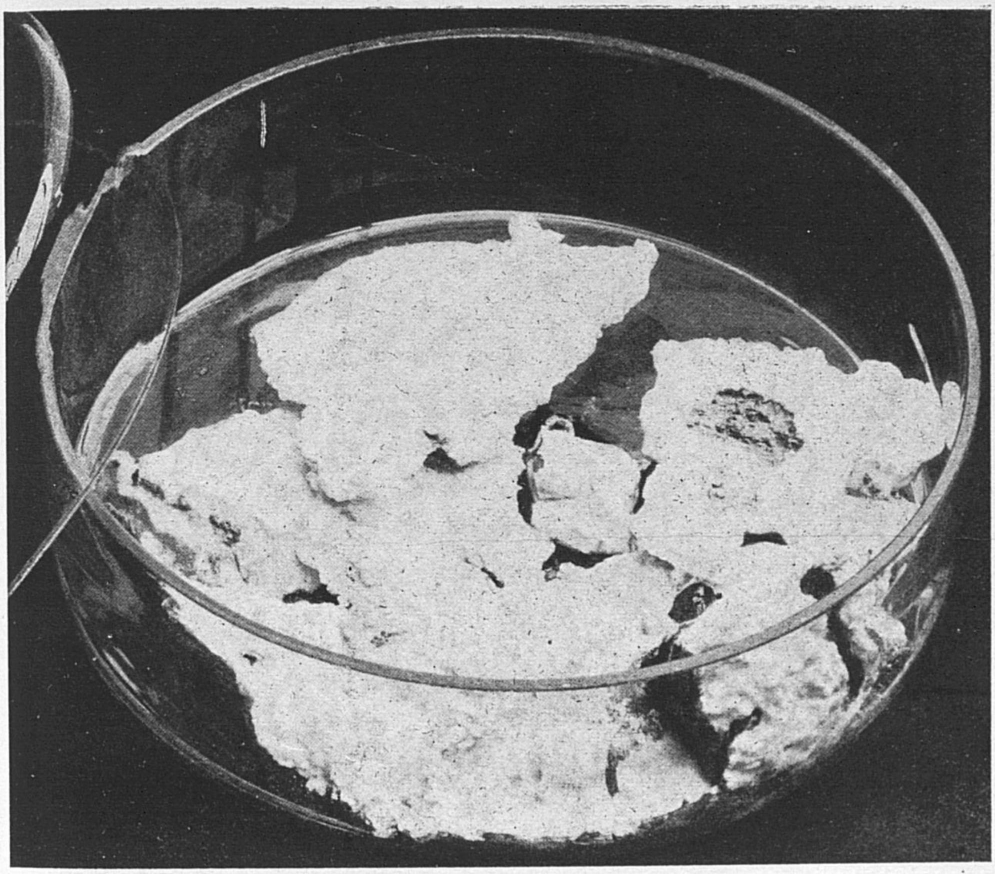

FIG. 6.—A large culture dish with the chinch-bug fungus growing on corn meal. Reduced to less than half real size.

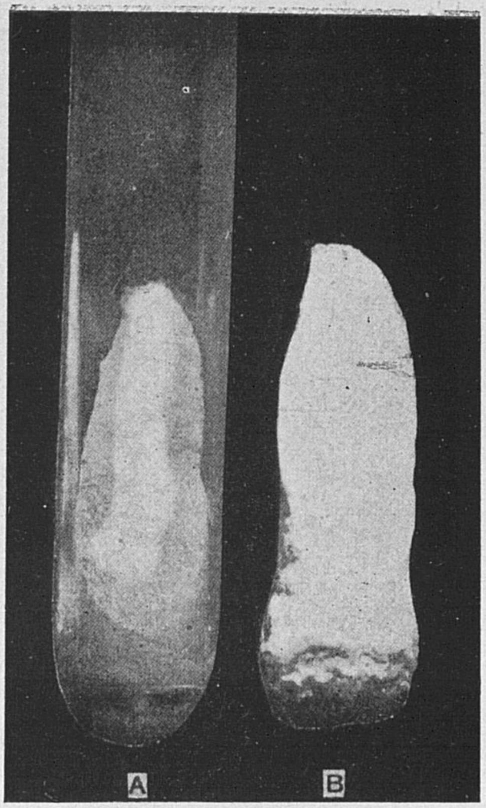

FIG. 7.—A, test tube with chinch-bug fungus growing on potato; B, growth removed from test tube.

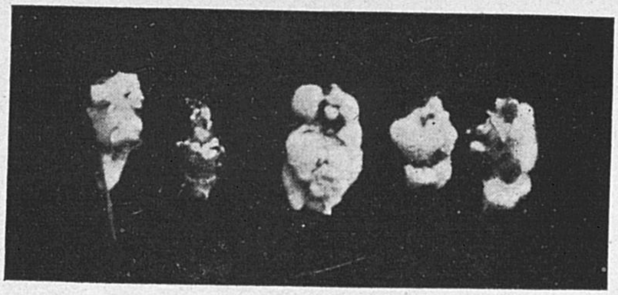

FIG. 8.—Chinch-bugs with bodies covered with the fungus. Enlarged to about twice natural size.

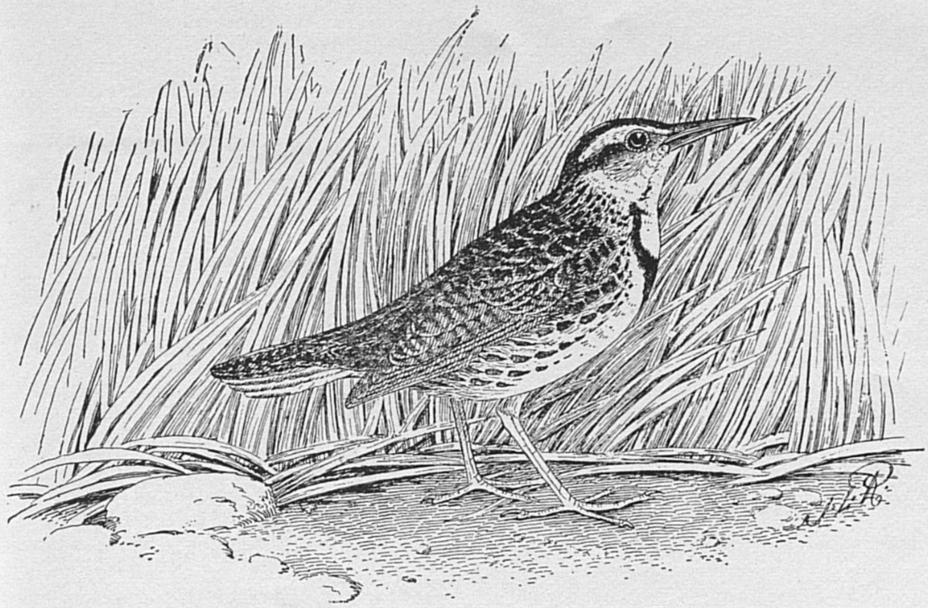

FIG. 9.—The Meadow Lark (*Sturnella magna*), a friend of the farmer. (From Beal, Yearbook, U. S. Dep. Agr., 1895. By courtesy of Division of Ornithology and Mammalogy).

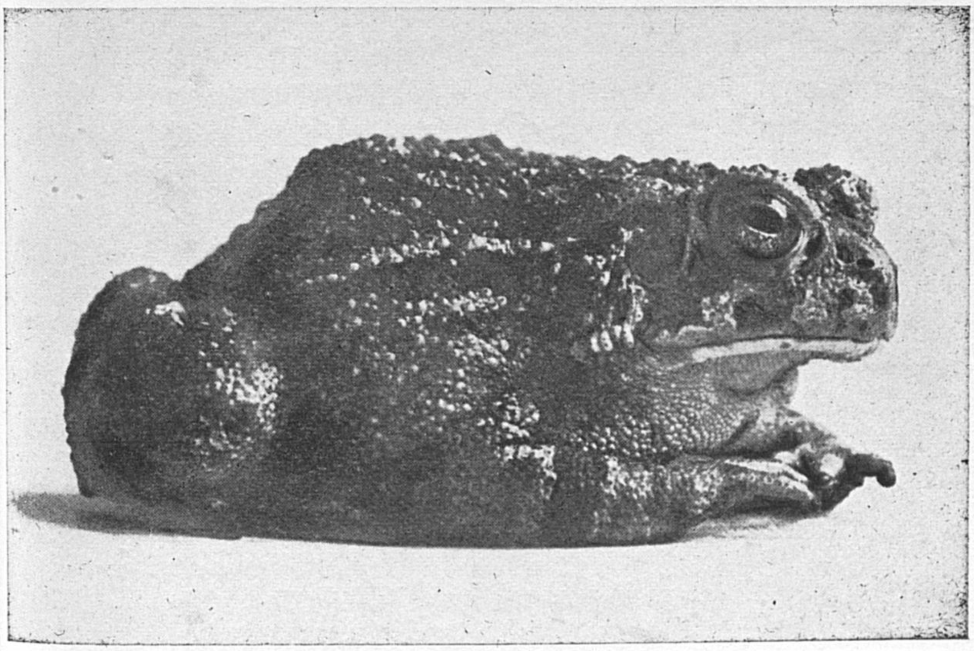

FIG. 10.—The common toad, an inveterate bug hunter and a good friend of the farmer. Photographed from life by H. Garman.

2. EARTHWORMS A SOURCE OF GAPES IN POULTRY.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Bulletin No. 70 of the Kentucky Station contains an account of an experiment made in the spring of 1897 by the writer, with a view to getting information as to the source from which chickens obtain gape worms, and it was shown that the worms were not obtained by chicks kept from the time they hatched on a wooden floor, and the conclusion was drawn that the lot under experiment which became affected with the disease obtained the gape worms either from the soil or from fish worms.

This spring six chicks taken direct from the nest in which they hatched were divided into two equal lots and kept in two cages with wooden bottoms and wire gauze sides, which were suspended at first over the hot water pipes of the Vivarium of my Division, and later were placed upon slate-topped tables. One lot was given a daily ration of earthworms with its other food, while the check lot received no earthworms. Some sand and gravel was put in each cage, but was first thoroughly sterilized by baking in an oven used commonly for bacteriological work. They were confined in the cages March 19th. It soon became evident that the lot which received the earthworms was growing faster than the other, and to supply the place of the worms, cooked meat was thereafter given to the check lot. Chicks in both lots suffered from a trouble resembling rheumatism, in its effect on the legs, probably caused by dampness in the Vivarium, or lack of exercise. Later, a bowel trouble became apparent, culminating April 26th in the death of one of the check lot. Its trachea was examined for gape worms, but none were present.

On April 27th one of the lot which ate earthworms was observed to show symptoms of gapes. April 28th a second chick was affected. On the night of April 29th both of these chicks died. Both had gape worms in the trachea. The third chick appeared to suffer occasionally from an obstruction in its trachea, and sometimes when it exercised more vigorously than usual became afflicted with something resembling a spasm, lying upon the bottom of the box, opening its mouth and twisting its head about as if suffering acutely. It was now of considerable size, and although these outward symptoms were not those usually presented by fowls suffering from gapes, it was decided to kill it and make an examination of the trachea, which was done May 3rd. On opening the trachea the lower part was found empty and in good condition, but just below the glottis it was plugged with a mass of mucus in which was a single gape worm.

The two remaining chicks of the check lot are still alive, and have not thus far shown any symptoms of the disease.

I can draw only one conclusion from the experiment, which is, that the earthworms conveyed the disease to the treated lot. So far as the experiment is of immediate practical interest, this is all that need be said.

Several questions arise, however, that have a scientific interest, and may eventually prove to have important practical bearings. How does the gape-worm get into the body of the earthworm; is it swallowed with earth or other matter taken into the alimentary canal as food; or does it make its way in by boring through the skin? How long does it remain alive in the bodies of earthworms, and in what situation and condition? Does it infest the bodies of all earthworms, or only of particular species?* It may be suggested that since earthworms live in soil, it is possible that the young gape-worms adhere to the outside of their bodies in particles of

*The worms fed to the chicks were largely obtained on my own place, and consisted of three or four species. The most common was *Allolobophora turgida*, the next in numbers was *Allolobophora fœtida*, the small brown-banded worm, common everywhere in the United States and Europe. The others I am not sure about, but think I observed among them *A. mucosa*.

dirt. The worms were always washed carefully to remove all traces of soil, under the tap of a sink, before being fed to the chicks. But even with this precaution it cannot be denied that a minute gape-worm might adhere to the moist skin of an earthworm. I have no desire to argue this question now, but merely to point out the possibilities. The experiments have been made from the point of view of the practical man, to whom it is immaterial what the condition of the gape-worms may be when introduced. *The main question is settled that earthworms will convey the gape disease to poultry*, and the common practice of feeding young chicks with these worms is consequently not to be commended.

By itself the experiment made in 1897 was not conclusive as to the part taken by earthworms in conveying the gape-worm; but taken in connection with the experiment just reported, it has more weight as evidence that the gape-worm is obtained by chickens from earthworms. Briefly told, the result of the experiments, taken together, is: Number of treated chicks affected with gapes, 100 per cent.; number of untreated chicks affected, none.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 75.

COMMERCIAL FERTILIZERS.

LEXINGTON, KENTUCKY.
June, 1898.

KENTUCKY

Agricultural Experiment Station.

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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. 75.

COMMERCIAL FERTILIZERS.

The Legislature, at its last session, amended the law regulating the sale of fertilizers in this Commonwealth in several very important particulars. The new law went into effect March 14th, in the midst of the spring season, when a large number of manufacturers had already entered their fertilizers for sale in the State for the year 1898 under the provisions of the old law. The passage of the new law could not effect these, but all applications received after March 14th were entered according to the new law. We publish in this bulletin the analyses of all the samples that had been entered by manufacturers for 1898 under the old law, and also the analyses of four samples, Nos. 3800 to 3803, entered by Dunn & Backer, Troy, Ind., in 1897 which were omitted from Bulletin No. 71 through oversight.

As soon as possible after the passage of the new law, all manufacturers of fertilizers doing business in the State were notified of its provisions, and we take this opportunity of publishing the law among the farmers of the State, and of adding a few words of explanation of the most important changes that were made, and of the proper method to follow in applying for free analyses under the law.

The new law requires manufacturers to make affidavit to the Director guaranteeing the minimum analysis of each brand of fertilizer which they propose to sell in the State and the Director shall print this guaranteed analysis over his facsimile signature in the form of a tag, and every package of fertilizer sold or offered for sale in the State shall have one of these tags attached, and this tag analysis shall be the standard by which the fertilizer is to be judged. The tag shall also show the net weight of fertilizer contained in each package. The manufacturer also sends to the Director a fair sample of each kind of fertilizer which he proposes to put on sale. The Director is given authority to take samples for analysis from any fertilizer on sale in the state, and is required to make every year at least one analysis of each kind of fertilizer that has been entered for sale. The law also provides that 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 a 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 appear that the law has been violated.

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 84.) 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.

ESTIMATED VALUATION. It will be noticed that under the new law the estimated value per ton is not given on the tag. It was thought best to leave it off for two reasons. First, because the ingredients of which fertilizers are made vary in price from time to time during the year and as the tags are good for a year, or until used, the estimated value might not represent anywhere near the true valuation during a portion of the year, at least. And second, because it is much more important that the farmer should buy on the percentage of phosphoric acid, nitrogen and potash in the fertilizer than on the estimated value. The estimated value includes the value of the nitrogen, the phosphoric acid and the potash. Some soils only need phosphoric acid and others nitrogen, while still others potash. Take, for example, a soil that needs potash only—as the blue grass soil of Kentucky; it is evident that a fertilizer rich in potash should be purchased. Suppose, however, that a farmer living in the blue grass region should be offered a fertilizer containing 10 per cent. of available phosphoric acid, 5 per cent. of nitrogen and 1 per cent. of potash. The estimated value of this would be $32.90 a ton; the potash in the fertilizer is valued at $1.40, the phosphoric acid at $14.00 and the nitrogen at $17.50. Now, if he were offered this fertilizer, say at $25.00 a ton and its estimated value was $32.90, he might think he was getting it at a low figure, and would purchase it in preference to another fertilizer rich in potash. He would be paying a large amount, however, for the phosphoric acid and nitrogen, which he did not need. If, however, he did not purchase on the valuation, but on the percentages of the ingredients, he would see at once that 1 per cent. of potash and 10 per cent. of phosphoric acid and 5 per cent. of nitrogen was not the composition of fertilizer he was seeking, and he would refuse to buy because it did not contain potash in large quantities. Other examples might be given where nitrogen was needed, also phosphoric acid. The only true way for a farmer to purchase a fertilizer is on its composition. He must look to see how much available phosphoric acid, how much nitrogen and how much potash it contains, and purchase accordingly.

The estimated value of each fertilizer will be found in the fertilizer bulletins.

The following is the law in full, and all farmers interested in the use of fertilizers are requested to read it through carefully. To guide those who intend sending samples of fertilizers for free analysis we have printed after the law the form of certificate filled out so as to indicate how the blanks should be filled :

The Kentucky Fertilizer Law.

AN ACT REGULATING THE SALE OF FERTILIZERS IN THIS COMMONWEALTH.

SECTION 1. In each year, before any person or company shall sell, offer or expose for sale in this State any commercial fertilizer, said person or company shall furnish to the Director of the Agricultural Experiment Station of the Agricultural and Mechanical College of Kentucky, which Station is hereby recognized as the "Kentucky Agricultural Experiment Station," a sealed quantity of such commercial fertilizer, not less than one pound, sufficient for analysis, accompanied by an affidavit that the sample so furnished is a fair and true sample of a commercial fertilizer which the said person or company desires to sell in this State ; and said affidavit shall also state the name and address of the manufacturer, the name of the fertilizer, the number of net pounds in each package, and the minimum percentages of the essential ingredients guaranteed in said fertilizer, in such form and manner as may be prescribed by said Director.

SEC. 2. The Director of said Experiment Station, upon receipt of affidavit and sample as provided for in section 1 and upon receipt of the fees hereinafter provided, shall issue to said person or company a sufficient number of labels to tag not less than twenty (20) tons of said fertilizer, on which label shall be printed the name and address of the manufacturer, the name of the fertilizer, the number of net pounds in each package, and the minimum percentage composition in terms approved by the said Director as certified to in affidavit furnished by said person or company, together with a certificate from the Director over his facsimile signature, authorizing the sale of such package according to the provisions of this Act.

SEC. 3. Every bag or other package or quantity of any commercial fertilizer, in any shape or form whatever, sold or offered for sale in this State, shall have attached to it in a conspicuous place a label as provided in section 2.

SEC. 4. Any manufacturer or vendor of any commercial fertilizer, or any person or company who shall sell, offer or expose for sale any fertilizer without having previously complied with the provisions of this Act, shall be fined not less than one hundred nor more than five hundred dollars for each violation or evasion of this Act.

SEC. 5. The Director shall receive for the labels described in section 2 of this Act fifty (50) cents for such number as may be required for one ton of fertilizer; provided, That he may not furnish at any one time a less number than is sufficient for ten (10) tons of fertilizer.

SEC. 6. The Director of said Kentucky Agricultural Experiment Station shall pay all such fees received by him into the Treasury of the Kentucky Agricultural Experiment Station, the authorities of which shall expend the same in meeting the legitimate expenses of the Station, and for inspecting and making analyses of fertilizers, in experimental tests of same, and in such other experimental work and purchases as shall inure to the benefit of the farmers of this Commonwealth. The Director shall, within two months of the biennial meeting of the General Assembly, present to the Commissioner of Agriculture a report of the work done by him, together with an itemized statement of receipts and expenditures for the two years preceding under the operations of this Act.

SEC. 7. The Director of said Experiment Station is hereby authorized, in person or by deputy, to take samples for analysis from any bag or other package or quantity of any commercial fertilizer in the possession of any dealer or transportation company in this State; to enforce the provisions of this Act; and to make and enforce such rules and regulations as he may deem necessary to carry fully into effect the true intent and meaning of this Act.

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 sample 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.

SEC. 9. The label attached, according to section 2, to any bag or other package of commercial fertilizer sold, offered or exposed for sale in this State, shall be accepted as the guarantee of the manufacturer, dealer or agent, that the fertilizer contains the kinds and amounts of essential ingredients printed on the tag; and any person fraudulently attaching or permitting to be attached to any package of fertilizer a fraudulent or counterfeit label, a genuine label used a second time, or a label representing it to contain a larger percentage of any one or more of the essential ingredients than is actually found by analysis to be contained in the said fertilizer, may be fined as provided in section 4 of this Act and shall also be liable for reasonable damages sustained by the purchaser of such fertilizer; Provided, however, That a deficiency of one-fourth of one per cent. in any of the essential ingredients shall not be considered evidence of fraudulent intent.

SEC. 10. The Director of said Experiment Station shall annually analyze or cause to be analyzed at least one sample of every fertilizer sold or offered for sale under the provisions of this Act; and he shall publish in one or more bulletins the analyses made during the year, together with the relative commercial value of each fertilizer computed from its analysis as he may determine, and the analysis guaranteed by the manufacturer.

SEC 11. To facilitate the inspection of fertilizers, the Director is authorized to require all manufacturers making shipments into or within the State to notify him of the kinds, amounts, dates, destinations and consignees of all such shipments.

SEC. 12. If the Director of the said Experiment Station shall believe that any fertilizer offered for sale in this State is of no practical manurial value, he shall refuse to furnish any labels to be placed on such fertilizer.

SEC. 13. All Acts or parts of Acts in conflict with this Act are hereby repealed. Whereas, the time is near at hand for the purchase of fertilizers for the spring crops, and as agriculturists are anxious to test the analysis of their fertilizers, Therefore, an emergency is hereby declared to exist, so this Act shall take effect from and after its passage.

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, 1898.

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.

(Signature) *John Smith,*

(P. O. Address) *Smithville, Ky.*

Signature of Witnesses:

Sam Jones.

Will Brown.

Explanations in Regard to the Tables.

For convenience, the analyses in this bulletin are arranged in two tables:

Table I., contains ground bones, ammoniated bones, etc.

Table II., those fertilizers whose phosphatic materials have been acted upon by sulphuric acid in order to render the phosphoric acid in them more soluble.

The finer a bone is ground the more valuable it is. For this reason we divide ground bone into "fine bone" and "medium bone" and give the amount of phosphoric acid in each separately in the tables. In computing the estimated value, the phosphoric acid in the "fine bone" is given a greater value than that in the "medium bone."

In Table II., the phosphoric acid is stated as "soluble," "reverted" and "insoluble" phosphoric acid in the fertilizer. The sum of the "soluble" and "reverted" is "available" phosphoric acid, or the phosphoric acid that is of immediate use to plants. In this table is also given the nitrogen, as well as its "equivalent in ammonia," or, in other words, the greatest amount of ammonia which would be possible to be made from the nitrogen; also the amount of potash either in the form of sulphate or muriate or both. As sulphate of potash is somewhat more costly than muriate, it is thought best to give the form in which the potash is found in the fertilizers analyzed.

Values Used.

The same values for the "essential ingredients" will be used in 1898 as in 1897, as follows:

Soluble and reverted phosphoric acid in mixed fertilizers, 7 cents; in plain acid and unacidulated phosphates, 5 cents per pound.

Insoluble phosphoric acid in mixed fertilizers, 2½ cents; in plain acid phosphates, nothing; in Orchilla guano, 3 cents; in other unacidulated phosphates, 2 cents per pound.

Phosphoric acid in fine bone*, 4 cents; in medium bone*, 3 cents per pound.

Nitrogen in all fertilizers, 17½ cents per pound.

Potash in all fertilizers, from sulphate, 7 cents; from muriate, 6 cents per pound.

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*Fine Bone is all that passes through a sieve with meshes 1-25 inch square. Medium bone passes through a sieve with meshes 1-6 inch square, but does not include fine bone.

TABLE I.—Raw Bone Manures.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred. Phosphoric Acid. In Fine Bone.	Phosphoric Acid. In Medium Bone.	Phosphoric Acid. Total.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	Estimated Value per Ton.
4159	The Armour Fertilizer Works, Chicago, Ill.	Raw Bone Meal	17.00	8.53	25.53	55.77	3.91	4.75	$32 41
4160	Same	Bone Meal	20.95	4.51	25.46	55.60	3.36	4.08	31 23
4246	The Cleveland Dryer Co., Cleveland, O.	Superior Bone	12.67	12.56	25.23	55.10	3.89	4.72	31 30
3802	Dunn & Backer, Troy, Ind.	Clover Leaf Brand, No. 7 Grower	10.49	5.19	15.68	34.25	3.48	4.22	31 85*
3803	Same	Clover Leaf Brand, No. 9 Grower	16.30	8.77	25.07	54.76	3.88	4.71	31 88
4212	J. B. Jones, Louisville, Ky	Raw Bone Meal	12.27	8.63	20.90	45.65	4.29	5.21	30 02
4213	Same	Ammoniated Bone Meal	10.87	2.31	13.18	28.78	3.29	3.99	21 61
4123	The Jones Fertilizing Co., Cincinnati, O.	Fine Ground Bone	16.20	6.42	22.62	49.40	3.60	4.37	29 41
4124	Same	Ammoniated Bone Meal	18.89	4.04	22.93	50.07	3.46	4.20	29 64

4223	Michigan Carbon Works, Detroit, Mich.	Desiccated Bone	26.54	5.44	31.98	69.86	1.27	1.54	28 94
4224	Same	Banner Raw Bone	13.83	8.33	22.16	48.39	3.68	4.47	28 94
4165	North-Western Fertilizing Co., Chicago, Ill.	Horse Shoe Brand Fine Raw Bone	14.75	9.04	23.79	51.97	4.03	4.89	31 33
4171	Same	H. S. B. Pure Ground Bone	16.32	5.50	21.82	47.67	3 70	4.49	29 31

* Potash from muriate 6.81 per cent

TABLE II.—Complete Fertilizers, Superphosphates, Etc.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred.							Estimated Value per Ton.
			Phosphoric Acid.					Potash.		
			Soluble.	Reverted.	Insoluble.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	
4161	The Armour Fertilizer Works, Chicago, Ill.	Tobacco Grower	6.35	3.00	2.34	1.94	2.36	....	4.96	$27 99
4162	Same	Ammoniated Bone with Potash	5.50	3.06	2.80	3.24	3.93	....	2.32	27 97
4163	Same	Grain Grower	6.58	3.06	2.96	2 24	2.72	2.14	....	25 39
4164	Same	White Burley and Black Tobacco	4.31	6.03	2.98	3.18	3.86	....	7.07	37 00
4194	George S. Bartlett, Cincinnati, O.	Indian Brand Ohio Valley Phosphate	6.36	3.84	2.85	2.17	2.63	3 21	....	27 16
4206	Same	Indian Brand Pure Acidulated Bone	3.54	8.39	7.52	3.55	4.31	....	....	32 89
4251	Same	Indian Brand Tobacco and Potato Fertilizer	2 34	5.99	3.72	5.06	6.14	....	5.60	39 07
4239	The Cleveland Dryer Co., Cleveland, O	Buckeye Ammoniated Bone Superphosphate	7.11	3.29	3.26	2.91	3.53	0.67	....	27 18
4240	Same	Ohio Seed Maker	6.01	4.85	3.54	1.78	2.16	....	....	23 20
4241	Same	Ohio Seed Maker and Potash	6.43	3.57	4.03	1.55	1.88	2.73	....	24 73

4242	Same	Phospho Bone	6.81	2.94	1.98	1.03	1.25	1.50	....	20 05
4243	Same	XXX Superphosphate	3.53	9.80	2.24	....	....	....	....	13 33
4244	Same	Horsehead Phosphate	7.41	3.60	1.32	....	....	....	....	11 01
4245	Same	Square Bone	2.88	10.57	9.45	2.59	3.14	....	....	32 63
4247	Same	White Burley Tobacco Fertilizer	7.18	2 18	3.84	2.86	3.47	2.93	....	28 55
4248	Same	Potato and General Crop Fertilizer	5.77	3.25	3.65	1.65	2.00	6.17	....	27 64
4249	Same	Kentucky Tobacco Grower	6.32	3.50	4.11	1.58	1.92	2.57	....	24 42
4263	The Currie Fertilizer Co., Louisville, Ky.	Currie's Special for Oats, Corn and Grass	8.17	2.32	2.49	0.85	1.03	....	2.65	22 63
4264	Same	Currie's Corn and Wheat Special	8.53	3.49	3.98	0.32	0.39	....	0.79	21 05
4265	Same	Currie's Golden Leaf Tobacco and Potato Grower	6.67	2.32	1.82	1.50	1.82	....	4.04	24 41
4266	Same	Currie's Climax Tobacco and Potato Grower	8.67	2.65	3.16	0.52	0.63	....	1.40	21 21
4267	Same	Currie's Soluble Bone	8.83	2.68	3.19	0.50	0.61	....	1.45	21 49
4268	Same	Currie's Corn Grower	8 57	2.98	3.17	0.49	0.59	....	1.39	21 43
3800	Dunn & Backer, Troy, Ind.	Clover Leaf Brand, No 3 Grower	2.81	3.60	7.71	2.32	2.82	9.09	....	31 86
3801	Same	Clover Leaf Brand, No. 4 Grower	0.82	4.31	7.80	3·93	4.77	10.74	....	37 73
4183	Globe Fertilizer Co., Louisville, Ky.	Globe Special Tobacco Grower	8.62	1.46	0.78	2.78	3.37	....	10 65	39 14
4184	Same	Globe Potato Grower	8.05	1.61	1.00	3.97	4.82	....	5.04	34 98
4185	Same	Globe Soluble Vegetable Manure	8.85	1.67	1.06	2.87	3.48	....	3 42	30 10

TABLE II.—Complete Fertilizers, Superphosphates, Etc.—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred. Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	Potash. From Sulphate.	Estimated Value per Ton.
4186	Globe Fertilizer Co., Louisville, Ky..	Kentucky Standard Tobacco Grower	8.65	1.72	1.02	3.04	3.69	....	3.37	30 39
4187	Same	Big Four Tobacco Grower	7.57	1.62	0.74	2.23	2.71	....	3.13	25 43
4188	Same	Eagle Corn and Wheat Grower	8.34	1.75	1.27	2.40	2.91	....	2.09	26 10
4189	Same	Globe Bone Dust	7.54	2.30	1.57	1.76	2.14	....	0.83	21 89
4190	Same	Bone and Potash	10.49	2.34	0.86	0.38	0 46	... .	1.28	21 51
4191	Same	Globe Wheat Grower	8.44	1.94	1.02	2.33	2.83	....	2.06	26 08
4192	Same	Golden Harvest Bone Meal	9.74	2.81	1.34	2.45	2.97	....	1.05	28 29
4230	Same	Progress Corn and Wheat Grower	7.59	1.95	1.51	2.01	2.44	....	1.32	23 01
4211	Greer Machinery Co., Knoxville, Tenn..........	Farmers Compound Fertilizer..	7.29	4.99	1.51	....	....	2.10	....	20 47
4259	Same	Greer's Challenge Fertilizer.....	9.81	2.88	2.19	2.07	2.51	2.26	....	28 83

4259	Same	Greer's Challenge Fertilizer	9.81	2.88	2.19	2.07	2.51	2.26	....	28 83
4141	J. B. Jones, Louisville, Ky.	Tobacco and Potato Grower	7.71	3.13	1.94	2.83	3.44	....	7.62	36 73
4214	Same	Kentucky Phosphate	4.71	5.24	2.93	2.68	3.25	3.61	....	29 11
4125	The Jones Fertilizing Co., Cincinnati, O.	Acidulated Bone Meal	2.80	6.46	7.01	5.09	6.18	....	....	34 30
4127	Same	Bone and Potash	2.44	3.91	2.84	1.50	1.82	....	4.85	22 35
4129	Same	Jones Reliable Phosphate	2 88	4.35	2.83	1.50	1.82	....	2.08	19 70
4130	Same	Jewel Phosphate	2.62	5.71	2.58	0.90	1.09	....	....	16 10
4201	Same	Miami Valley Phosphate	3.07	6.70	5.17	3.44	4.18	....	3.47	33 17
4202	Same	Tobacco and Potato Grower	4.27	5.60	3.22	3.88	4.71	....	7.13	38 99
4215	The Loudenback Fertilizer Co., Urbana, O.	Urbana Bone Phosphate and Potash	7.04	3.05	2.52	1.18	1.43	2.37	....	22 36
4158	The Louisville Fertilizer Works, Louisville, Ky.	Potato and Tobacco Grower	2.74	7.39	3.58	2.55	3.07	....	3.23	29 35
4203	Same	Special Tobacco and Corn Grower	5.09	5.97	1.92	0.95	1.15	....	2.55	23 34
4221	Michigan Carbon Works, Detroit, Mich.	Homestead Corn and Wheat Grower	6.69	3.66	1.29	2.54	3.08	3.29	....	27 98
4274	Same	Same	9 15	1.29	0.72	2.33	2.83	1.94	....	25 47
4222	Same	Homestead Tobacco Grower	10.25	0.09	0.18	3.40	4.13	3 98	....	31 25
4225	Same	Acid Phosphate	5 69	7.50	1.61	....	....	....	....	13 19
4226	Same	Red Line Ammoniated Phosphate	6.22	2.58	2.33	1.80	2.19	....	....	19 79
4227	Same	Red Line Phosphate with Potash	1.77	9.28	1.68	....	....	2.91	....	19 80
4228	Same	Red Line Complete Manure	2.26	6.86	2.62	1.26	1.53	2.08	....	20 99

TABLE II.—Complete Fertilizers, Superphosphates, Etc.—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred. Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	From Sulphate.	Estimated Value per Ton.
4166	North-Western Fertilizing Co., Chicago, Ill.	Horse Shoe Brand Tobacco Grower	3.02	5.55	3.17	3.37	4.09	...	3.21	29 88
4167	Same	H. S. B. Ky. Tobacco Grower	3.98	2.74	1.66	2.58	3.13	....	2.01	22 08
4168	Same	H. S. B. Corn and Wheat Grower	6.08	3.73	2.37	2.29	2.78	....	1.71	25 33
4169	Same	H. S. B. Acidulated Bone	7.09	2.67	3.01	1.38	1.68	....	....	20 00
4170	Same	H. S. B. Bone and Potash	8.96	2.21	2.85	0.61	0.74	....	1.12	20 78
4172	Same	H. S. B. Quick Acting Phosphate	12.13	2.72	3.90	....	....	....	....	14 85
4173	Same	H. S. B. Dissolved Bone Phosphate	8.51	2.06	2.39	1.43	1.74	....	....	21 01
4174	Same	H. S. B. Challenge Corn Grower	3.54	4.79	2.15	3.03	3.68	....	1.81	25 88
4175	Same	H. S. B. Ky-Ana Phosphate	5.09	1.90	2.21	1.49	1.81	....	....	16 12
4176	Same	H. S. B. Prairie Phosphate	3.84	2.22	4.35	2.20	2.67	....	1.60	20 60

4176	Same	H. S. B. Prairie Phosphate	3.84	2.22	4.35	2.20	2.67	....	1.60	20 60
4177	Same	H. S. B. Acidulated Bone and Potash	8.80	1.86	2.43	1.12	1.36	....	2.06	22 94
4178	Same	H. S. B. Raw Bone and Phosphate Mixture	3.03	6.43	5.94	3.51	4.26	....	0.74	29 54
4179	Same	H. S. B. Potato Grower	3.30	4.22	2.38	3.00	3.64	....	2.93	26 32
4260	Read Fertilizer Company, Charleston, S. C.	Read's High Grade Tobacco Grower	3.29	4.60	2.10	1.89	2.29	4.04	....	23 57
4283	Same	Same	3 17	5.30	2.24	1.76	2 14	4.47	....	24 50
4261	Same	Alkaline Bone	8.33	2.71	1.57	....	....	2.47	....	19 21
4262	Same	Blood and Bone Fertilizer No. 1	4.43	4.52	3.15	1 94	2.36	2.75	....	24 20
4151	J. F. & W. H. Singer, Nashville, Tenn.	Singer's Tobacco Grower	7.05	3.43	1.65	2.76	3.35	....	2.63	28 84
4154	Tennessee Chemical Co, Nashville, Tenn.	Ox Bone with Ammonia and Potash	7.47	3.25	2.11	0.93	1.13	1.13	....	20 69
4197	Same	Ox Special Tobacco Guano	8 61	3.49	1.59	2.08	2.53	2.52	....	28 04
4198	Same	Ox High Grade Dissolved Bone	12.15	2.42	1.68	....	....	....	....	14 57
4204	Same	Ox Special Wheat and Grass Guano	10.59	2.93	1.93	1.24	1.51	1.59	....	26 15
4216	Same	Ox Alkaline Bone	6.24	4.39	1.24	....	....	2.27	....	18 22
4217	Same	Ox Special Corn Guano	11.44	3.47	1.55	1.31	1.59	1.69	....	28 27
4142	S. W. Travers & Company, Richmond, Va.	Capital Dissolved S. C. Bone	7.97	3.36	2.44	....	....	....	....	11 33
4143	Same	Travers Dissolved Bone Phosphate	12 09	1.99	2.32	....	....	....	....	14 08
4144	Same	Capital Bone Potash Compound	7.33	2.31	1.80	....	....	1.70	....	16 44

TABLE II.—Complete Fertilizers, Superphosphates, Etc.—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred. Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	Potash. From Sulphate.	Estimated Value per Ton.
4145	Same	Champion Corn Grower	7.20	1.96	0.70	1.15	1.40	2.64	....	20 37
4146	Same	Capital Tobacco Fertilizer	4.64	2.01	1.52	3.98	4.83	3.88	0.93	29 96
4147	Same	National Tobacco Fertilizer	4.84	1.75	2.19	2.29	2.78	1.14	3.13	24 10
4148	Same	Beef Blood and Bone Fertilizer	5.26	2.91	4.43	1.91	2.32	2.17	....	22 95
4149	Same	Orchilla Guano	....	5.49	12.04	......	....	....	....	12 71
4150	Same	National Wheat and Grass Grower	6.56	2.06	1.70	2.16	2.62	2 03	....	22 92

June 1, 1898.

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

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO 76.

COMMERCIAL FERTILIZERS.

LEXINGTON, KENTUCKY.

August, 1898.

KENTUCKY

Agricultural Experiment Station.

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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. 76.

COMMERCIAL FERTILIZERS.

In this bulletin are published the names of all fertilizers that have been entered under the new law for sale in the State, together with the analysis of each, given in the affidavit of the manufacturer as the lowest percentages 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 analysis, and the estimated value per ton calculated from each, as required by law. The analyses of all fertilizers entered this year before the new law went into effect have been published in Bulletin 75.

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 appear 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 99.) 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.

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

Smithville, Ky., June 1st, 1898.

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.

(Signature) *John Smith,*

(P. O. Address) *Smithville, Ky.*

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 sample 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 a 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 percents, of all fertilizers that have been entered under the new law up to the date of this bulletin. For the analyses of the fertilizers that were entered this year under the old law see Bulletin 75. These tables and those of Bulletin 75 together contain the names of all brands legally on sale in the State up to the date of the present issue.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis.—Per Cent. Phosphoric Acid. Soluble	Phosphoric Acid. Reverted.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	Potash. From Sulphate.
	A. D. Adair & McCarty Bros., Atlanta, Ga.	See Furman Farm Improvement Co.								
4358	Armour & Co., Chicago, Ill.	Bone Blood and Potash	6.00	2.00	8.00	10.00	4.11	5.00	....	7.00
	William Casler, Louisville, Ky.	See R. H. Hoskins.								
4443	Continental Fertilizer Co, Nashville, Tenn.	Bear Wheat Grower	9.00	2.00	11.00	12.00	....	....	2.00	....
4444	Same	Bear Dissolved Bone	8.00	6.00	14.00	15.00	....	....	....	....
4357	The Currie Fertilizer Co., Louisville, Ky.	Currie's Tobacco and Potato Grower	....	....	7.00	8.00	2.06	2.50	....	8.00
4508	Same	Currie's Butchertown Raw Bone Meal	5.00	5.25	10.25	15.00	0.82	1.00	....	1.25
4509	Same	Currie's Raw Bone Meal	....	....	....	22.00	3.71	4.50	....	....
4510	Same	Currie's Fine Ground Raw Bone Meal	....	....	....	23.00	1.65	2.00	....	....
4511	Same	Currie's Wheat Grower	8.50	2.50	11.00	14.00	0.41	0.50	....	1.25

4353	Dunn & Backer, Troy, Ind.	No. 2 Potato, Corn and Tobacco Grower	....	....	7.00	10.00	1.65	2.00	3.00	....
4354	Same	No. 3 Tobacco &c. Grower	....	....	8.00	11.00	2.47	3.00	5.00	....
4355	Same	No. 8 Grower, Raw Bone and Tankage Mixture	....	....	....	15.00	3.30	4.00	....	....
4356	Same	No. 9 Grower, Pure Raw Bone Meal	....	....	....	25.00	3.71	4.50	....	....
4292	Furman Farm Improvement Co., Atlanta, Ga.	Furman Soluble Bone with Ammonia and Potash	....	....	10.00	12.00	0.82	1.00	2.00	....
4293	Same	Farish Furman Formula	....	....	10.00	12.00	....	....	2.00	....
4341	Same	Furman High Grade Fertilizer	6.00	3.00	9.00	11.00	1.65	2.00	2.00	....
	Greer Machinery, Co., Knoxville, Tenn.	See Southern Fertilizer Co.								
4497	R. H. Hoskins, Louisville, Ky.	Champion Raw Bone Meal	....	....	....	22.00	3.30	4.00	....	....
4506	The Jarecki Chemical Co., Sandusky, O.	Lake Erie Fish Guano	8.00	2.00	10.00	12.00	1.65	2.00	0.50	0.50
4278	The Louisville Fertilizer Works, Louisville, Ky.	Corn and Wheat Grower	....	....	10.00	....	0.21	0.25	....	0.25
4494	Same	Bone Meal	....	....	....	18.00	1.65	2.00	....	....
4524	Same	Soluble Bone and Potash	....	....	8.00	10.00	0.82	1.00	....	1.50
4314	A. B. Mayer Manufacturing Co., St. Louis, Mo.	Anchor Brand Complete Fertilizer	4.00	4.00	....	12.00	2.88	3.50	....	3.75
4315	Same	Anchor Brand Corn and Wheat Grower	4.00	5.00	....	12.00	3.30	4.00	....	2.50
4316	Same	Anchor Brand Pure Bone Meal	....	....	....	22.00	3.71	4.50	....	....
4543	Meridian Fertilizer Factory, Meridian, Miss.	Meridian Home Mixture	8.00	2.00	10.00	11.00	2.47	3.00	2.50	....

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Guaranteed Minimum Analysis.—Per Cent. Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	Potash. From Sulphate.
4544	Meridian Fertilizer Factory, Meridian, Miss....	Meridian Corn and Wheat Grower	8.00	2.00	10.00	11.00	2.47	3.00	2.50	....
4307	National Fertilizer Co., Nashville, Tenn...........	Acid Phosphate	....	....	15.00	....	....	....	....	....
4308	Same........................	Acid Phosphate with Potash (Sadler's Formula)...........	....	....	12.00	....	....	....	2.00	....
4309	Same...........................	Tobacco Grower....................	....	....	10.00	....	1.65	2.00	2.00	....
4310	Same..........................	Tobacco Fertilizer.....................	....	....	10.00	....	2.06	2.50	3.00	....
4311	Same..........................	Bone Meal.......................	....	....	....	20.00	2.47	3.00	....	....
4312	Same..........................	Corn Grower	....	....	12.00	....	0.82	1.00	1.00	....
4507	The E. Rauh & Son's Fertilizer Co., Indianapolis, Ind...........	Pure Raw Bone	....	....	....	22.00	4.00	4.86	....	....
4503	Read Fertilizer Company, Charleston, S. C......	Farmer's Special Manure........	....	....	10.00	11.00	0.82	1.00	3.00	....
4504	Same........................	Dissolved Bone........................	....	....	13.00	14.00	....	....	....	....

4504	Same	Dissolved Bone	....	....	13.00	14.00	....	....	....	....
4505	Same	Read's High Grade Special Potash Mixture	....	....	10.00	11.00	....	....	4.00	....
4318	The J. & F. Schroth Packing Co., Cincinnati, O.	Schroth's Special	....	....	7.00	10.00	1.65	2.00	1.00	....
4319	Same	Corn and Wheat Grower	....	....	9.00	12.00	3.30	4.00	4.00	....
4500	Southern Fertilizer Co., Rome, Ga.	Greer's Compound Fertilizer	9.00	3.00	12.00	14.00	....	....	2.00	....
4515	Stan'd Guano & Chemical Mfg Co., New Orleans, La	Pure Ground Bone	....	....	....	20.00	3.09	3.75	....	....
4303	Swift & Co., Chicago, Ill.	Ground Steamed Bone	....	....	....	23.75	3.28	4.00	....	....
4304	Same	Bone and Potash, 3 per cent	....	....	....	24.50	2.05	2.50	....	3.00
4305	Same	Bone Tankage & Potash, 3 per cent	....	....	....	17.00	4.92	6.00	....	3.00
4306	Same	Potato and Tobacco Grower	8.00	2.00	10.00	12.00	3.28	4.00	....	5.00
4379	Same	Raw Bone Meal	....	....	....	23.00	3.70	4.50	....	....
4380	Same	Bone Tankage	....	....	....	17.00	4.92	6.00	....	....
4381	Same	Superphosphate	6.00	2.00	8.00	10.00	2.46	3.00	....	2.00
4445	Tennessee Chemical Co., Nashville, Tenn.	Ox Ammoniated Bone	6.00	4.00	10.00	11.00	1.65	2.00	2.00	....
4446	Same	Ox Alkaline Bone	9.00	3.00	12.00	13.00	....	....	2.00	....

AUGUST 25, 1898.

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

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 77.

WHEAT.

1. Test of Varieties.
2. Test of Fertilizers.
3. Notes and Descriptions.
4. Red Rust of Wheat.

LEXINGTON, KENTUCKY.

September, 1898.

KENTUCKY

Agricultural Experiment Station.

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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. 77.

WHEAT.

The Soil.—The experiments were conducted on the Experiment Station grounds, the character of the soil of which has been described in previous bulletins.

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, 1897–1898.	Per Cent. Sunshine	Clouds.	Amount of Rain-fall in inches.	Temperature, Degrees. Mean.	Highest.	Lowest.
September	82.0	18.0	.80	72.4	96	40
October	76.0	24.0	.38	63.9	88	36
November	39.0	61.0	4.83	46.4	71	17
December	20.0	80.0	5.11	36.8	67	8
January	24.0	76.0	9.56	38.0	68	11
February	28.0	72.0	2.20	36.1	66	-1
March	19.0	81.0	8.18	49.0	72	26
April	31.0	69.0	3.29	50.7	77	22
May	45.0	55.0	6.13	65.4	85	33
June	47.0	53.0	7.94	74.4	93	57

1. TEST OF VARIETIES.

Twenty varieties were under test. Each variety was planted on a one-twentieth-acre plot, in drills seven inches apart. The amount of seed sown was at the rate of one and one-half bushels per acre. All plots were planted October 25 1897, and harvested June 27, 1898.

Notes on Varieties.

Plot Number.	Name of Variety.	Head S—Smooth B—Bearded	Average Height—Inches.	Length of Head—Inches.	Average Stalks to Stool.
1	Jones' Winter Fife	S.	46	4.5	14
2	American Bronze	S.	48	4.5	12
3	Early White Leader	S.	44	4.	11
4	Pride of Genesee	B.	46	4.75	13
5	Oatka Chief	B.	42	3.75	10
6	Long Amber	S.	48	4.75	14
7	Jones' Bearded	B.	40	3.5	9
8	Pride	B.	43	4.5	9
9	Bearded Winter Fife	B.	42	4.25	10
10	Early Arcadian	S.	39	3.25	10
11	Pedigreed Early Genesee Giant	B.	38	2.75	11
12	Diamond Grit	B.	39	3.5	12
13	White Golden Cross	B.	34	2.75	8
14	Lancaster Red	B.	43	4.	15
15	Democrat	B.	36	3.75	16
16	Gold Coin	S.	37	3.5	11
17	Dawson's Golden Chaff	S.	38	4.25	13
18	Jersey Fultz	S.	43	3.75	17
19	Extra Early Oakley	S.	40	2.75	14
20	(Gold Coin?)	S.	35	3.	7

The following table gives the yield of each variety and the weight of wheat per measured bushel:

Plot Number	Name of Variety.	Head B—Bearded S—Smooth head.	Yield per Acre. Grain, Bushels.	Yield per Acre. Straw, Pounds.	Weight per bushel, lbs.
1	Jones' Winter Fife	S.	22.3	2160	63.7
2	American Bronze	S.	18.5	1790	62.8
3	Early White Leader	S.	19.0	2160	60.2
4	Pride of Genesee	B.	16.5	1710	64.4
5	Oatka Chief	B.	13.3	1400	60.8
6	Long Amber	S.	10.8	1050	60.8
7	Jones' Bearded	B.	13.2	1510	60.4
8	Pride	B.	14.8	1510	64.0
9	Bearded Winter Fife	B.	18.2	610	64.0
10	Early Arcadian	S.	12.8	2230	59.0
11	Pedigreed Early Genesee Giant	B.	16.5	1310	61.6
12	Diamond Grit	B.	16.5	1610	64.0
13	White Golden Cross	B.	11.5	1210	59.0
14	Lancaster Red	B.	17.7	1640	63.8
15	Democrat	B.	12.2	1370	64.3
16	Gold Coin	S.	12.3	1060	61.8
17	Dawson's Golden Chaff	S.	11.3	1120	62.6
18	Jersey Fultz	S.	17.8	1330	64.7
19	Extra Early Oakley	S.	15.2	1690	64.2
20	(Gold Coin?)	S.	13.6	780	63.0

Some of these varieties have been grown by us for several years. The following table gives the yield of such varieties for the different years, and the average yield for the whole period :

Comparative Yield in Different Years.

Name of Variety.	Yield in Bushels per Acre.					
	1891	1892	1895	1897	1898	Av'ge.
Jones' Winter Fife	30.7	22.8	14.6	23.0	22.3	22.7
American Bronze	....	....	....	16.0	18.5	17.3
Eraly White Leader	....	....	....	7.3	19.0	13.2
Pride of Genesee	....	....	....	21.8	16.5	19.2
Oatka Chief	....	....	....	25.3	13.3	19.3
Long Amber	....	....	....	20.0	10.8	15.4
Jones' Bearded	....	....	....	15.0	13.2	14.1
Pride	....	....	....	19.5	14.8	17.2
Bearded Winter Fife	....	....	....	30.5	18.2	24.4
Early Arcadian	....	....	....	27.4	12.8	20.1
Pedigreed Early Genesee Giant	....	....	....	26.8	16.5	21.7
Diamond Grit	....	....	....	21.0	16.5	18.8
White Golden Cross	....	....	....	27.9	11.5	19.7
Lancaster Red	....	....	15.0	16.9	17.7	16.5
Democrat	....	....	16.8	21.3	12.2	16.8
Gold Coin	....	....	13.1	21.	12.3	15.5
Dawson's Golden Chaff	....	....	....	17.	11.3	14.2
Jersey Fultz	....	....	....	....	17.8	17.8
Extra Early Oakley	21.8	20.0	....	....	15.2	19.0
Plot 20 (Gold Coin?)	....	....	....	....	13.6	13.6

Milling Qualities.

In order to test the different varieties of wheat as to their milling qualities the several samples were submitted, with their names, to Mr. C. S. Brent, and also, by their numbers, without disclosing their names, to Messrs. D. C. Frost, W. B. Talbert and R. S. Webb, who rated them independently, as follows:

By C. S. Brent. First rank as milling wheat, sample No. 18; second, No. 19; third, No. 12; fourth, No. 8; fifth, No. 4; sixth, No. 14; good, Nos. 9 and 15; fair, No. 2; bad, Nos. 1, 3, 5, 6, 7, 10, 11, 13, 16, 17 and 20.

By D. C. Frost. First, samples No. 18 and 19; second, Nos. 12 and 14; third, Nos. 2 and 15; fourth, Nos. 4 and 8; fifth, Nos. 5, 10, 11 and 13; sixth, Nos. 1 and 9; seventh, Nos. 6, 7 and 17; eighth, No. 3; ninth, Nos. 16 and 20.

By W. B. Talbert. First, Nos. 12, 14, 18 and 19; second Nos. 1, 2 and 15; third, Nos. 3, 9 and 20; fourth, Nos. 5, 10 and 13; fifth, Nos. 4, 6, 7, 8, 11, 16 and 17.

By R. S. Webb. First, Nos. 2, 12, 14, 18 and 19; second, Nos. 4 and 8; third, Nos. 11 and 15; fourth, Nos. 1, 6, 13 and 17; fifth, Nos. 5, 7, 9 and 10; sixth, not worth planting, Nos. 3, 16 and 20.

2. TEST OF FERTILIZERS.

This year, as heretofore, fertilizers had no appreciable effect on the yield of grain or straw. The kind of fertilizers used and the manner of applying them were the same as in years previous, for which see Bulletin 57. The results of the year are of so little value when taken alone that it is thought best not to publish them herein.

Co-operative Fertilizer Tests.

A few co-operative tests with fertilizers were undertaken last year by farmers. The following results were obtained by Mr. E. G. Austin, of Prentis, Ohio County, Ky. Ohio

County is in the western coal measures of Kentucky. The results obtained by Mr. Austin will undoubtedly be of benefit to all farmers situated on this geological formation. The following is Mr. Austin's report:

Results Obtained With Fertilizers by Mr. Austin.

No. of Plot.	Fertilizers Applied.	Amount in pounds used per acre.	Yield of Wheat, bushels.	Weight per bu.
1.	No Fertilizer..	....	3.9	55
2.	Nitrate of soda..	160 lbs.	9.4	58
3.	Acid phosphate..	320 "	15.3	58
4.	Muriate of potash	160 "	6.4	57
5.	No Fertilizer	....	7.6	57
6.	Nitrate of soda Acid phosphate	160 lbs. 320 "	19.6	59
7.	Nitrate of soda Muriate of potash	160 " 160 "	8.3	58
8.	Acid phosphate Muriate of potash	320 " 160 "	16.2	59
9.	Nitrate of soda Acid Phosphate Muriate of potash	160 " 320 " 160 "	20.7	60
10.	....	....	8.1	58

Mr. Austin says: "Find enclosed report of test with fertilizers furnished me last fall. The land upon which these tests were made has been in cultivation nearly fifty years—a thin clay, upland soil, cultivated in corn in 1896, followed by rye, then cow peas, followed by wheat. The yield of corn was somewhere from fifteen to twenty bushels of inferior corn. The rye, a very scattering and inferior crop, was turned under in May and sowed to peas, which made a fair crop. That was removed for seed, the stubble harrowed twice with disc harrow, dragged once, and wheat drilled in with 250 pounds acid phosphate and fifty pounds muriate of potash with one bushel of wheat to the acre. The field, containing eleven and a half acres, yielded 192 bushels—the experimental acre eleven and a half bushels, and the balance of the field, ten and a half acres, 180½ bushels. One bushel of wheat drilled in our plots October 16th, 1897. Wheat all up and fertilizers sowed on top October 25th, 1897. Wheat weighed and tested by Beaver Dam Milling Co."

"The poor yield on Plot No. 1, I think, was due to bad drainage, as this plot lies very level, although high. The wheat on balance of field adjoining No. 1 was good. The field greened up and showed the effect of the fertilizers much earlier in the season than the plots did, due, I suppose, to the fertilizers on field having been put in with the wheat at the time of drilling. Plots Nos. 3, 6, 8 and 9 showed a rank growth early in the spring, and a very perceptible difference in their favor over plots 1, 2, 3, 4, 5, 7 and 10. Very little, in fact, no perceptible difference in the latter all through the season. Neither was there any perceptible difference in the former until near harvest time, when No. 9 began to show the best. The whole stood the winter well."

The above results of Mr. Austin strongly indicate the need of phosphoric acid on Mr. Austin's land. It may be possible that this is true also of nearly all the coal measures of Western Kentucky. These results show that Mr. Austin should use a fertilizer rich in phosphoric acid and containing a small amount of nitrogen. It seems that potash has little, if any, effect on wheat. It would be interesting to note whether this is true also of corn and potatoes.

3. NOTES ON THE VARIETIES.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

With the exception of Nos. 18, 19 and 20, the wheats grown this season are of the same varieties as those grown in 1897, and it will not, therefore, be necessary to describe all of them fully, since most of them are described and figured in Bulletin 79, published in September, 1897. The seasons of 1897 and 1898 were so different in the matter of rainfall that we should expect to find a corresponding seasonal difference in the wheats. It was anticipated that the frequent rains of 1898 would improve both the yield and the quality, but the following table shows that the reverse is true—that the heads of wheat produced in 1898 bore fewer seeds of less weight than those produced in 1897. The exceptions are No. 10, Early Arcadian, and No. 17, Dawson's Golden Chaff, both of which produced more seeds and of greater weight than in 1897. One point is to be kept in mind in using such figures as are given below, namely, that a variety may produce a large spike and but few of them to a stool, and that, consequently, another variety producing a much smaller head but more of them, may yield more to the acre. Again, the head may be large and the seed light, off color, or of poor milling qualities; hence, it is only by consideration of data obtained both in the field and in the laboratory that a safe conclusion with regard to a variety can be reached. The desideratum seems to be a wheat that will produce a large number of large heads with a plump seed of good weight. These qualities ought to mean a large yield per acre.

The effect of the wet season of 1898 seems to have been to increase the rust on many of the varieties. On several it is about the same as last year, while on only one—No. 6—was there less rust in 1898 than in 1897. An interesting fact appears in this relation. Nos. 18, 19 and 20, which were grown from seeds obtained from a local dealer, were free from rust, while all the other numbers, grown from seed raised on the Experiment Farm, were more or less rusted. Now, the same varieties were, in many cases, affected with rust in 1897, and it may be supposed that the rust in 1898 was transmitted largely from the rusted wheat of the preceding year. The fact confirms the view often expressed that red rust is hereditary, and illustrates the importance of getting untainted seed for planting.

The Rating of Wheat in Bluegrass Kentucky.

The farmer of this region wants a good yielder in weight per acre. The color of the wheat is of little importance to him, except as it affects its sale. The general impression is, however, that white wheats do not do well here, and the result is that many farmers prefer a red wheat. The miller wants a good milling wheat, by which I understand that he desires wheat that is well ripened, plump, heavy and hard. The white wheats grown on the Experiment farm are not as hard as the red varieties and generally not as heavy. In rating them the miller and seedsman discriminate against them, however, with little regard to weight and hardness, and most of those who examined our wheats this year considered Nos. 16 and 20 (both white) as of poor quality, though their weight is exactly that of the red wheat No. 12, which was always rated as one of the best. That the white varieties are not from their nature inferior to the red in weight and hardness is shown by the fact that two white wheats before me, grown in New York, one bearded, the other smooth, weigh 7.5 grams per ten cubic centimeters, being thus heavier than the heaviest red wheat grown by us on the Experiment Farm. The size of the seed is of but little consequence to the millers, and Nos. 12, 18 and 19, which have the smallest seeds of those grown on the Experiment farm, are generally rated highest by them.

No. 18. Jersey Fultz.

Beardless. Seeds red. Spike small, tapering, the two diameters equal, about 0.375 inch. Length of spike, 3.6875 inches. Glumes not pubescent. Empty outer glumes terminating in a short blunt claw. Flowering glumes with a slightly longer claw-like tip, a few at the upper extremity sometimes three-fourths inch long. Color of spike and stem, yellow. Average number of seeds from a spike, 33.75. Average weight of seeds from a spike, 1.175 grams.

This wheat seems to me to be identical with No. 19. The size and character of the head is the same, but the seed of this is a little heavier. It was rated first, or among the first, by every practical man who saw it. It is the heaviest wheat grown on the farm. Rust rare.

No. 19. Extra Early Oakley.

Beardless. Seeds red. Spike small, tapering, the two diameters equal, about 0.375 inch. Length of spike, 3.781 inches. Glumes not pubescent. Empty outer glumes terminating in short claws. Inner glumes with acute tips which in some cases reach a length of three-fourths inch at the extremities of spikes. Color of spike and stem, yellow. Average number of seeds from a spike, 43. Average weight of seeds from a spike, 1.55 gram.

This variety is in high favor in this section, and is always rated well by millers. It seems to me to be the same as No. 18, although its seeds do not weigh quite as much, bulk for bulk, and average a trifle larger. Rust rare.

No. 20. Gold Coin (?).

Beardless. Seeds white. Spike rather small, enlarging slightly at tip; greater diameter, 0.50 inch; lesser diameter, 0.375 inch. Length, 3.935 inches. Not pubescent. A few bristles on inner glumes at tip of spike one-fourth inch long, the rest with short and mostly blunt tips. Color of spike, bronzy; of stem, purplish. Average number of seeds from a spike, 42.75. Average weight of seeds from a spike, 1.525 gram.

This variety was obtained from a local dealer in seeds, and was marked No. 6, but appears to be the same as No. 16, which has been grown at the Station for some time. It is not liked by the millers. Rust rare.

No.	Name	Year.	Average length of spike in inches.	Average weight of seeds from one spike in grams	Weight of 10 cubic centimeters of seed in grams.	Average number of seeds from spike.	Rust.
1	Jones' Winter Fife.	1897	5.125	3.2875		86.75	Frequent.
		1898	5.125	2.25	7.	54.25	Frequent.
2	American Bronze.	1897	5.3125	2.4		56.5	Frequent.
		1898	4.375	2.175	7.2	52.	Frequent.
3	Early White Leader.	1897	5.34	2.85		74.25	Very abundant.
		1898	4.871	2.325	6.8	60.	Frequent.
4	Pride of Genesee.	1897	5.81	2.95		79.5	Frequent.
		1898	5.1875	2.925	7.1	71.50	Frequent.
5	Oatka Chief.	1897	4.44	2.67		74.	Rare.
		1898	4.0625	2.275	6.8	61.5	Frequent.
6	Long Amber.	1897	5.53	2.32		59.25	Frequent.
		1898	5.5625	2.	7.00	55.50	Rare.
7	Jones' Bearded.	1897	4.53	3.04		85.75	Rare.
		1898	4.375	1.875	6.5	56.25	Frequent.
8	Pride	1897	5.06	2.65		70.5	Abundant
		1898	5.125	2.425	7.1	67.	Frequent.
9	Bearded Winter Fife.	1897	4.80	2.57		61.	Frequent.
		1898	4.875	2.2	6.9	54.75	Frequent.
10	Early Arcadian.	1897	3.37	2.5		65.	Rare.
		1898	3.375	2.625	6.75	74.25	Frequent.
11	Early Genesee Giant (Pedigreed Giant).	1897	3.18	3.2		72.5	None.
		1898	3.0937	2.425	7.1	68.5	Frequent.
12	Diamond Grit.	1897	4.19	2.2		60.	Frequent.
		1898	4.0625	1.75	7.1	58 75	Frequent.

No.	NAME.	Year.	Average length of spike in inches.	Average weight of seeds from one spike in grams.	Weight of 10 cubic centimeters in grams.	Average number of seeds from spike.	Rust.
13	White Seeded Golden Cross.	1897	3.19	2.85		63.5	None.
		1898	3.1875	2.25	6.9	60.5	Frequent.
14	Lancaster Red	1897	4.34	1.95		49.25	None.
		1898	4.37	1.925	7.4	51.75	Rare.
15	Democrat.	1897	4.43	2.		51.75	None.
		1898	4.718	1.975	7.1	54.75	Frequent.
16	Gold Coin.	1897	4.06	2.44		60.	Rare.
		1898	3.7812	1.6875	7.1	48.5	Abundant.
17	Dawson's Golden Chaff.	1897	3.81	1.82		43.75	None.
		1898	4.34	1.875	7.2	51.75	Frequent.
18	Jersey Fultz.						
		1898	3.6875	1.175	7.4	33.75	Rare.
19	Extra Early Oakley.						
		1898	3.781	1.55	7.2	43.	Rare.
20	Gold Coin (?)						
		1898	3.9375	1.525	7.1	42.25	Rare.

4. RED RUST OF WHEAT.

BY H. GARMAN.

The prevalence of this disease, owing to the wet weather during the present season, has led to frequent inquiries from farmers as to its cause and methods of prevention. The subject, together with a discussion of other common diseases of wheat, was presented by the writer last August before the Farmers' Institute at Shelbyville, Ky., and the paper then read was subsequently published in full in the Farmers' Home Journal and the Shelby News, to which papers the reader is referred for a full account of the disease. The use of bluestone or hot water on seed wheat appears to have no effect in checking this disease. All of our wheat on the Experiment Farm was treated by one or the other of these methods last fall, but the rust was prevalent, notwithstanding. The following with reference to the prevention of red rust is quoted from the article above mentioned, as it is printed in the Farmers' Home Journal of August 27th.

"This rust grows on all the small grains and many of the grasses. It becomes common here in midsummer and does its greatest injury then. From what has been said of its development it will be apparent that direct applications to the attacked plants cannot be made with any assurance of success. The parasite grows in the interior of its host-plants, and only appears at the surface to form its spores, and after its growth is complete and its injury done. Applications of such substances as bluestone at this time would doubtless destroy many of these spores, but we do not consider the application of any solution of this kind practicable after grain is pretty well grown; and, as has been intimated, the spores do not become apparent early in the spring.

"The fact that winter spores remain in stubble and straw is the most important one from the practical point of view which my sketch of the development of red rust discloses. It is always this old straw and stubble which furnishes much of the rust which appears on wheat, and where rust is troublesome injury can be reduced by care in removing and burning straw refuse, and in burning off the stubble after the grain is harvested. Stable manure containing straw from bedding is a common source of injury from rust, and is not to be recommended for use until well rotted.

"I have no evidence on this head myself, but it is believed by good authorities that red rust is hereditary; that is, the small growing threads of which I have spoken penetrate the kernels of grain while the latter are still immature and remain there dormant until the kernels produce plants, when they become active and produce spores. It is asserted that seed grain saved from badly rusted wheat or oats produces badly rusted plants, and that by avoiding such plants in getting seed, then using the precautions in the matter of straw and stable manure which I have recommended, rust need not be feared."

KENTUCKY

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OF THE

STATE COLLEGE OF KENTUCKY.

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Ginseng, Its Nature and Culture.

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BOARD OF CONTROL.

STATION OFFICERS.

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ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,

LEXINGTON, KY.

BULLETIN No. 78.

GINSENG, ITS NATURE AND CULTURE.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Hunting ginseng, or sang, as it is often called in rural Kentucky, has long been a means of earning pin money to Kentuckians living in the more rugged and unsettled parts of the State. So eagerly has it been sought out that it is now becoming scarce, and in a few years wild plants will be exceedingly hard to find. This increasing scarcity of ginseng together with the high prices paid for it has drawn attention to the subject of its artificial culture for the market, and is the reason for the preparation of this bulletin.

For more than a century the roots of ginseng have been included among the principal exports of the United States. The statement will be a surprise to many of our people, but it is a fact that from 1790 till the present time the quantity annually exported to China from the United States has ranged from 29,208 to 753,717 pounds. From 1820 to 1897 inclusive the quantity of dried roots annually shipped from this country was never below 46,581 pounds, and ranged in value, according to statistics published by the national government, from $17,339 to $840,648, the latter sum representing the value of the roots exported in 1897. During a period of sixty-five years (1821 to 1879 inclusive, and 1892 to 1897 inclusive) records published by the Government show that our people exported ginseng roots to the value of $20,023,710. The following figures taken from various statistical reports in the Station library show how the supply has diminished and the price increased.

YEAR.	QUANTITY EXPORTED, POUNDS.	VALUE.	VALUE PER POUND.
1821	352,992	$171,786	$ .48
1822	753,717	313,943	
1823	385,877	150,976	
1824	600,046	229,080	
1825	475,974	144,599	
1841	640,967	437,245	.71
1842	144,426	63,702	
1843	556,533	193,870	
1844	301,408	95,008	
1845	468,530	177,146	
1861	347,577	292,899	.84
1862	630,714	408,590	
1863	372,945	295,129	
1864	360,950	474,920	
1865	414,507	547,653	
1892	228,916	803,529	3.51
1893	251,205	792,928	
1894	194,564	619,114	
1895	233,236	826,713	
1896	199,136	770,673	
1897	179,573	840,686	4.68

This export consists almost entirely of wild roots, for while ginseng has for many years been grown in China, Japan, and probably Russia and other countries, it is only recently that attempts, more or less successful, to grow our species, have been made in a small way in this country. The plant occurs over much of the eastern United States, from Canada to Alabama, and is gathered over the whole of this territory, the bulk of it eventually going abroad from New York City.

The small quantities gathered by individual collectors are sold to druggists, grocers and others in the immediate neighborhood, and by these in turn sent to the nearest city. Traveling agents of dealers in hides, waste iron, etc., pick up a good deal of the ginseng collected in the mountain counties.

In Canada ginseng is said to have been discovered in 1716 by a Jesuit missionary, Father Lafitau. The Canadian French shortly afterward began collecting it for export to China, and large numbers of Indians were at one time interested in the search for roots. In 1890 Canada is stated to have exported roots to the value of $100,000. The price paid for dry roots in that region is from $3.00 to $3.50 per pound.

Laws Relating to Ginseng.

The value of the plant is fully realized by the Canadians, and in the Province of Ontario a law has been enacted forbidding the destruction of plants in the woods during the season when berries are produced. The two following sections of the law are given here as published in Bulletin LXV of the Ontario Agricultural College Experiment Station, June, 1891:

1. Except for the purpose of clearing or bringing land into cultivation, no person shall, between the first day of January and the first day of September in any year, cut, root up, gather or destroy the plant known by the name of ginseng whenever such plant may be found growing in a wild or uncultivated state.

2. Any person who contravenes the provision of this Act shall, for every such offense, upon summary conviction before any Justice of the Peace, be subject to a fine of not less than $5.00 or more than $20.00, together with costs of prosecution, and one-half of such penalty shall be paid to the prosecutor, unless otherwise ordered by said Justice convicting.

Our neighbors in West Virginia, who have always derived a good deal of profit from ginseng, have provided for the future by enacting a law prohibiting the collecting of ginseng, or of medicinal roots of any kind, on land belonging to another person, without the consent of the owner, in the counties of Pocahontas, Greenbrier and Webster. Any other county in the State is permitted to adopt the law when one hundred residents petition the County Court to have its provisions enforced therein.

The law does not seem as likely to prove effective in protecting ginseng as does the one enacted by the Canadians. It is so easy for roamers in the woods to gather ginseng and other roots without detection, or in other cases to get permission to collect, that it would seem scarcely possible to check their extermination with a law of this sort. A law embodying the ideas in both of the above would very likely prove more effective than either.

Ginseng in Kentucky.

There is probably not a county in Kentucky in which ginseng is not present and at one time grew more or less abundantly. It is of course most common in the heavily wooded sections, and in the mountains of Eastern Kentucky is still collected in considerable quanities. The experienced ginseng hunter of that section roams the woods armed with a light spade made like a chisel, a couple of inches wide and with a round handle about three feet long, or else carries a small eye-hoe, made for the purpose. Other tools lacking, he uses a sharpened stick, and on a pinch digs up the roots with his fingers or jack-knife. He carries at his side to hold the roots a simple home-made cloth or linoleum satchel, shaped like those used by school children for books; and frequently, with an eye to both pleasure and profit, takes his rifle with him also. A collector whom I met near Somerset some time ago told me that he had that day collected a dollar's worth; and judging by what I saw brought in by other collectors, this is not an uncommon day's wage from ginseng hunting. Few of those who have no established business on their hands could find more profitable employment. To collect successfully requires a certain amount of hardihood and forest lore too, and only he can expect to find the largest and finest roots who has strength and inclination to tramp and climb in all sorts of out-of-the-way nooks, where commonplace men and the ubiquitous hog and cow rarely penetrate. For ginseng is a wild thing, hiding away in deep ravines and in undisturbed forests, so dense that the winds only sweep over the tops, and in their depths the owls hoot in the daytime. In places such as these it flourishes, sending down its curious forked root into the rich mold consisting largely of the decomposed remains of dead trees and their leaves.

The collector in the mountains often strings his roots, running a needle and piece of twine or thread through them and hangs them to the walls and rafters of his dwelling to dry. The purchaser occasionally gets strings of this sort which are several yards long.

Kentuckians probably began collecting the roots as soon as the demand for them arose, in 1790, or earlier, before the territory was separated from Virginia. In the earlier days when much of its surface was covered with forest, the State doubtless produced a large share of the total product shipped out of the country. In the Western Farm Journal, Volume 1, published at Louisville in 1856, I find it mentioned in the market quotations as selling for from 25 to 28 cents per pound. In the issue of the same journal for August 10, 1857, under the head of market quotations it is given a special paragraph which reads: "Prices have again advanced, with sales from store at 37½ to 40 cents, generally at the outside figure, and from wagons at from 36 to 37 cents. The demand is largely in excess of the supply." At present it sells readily for cash at from $1.50 to $3.25 per pound, according to quality, the small and poorly dried roots being rated lowest, because, as I am informed by a local buyer, they contain a good deal of waste in the shape of fibrous parts, stems, etc.

Messrs. Speyer & Son, of Lexington, inform me that they handle $25,000 worth a year, and last year bought $6,000 worth at Glasgow, Ky., alone. They also buy large quantities about Nashville, Tenn.

Samuel Wells & Company, 211 and 213 Vine Street, Cincinnati, are large dealers in the roots, but tell me they handle but little of the Kentucky ginseng because of its inferior quality. Quality, it seems, is merely a matter of size, and so far as I can learn our roots are not otherwise inferior to those collected at the North and East.

In a recent letter Mr. Aug. Wahking, of the firm of W. H. Newman & Co., 732 West Main Street, Louisville, estimates the quantity of ginseng annually handled in Louisville at 20,000 pounds, at an average price of $2.75 per pound.

Mr. Isaac Rosenbaum, of 321 and 323 East Market Street, Louisville, tells me he handles 12,000 to 13,000 pounds each year, and, as there are five or six other dealers in the city, thinks the total quantity annually handled, from 35,000 to 40,000 pounds. This estimate includes ginseng collected in Indiana, Kentucky, Tennessee, Alabama, and other states.

A conservative estimate of the Kentucky ginseng handled in Louisville is given below, and has been kindly furnished at my request by Mr. James F. Buckner, Jr., Secretary and Superintendent of the Louisville Board of Trade.

BOARD OF TRADE,
LOUISVILLE, KY., Oct. 28, 1898.

Prof. H. Garman, Lexington, Ky.

DEAR SIR:—In reply to your inquiry of the 20th inst. asking information concerning the quantity of ginseng handled in Louisville annually and the price paid by dealers here for same, I have to say that, as ginseng is brought in generally in small quantities and sold to a large number of people, it is difficult to obtain very accurate information regarding it; but I have consulted a number of the largest dealers here, and from information received from other sources, I believe I am able to give you information that will approximate the truth, and I enclose you herewith a statement showing the estimates made by four of the largest dealers, and also my own estimate, as to the quantity and average price made from the returns to me above referred to, and from other sources.

The price fluctuates greatly owing to the uneveness of the supply and also to the demand for it from China, that country being our principal market for the product.

The prices given you apply strictly to Kentucky ginseng, as the size of the root affects the price very considerably, and the root produced farther north is considered in the market as of somewhat better quality.

Trusting the information furnished you will be of value,

I am very truly yours,

JAMES F. BUCKNER, JR., Supt.

GINSENG.

Estimate as to number of pounds handled annually in Louisville, Ky., and prices paid for same by dealers:

No. Dealers Making Returns.	Average Amount.	Range per Lb.	Av. Price.
D. Davis & Son	9,500	\$1.50 to \$3.50	\$2.65
A. Wahking.........	20,000	1.85 to 3.50	2.75
John White & Co ...	50,000	2.80 to 3.25	3.10
M. Sabel & Sons.....	27,500	2.75 to 3.10	2.90
Board of Trade estimate from returns made and other sources.			
	30,000		\$2.85

JAMES F. BUCKNER, JR., Supt.

Numerous circular letters have recently been addressed to correspondents of the Station residing in every county in the State, inquiring as to the abundance of ginseng and about other matters relating to its growth. From the replies received it is evident that the plant is now very scarce, taking the State as a whole, but that it still occurs in nearly or quite all of the counties. The following letters will serve to give an idea of the character of the replies received.

CLOVERPORT, KY., October 28, 1898.

H. Garman, Lexington, Ky.,

DEAR SIR:—In answer to your questions in regard to ginseng, will state as follows:

1. It is not abundant from the fact that it is dug from the time the plant gets above the ground, until killed by frost.

2. It grows best on east and north hill sides, but can be grown anywhere in the shade.

3. No [not extensively collected]. From the fact that there is but little to be collected.

4. It is first sold in the local markets, shipped to New York City, and from there to China. The price paid in local markets is from $2.50 to $3.50 per pound, but when exported the roots are carefully assorted and bring fancy prices, ranging from $8.00 to $25.00 per pound.

5. There is only one man in this State (Kentucky) besides myself that I know of, that is growing it. I am satisfied that ginseng can be grown successfully. I have only been experimenting in that line four years.

I had my plantation raided upon two occasions, and lost 2,000 four-year-old plants. I then concluded not to cultivate the roots, so the undergrowth would make the digging by thieves more difficult. To balance want of cultivation I covered the land with stable manure and straw as a mulch, but that made a harbor for ground mice, which have proven very destructive. In the future I shall cultivate and take the chances of theft. Will plant largely next month.

Yours truly, W. S. Ashby.

Middlesborough, Ky., Nov. 1, 1898.

H. Garman, Entomologist and Botanist, Lexington, Ky.

Dear Sir:—Your favor of October 3rd has been on my desk for some time. In the meantime I have been endeavoring to secure for you such information as will be of service on the subject of your inquiries.

I have gone out with the "sangers" some this fall looking for the ginseng seed. I find that a great amount of this root has been dug and sold in this county since the close of the Civil War. At one time nearly the whole population turned out to dig it. In the early days the roots were very large and easily gathered. To-day in the more frequented parts of the mountains there is very little left and that is very small, rarely more than three years old.

It is bought up by dealers and shipped east where very much better prices are obtained for it. One of our merchants has more than $6,000 now invested in it, of roots bought here.

No attempt has been made to cultivate it in this county recently. Some years ago an effort was made to grow it by some enterprising citizens, but some other equally enterprising persons gathered it for them "atween the days," and so the effort was abandoned. I have been trying to get others to try it, but the difficulty of preventing the depredations of the professional or habitual "sanger" has hindered. I have gathered a few seeds to make an effort myself. It grows luxuriantly on the cool and shady north sides of the mountains but makes the largest root in the more open and exposed localities. It requires some shade and will not grow in the open the "sangers" declare. Yours truly,

J. M. BROOKS.

Some of the correspondents in Bluegrass Kentucky and in Jefferson and Breckinridge counties, report no ginseng present; others, however, from the same regions report it present, but rare. In such counties as Madison, Clark, Fayette, Montgomery, Bourbon, Scott and Shelby, where stock-raising is the dominating industry, we should not expect to find ginseng common, and it is from these counties that most of the replies indicating its absence come. Yet Fayette is perhaps as closely grazed and cultivated as any county in the State, and I know that a few pounds of ginseng roots are collected near Kentucky River each year. The only counties in which it has been reported abundant are, Rockcastle, Adair, Green, Logan, Trigg, Warren and Barren.

Mr. C. F. James, of Auburn, Logan county, writes under date of October 15, 1898: "It grows abundantly on Mud River in the neighborhood of Lewisburg, the hillsides, sandy hills, being literally covered with it."

The unanimous testimony is that it thrives best in rich soil and in dense shade. Some report it most often found in beech woods, others in forests consisting largely of oak. "Northern slopes" and "deep coves" are common expressions used by correspondents in describing the locations in which it most frequently grows. A correspondent living in Ballard county writes that it does best there in rich soil on what is known as second bottom land. From the testimony it appears that it does well where either sandstone or limestone rocks prevail at the surface, but there is a slight preponderance of testimony in favor of its more thrifty growth and greater abundance in regions where sand is present in the soil.

What it wants is soil rich in vegetable matter, and shade, and with these two conditions fulfilled it seems to do well anywhere in Kentucky.

FIG. 1.—A GROUP OF CHINESE MERCHANTS.

Ginseng as a Medicine.

Ginseng is used almost exclusively by the Chinese and Japanese, who consider it a tonic of marvelous quality to be employed in cases of debility, much as we use quinine. It is said to be to some extent mixed with quinine by Chinese doctors. While accepting every penny the Chinese will pay for it, our people are disposed to scoff at ginseng as a medicine, and to look upon its use by the Chinese as the result of superstition, aroused by the grotesque resemblance to the human body often assumed by the roots. I have seen it stated that roots most closely resembling the human body in shape are believed by the Chinese to have exceptional virtues in banishing weakness and prolonging life. Even people of scientific attainment unhesitatingly pronounce its healing properties a myth. On the other hand, so firmly fixed is ginseng in the esteem of the Chinese and Japanese that they have "saws" based upon it implying the most implicit faith in its healing virtues. The substance of one of them is to the effect that ginseng cures only to allow you to die of starvation. And we can fully appreciate the force of the saying when we read the statements of our English writers as to the prices paid for it in China. When of exceptionally good quality the prepared ginseng is said to sell for its weight in gold. It seems there is some evidence even in Chinese literature indicating that the curative properties of ginseng are fancied; but the same thing could be said of our own medicines. The following story is quoted from a Chinese botanical work by an English writer, and serves to illustrate an attitude assumed by some Chinese toward ginseng: "In the region of Wen Ti, Emperor of the Siu dynasty, a man living at Shang-tang used every night to hear a human voice calling to him from behind his house, but could never find out who it was. One day, at a distance of 600 yards from his house, he found a ginseng plant with an extraordinary thick stem. He dug up the root; it penetrated to a depth of five feet, and resembled the body of a man, with the head and limbs complete; after this the nightly voice ceased."

To a very limited extent the dried roots are sold by druggists in this country, the demand coming, it is said, from people who have acquired a fondness for chewing them. In the United States Dispensatory (15th edition), by Wood, Remington and Sadtler, page 1718, ginseng is seriously discussed, but the subject is finally dismissed with the statement that "it is little more than a demulcent."

The root (presumably of the Chinese species) was long ago examined by British chemists, who reported that it contained little or nothing of medicinal value. An American chemist, Mr. S. S. Garrigues, of Philadelphia, some years ago discovered in the roots of our plant a peculiar substance for which the name *panaquilon* was proposed. A recent partial analysis of dried roots is published by Dr. A. M. Peter in the annual report of this Station for the year 1892, and is quoted below:

ANALYSIS.

	Per Cent. in the Roots.	Per Cent. in the Ash.
Crude Ash	5.278	....
Nitrogen	1.660	....
Lime	0.856	16.22
Phosphoric Acid	0.535	10.14
Potash	0.776	14.70

We have too much respect for the intelligence and commercial astuteness of the Chinese and Japanese, for the latter also use the root to some extent, to be willing to credit all the stories told of their faith in things of no value. Matched with the Caucasian in our schools they have repeatedly shown themselves our equals in capacity for any sort of brain work, while in natural art talent they are far and away our superiors. Anyway it is just as well to suspend judgment on the medicinal properties of ginseng until we know more about it—remembering, at the same time, that the spectacle of a whole people, from the Emperor down to the poorest and most ignorant laborer, tenaciously adhering to a delusion for centuries is not without its parallel in the history of other races.

"And though perchance the cricketer
Or Chinaman that flies
His dragon kite with boys and girls,
May seem to some unwise,
I see no folly in his play
But sense that underlies."

The Chinaman has his philosophy of right living, and who shall say that it is not a better one than our own? And we should not flatter ourselves, though a trading people, that we are more than his match at a bargain. At our trickiest of tricky games he has sometimes shown remarkable aptitude.

"Which I wish to remark,
And my language is plain,
That for ways that are dark,
And tricks that are vain,
The heathen Chinee is peculiar;
Which that same I would rise to explain."

The Name Ginseng.

The proper Chinese form for the word is said to be jen-shen, which means literally man-wort. The Chinese originally obtained all their supply from their native plant, known to botanists as *Panax ginseng*, but the home supply getting low, they were forced first to regulate the collection of the roots by law, large tracts of wild land being made government preserves, and the government itself taking a large portion of all roots collected therein, and finally to import the roots of the closely related American species, *Panax quinquefolium*.

The Botany of Our Species.

The American ginseng belongs to the family Araliaceæ, including for the eastern part of North America but six species belonging to the two genera Aralia and Panax. The family is closely related to the carrot family. It contains, among other interesting plants widely distributed over the globe, English ivy as one of its species. Four, and possibly more, of the six species found in Eastern States of the Union occur in this State, as follows:

1. Hercules club, Toothache tree (*Aralia spinosa*). A small tree or shrub generally six to ten feet high, but often reaching a height of 25 or 30 feet, and bearing in the fall large broad clusters of small black berries; stem armed with stout prickles. It is cultivated both in this country and Europe for ornament. Occurs throughout the State, but is especially common in the mountains, and in the southern counties elsewhere. Its bark, root and berries possess medicinal properties, being employed as remedies for rheumatism, skin diseases, toothache and other ailments.

2. Spikenard, Indian root, False sarsaparilla (*Aralia racemosa*). This is an herb, commonly about 1½ to 2 feet high, though sometimes considerably taller. The leaflets are more or less heart-shaped, toothed, and pointed at the apex. The flowers are small and inconspicuous, but form rather large elongated clusters, which finally produce small purple berries. The root is relatively large and stout.

It occurs everywhere in Kentucky in rich woods. Its medicinal properties are similar to those of genuine American sarsaparilla, for which plant this species is sometimes mistaken.

3. Ginseng, Genseng, Sang, Jenshen, Ninjin (Japanese), Garentoquen (Iroquois Indians), *Panax quinquefolium*. Our ginseng is a perennial herb, propagated from the roots, which send up each year a new stem bearing at the top, leaves, flowers, and finally berries. Plants vary from six to twenty-four inches in height, sometimes reaching a height of two and a half feet to the tops of the fruit cluster. The leaves vary in number with age. The first year a single one with three leaflets is produced. The second year three leaves develop, each with from three to five leaflets. Subsequently, in cultivated plants at least, the number of both leaves and leaflets increases with age, some having as many as seven leaves and eleven leaflets. The flower stem does not appear the first year. It varies from about an inch in length, when it is much shorter than the petioles of the leaves, to seven or eight inches in length, when it extends much above the leaves. It bears, generally, an umbel of small flowers varying in number from about twelve in young plants to more than a hundred in old ones. The berries are one to four-seeded, often flattened, when ripe with a shining surface and of a bright red color, much like flowering dogwood berries. The roots are in general spindle-shaped, but vary extremely with individual plants, and with age of same plant. The young are more generally without forks, and look much like small carrots or parsnips.

4. Dwarf Ginseng, Ground nut (*Panax trifolium*). Dwarf ginseng may be known from its relative, the true ginseng, by its smaller size, being but about eight inches high,

by its stalkless leaflets, and by its globular root. It is credited to this State by Doctors Short and Peter in a supplement to their list of Kentucky plants published in 1833.

American Ginseng.

(*Panax quinquefolium*).

ROOT.—The root of our ginseng is firm to the touch, somewhat juicy, yellowish without, though varying in depth of color with age and soil, the cut surface pure white. In cross section it is circular in outline, and shows concentric rings like a tree, of slightly different colors, denoting its age. The surface at first is smooth, but the second season wrinkles appear, those running around the upper part being especially conspicuous. This wrinkling of the surface is sometimes imitated by wrapping the roots with hair, thus giving an appearanee of age; but the deception is readily recognized by any one familiar with ginseng. Under the microscope the cells are seen to be loaded with starch, which indeed is, aside from the cell walls, the most conspicuous constituent of the root visible. In certain cells forming the skin or bark are a good many star-shaped crystals, probably oxalate of lime, such as are often seen in other plants.

The starch when undisturbed is in curious little clusters, or compound grains (D, Fig. 7), like that obtained from sarsaparilla. When it is removed for examination most of these grains are broken apart and the separated granules present angles and surfaces somewhat like those seen in corn starch. At the proper focal distance granules show a small central point, like corn starch, but radiating lines are wanting. Iodine solutions stain large and small granules blue very promptly. They show nothing characteristic with polarized light. The individual granules measure from .002 to .008 millimeter in diameter. A compound grain measures .016 millimeter in diameter, and consists of three or four granules.

The fresh root contains a large proportion of water, and hence loses much of its weight in drying. It tastes of starch and has besides a slightly aromatic carroty taste, with a suggestion of liquorice. These different effects on the tongue are probably due to as many different constituents of the root.

At the close of the first season the roots are small, too small for the market. Six roots from seed planted by Mr. J. W. Sears, of Somerset, Ky., in the spring of 1898 and taken up in October, weigh, green, just 6.8 grams, an average of 1.1333 gram (.0399 ounce, Av.). These roots vary from ⅞ inch to 4¼ inches in length, and the thickest measures ⅜ inch in diameter at the top. They are very light in color, without wrinkles, very watery, probably containing ¾ or more of their weight in water. Most of those I have seen are simple tapering roots with the greatest thickness at or near the top, thus resembling a small parsnip. Some, however, are short, while occasional roots possess two widely diverging branches as appears in Fig. 8, A. Each root has at its upper end a small rounded bud, growing out at the side of the attached end of the annual stem. From this bud come the leaves and fruit of the next season.

Two-year-old roots show a decided increase in size and weight. Seven roots before me weigh together, green, 54.2 grams, an average of 7.7428 grams (.2731 ounce, Av.). The heaviest of these weighs a trifle over .5000 ounce, the lightest weighs .1028 ounce, or only one-fifth as much. At this time they have not increased so much in length as in diameter. The longest is five inches, while the shortest is two and a half inches long. A larger proportion are branched than in one-year-olds, the branches developing at the lower end in some cases, and again in others at the upper end, the new branch being produced by a thickening of what was originally only a slender fibrous root. The diameter has now in some cases increased to three-fourths inch.

Three-year-old roots show little increase in length, but a decided increase in weight. Five examples before me weigh together 93.7 grams, an average of 18.74 grams per root, or a fraction more than .65 ounce. The thickest is ⅞ inch in diameter. The heaviest weighs 33.9 grams (about 1 and 5-16 ounce). The longest root measures eight inches, and the shortest three and three-fourths. Every one is branched.

Four-year-old roots show a still further gain in weight. Three examples in my possession weigh 114.3 grams, averaging thus 38.1 grams, or about 1.333 ounce. The heaviest weighs 47.7 grams, or about 1¾ ounce. The longest root is 6½ inches, while the shortest is 5½ inches long. The thickest is one inch in diameter, while the most slender measures at its thickest place but 13-16 inch. All are branched.

Five-year-old roots in Mr. Sears' possession weigh, he tells me, in some cases three ounces, and average two and a half ounces. I have not myself weighed roots of this age.

Roots from wild plants are in some respects different from those that have been cultivated. The tendency to branch is somewhat greater, and the disposition of the branches to diverge widely is more pronounced. This I think is in many cases due to the character of the soil, often, probably, the result of its being less easily penetrated by the young roots, and to obstructions in the shape of stones and roots of trees. A glance at Fig. 12, which represents several wild roots, will show more definitely what the difference amounts to. Many wild plants have at the upper end of the thickened root a short underground stem, sometimes two inches long, which in turn gives origin to the annual stem that each year appears above ground. In some wild roots that I have seen, this neck is short, but it is generally quite noticeable. Cultivated roots from one to five years old show only a short thick neck representing this stem, but it increases with age, and its great length in wild plants indicates that they are old. We have thus in this structure a means of approximating the age of plants, and the fact at once impresses us that wild plants grow much more slowly than those which are cultivated and furnished with a rich and easily penetrated soil. A wild root in my possession, which from the length of this stem and the nnmber of scars left by the annual above-ground stem, must be twelve years old, weighs only 7.2 grams (about ¼ ounce); its underground stem measures 1¼ inch long. Another example seven years old weighs 5.3 grams. The former is five inches long with its greatest diameter 9-16 inch. No doubt many wild roots, favorably situated, grow more rapidly than these appear to have done, but from an inspection of quantities of wild roots I am satisfied that in general they grow much less rapidly than cultivated ones. Some of the very large roots reported by collectors must therefore have represented plants that had persisted in the forest for a long period of time, possibly in some cases for as much as fifty years. Mr. Sears has now in his possession wild roots that weigh from three to nine ounces, green. Some time ago he planted on his place a wild root weighing about ten ounces, cultivated it for several years and finally sold it when it had reached a weight of one pound. One of his uncles, he tells me, dug up at one time, on the place now used by Mr. Sears as a ginseng plantation, a root that weighed one and a fourth pounds. Others obtained in the neighborhood a root weighing one and a half pounds. There is evidence indicating that roots were occasionally found in the early days of ginseng collecting that weighed even more, but the evidence as to the exact weight of some of the notable finds now reported is not as definite and safe as that given above.

Stem.—Either we must consider the stem of ginseng as consisting of an underground persistent part and an above-ground annual part, or else the real stem is the underground neck-like portion already described as conspicuous in wild plants, in which case the stem appearing above ground each year is the petiole of a compound leaf. This latter stem dies away each fall, leaving on the underground stem a scar like that left by the leaf petiole of other plants, and the resemblance to a leaf petiole is enhanced by the fact that the bud is developed in its axil. One thing is certain, namely, that during the first year of its existence this stem must be considered the petiole, corresponding exactly to the petiole of a strawberry leaf, or else we are left in the predicament of assuming that the leaflets have no petiole; for they are attached to the top of this stem, and are sessile at that. See A, figure 3, representing a young plant of the first year.

At the end of the first season this stem is very slender and has attained a height of about four inches. Subsequent seasons show it more stout and tall. A three-year-old plant in my possession measures twenty inches from the top of the root to the tops of the flowers. Older plants are stouter and taller. Mr. Sears has measured one on his place, that was four or five years old, and found it two and a half feet high

LEAF.—The leaves vary greatly both in the cultivated and wild plants. During the first season but three small leaflets, from 1¼ to 1½ inches long, develop. They are attached directly to the top of the stem which grows up from the ground, the individual leaflet having no stalk of its own. They are oval in general shape, widest near the base; the margin simply toothed and the apex acute. The three leaflets are about equal in size. The second year the number of leaflets is increased to five, the two outer ones being generally much smaller than the others and nearly or quite sessile, whereas the three middle leaflets are stalked. The greatest diameter of the middle leaflets has been shifted outward towards the tips, producing what is described in botanies as an obovate leaflet. The teeth on the margin, too, become broken up by additional notches. The tip remains quite acute, the leaf contracting rather abruptly from its widest part. After the second year the number of leaflets increases to some extent. Seven leaflets is a common number; nine are sometimes developed, and occasionally eleven. At my request Mr. Sears has examined his cultivated plants and reports that he finds three to five leaflets on plants during the second year, three to five on those three years old, and from four to seven on plants four to five years old. On a large wild plant transplanted to his place and grown there three years, he finds from five to eleven leaflets. In old plants quite often a leaflet is cut into three portions producing a group resembling the three leaflets of the first year. It has not been possible yet to examine a large number of wild plants with reference to the variation in number of leaflets, but from what has been seen of them it is concluded that they vary in the same direction, but are less variable than cultivated plants.

In color the leaflets are a dull green above, the veins at first not differing in tint. In the fall they are disposed to assume bright colors, when the veins often become pronounced because of their different color. Below, the color of the leaflets is the same as above, but an obscure luster becomes apparent on turning them about in the light. Single leaflets reach a length in some cases of seven inches.

The number of leaves (using the word as it is applied to ginseng in botanies) varies from two to seven. On young plants three is the common number; on old ones four is a more common one. The petioles may be five inches long.

FLOWER.—The flower stem arises from the midst of the leaves, growing straight up, like a continuation of the stem. Plants do not bear flowers the first year, and only a part of the two-year-olds bear them. The flower stem is short at first, not attaining the length of the leaf stalks. An example measures just one inch. As it grows older the flower stem (peduncle) increases in length. On a plant three years old measured by me it was 9.375 inches long, and no doubt on older plants is considerably longer. At its upper extremity it expands a little and forms a convex-topped platform from which the slender pedicels, or stalks, of the small flowers arise. These little stalks are from one-half to one inch long. Each bears a very small greenish flower at its extremity, the whole forming a compact cluster (umbel). The umbel is convex above, and bears at the base a few slender bracts, these in some cases resembling very small leaves with petiole and blade. The number of flowers composing an umbel is said in one of our best works on botany to be from six to twelve. Like everything else about this plant there is great variation in the number of flowers with the individual, and with age. It can only be said of young plants that they bear few flowers and of old ones that they bear many. An old plant just examined by me, taken in October, has during the season produced 129 flowers. A typical umbel measures from 1¼ to 1½ inches across, all of the little flower-bearing pedicels arising on the top of the larger stem and diverging from each other, so that when flower and fruit is all gone they appear in the fall of the year somewhat like a dandelion top with ripened seeds, as may be seen at D, Fig. 6.

Other clusters of flowers, and this is most frequently true of old plants, wild or cultivated, are developed in several rings or whorls, with a terminal umbel, in addition, like that described.

Three wild plants, the tops of which were received in October from Somerset, Ky., show this peculiarity in a very striking manner. They bear respectively 18, 42 and 75 flower pedicels, some of which still retain berries in various stages of development. In one of these plants the lowest whorl of flowers is 1¼ inch from the next, and this is 1⅛ inch from the terminal cluster. In the second plant the three clusters are equally distant from each other, about one inch. A noticeable peculiarity of these plants is the tendency to form secondary umbels in the lower flower whorl. In one of the plants there are three simple pedicels, each with a berry at its extremity; one pedicel bears a single branch and has a scar showing that others have been broken off; another stalk arising in the same whorl as these, bears at its extremity twenty-three small pedicels with berries. In the second plant the lower whorl consists of four stalks, bearing, respectively, secondary flower pedicels to the number of 5, 5, 13 and 24 (see Fig. 7, A and C). I have not observed this peculiarity in cultivated plants.

The flowers appear early in the summer, maturing first on the outer pedicels, and continuing to mature towards the center of the cluster until fall. Cultivated plants sometimes bear flowers and flower buds in October. An entire flower measures about four millimeters (about 1-6 inch) in length, and across the expanded petals is about 3½ millimeters. Normally it has five divisions—five sepals, five petals, and five stamens—while the stigmas number but two, but in many flowers six sepals and six petals may be counted, and three and even four styles and stigmas are often present. The petals are green, with narrow whitish margins; they soon fall off, while the sepals and stigmas remain attached to the maturing berry, the calyx, as in the case of the apple, forming a part of the berry itself.

FRUIT.—Some of the berries are ripe by July 20th, while others are immature when frost kills the upper part of the plants. They are generally somewhat flattened, are smooth and shining, and when ripe are of a very bright red color. Examples measure from 5 millimeters (1-5 inch) to 14 millimeters (½ inch, about) in greatest diameter by from 5 to 9 millimeters in lesser diameter. Examples are frequently quite spherical, others are three-lobed and somewhat triangular in outline seen from above, while one berry from a wild plant is four-sided. Two flattened seeds are generally embedded in the soft mealy pulp of the ripe berry, but the small round berries often have but one, while the three-lobed ones have three, and the four-sided have four. When the pulp is completely removed from them they are seen to have a hard thick coat, slightly roughened (rugose), of an opaque whitish or yellowish color, and to be more or less flattened. When two or more seeds develop in the same berry the inner edges that nearly meet are straight, while the outer ones are rounded; a shallow groove runs about each seed. They look very much like small bits of gravel; would easily be taken for such objects if noticed in the soil. The smallest observed measures 5 millimeters long, 4 millimeters wide, and 2.50 millimeters thick. Larger ones measure 7 millimeters long, 5 millimeters wide, and 2.75 millimeters thick. In small spherical berries the single seed produced may be relatively and absolutely much thicker (as much as 3.50 millimeters).

The Cultivation of Ginseng.

By the circular letters already referred to, I have endeavored to learn to what extent ginseng has been successfully grown in Kentucky. Several of the replies indicate that attempts have been made in different parts of the State, but thus far the only instance of success, of which I have absolute knowledge, is that furnished by Mr. J. W. Sears of Somerset. I visited his place this fall and can say from my own knowledge that he is at present growing ginseng both from the seed and from transplanted wild roots. There can be no question but that the plant can be as easily grown as other cultivated plants, provided it is furnished with the *right kind of soil and with shade*. I would not advise anyone to undertake ginseng culture unless he has on his land the means of supplying these necessary conditions, or else is willing to incur the expense and trouble of furnishing them artificially. The latter procedure is not difficult, especially in a region where forest prevails, and need not deter anyone possessed of average intelligence and persistence from undertaking the growing of ginseng.

PLANTING THE SEEDS.—The seeds are gathered from berries on either wild or cultivated plants during the summer and preserved in a slightly damp loose humus, consisting of a mixture of soil and decayed leaves and other vegetation. They must not be allowed to dry out thoroughly at any time. When I visited him Mr. Sears had his seed mixed with such humus in shallow wooden trays, set on the ground under a small wooden shelter that kept them from the sun and rain. The pulp of the berry may be removed or not as preferred. They should be planted, if possible, like the seeds of walnut and other forest trees, in the fall before heavy frosts occur. They can, however, be planted in the spring, though this may involve a longer wait for their germination. Mr. Sears declares that some of the seeds which ripen early in the season, and some of them are ripe as early as July 20, will, if planted the succeeding fall, germinate the next spring, but that seeds from the same plants ripening late in the summer or fall will when planted germinate at the end of about eighteen months, a year from the following spring. This peculiarity of the seeds has doubtless more than once discouraged men who have, without knowing much of the habits of the plant, attempted to get a start.

The seeds are planted from one-half to one inch deep in a rich loam, or humus, containing a large proportion of decaying vegetable matter. Dead leaves should be raked up in the fall, mixed with soil and made into heaps where they will decay during the winter and be ready for use the following season. The debris or crumbled remains of logs and stumps is excellent for the purpose. In the absence of these, well rotted stable manure may be used. If the plantation is made in an undisturbed forest, but little need be done to prepare the soil beyond clearing away underbrush and making room for the beds, then digging up the ground with a spading fork. Care must be exercised in this case not to remove so many trees as to expose the ground to the sun. Mr. Sears tells me he made this mistake on a part of his place. In preparing the beds the roots of trees should be cut away where they lie near the surface, and encroach on the beds.

Most growers sow the seed six to eight inches apart in drills, the latter not less than a foot apart to give room for the plants when of large size. The beds may be made of any length, but should not be more than four or five feet wide, and should have a walk between them of 18 inches or two feet in width for convenience in removing the weeds. These paths are an important consideration, since the growth of the plants at the age of four or five years is so rank that it is not best to go among them in the beds. After planting, the beds are covered with a thin layer of dead leaves and left to themselves until the plants come up. When the young plants appear all weeds should be removed to give them as much room as possible. Later, they cover the ground so completely that but little attention is required. In Mr. Sears' place at Somerset I saw recently plants four and five years old, averaging perhaps 15 to 20 inches in height, that looked as thrifty and occurred as regularly in the rows as do strawberry or any other plants commonly grown by us.

PLANTING THE WILD ROOTS.—In some cases it is most convenient to collect the wild roots and transplant them in beds. Mr. Sears has practiced this to some extent, and it has been for some years done successfully by others in various parts of the United States. Mr. Stanton, of New York, recommends this as the easiest way to get a start. The soil should be prepared as for the seeds by digging it up a few inches deep and mixing it with a compost made of dead leaves or wood, when the roots may be planted in rows like the seed, care being taken to have the little bud at the top completely covered and thus protected from injury during the succeeding winter. In either case, fall is the proper time to start beds.

PROFITS FROM GINSENG.—The prices paid by country merchants to the collector vary much with the locality and often range widely in the same locality. Of course the price must range with the quality of the ginseng. From the replies received from correspondents giving prices paid for ginseng in Kentucky, it seems that the collector may expect to receive from $2.00 to $3.00 per pound for dried roots of good quality —roots that are thoroughly dry and not too small. The stems should always be removed, the root then be washed free from all soil and kept in a dry place in shallow wooden trays until completely dry. The buyers object to the thread on which ginseng roots are sometimes strung, because it requires time to remove it. Green roots are bought by some dealers, the price paid ranging from 0.25 to 0.75 per pound, but the collector will get a fairer return as a rule by looking up the market price of dried ginseng and selling only the dried roots.

It is sometimes remarked that most of the profit from ginseng goes to the middlemen, but the collector generally knows pretty well what his ginseng is worth, and from all I can learn is able to take care of himself. *They say* he sometimes runs a little melted lead into his roots, conceals nails in them, and occasionally adds the roots of other plants, to turn an extra penny and balance the account.

The following are prices paid for the dried roots (except when otherwise stated) to the collectors, as given me by correspondents. Where several reports were received from the same county they are indicated by numbers in parenthesis:

County.	*Price per Lb.*
Adair ....(1)	$2.00 to $2.50
" ....(2)	2.25 to 2.50
Allen	2.50
Anderson .... (1)	2.00
" " ....(2)	2.00 to 2.25
Barren	2.00 to 3.00
Bell ....(1)	2.50
" ....(2)	2.75
Boone	2.50 to 3.00
Boyd ....(1)	1.50 to 1.75
" ....(2)	2.50
Boyle	1.75 to 2 60
Bracken	1.50 to 2.00
Breathitt	2.25 to 2.75
Breckinridge	2.25
Bullitt ....(1)	2.25 to 2.50
" ....(2)	2.50 to 2.75
Butler ....(1)	2.00
" ....(2)	2.50 to 3.00
Caldwell	1.50 to 2.00
Campbell	1.00 to 2.00
Carlisle .. ..(1)	0.90 to 2.00
" " ....(2)	3.00 to 3.50
Carroll.......	2.00
Carter ....(1)	2.75 to 3.25
" .. ..(2)	2 00 to 3.00
" ....(3)	2.50 to 3.00
Casey ....(1)	2.00
" ....(2)	2.25
Christian	2.00 to 2.25

County.	*Price per Lb.*
Clinton (1)	2.00
" " (2)	2.60 to 3.00
" " (3)	1.50 to 2.00
Cumberland	2.25
Daviess	2.50 to 3.50
Elliott	1.25 to 2.50
Estill	2.50
Fayette (1)	3.50
" " (2)	1.60
Fleming (1)	0.50 to 1.00
" " (2)	2.60
Fulton	0.25, green.
Grayson	2.00 to 2.50
Green	2.50 to 3.00
Greenup (1)	2.50
" " (2)	3.50
Hancock (1)	1.50
" " (2)	0.50, green,
" "	2.00, dried.
Hardin	1.50 to 3.00
Harrison	0.80 to 3.50
Hart (1)	2.25 to 2.50
" (2)	2.50
Henderson	2.50
Hopkins	0.50, green.
Jackson	2.50 to 3.00
Jessamine	1.50 to 2.00
Johnson	2.50
Knott	2.50 to 2.65
Knox (1)	2.50 to 2.75
" (2)	2.25
Laurel	2.50
Lawrence	2.50
Leslie (1)	2.25
" (2)	2.50
Letcher (1)	2.50 to 3.00
" (2)	2.50
" (3)	2.50
Lewis	2.50 to 3.00
Lincoln (1)	2.00 to 3.00
" (2)	2.25
" (3)	2.00 to 3.00
Livingston	2.00
Lyon (1)	1.50 to 3.00
" (2)	2.00
Magoffin	2.50
Marion (1)	2.50
" (2)	2.75
" (3)	2.00
" (4)	2.00 to 3.00
Marshall (1)	2.00
" (2)	1.50 to 2.50

County.	*Price per Lb.*
Martin (1)	2.75 to 3.00
" (2)	2.75 to 4.00
Mason	3.00
McCracken	1.00 to 2.50
McLean	1.50
Meade (1)	2.50
" (2)	2.00 to 2.25
Menifee	1.75 to 2.25
Metcalfe	1.25
Monroe (1)	2.00 to 2.25
" (2)	2.25 to 2.50
Morgan (1)	2.40
" (2)	2.50
" (3)	2.00 to 3.00
Muhlenberg	2.00
Nelson	1.50 to 1.75
Ohio (1)	2.50 to 3.00
" (2)	2.25 to 2.50
Oldham	1.50 to 2.10
Owen	1.00 to 3.00
Owsley (1)	2.50
" (2)	2.25
" (3)	2.50
Pendleton	2.75 to 3.00
Perry	2.00 to 3.00
Pike (1)	3.00
" (2)	2.75 to 3.00
Powell (1)	1.50
" (2)	2.50 to 3.00
Pulaski (1)	2.50 to 3.00
" (2)	2.25 to 2.50
Robertson	1.00
Rockcastle (1)	2 50
" " (2)	2.00 to 2.50
" " (3)	1.50 to 2.50
Rowan (1)	2.00 to 2.50
" (2)	2.75
Spencer	1.00 to 2.00
Todd (1)	2.00 to 3.00
" (2)	0.75 to 1.00,
green, and	2.50, dried.
Trigg	3.00
Trimble	2.00 to 3.00
Warren	1.50
Washington (1)	0.50, green,
" "	2.00, dried.
" " (2)	1.50 to 2.00
Wayne	2.00 to 2.50
Woodford	2.50 to 3.00
Wolfe (1)	2.50 to 3.25
" (2)	2.25

The price paid for first rate cultivated roots is better than that realized by most collectors of the wild ginseng. The roots of cultivated plants are larger and weigh more at four years than the average of wild roots. Mr. Sears has recently sold some for $4.50 per pound dry, and disposed of ten pounds of green roots for $2.00 per pound. Not the least valuable part of the crop is the seeds, which sell readily for about $1.00 per ounce. Mr. Sears writes me that he has lately sold 7½ pounds of seed for $128.00.

As an illustration of what can be done with ginseng the following experience, reported in Garden and Forest, Volume VI, 1893, page 490, may be given:

Mr. George Stanton of Summit Station, New York, obtained in 1893 from three small beds, sixteen feet long and three feet wide, containing in one case plants from roots collected in the woods five years ago, and in the other two beds, four years ago, 833 roots weighing over twenty pounds which he reserved for planting, and had besides fifty-two pounds and fourteen ounces of roots for sale. The latter when dry it was estimated would weigh about seventeen pounds and would be worth from $3.00 to $3.50 per pound. In addition to this Mr. Stanton saved from his plants seed to the value of forty dollars.

In writing of his experience somewhat later Mr. Stanton says that his beds have been made in an open garden and that in 1892 they made such a fine appearance that they excited the admiration of every one who saw them. His seed gathered from beds, altogether three hundred feet long and three feet wide, was worth over $100. It seems his plan at that time was to plant the seed one inch apart and when the roots were two or three years old to transplant them, placing them from four to six inches apart each way. It is not necessary, however, to take this trouble in growing ginseng if one has enough room. No doubt the operation of transplanting roots checks them to some slight extent, and on this account, as well as to avoid expense in handling, it is advisable to plant the seeds at distances sufficient to give the roots room to develop to their full extent without moving them.

In an article published in the Rural New Yorker, June 8, 1898, Mr. Stanton gives a more complete and recent statement of the results obtained by him, from which the following is quoted:

"A detailed statement of the product of a few beds will give some idea as to possibilities. In 1895, from 7½ beds, 3 x 16 feet each, were taken 2,545 roots, weight 148 and 5-16 pounds; from these were taken out for replanting 2,312 roots, weight 59⅞ pounds, leaving 88 and 7-16 pounds to be dried for the market, making 30¼ pounds dry, which sold for $161. Six of the beds also produced 2,408 seedling roots, weight 19 pounds. In 1896, from 3 x 28 feet of ground, 587 roots, weight 46 pounds, were taken, and 491 roots, weight 13 pounds, taken out for replanting, leaving 33 pounds to be dried, making 11 pounds dry, which sold for $60. There were also 704 seedling roots, weight 4 and 9-16 pounds. In 1897, from 8½ beds, 3 x 16 feet each, 2,270 roots, weight 126⅛ pounds were taken; 1,582 taken out for replanting, weight 29 and15-16 pounds, leaving 96 and 3-16 pounds to be dried, which made 32 pounds dry, value $165. There were also 1,505 seedling roots, weight 8⅛ pounds. Had the entire product of marketable roots from the 18 beds, 320 pounds, been dried, it would have made about 106 pounds dry, which would have sold for $575. This will do very well for 4½ square rods, with five years' cultivation. I do not need to add the value of seed produced during cultivation, or the value of the 4,617 seedling roots. I have said enough already to endanger my reputation for truth. The above figures are matters of record in my books, and open to the inspection of all who may wish to investigate. Can others attain as good results? I don't know why they may not, but I do not expect all who attempt ginseng culture will make a success."

Time to Sell.—The rate at which ginseng grows is shown in another part of this bulletin and need not be dwelt upon here. Roots of cultivated plants can be sold when they are three years old; they are then larger than wild roots when these are much older, and indeed the wild roots I have seen stored in barrels by dealers were, in most cases, not larger than the three-year-old roots. Four years is a good age at which to take them up for market. They have by this time reached a good size and weight, and have assumed all the characteristics that give them value in the estimation of the Chinese. The roots should be taken up in September or later, when they have ceased growing and have their greatest weight for the season.

Location of the Sears Plantation.—Mr. Sears' plantation is situated seven miles east of Somerset, among foot hills forming part of the Cumberland mountain system.

It is a natural habitat of the plant, which grew originally without cultivation on the site now occupied by his plantation, and is at present not especially rare in the adjoining country. He began in a small way in 1891, and has about three acres of forest-covered land on a north slope enclosed with a slat fence, to keep out marauders. To make sure that his roots are not stolen he has a man living at the edge of the enclosed land. Perhaps one-third of this enclosed area is at present occupied by ginseng beds. The trees growing on this piece of ground are such as grow everywhere in its neighborhood—oak, flowering dogwood, sugar maple, beech, black walnut, basswood, etc. The ginseng beds are made in the shade of these trees, which cover them in the fall with a layer of leaves, and thus afford at all seasons the natural protection which the wild plants get in the woods.

ARTIFICIAL SHELTER.—Mr. Sears, as well as Mr. Stanton, has demonstrated that ginseng can be grown under an artificial cover. I saw on his place some beds of young plants in a somewhat open place protected from the sun by a structure consisting of upright posts set in the ground, with a light framework nailed to their tops, on which in turn were secured strips of wood an inch or two apart. Ordinary four-foot laths can be made to answer the same purpose. In this case the posts should be placed five or six feet apart along the sides of the beds; their tops should be cut to a level and on these may be nailed strips two or three inches wide, and the lath be nailed from side to side across the top. For convenience in getting to the plants it is well to make the posts four or five feet in height—Mr. Sears thinks the top should be made high enough to permit a man to walk erect under it. Such shelters protect the plants from the fierce heat of the sun, and at the same time allow a free circulation of air. One thing which struck me very forcibly in passing the wooden structure on Mr. Sears' place, was that some young plants, from seed planted last spring and forming part of one of the beds under shelter, were badly scorched and checked in growth by the sun's heat, whereas plants under the frame were still green and bore a thrifty appearance.

THE CULTIVATION OF GINSENG IN JAPAN AND CHINA.—The cultivation of ginseng in this country is in its infancy, but in Japan, Corea and China it has been practiced for a long period, for several centuries in Japan, and perhaps as long in China. A black soil rich in humus is preferred, and must not be too wet. Red soils, they believe, produce a reddish colored root, which is not as valuable as the white ones. The soil is carefully prepared, being enriched when this is necessary, and the beds are protected from the sun by a frame-work covered with straw. The seeds are planted so that they are two or three inches apart every way. The roots are not harvested until the fourth year, and in the fields may be seen at the same time, beds of one, two, three and four year old plants. They are dug up for sale in July and August, being first washed carefully and then dried by heat, sometimes artificially supplied, and ranging from 212 to 248 degrees F. In other cases they are dried in the sun. Dried roots are said to sell in Japan for from $5.00 to $7.00 per pound, while in China the same roots bring $10.00 per pound. From descriptions it is evident that the plant under cultivation is so closely like our own that the experience and methods of the Japanese are a safe general guide for our people in propagating the American species.

THE ENEMIES OF GINSENG.—Moles are very troublesome in the beds at times and are declared by growers to feed upon the roots. Similar assertions have been made concerning their eating sweet potatoes and seed corn, but there is no reliable evidence on record convicting the mole of intentionally eating vegetable matter of any sort. Fragments of such matter are frequently found in its stomach, but their character and number indicate that they are taken only by accident during the capture of worms and insects, which constitute the great bulk of the food. The real injury done by moles consists in burrowing among the plants and disturbing their roots. The best way to get rid of them in most ordinary cases is to watch for them with a spading-fork in hand, and when one is observed moving the earth quickly throw it out and destroy it. Mr. Sears has invented a mole trap, consisting of a piece of plank armed with long sharp spikes, which is set over the burrow on a figure-four support, the plank being loaded with a heavy rock. When the mole releases the figure-four the plank falls and the weight forces the spikes into the ground, thus securing the mole. Similar traps have been on the market for a good many years, and can be bought of most seedsmen in the East.

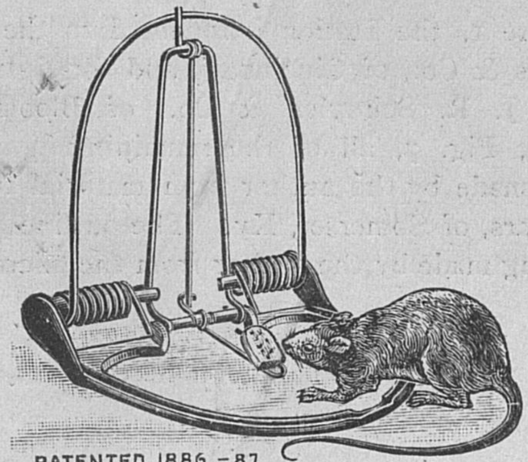

FIG. 2.—SCHUYLER'S MOUSE KILLER.

Mice are also occasionally troublesome, and in this case no doubt the roots are sometimes gnawed. The use of traps and poisoned bait is about the only remedy to be recommended. One of the most excellent mouse traps known to me is manufactured by J. R. Schuyler & Co., Bloomsburg, Pa. It is made of wire, is completely open, and is so simple and inconspicuous that when set in their runways mice often run into it when no bait is used. It is styled by the manufacturer, Schuyler's Mouse Killer (No. 3). Sample traps are sold by this company for 15 cents. To those getting a dozen or more a liberal discount is allowed.

A small green worm or larva (probably the young of some Tineid) has been observed by me feeding on the ginseng leaves. Mr. Sears reports that a white fly (probably an Aphid) sometimes infests the stems. In all probability still other insects will be found to attack the plants in one way or another.

A rot has been reported as destroying wild roots at times, but Mr. Sears says it does not attack his cultivated plants. Whether it will prove to be restricted to plants which grow in the woods remains to be seen. Cattle are said by correspondents to eat the young leaves freely.

THE FIGURES.

For figure 1, the Station is indebted to the courtesy of Samuel Wells & Co., of Cincinnati, and for figure 2, to the kindness of J. R. Schuyler & Co., of Bloomsburg, Pa. Excepting D, Fig. 7, all of the remaining figures are from photographs made by the author from material furnished by Mr. J. W. Sears, of Somerset, Ky. The outline D, Fig. 7, is from a drawing made by the author from the microscope.

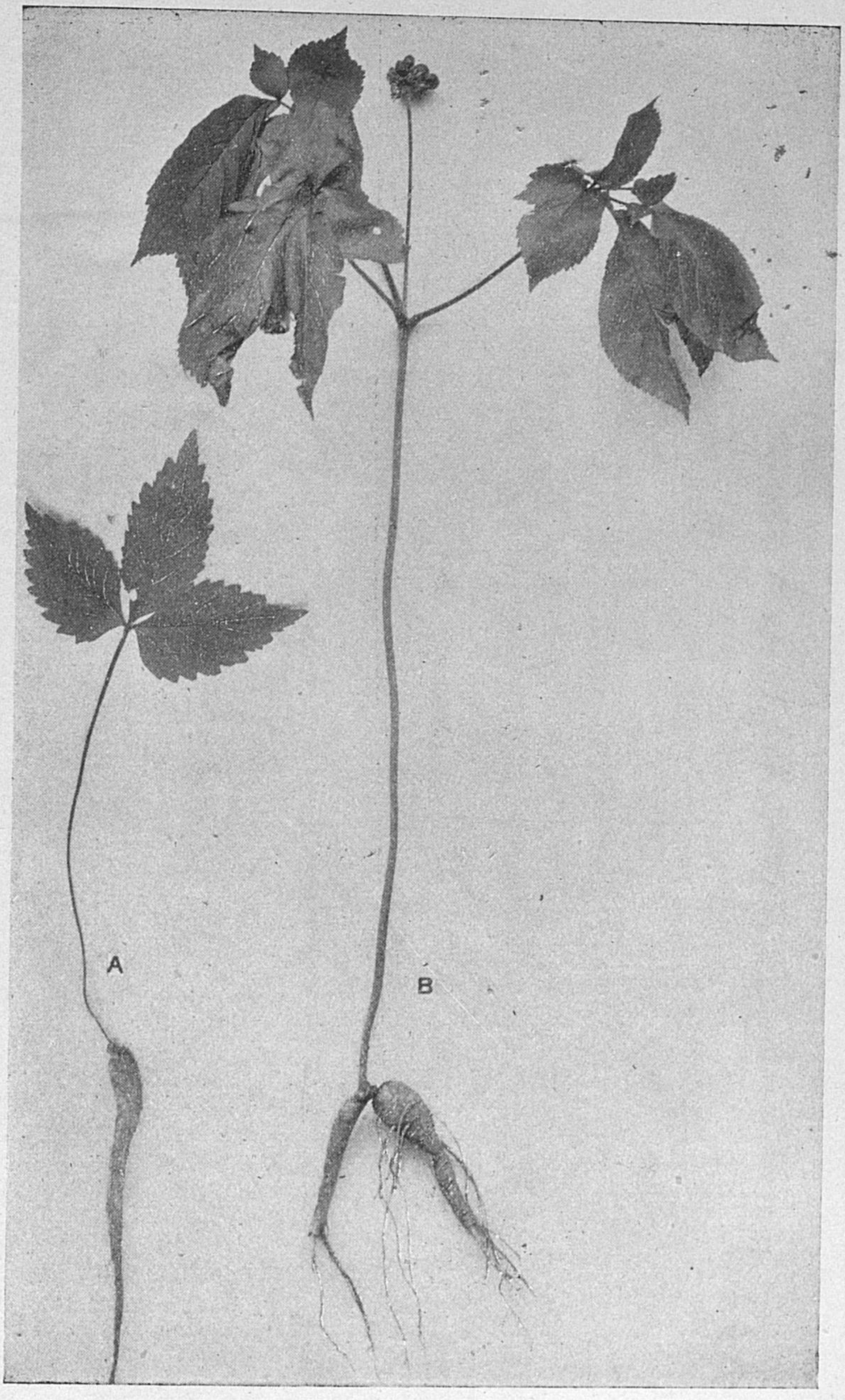

FIG. 3.—*A*, A young plant, as it appears the first year. *B*, A three-year-old plant, with three leaves and a flower stem rising from their midst. Both figures reduced.

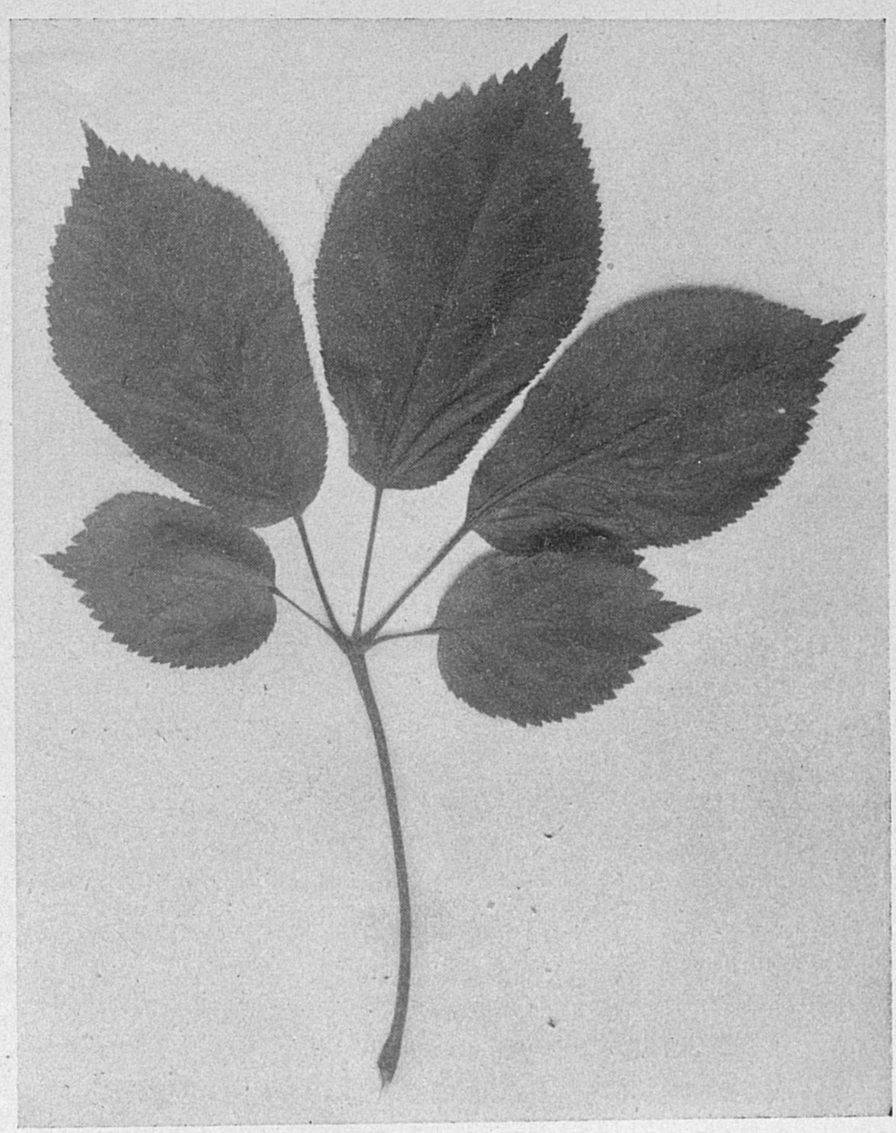

FIG 4.—A typical ginseng leaf, with five stalked leaflets. Reduced in size from the original.

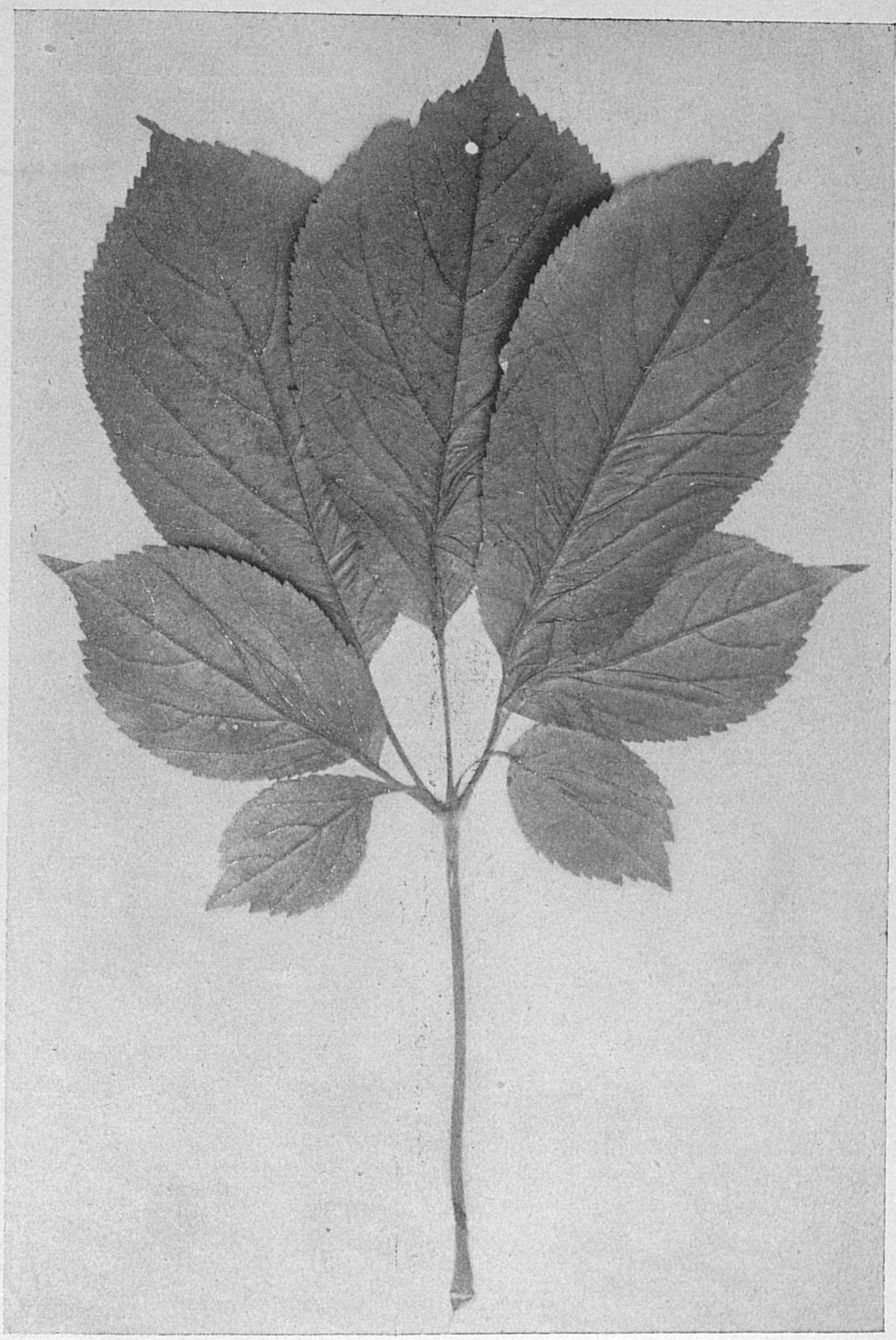

FIG. 5.—A leaf from an older plant, with seven leaflets. Reduced in size.

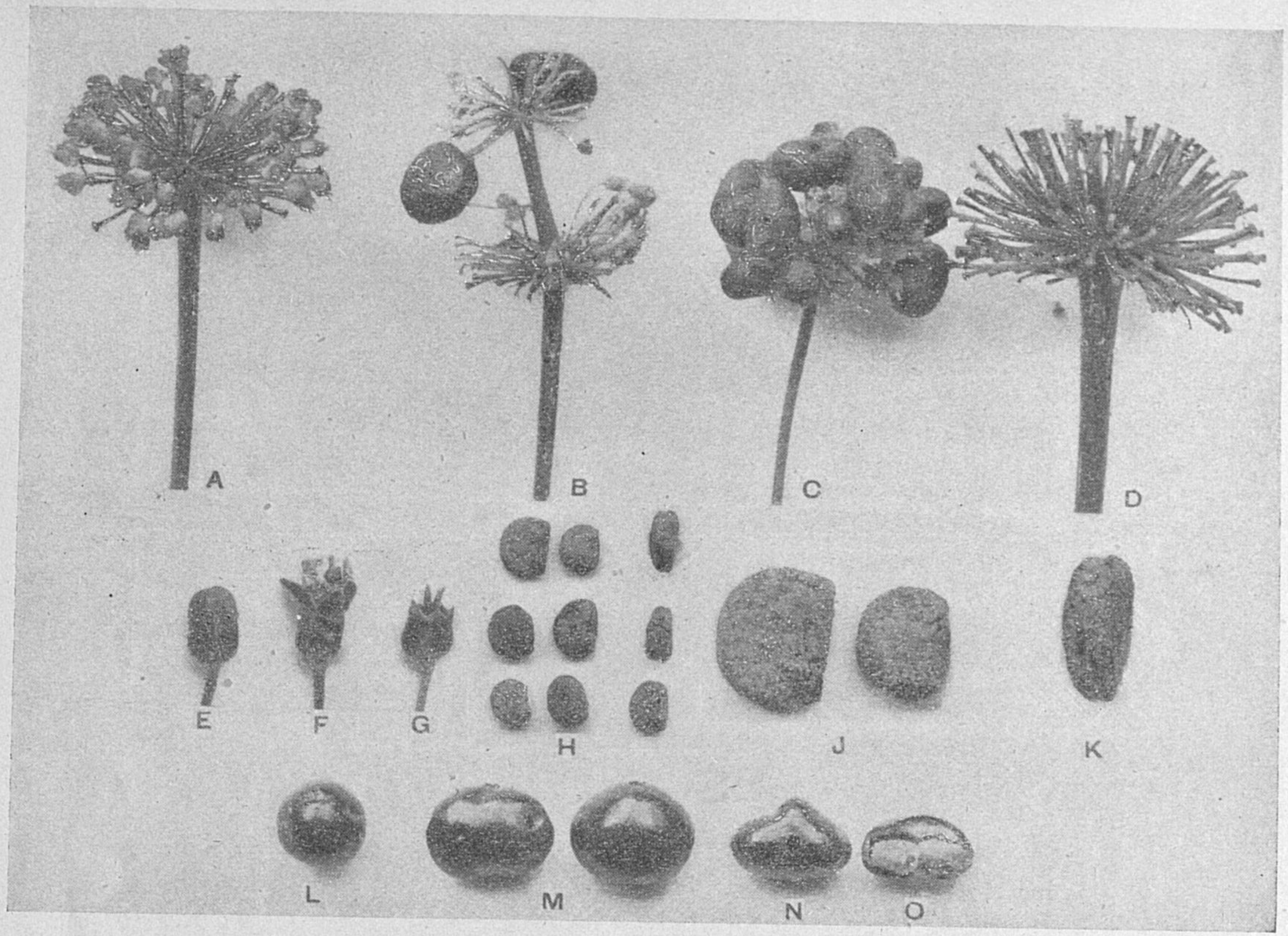

FIG. 6.—*A-D*, Fruit clusters in different conditions, natural size. *E-G*, Three conditions of the flower, enlarged. *H*, Seeds, natural size. *I-K*, Seeds enlarged. *L-N*, Fresh berries, natural size. *O*, A berry cut open to show seeds, natural size.

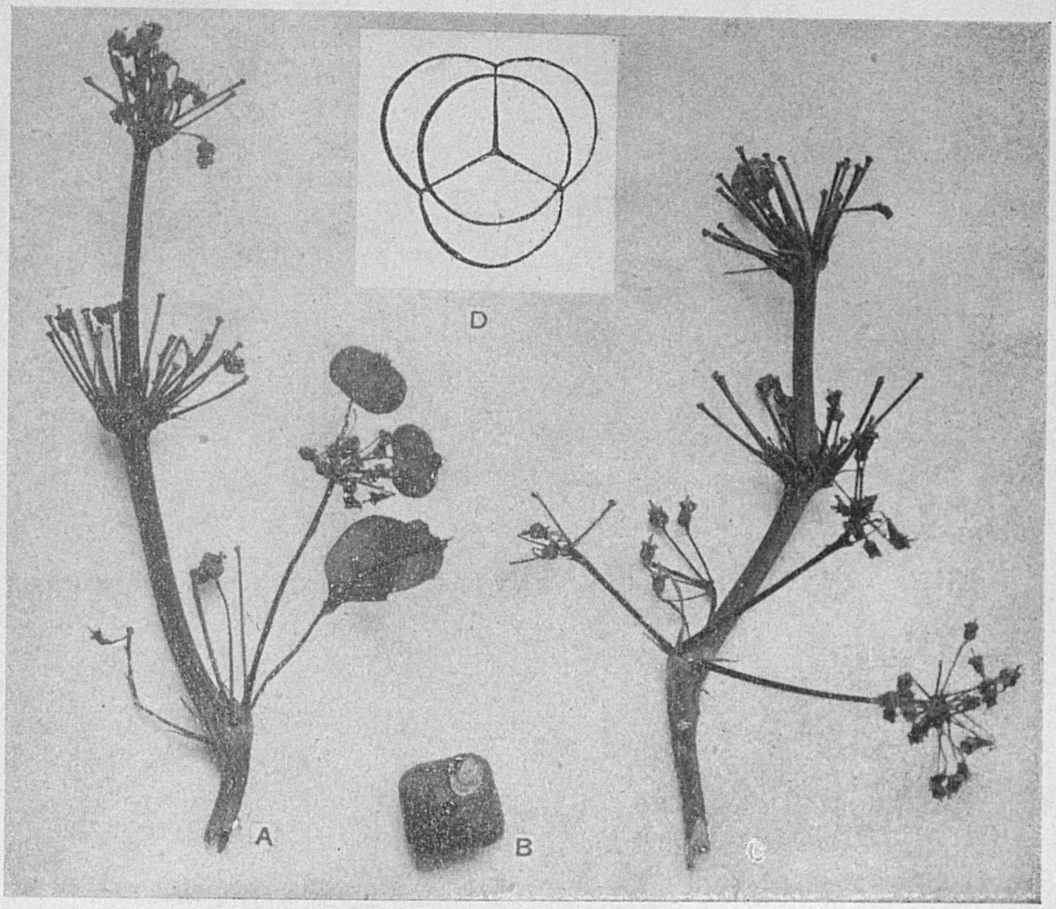

FIG. 7.—*A* and *C*, Tops of wild plants each with three flower clusters, the lower with secondary clusters. *B*, A four-seeded berry, seen from above. *D*, An outline showing character of starch; greatly magnified. Natural size (except *D*).

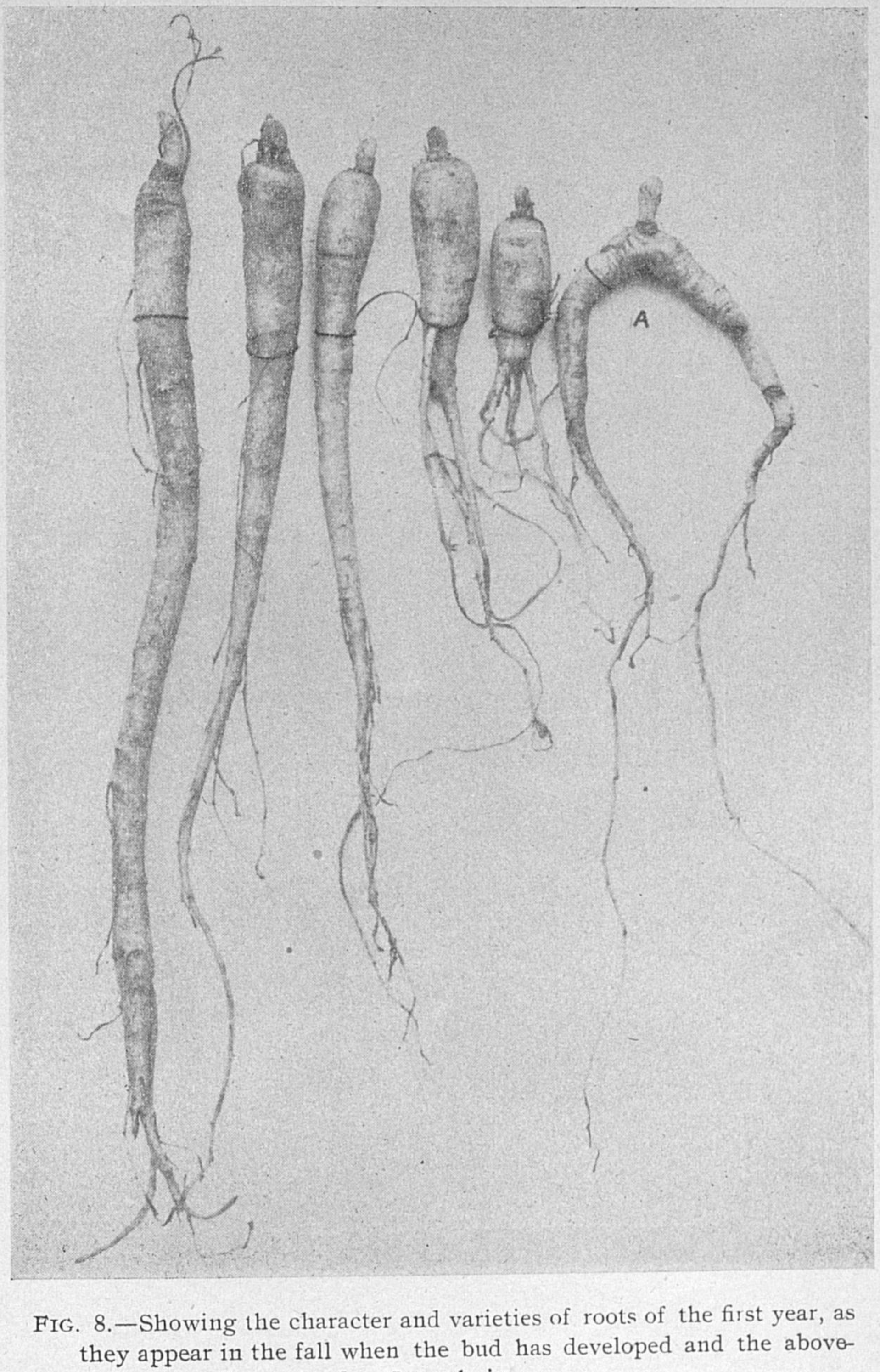

FIG. 8.—Showing the character and varieties of roots of the first year, as they appear in the fall when the bud has developed and the above-ground stem is removed. Natural size.

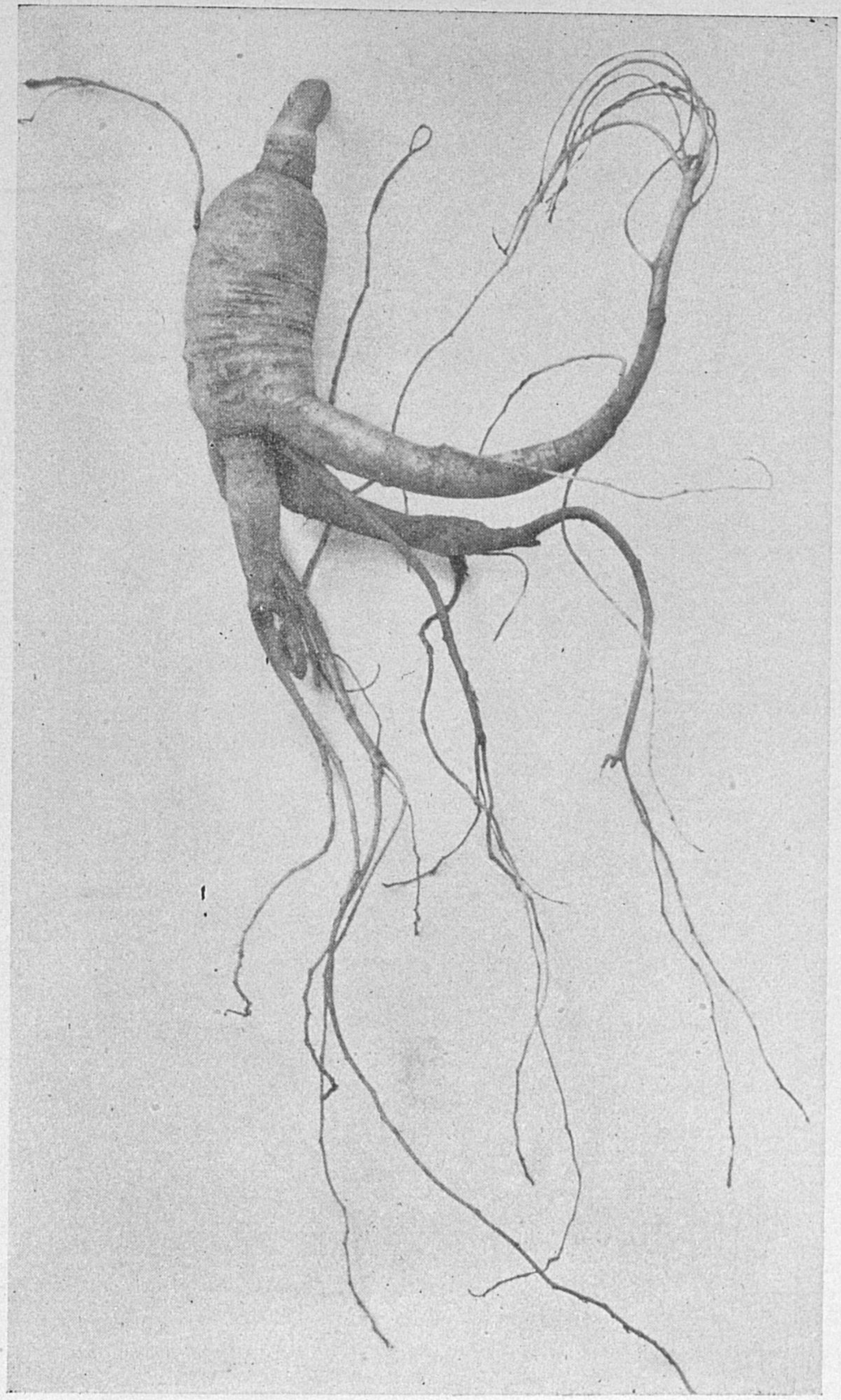

FIG. 9.—A root as it appears in the fall of the second season. Natural size.

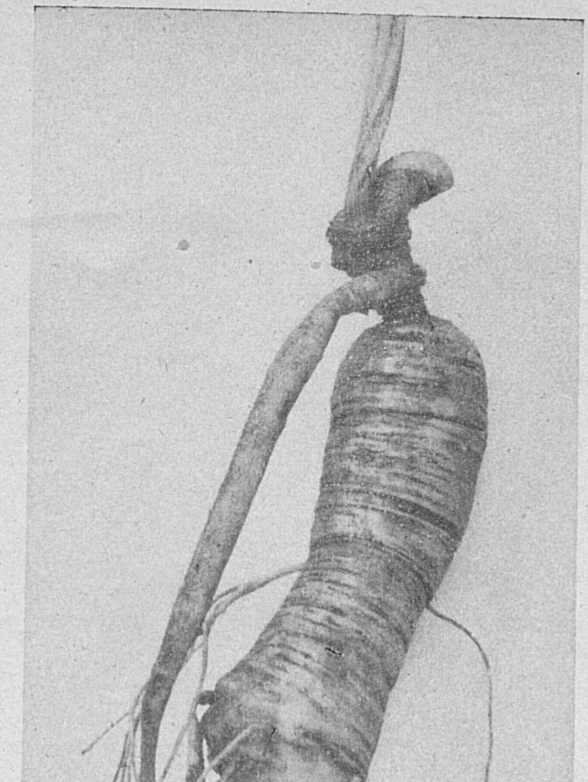

FIG. 10.—A root of the third year with the above-ground stem still attached. Natural size.

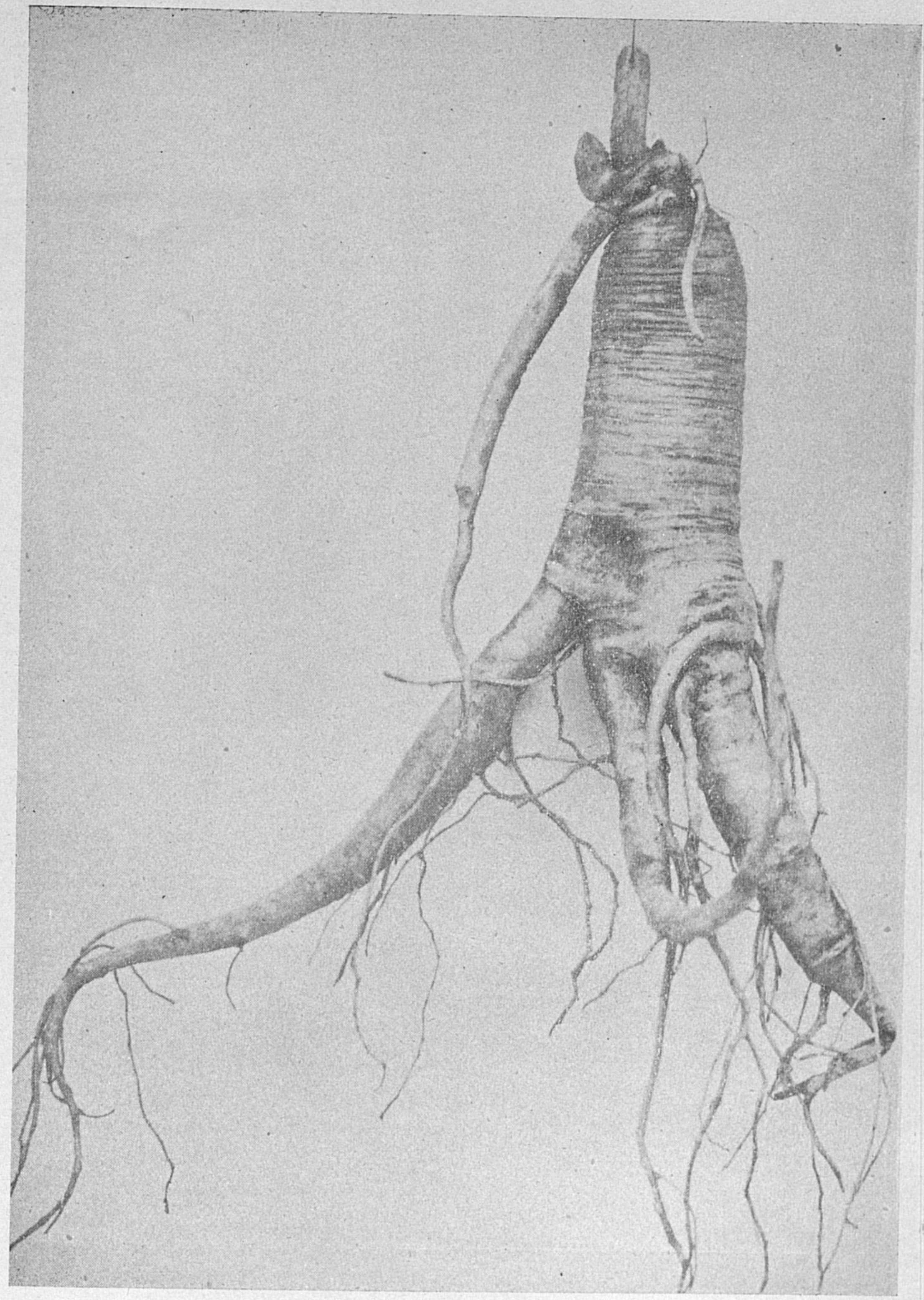

FIG. 11.—A root of the fourth year, showing annual stem and bud at the top. Natural size.

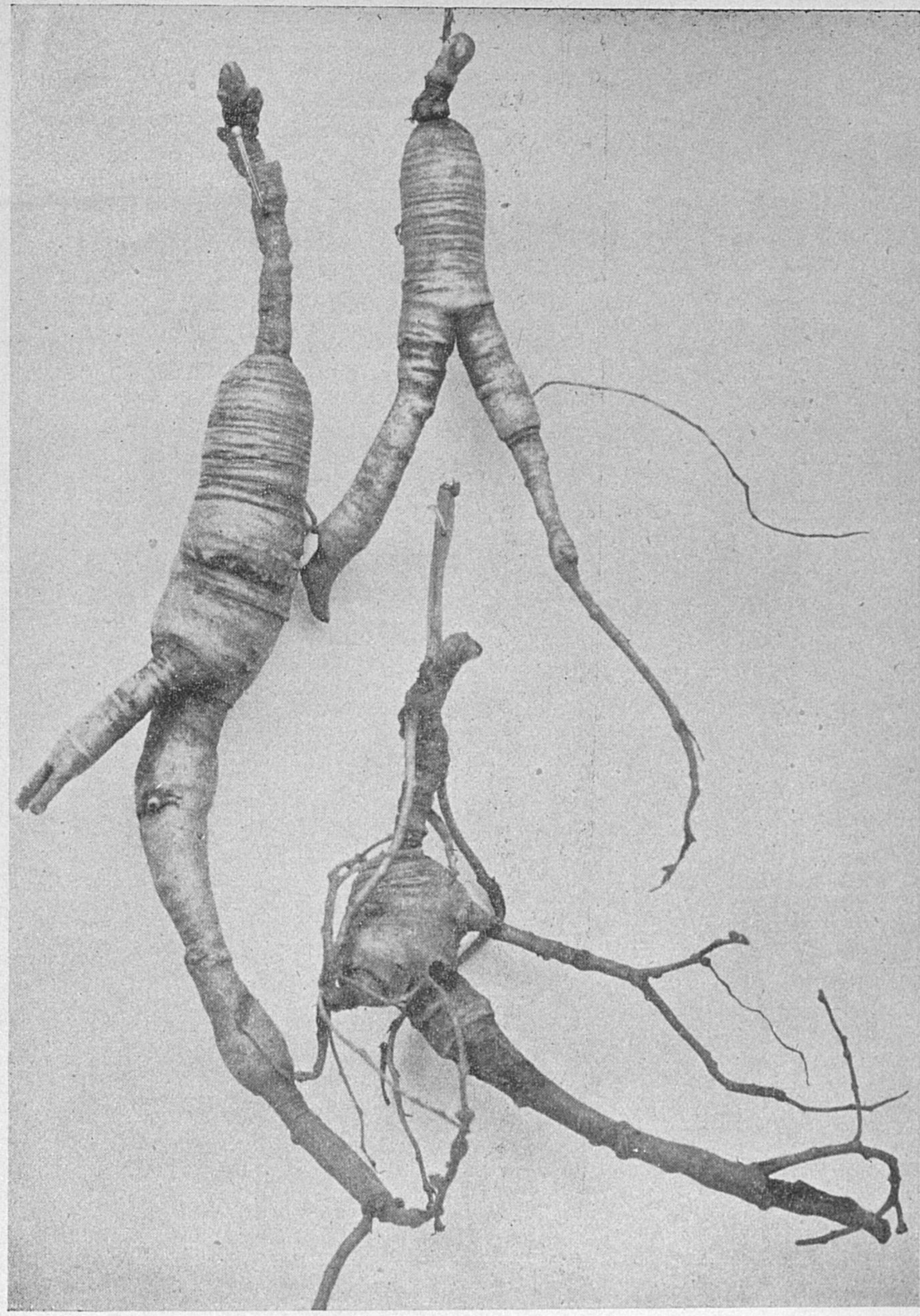

FIG. 12.—Three wild roots, with long under-ground stems. Natural size.

KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 79,

COMMERCIAL FERTILIZERS.

LEXINGTON, KENTUCKY.
December, 1898.

KENTUCKY

Agricultural Experiment Station.

BOARD OF CONTROL.

STATION OFFICERS.

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. 79,

Commercial Fertilizers.

It will be noticed that the analyses of fertilizers in this bulletin are collected in two tables: Table I comprises those entered for sale under the old law, and Table II, those under the new law.

The "official analysis" under the old law was the analysis of the sample sent to the Station by the manufacturer under affidavit that it was a fair and true sample of the brand which the manufacturer desired to sell in this State. The analysis on the tags furnished by the Station, under the old law, was the "official analysis."

Under the new law, the manufacturer guarantees, under affidavit, the analysis as found on the tags furnished by the Station. This analysis is the *minimum* "guaranteed analysis" of the manufacturer.

GUARANTEED AND ACTUAL COMPOSITION.

A detailed examination of Table I, shows that out of forty-nine samples taken from goods sold in the State, twenty of them fall materially below the samples sent here by the manufacturers to represent them, while four samples are above such guarantee. Of the remaining twenty-five samples, nine are above the official samples and sixteen are below them, but the differences are not such as require comment, and in none of these is the difference in value as much as $2 per ton.

The four brands which were above the official samples are:

4339—Farmers Compound Fertilizer, manufactured by the Greer Machinery Co , Knoxville, Tenn. The sample collected showed 2.46 per cent. more available phosphoric acid, and the estimated value was $3.27 more than that shown on the official tag.

4971—Bone Meal, manufactured by the Louisville Fertilizer Works, Louisville, Ky. The sample collected showed 1.21 per cent. more total phosphoric acid, 0.84 per cent more nitrogen, and an estimated value of $2.47 more than that found on the official tag.

4968—Ox Alkaline Bone, manufactured by the Tennessee Chemical Co., Nashville, Tenn. The sample collected contained 1.38 per cent more available and 6.22 per cent. more total phosphoric acid, giving a valuation $3.29 more than the official analysis, but contained 0.89 per cent. less potash than the official analysis. This shows bad mixing, and it is a question whether the persons purchasing this fertilizer on the official tag analysis were getting more than they really bargained for or not. Those farmers applying it to soils needing phosphoric acid received more than they bargained for, while those applying it to soils needing potash, and not phosphoric acid, received less than they should have had.

4416—Champion Corn Grower, manufactured by S. W. Travers & Co., Richmond, Va. The sample collected contained 0.42 per cent. more available and 0.70 per cent. more total phosphoric acid and 0.52 per cent. more nitrogen, and the estimated value was $2.35 more than shown by the official analysis.

The 20 samples that fall much below the official samples are given in the following table, and the percentage each fertilizer falls below in phosphoric acid, nitrogen and potash, and the amount it falls below in value, is there shown.

Fertilizers Falling Below the Official Samples.

Station Number.	Name of Fertilizer.	Manufacturer.	Pounds per Hundred Less Than on Tag.				Less in Estimated Value.
			Phosphoric Acid				
			Available	Total.	Nitrogen.	Potash.	
4978	Grain Grower	Armour Fertilizer Works	1.07	0.15	0.42	0.42	$2.67
4876	Square Bone	Cleveland Dryer Co.	2.64	4.94	1.01	......	8.39
4894	Currie's Raw Bone Meal	The Currie Fertilizer Co	....	2.04	0.56	......	2.75
4939	Currie's Fine Ground Raw Bone Meal	Same	....	2.92	0.92	....	5.49
4846	Fine Ground Bone	The Jones Fertilizing Co.	....	1.77	0.46	....	2.83
4845	Ammoniated Bone Meal	Same	....	12.26	0.98	....	12.67
4847	"	"	....	13.10	0.57	....	11.90
4956	"	"	....	9.19	*1.47	....	1.79
4977	"	"	....	2.36	....	....	1.70
4848	Jones Reliable	"	2.27	3.22	0.70	*.54	5.19

*Above the Official Analysis.

Fertilizers Falling Below the Official Samples.—Continued.

Station Number.	Name of Fertilizer.	Manufacturer.	Pounds per Hundred Less Than on Tag.				Less in Estimated Value.
			Phosphoric Acid				
			Available.	Total.	Nitrogen,	Potash.	
4877	Bone and Potash..................	The Jones Fertilizing Co......	2.18	2.65	*.56	0.33	$ 1.78
4878	Miami Valley Phosphate	Same	5.26	8.75	1.60	*.24	14.39
4957	"	"	....	1.24	0.40	0.67	2.94
4317	Potato and Tobacco Grower ...	Louisville Fertilizer Works....	0.65	1.48	0.56	*1.04	1.82
4970	"	Same	*2.30	*3.89	1.27	1.82	2.98
4941	Homestead Corn and Wheat Grower	Michigan Carbon Works.......	0.14	0.15	0.37	1.22	2.97
4942	Red Line Complete Manure	Same	0.36	1.83	0.18	0.38	2.33
4893	H. S. B. Raw Bone and Phosphate Mixture	North-Western Fertilizing Co	*.87	*.39	0.95	0.18	2.61
4415	Capital Tobacco Fertilizer	S. W. Travers & Co.............	*1.18	*1.48	0.19	1.79	1.20
4429	"	Same	*1.70	*2.06	0.44	2.20	1.81

*Above the official analyses.

Under the old law the manufacturer was required to send a sample of each fertilizer to the Station at the beginning of the year, and this sample represented all of a fertilizer made under that brand during the year. As it often happens that the manufacturer makes new mixtures of his various brands from time to time during the year, depending upon the quantity sold, it is nearly impossible to send a single sample, the analysis of which will represent exactly the composition of the various mixtures of a brand during the year. But by analyzing each of the ingredients of a fertilizer every time a new mixture is made, and by carefully mixing, the manufacturer should be able to keep this variation in composition within reasonable limits.

If a fertilizer were found to be not more than one per cent. in phosphoric acid, one-half per cent. in potash, or three-tenths per cent. in nitrogen, or $2.00 in estimated value below the official analysis, it might be considered up to standard under the old law as, from what has been said above, some allowance should be made for variation in different samples of the same fertilizer, especially when such samples are taken from different bulks, made at different times. When the variations are more in any fertilizer than those given above, such fertilizer must be condemned as not coming up to the official analysis. In cases Nos. 4978, 4957, 4317, 4970, 4941 and 4893, in the table above, the variations may be laid to careless or bad mixing. When the discrepancies are as great as in samples Nos. 4876, 4939, 4845, 4847, 4956, 4848 and 4878, ignorance or gross carelessness in the manufacture of the fertilizer must be charged against the manufacturer. From what information we have of each of these cases, we are of the opinion that in every one the manufacturer supposed he was supplying a fertilizer fully up to guarantee, and the bad results came from the use of tankage or other ingredients of irregular composition in the fertilizer, under the supposition that these ingredients did not vary in composition, without determining by analysis the amount of phosphoric acid, nitrogen and potash they really contained. But such a plea cannot be considered an excuse, and it gives very little comfort to the farmer who buys such a fertilizer to know that, although fraud was not intended, nevertheless he received only a portion of what he purchased under the supposition that he was receiving the whole.

The results of the analyses of the samples taken in open market show conclusively the importance of inspection of fertilizers at the time of purchase, under regulations laid down in Section 8 of the fertilizer law. As to how to take samples and proper form of certificate to send with them, see page 170, of this bulletin.

In Table II may be found the analyses of fertilizers coming under the new law. As stated before, under our present law, the manufacturer guarantees the amount of phosphoric acid, nitrogen and potash which his fertilizer will contain, and it is the *minimum* guarantee of the manufacturer that is printed on the official tags. As the manufacturer guarantees that the fertilizer *will not fall below* the figures given, he should make his mixtures in such proportions that the percentages of the phosphoric acid, nitrogen and potash should be a little above the minimum guarantee. Under the present law, therefore, the phosphoric acid, nitrogen and potash in a fertilizer should not fall below the analysis on the official tag, but the law allows a margin of one-fourth of one per cent. to cover unavoidable differences in sampling. If it were possible to get an absolutely true sample of a fertilizer for analysis, the percentages of the different ingredients of a fertilizer should not fall even as much as one-fourth per cent. below the guarantee. A small variation, however, is to be expected, from the fact that most commercial fertilizers are mixtures of various materials, and however well mixed, it is impossible to make them of perfectly uniform composition. When a fertilizer falls even slightly more than ¼ per cent. below the guarantee in one ingredient, but is enough over the guarantee in one or both of the other ingredients to compensate in value, such fertilizer should be considered up to guarantee.

In Table II the following fertilizers are so much below guarantee that attention is hereby called to them.

4510---Currie's Fine Ground Raw Bone Meal, manufactured by The Currie Fertilizer Co., Louisville, Ky.; below guarantee in phosphoric acid 4.27 per cent., nitrogen 0.36 per cent., in estimated value $4.60.

4314—Anchor Brand Complete Fertilizer, manufactured by A. B. Mayer Manufacturing Co., St. Louis, Mo.: below in potash 1.89 per cent., in estimated value $1.26; above in available phosphoric acid 0.80 per cent.

4305—Bone Tankage and Potash, manufactured by Swift & Co., Chicago, Ill.; below guarantee in potash 1.30 per cent., in total phosphoric acid 0.52 per cent; above in nitrogen 0.48 per cent.

The following table gives the fertilizers much above guarantee, and the percentages of phosphoric acid, nitrogen and potash above guarantee, and the value above the estimated value. We have included here only those in which the relative commercial value per ton was two dollars or more above that calculated from the guaranteed minimum analysis.

Fertilizers Running above Guarantee.

Station Number.	Name of Fertilizer.	Manufacturer.	Pounds Per Hundred More Than Guaranteed. Phosphoric Acid: Available.	Phosphoric Acid: Total.	Nitrogen.	Potash.	Relative Value Above Guarantee.
4358	Bone Blood and Potash.......	Armour Fertilizer Works.....	1.08	0.99	0.41	0.36	$3.40
4995	Invincible Bone Meal.	A. Button & Son....... ...	....	*.25	0.81	....	2.64
4625	Crocker's Universal Grain Grower..................	Crocker Fertilizer and Chemical Company................	0.64	1.43	0.48	0.65	3.76
4357	Currie's Tobacco and Potato Grower......	The Currie Fertilizer Co.......	1.40	4.03	*.67	3.49	5.83
4508	Currie's Butchertown Raw Bone Meal........................	Same.	0.72	2.94	1.47	*.41	6.70
4511	Currie's Wheat Grower	"	1.14	0.99	0.04	0.49	2.36
4353	No. 2 Potato, Corn and Tobacco Grower	Dunn & Backer....	1.61	0.32	0.62	1.64	5.75
4355	No. 8 Grower....................	Same.	....	*.21	0.85	....	2.82
4293	Farish Furman Formula..........	Furman Farm Imp. Co.....	2.16	3.20	....	0.37	3.98

4659	Globe Bone Meal	Globe Fertilizer Co	....	6.56	0.21	....	5.35
4497	Champion Raw Bone Meal	R. H. Hoskins	....	1.46	0.97	....	4.57
4506	Lake Erie Fish Guano	Jarecki Chemical Co	0.72	1.24	0.02	0.65	2.02
4278	Corn and Wheat Grower	Louisville Fertilizer Works	1.57	....	0.35	*.16	4.11
4524	Soluble Bone and Potash	Same.	1.01	2.17	0.54	*.36	3.38
4578	Jarves Drill Phosphate	Michigan Carbon Works	0.52	0.67	0.62	0.10	2.95
4307	Acid Phosphate	National Fertilizer Co	2.97	....	....	....	2.97
4308	Acid Phosphate with Potash	Same.	1.14	....	....	3.19	5.78
4309	Tobacco Grower	"	3.33	....	*.59	*.57	3.51
4310	Tobacco Fertilizer	"	1.24	....	*.09	0.43	3.55
4311	Bone Meal	"	....	1.77	1.54	....	6.81
4312	Corn Grower	"	2.86	....	*.33	*.32	3.36
4588	Wheat Grower	"	1.43	....	0.16	0.37	3.71
4810	Sadler's Formula	"	1.97	....	....	*.03	4.48
4590	National Dissolved Bone	"	1.00	....	0.08	0.67	3.10
4591	Pure Bone Meal	"	....	2.49	1.40	....	6.75

Fertilizers Running Above Guarantee.—Continued.

Station Number.	Name of Fertilizer.	Manufacturer.	Pounds Per Hundred More Than Guaranteed. Phosphoric Acid: Available.	Phosphoric Acid: Total.	Nitrogen.	Potash.	Relative Value Above Guarantee.
4505	Read's High Grade Special Potash Mixture	Read Fertilizer Co.	1.65	2.57	....	0.48	$3.35
4580	Read's Wheat Grower	Same.	*.38	1.41	0.44	0.32	2.29
4318	Schroth's Special	J. & F. Schroth Packing Co.	0.87	1.82	0.45	0.28	3.61
4319	Corn and Wheat Grower	Same.	*.39	0.23	0.61	1.01	3.11
4500	Greer's Compound Fertilizer	Southern Fertilizer Co.	2.93	3.32	....	0.21	4.55
4515	Pure Ground Bone	Standard Guano and Chemical Manufacturing Co.	....	3.85	0.95	....	6.12
4304	Bone and Potash 3 per cent.	Swift & Co.	....	0.52	0.68	0.49	3.48
4445	Ox Ammoniated Bone	Tennessee Chemical Co.	0.62	2.15	0.32	0.54	3.41
4660	Bone Meal	Same.	....	4.56	*.36	....	2.32

*Less than Guaranteed.

In the following tables are published the analyses of all fertilizers entered by manufacturers in 1898 not already published in Bulletin 75, and also analyses of samples collected by deputy inspectors or sent by farmers. Most of the inspectors and farmers' samples were of brands entered under the old law. The reason for this is that the new law went into effect after most of the fertilizers had been entered under the old law. The analyses of brands entered under the old law are given in Table I; those entered under the new law, in Table II, together with the manufacturer's guaranteed minimum analyses for comparison.

In the future it will be our policy to analyze samples of every brand of fertilizer licensed in the State, taken from goods actually on sale, and samples sent by manufacturers will be analyzed only in cases where we are unable to get samples from goods in the State, or for some other special reason.

FERTILIZER LAW.

The 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 appear 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.

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. Any one intending to send a sample for free analysis can get these blank certificates by sending to the Station.

CERTIFICATE FOR FREE ANALYSIS.

Smithville, Ky., June 1, 1898.

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 the 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) *John Smith,*

(P. O Address) *Smithville, Ky.*

Signature of Witnesses:

Sam Jones.

Will Brown.

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 170.) 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.

Section Providing for Free Analysis. 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 sample 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 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 a 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.

In Table I we have followed the plan used in former bulletins of giving first the tag analysis or "official" analysis of each brand in bold faced type and just under it the analysis of samples of the same brand collected at various places.

In Table II are given in bold faced type the guaranteed analyses of all brands entered in 1898 under the new law, and just under this the analysis of the samples of the same brands sent by the manufacturer and also the analysis of any samples sent in by farmers and inspectors

In both Tables the names of manufacturers are arranged in alphabetical order.

VALUES USED.

In calculating the "estimated value per ton" or "relative commercial value,' the same values were used as in bulletin 75, as follows:

Soluble and reverted phosphoric acid in mixed fertilizers, 7 cents ;in plain acid and unacidulated phosphates, 5 cents per pound.

Insoluble phosphoric acid in mixed fertilizers, $2\frac{1}{2}$ cents; in plain acid phosphates, nothing; in Orchilla guano, 3 cents; in other unacidulated phosphates, 2 cents per pound.

Phosphoric acid in fine* bone, 4 cents; in medium* bone, 3 cents per pound.

Nitrogen in all fertilizers, $17\frac{1}{2}$ cents per pound.

Potash in all fertilizers, from sulphate, 7 cents; from muriate, 6 cents per pound.

DESCRIPTION OF SAMPLES IN TABLE I.

THE ARMOUR FERTILIZER WORKS, CHICAGO, ILL.

No. 4972—Bone Meal, collected by deputy inspector from stock of B. B. Smith, Guthrie, Ky. Tags corresponded to No. 4160.

No. 4978—Grain Grower, collected by deputy inspector from stock of Chas. Ratliffe, Princeton, Ky. Tags corresponded to No. 4163.

THE CLEVELAND DRYER CO., CLEVELAND, O.

No. 4876—Square Bone, sent by P. K. Patterson, Melrose, Ky. Tag sent corresponded to No. 4245.

CROCKER FERTILIZER & CHEMICAL CO., BUFFALO, N. Y.

No. 4414—Crocker's Kentucky Tobacco Fertilizer, collected by deputy inspector from stock of Fullenweider & Son, Shelbyville, Ky. Tags corresponded to No. 3238.

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*Fine Bone is all that passes through a sieve with meshes 1-25 inch square. Medium Bone passes through a sieve with meshes 1-6 inch square, but does not include fine bone.

THE CURRIE FERTILIZER CO., LOUISVILLE, KY.

No. 4894—Currie's Raw Bone Meal, collected by deputy inspector from stock of L. S. Brough, Bowling Green, Ky. Tags corresponded to No. 3913.

No. 4895—Currie's Soluble Bone, collected by deputy inspector from stock of L. S. Brough, Bowling Green, Ky. Tags corresponded to No. 3772.

No. 4939—Currie's Fine Ground Raw Bone Meal, collected by deputy inspector from stock of L. S. Brough, Bowling Green, Ky. Tags corresponded to No. 3912.

No. 4940—Currie's Climax Tobacco and Potato Grower collected by deputy inspector from stock of Tandy & Young, Hopkinsville, Ky. Tags corresponded to No. 4266.

No. 4973—Same brand, sent by J. W. Riley, Newstead, Ky. Tag sent corresponded to No. 4266.

EMPIRE CARBON WORKS, ST. LOUIS, MO.

No. 4996—Empire Pure Raw Bone Meal, collected by deputy inspector from stock of A. Button & Son, Louisville, Ky. Tags corresponded to No. 3960.

GLOBE FERTILIZER CO., LOUISVILLE, KY.

No. 4417—Globe Special Tobacco Grower, collected by deputy inspector from stock of Hall & Son, Shelbyville, Ky. Tags corresponded to No. 4183.

No. 4944—Big Four Tobacco Grower, collected by deputy inspector from stock of Porter & Ellis, Bowling Green, Ky. Tags corresponded to No. 4187.

No. 4959—Eagle Corn and Wheat Grower, collected by deputy inspector from stock of Elrod & McQuery, Somerset, Ky. Tags corresponded to No. 4188.

No. 4960—Progress Corn and Wheat Grower, collected by deputy inspector from stock of Elrod & McQuery, Somerset, Ky. Tags corresponded to No. 4230.

GREER MACHINERY CO., KNOXVILLE, TENN.

No. 4339—Farmers' Compound Fertilizer, sent by J. L. Yaden, London, Ky. Tag sent corresponded to No. 4211.

J. B. JONES, LOUISVILLE, KY.

No. 4592—Raw Bone Meal, sent by D. M. Crum, Beard, Ky. Tag sent corresponded to No. 4212.

THE JONES FERTILIZING CO., CINCINNATI, O.

No. 4844—Fine Ground Bone, sent by T. J. Stuart, Glendale, Ky. Tag sent corresponded to No. 4123.

No. 4846—Same brand, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky. Tags corresponded to No. 4123.

No. 4845—Ammoniated Bone Meal, sent by T. J. Stuart, Glendale, Ky. Tag sent corresponded to No. 4124.

No. 4847—Same brand, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky. Tags corresponded to No. 4124.

No. 4956—Same brand, collected by deputy inspector from stock of E. R. Sparks, Nicholasville, Ky. Tags corresponded to No. 4124.

No. 4977—Same brand, sent by S. H. Bland, Glendale, Ky. Tag sent corresponded to No. 4124.

No. 4848—Jones' Reliable, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky. Tags corresponded to No. 2422.

No. 4877—Bone and Potash, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky. Tags corresponded to No. 4127.

No. 4878—Miami Valley Phosphate, collected by deputy inspector from stock of A. S. White, Hopkinsville, Ky. Tags corresponded to No. 4201.

No. 4957—Same brand, collected by deputy inspector from stock of E. R. Sparks, Nicholasville, Ky. Tags corresponded to No. 4201.

THE LOUISVILLE FERTILIZER WORKS, LOUISVILLE, KY.

No. 4317—Potato and Tobacco Grower, sent by J. C. Catlett, Elmo, Ky. Tag sent corresponded to No. 4158.

No. 4970—Same brand, collected by deputy inspector from stock of W. T. Kirkman, Elkton, Ky. Tags corresponded to No. 4158.

No. 4971—Bone Meal, collected by deputy inspector from stock of W. T. Kirkman, Elkton, Ky. Tags corresponded to No. 3917.

MICHIGAN CARBON WORKS, DETROIT, MICH.

No. 4890—Homestead Corn and Wheat Grower, sent by L. D. Stringer, Pulaski, Ky. Tag sent corresponded to No. 4274.

No. 4958—Same brand, collected by deputy inspector from stock of J. H. Thurman, Somerset, Ky. Tags corresponded to No. 4274.

No. 4941—Same brand, collected by deputy inspector from stock of G. H. Bransford, Fulton, Ky. Tags corresponded to No. 4221.

No. 4942—Red Line Complete Manure, collected by deputy inspector from stock of J. H. Thurman, Somerset, Ky. Tags corresponded to No. 4228.

NORTH-WESTERN FERTILIZING CO., CHICAGO, ILL.

No. 4724—Horse Shoe Brand Acidulated Bone, sent by George Gray, Harned, Ky. Tag sent corresponded to No. 4169.

No. 4879—H. S. B. Fine Raw Bone, collected by deputy inspector from stock of Forbes & Bro., Hopkinsville, Ky. Tags corresponded to No. 4165.

No. 4891—Same brand etc., from stock of Miller & Wells, Elkton, Ky. Tags corresponded to No. 4165.

No. 4881 H. S. B. Ky. Tobacco Grower, collected by deputy inspector from stock of R. G. Terrell, Paducah, Ky. Tags corresponded to No. 4167.

No. 4892—H. S. B. Bone and Potash, collected by deputy inspector from stock of Miller & Wells, Elkton, Ky. Tags corresponded to No. 4170.

No. 4893—H. S. B. Raw Bone and Phosphate Mixture, collected by deputy inspector from stock of Miller & Wells, Elkton, Ky. Tags corresponded to No. 4178.

READ FERTILIZER CO., CHARLESTON, S. C.

No. 4361—Read's High Grade Tobacco Grower, sent by J. C. Alexander, Bowling Green, Ky. Tag sent corresponded to No. 4283.

No. 4993—Same brand, collected by deputy inspector from stock of J. W. Bearce, Bowling Green, Ky. Tags corresponded to No. 4283.

TENNESSEE CHEMICAL CO., NASHVILLE, TENN.

No. 4961—Ox Bone with Ammonia and Potash, collected by deputy inspector from stock of McElrath & Sexton, Murray, Ky Tags corresponded to No. 4154.

No. 4968—Ox Alkaline Bone, collected by deputy inspector from stock of McElrath & Sexton, Murray, Ky. Tags corresponded to No. 4216.

S. W. TRAVERS & CO., RICHMOND, VA.

No. 4415—Capital Tobacco Fertilizer, collected by deputy inspector from one-half sack in the hands of B. F. Bryant, Shelbyville, Ky. There being no tag on this half sack, the analysis is compared with the official for 1898, No. 4146.

No. 4429—Same brand, sent by Capt. Thomas Todd, Shelbyville, Ky. Sample taken from part of sack remaining from half a ton purchased from B. F. Bryant. Mr. Bryant purchased a ton of this fertilizer and these two samples, Nos. 4415 and 4429 are both from this lot.

No. 4416—Champion Corn Grower, collected by deputy inspector from stock of B. F. Bryant, Shelbyville, Ky. Tags corresponded to No. 3224.

No. 4447—National Tobacco Fertilizer, collected by deputy inspector from stock of R. C. King, Carlisle, Ky. Tags corresponded to No 2811.

No. 4991—Beef, Blood and Bone Fertilizer, collected by deputy inspector from stock of Eldred & Co., Princeton, Ky. Tags corresponded to No. 4148.

No. 4992—Capital Bone Potash Compound, collected by deputy inspector from stock of Eldred & Co., Princeton, Ky. Tags corresponded to No. 4144.

TABLE I.

Name of Brand.	Sample.	Station Number.	Pounds in the Hundred.									Estimated Value Per Ton.
			Phosphoric Acid.							Potash.		
			In Fine Bone.	In Medium Bone.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	
Bone Meal.	*Official*, 1898	4160	20.95	4.51	.....	.....	25.46	3.36	4.08	.....	.....	$31.23
	Guthrie	4972	21.45	5.57	.....	.....	27.02	2.76	3.35	.....	.....	30.16
Grain Grower.	*Official*, 1898	4163	.....	.....	9.64	2.96	12.60	2.24	2.72	2.14	.....	25.39
	Princeton	4978	.....	.....	8.57	3.88	12.45	1.82	2.21	.....	1.72	22.72
Square Bone.	*Official*, 1898	4245	.....	.....	13.45	9.45	22.90	2.59	3.14	.....	.....	32.63
	Melrose	4876	.....	.....	10.81	7.15	17.96	1.58	1.92	.....	.....	24.24
Crocker's Kentucky Tobacco Fertilizer.	*Official*, 1896	3238	.....	.....	10.63	2.66	13.29	2.23	2.71	3.49	.....	28.21
	Shelbyville	4414	.....	.....	10.22	2.19	12.41	2.27	2.76	3.83	.....	27.96
Currie's Raw Bone Meal.	*Official*, 1897	3913	10.98	11.43	.....	.....	22.41	3.94	4.78	.....	.....	29.43
	Bowling Green	4894	13.14	7.23	.....	.....	20.37	3.38	4.10	.....	.....	26.68

Currie's Soluble Bone	*Official*, **1897**	**3772**	.....	.....	**11.85**	**1.54**	**13 39**	**0.72**	**0.87**	.....	**2.91**	**23.95**
	Bowling Green	4895	.....	.....	10.92	3.24	14.16	0.80	0.97	.....	2.42	23.10
Currie's Fine Ground Raw Bone Meal.	*Official*, **1897**	**3912**	**21.09**	**2.50**	.....	.....	**23.59**	**2.15**	**2.61**	.....	.....	**25 90**
	Bowling Green	4939	18.46	2.21	...	....	20.67	1.23	1.49	.....	.....	20.41
Currie's Climax Tobacco and Potato Grower.	*Official*, **1898**	**4266**	.....	.....	**11.32**	**3.16**	**14.48**	**0.52**	**0.63**	.....	**1.40**	**21.21**
	Hopkinsville	4940	.....	.....	11.28	4.20	15.48	0.47	0.57	....	1.48	21.61
	Newstead	4973	.....	.....	11.40	3.91	15.31	0.56	0.68	.....	1.70	22.26
Empire Pure Raw Bone Meal.	*Official*, **1897**	**3960**	**22.06**	.....	.....	.....	**22.06**	**3.85**	**4 67**	...	.....	**31.13**
	Louisville	4996	22.00	.....	.....	.....	22.00	3.86	4.69	.....	.....	31.11
Globe Special Tobacco Grower.	*Official*, **1898**	**4183**	.....	.....	**10.08**	**0.78**	**10.86**	**2.78**	**3.37**	.....	**10.65**	**39.14**
	Shelbyville	4417	.....	.....	9.33	0.99	10.32	2.54	3.08	....	12.22	39.56
Big Four Tobacco Grower.	*Official*, **1898**	**4187**	.....	.....	**9.19**	**0.74**	**9.93**	**2.23**	**2.71**	.....	**3.13**	**25.43**
	Bowling Green	4944	.....	.....	9.32	1.30	10.62	2.26	2.74	.....	2.85	25.60
Eagle Corn and Wheat Grower.	*Official*, **1898**	**4188**	.....	.....	**10.09**	**1.27**	**11.36**	**2.40**	**2.91**	...	**2 09**	**26.10**
	Somerset	4959	.....	.....	10.86	1.00	11.86	1.99	2.42	2.25	.....	25.37
Progress Corn and Wheat Grower.	*Official*, **1898**	**4230**	.....	....	**9.54**	**1.51**	**11.05**	**2 01**	**2.44**	.....	**1 32**	**23.01**
	Somerset	4960	.....	.....	9.63	1.15	10.78	2.04	2.48	.....	0.83	22.36

TABLE I.—Continued.

Name of Brand.	Sample.	Station Number.	Pounds in the Hundred. Phosphoric Acid. In Fine Bone.	In Medium Bone.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate.	From Sulphate.	Estimated Value per Ton.
Farmers' Compound Fertilizer.	*Official*, 1898	**4211**	......	......	**12.28**	**1.51**	**13.79**	.....	......	**2.10**	.....	$ **20.47**
	London	4339	......	.....	14.74	1.05	15.79	......	......	2.14	......	23.74
Raw Bone Meal.	*Official*, 1898	**4212**	**12.27**	**8.63**	......	......	**20.90**	**4.29**	**5.21**	....	......	**30.02**
	Beard	4592	12.31	9.18	......	......	21.49	3.70	4.49	......	......	28.31
Fine Ground Bone.	*Official*, 1898	**4123**	**16.20**	**6.42**	......	......	**22.62**	**3.60**	**4.37**	.....	......	**29.41**
	Glendale	4844	13.60	10.78	......	......	24.38	3.45	4.19	.....	.....	29.43
	Hopkinsville	4846	15.39	5.46	......	.....	20.85	3.14	3.81	......	......	26.58
Ammoniated Bone Meal.	*Official*, 1898	**4124**	**18.89**	**4.04**	......	...	**22.93**	**3.46**	**4.20**	....	....	**29.64**
	Glendale	4845	9.41	1.26	......	......	10.67	2.48	3.01	......	.....	16.97
	Hopkinsville	4847	8.63	1.20	......	....	9.83	2.89	3.51	......	.....	17.74

	Nicholasville	4956	11.72	2.02	......	......	13.74	4.93	5.99	......	......	27.85
	Glendale.	4977	17.44	3.13		....	20.57	3.46	4.20	....	....	27.94
Jones Reliable.	*Official*, **1894**	**2422**	....	....	**5 97**	**2.79**	**8.76**	**2.52**	**3.06**	**0.77**	**0.96**	**20 84**
	Hopkinsville	4848	....	....	3.70	1.84	5.54	1.82	2 21	.....	2.27	15.65
Bone and Potash.	*Official*, **1898**	**4127**	......	....	**6.35**	**2.84**	**9.19**	**1.50**	**1.82**	.....	**4.85**	**22.35**
	Hopkinsville	4877	.....	.....	4.17	2.37	6.54	2 06	2.50	...	4.52	20.57
Miami Valley Phosphate.	*Official*, **1898**	**4201**	......	......	**9 77**	**5 17**	**14.94**	**3.44**	**4 18**	.....	**3.47**	**33.17**
	Hopkinsville	4878	......	....	4.51	1.68	6.19	1.84	2.23	.....	3.71	18.78
	Nicholasville	4957	......	....	9.79	3.91	13.70	3.04	3.69	......	2.80	30.23
Potato and Tobacco Grower.	*Official*, **1898**	**4158**	......	......	**10 13**	**3.58**	**13 71**	**2 53**	**3 07**	.....	**3.23**	**29 35**
	Elmo	4317	......	......	9.48	2.75	12.23	1.97	2.39	.....	4.27	27.53
	Elkton	4970	....	.....	12.43	5.17	17.60	1.26	1.53	...	1.41	26.37
Bone Meal.	*Official*, **1897**	**3917**	**16.41**	**1.70**	....	....	**18.11**	**3.01**	**3.65**	.....	......	**24.69**
	Elkton	4971	10.45	8.87	.....	....	19.32	3.85	4.67	.....	...	27.16
Homestead Corn and Wheat Grower.	*Official*, **1898**	**4274**	......	......	**10.44**	**0.72**	**11.16**	**2.33**	**2.83**	**1.94**	.....	**25.47**
	Pulaski...........	4890	......	......	9.68	0.75	10.43	2.17	2.63	2.06	.....	24.00
	Somerset	4958	......	....	9.95	0.83	10.78	2.33	2.83	1.87	......	24.75

TABLE I—Continued

Name of Brand.	Sample.	Station Number.	Pounds in the Hundred.									Estimated Value per Ton.
			Phosphoric Acid.							Potash.		
			In Fine Bone.	In Medium Bone.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	
Homestead Corn and Wheat Grower.	*Official*, 1898	**4221**	.....	.....	**10.35**	**1.29**	**11.64**	**2.54**	**3.08**	**3.29**	.....	**$27.98**
	Fulton	4941	.....	.....	10.21	1.28	11.49	2.17	2.63	2.07	.....	25.01
Red Line Complete Manure.	*Official*, 1898	**4228**	.....	.....	**9.12**	**2.62**	**11.74**	**1.26**	**1.53**	**2.08**	.....	**20.99**
	Somerset....... ...	4942	.....	.....	8.76	1.15	9.91	1.08	1.31	1.70	.....	18.66
H S. B. Acidulated Bone.	*Official*, 1898	**4169**	.....	.....	**9.76**	**3.01**	**12.77**	**1.38**	**1.68**	.....	.....	**20.00**
	Harned	4724	.....	.....	9.42	3.94	13.36	1.52	1.85	.....	.....	20.48
H. S. B. Fine Raw Bone.	*Official*, 1898	**4165**	**14.75**	**9.04**	.....	.....	**23.79**	**4.03**	**4.89**	.....	.....	**31.33**
	Hopkinsville.....	4879	16.82	5.26	.....	.....	22.08	4.00	4.86	.....	.....	30.62
	Elkton...........	4891	17.31	6.31	.....	.....	23.62	3.59	4.36	.....	.....	30.21
H. S B. Ky. Tobacco Grower.	*Official*, 1898	**4167**	.....	.....	**6.72**	**1.66**	**8.38**	**2.58**	**3.13**	.....	**2.01**	**22.08**
	Paducah.........	4881	.....	.....	6.97	1.64	8.61	2.35	2.85	.....	2.92	22.90

H. S. B. Bone and Potash.	*Official*, 1898......	4170	......	......	11.17	2.85	14.02	0.61	0.74	....	1.12	20.78
	Elkton......	4892	......	......	9.11	3.59	12.70	1.29	1.57	......	1.15	20.68
H. S. B. Raw Bone and Phosphate Mixture.	*Official*, 1898	4178	......	......	9.46	5.94	15.40	3.51	4.26	......	0.74	29.54
	Elkton............	4893	......	......	10.33	5.46	15.79	2.56	3.11	......	0.56	26.93
Read's High Grade Tobacco Grower.	*Official*, 1898.......	4283	......	......	8.47	2.24	10.71	1.76	2.14	4.47	......	24.50
	Bowling Green....	4361	......	......	6.25	2.85	9.10	2.17	2.63	5.01	......	23.79
	Bowling Green......	4993	......	......	7.21	3.34	10.55	1.89	2.29	4.43	......	23.70
Ox Bone With Ammonia and Potash.	*Official*, 1898.......	4154	......	......	10.72	2.11	12.83	0.93	1.13	1.13	......	20.69
	Murray...........	4961	......	......	9.70	4.90	14.60	1.16	1.41	1.65	......	22.07
Ox Alkaline Bone.	*Official*, 1898......	4216	......	......	10.63	1.24	11.87	.....	......	2.27	.....	18.22
	Murray..........	4968	....	......	12.01	6.08	18.09	.....	.....	1.38	....	21.51
Capital Tobacco Fertilizer.	*Official*, 1898.......	4146	......	.....	6.65	1.52	8.17	3.98	4.83	3.88	0.93	29.96
	Shelbyville.	4415	......	......	7.83	1.82	9.65	3.79	4.60	3.02	.....	28.76
	Shelbyville.........	4429	......	......	8.35	1.88	10.23	3.54	4.30	2 61	......	28.15

TABLE 1—Continued.

Name of Brand.	Sample.	Station Number.	Pounds in the Hundred. Phosphoric Acid. In Fine Bone.	In Medium Bone.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	Potash. From Muriate	From Sulphate.	Estimated Value per Ton.
Champion Corn Grower.	*Official*, 1896	3224	......	......	9.01	1.34	10.35	1.01	1.23	2.12	......	$19.36
	Shelbyville	4416	....	......	9.43	1.62	11.05	1.53	1.86	1.95	.....	21.71
National Tobacco Fertilizer.	*Official*, 1895	2811	......	.....	7.69	1.69	9.38	1.89	2.29	3.98	.....	23.02
	Carlisle	4447	......	......	8.38	0.72	9.10	1.64	1.99	3.80	......	22.39
Beef, Blood and Bone Fertilizer.	*Official*, 1898	4148	....	.....	8.17	4.43	12.60	1.91	2.32	2.17	......	22.95
	Princeton	4991	......	.....	8.32	3.76	12.08	1.70	2.06	2.20	......	22.12
Capital Bone Potash Compound.	*Official*, 1898	4144	......	......	9.64	1.80	11.44	......	.....	1.70	......	16.44
	Princeton	4992	......	.....	9.31	1.70	11.01	......	......	2.50	......	16.88

DESCRIPTION OF SAMPLES IN TABLE II.

A. BUTTON & SON, LOUISVILLE, KY.

No. 4995—Invincible Bone Meal, collected by deputy inspector from stock of A. Button & Son, Louisville, Ky.

THE LOUISVILLE FERTILIZER WORKS, LOUISVILLE, KY.

No. 4782—Bone Meal, sent by E. B. Oglesby, Cloverport, Ky.

MERIDIAN FERTILIZER FACTORY, MERIDIAN, MISS.

No. 4994—Meridian Home Mixture, collected by deputy inspector from stock of W. J. Goodwin, Somerset, Ky

NATIONAL FERTILIZER CO., NASHVILLE, TENN.

No. 4810—Sadler's Formula, sent by F. L. Ellis & Co., Hopkinsville, Ky.

SWIFT & CO., CHICAGO, ILL.

No. 4831—Raw Bone Meal, sent by John E. Daily, Caneyville, Ky.

TENNESSEE CHEMICAL CO., NASHVILLE, TENN.

No. 4969—Ox Alkaline Bone, collected by deputy inspector from stock of J. W. Bearce & Co. Bowling Green, Ky.

All analyses in Table II marked "Found" compared with the "guaranteed" analyses in bold face type, are of the samples furnished by manufacturers when entering their goods for sale.

TABLE II.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.	In Fine Bone.
	A. D. Adair & McCarty Bros., Atlanta, Ga.	See Furman Farm Improvement Company		
4358	The Armour Fertilizer Works, Chicago, Ill.	Bone, Blood and Potash	Guaranteed	
			Found	
4571	A. Button & Son, Louisville, Ky.	Invincible Bone Meal	Guaranteed	
			Found	22.18
4995			Louisville	21.75
	Wm. Casler, Louisville, Ky.	See R. H. Hoskins		
4443	Continental Fertilizer Co., Nashville, Tenn.	Bear Wheat Grower	Guaranteed	
			Found	
4444	Same.	Bear Dissolved Bone	Guaranteed	
			Found	
4625	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Crocker's Universal Grain Grower	Guaranteed	
			Found	
4357	The Currie Fertilizer Co., Louisville, Ky.	Currie's Tobacco and Potato Grower	Guaranteed	
			Found	
4508	Same.	Currie's Butchertown Raw Bone Meal	Guaranteed	
			Found	
4509	Same.	Currie's Raw Bone Meal	Guaranteed	
			Found	6.74
4510	Same.	Currie's Fine Ground Raw Bone Meal	Guaranteed	
			Found	17.04
4511	Same.	Currie's Wheat Grower	Guaranteed	
			Found	
4353	Dunn & Backer, Troy, Ind.	No. 2 Potato, Corn and Tobacco Grower	Guaranteed	
			Found	

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.
.....	.....	**6.00**	**2.00**	**8.00**	.....	**10.00**	**4.11**	**5.00**	.....	**7.00**	**$36.39**	4358
.....	.....	.....	.....	9.08	1.91	10.99	4.52	5.49	.....	7.36	39.79	
.....	.....	.....	.....	.....	.....	**22.00**	**3.30**	**4.00**	.....	.....	**29.15**	4571
22.18	.....	.....	.....	.....	.....	22.18	3.82	4.64	.....	.....	31.11	
21.75	.....	.....	.....	.....	.....	21.75	4.11	4.99	.....	.....	31.79	4995
.....	.....	**9.00**	**2.00**	**11.00**	.....	**12.00**	.....	.....	**2.00**	.....	**18.30**	4443
.....	.....	.....	.....	10.62	2.67	13.29	.....	.....	2.21	.....	18.86	
.....	.....	**8.00**	**6.00**	**14.00**	.....	**15.00**	.....	.....	.....	.....	**14.00**	4444
.....	.....	.....	.....	13.79	2.53	16.32	.....	.....	.....	.....	13.79	
.....	.....	**6.00**	**1.00**	**7.00**	.....	**8.00**	**0.82**	**1.00**	**2.70**	.....	**16.41**	4625
.....	.....	.....	.....	7.64	1.79	9.43	1.30	1.58	3.35	....	20.17	
.....	.....	.....	.....	**7.00**	.....	**8.00**	**2.06**	**2.50**	.....	**8.00**	**28.71**	4357
.....	.....	.....	.....	8.40	3.63	12.03	1.39	1.69	.....	11.49	34.54	
.....	.....	**5.00**	**5.25**	**10.25**	.....	**15.00**	**0.82**	**1.00**	.....	**1.25**	**21.35**	4508
.....	.....	.....	.....	10.97	6.97	17.94	2.29	2.78	.....	0.84	28.05	
.....	.....	.....	.....	.....	.....	**22.00**	**3.71**	**4.50**	.....	.....	**27.48**	4509
6.74	16.34	.....	.....	.....	.....	23.08	3.81	4.63	.....	.....	28.53	
.....	.....	.....	.....	.....	.....	**23.00**	**1.65**	**2.00**	.....	.....	**23.76**	4510
17.04	1.69	.....	.....	.....	.....	18.73	1.29	1.57	.....	.....	19.16	
.....	.....	**8.50**	**2.50**	**11.00**	.....	**14.00**	**0.41**	**0.50**	.....	**1.25**	**20.09**	4511
.....	.....	.....	.....	12.14	2.85	14.99	0.45	0.55	.....	1.74	22.45	
.....	.....	.....	.....	**7.00**	.....	**10.00**	**1.65**	**2.00**	**3.00**	......	**20.68**	4353
.....	.....	.....	.....	8.61	1.71	10.32	2.27	2.76	4.64	......	26.43	

TABLE II.—Continued.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	ANALYSIS.
4354	Dunn & Backer, Troy, Ind....	No. 3 Tobacco &c Grower....	Guaranteed
			Found.......
4355	Same.	No. 8 Grower, Raw Bone and Tankage Mixture..........	Guaranteed
			Found.....
4356	Same.	No. 9 Grower, Pure Raw Bone Meal......................	Guaranteed
			Found.....
4292	Furman Farm Improvement Co., Atlanta, Ga.	Furman Soluble Bone With Ammonia and Potash...	Guaranteed
			Found.....
4293	Same.	Farish Furman Formula......	Guaranteed
			Found.....
4341	Same.	Furman High Grade Fertilizer	Guaranteed
			Found.....
4659	Globe Fertilizer Co., Louisville, Ky.	Globe Bone Meal................	Guaranteed
			Found.....
	Greer Machinery Co., Knoxville, Tenn.	See Southern Fertilizer Co......	
4497	R. H. Hoskins, Louisville, Ky.	Champion Raw Bone Meal....	Guaranteed
			Found......
4506	The Jarecki Chemical Co., Sandusky, O.	Lake Erie Fish Guano........	Guaranteed
			Found.......
4278	The Louisville Fertilizer Works, Louisville, Ky.	Corn and Wheat Grower......	Guaranteed
			Found.....
4494	Same.	Bone Meal.....................	Guaranteed
			Found.....
4782			Cloverport.
4524	Same.	Soluble Bone and Potash......	Guaranteed
			Found.......

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.
......	......	......	......	8.00	......	11.00	2.47	3.00	5.00	....	$27.35	4354
......	......	......	......	7.90	2.21	10.11	2.73	3.31	6.15	......	29.11	
......	......	......	......	......	......	15.00	3.30	4.00	.....	......	22.76	4355
10.89	3.90	......	......	......	.....	14.79	4.15	5.04	... ...	....	25.58	
......	......	......	......	......	......	25.00	3.71	4.50	......	......	31.06	4356
15.47	9.68	......	......	......	......	25.15	3.88	4.71	......	.....	31.77	
......	......	......	......	10.00	2.00	12.00	0.82	1.00	2.00	.....	20.27	4292
......	......	......	......	9.78	3.84	13.62	0.95	1.15	1.63	.....	20.90	
......	......	......	......	10.00	2.00	12.00	......	......	2.00	....	17.40	4293
......	...	......	......	12.16	3.04	15.20	......	.....	2.37	......	21.38	
......	......	6.00	3.00	9.00	.....	11.00	1.65	2.00	2.00	....	21.78	4341
......	......	......	......	8.11	2.89	11.00	2.16	2.62	2.54	....	23.41	
......	......	......	......	......	......	20.00	3.30	4.00	......	......	25.61	4659
13.68	12.88	......	......	......	......	26.56	3.51	4.26	......	......	30.96	
......	......	......	......	......	......	22.00	3.30	4.00	.....	.....	29.15	4497
23.46	......	......	......	......	......	23.46	4.27	5.18	......	......	33.72	
......	.....	8.00	2.00	10.00	......	12.00	1.65	2.00	0.50	0.50	22.08	4506
......	......	......	......	10.72	2.52	13.24	1.67	2.03	1.65	.....	24.10	
......	......	.....	......	10.00	......	......	0.21	0.25	.....	0.25	15.09	4278
......	......	......	......	11.57	1.82	13.39	0.56	0.68	......	0.09	19.20	
......	......	......	......	......	......	18.00	1.65	2.00	......	.....	24.48	4494
.....	.....	......	......	12.35	8.30	20.65	1.78	2.16	......	......	27.67	
......	......	......	......	11.56	5.90	17.46	1.68	2.04	.....	....	25.01	4782
......	......	......	......	8.00	......	10.00	0.82	1.00	......	1.50	17.17	4524
......	......	......	.....	9.01	3.16	12.17	1.36	1.65	......	1.14	20.55	

TABLE II—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.	In Fine Bone.
4314	A. B. Mayer Manufacturing Co., St. Louis, Mo........	Anchor Brand Complete Fertilizer..........................	Guaranteed	... ...
			Found.....	......
4315	Same.	Anchor Brand Corn and Wheat Grower....	Guaranteed	......
			Found.....	......
4316	Same.	Anchor Brand Pure Bone Meal................................	Guaranteed	......
			Found.....	14.85
4543	Meridian Fertilizer Factory, Meridian, Miss..............	Meridian Home Mixture.......	Guaranteed	......
			Found.....	......
4994			Somerset...	......
4544	Same.	Meridian Corn and Wheat Grower............................	Guaranteed	......
			Found.....	......
4578	Michigan Carbon Works, Detroit, Mich....................	Jarves Drill Phosphate.......	Guaranteed	.....
			Found.....	.....
4307	National Fertilizer Co., Nashville, Tenn......................	Acid Phosphate..................	Guaranteed	.....
			Found....	.....
4308	Same.	Acid Phosphate with Potash (Sadler's Formula.)	Guaranteed	.....
			Found.....	.....
4309	Same.	Tobacco Grower.............	Guaranteed	......
			Found.....	......
4310	Same.	Tobacco Fertilizer............	Guaranteed	......
			Found....	......
4311	Same.	Bone Meal,................................	Guaranteed	......
			Found.....	21.77
4312	Same.	Corn Grower.......................	Guaranteed	......
			Found.....	......
4588	Same.	Wheat Grower..................	Guaranteed	.....
			Found.....	.....

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.
....	....	4.00	4.00	8.00	....	12.00	2.88	3.50	....	3.75	$28.53	4314
....	....	....	....	8.80	3.89	12.69	2.97	3.61	....	1.86	27.27	
....	....	4.00	5.00	9.00	....	12.00	3.30	4.00	....	2.50	29.15	4315
....	....	....	....	9.46	4.06	13.52	2.76	3.35	....	2.25	28.08	
....	....	....	....	....	....	22.00	3.71	4.50	....	....	29.21	4316
14.85	6.77	....	....	....	....	21.62	3.76	4.56	....	....	29.10	
....	....	8.00	2.00	10.00	....	11.00	2.47	3.00	2.50	....	26.15	4543
....	....	....	....	9.66	0.63	10.29	2.57	3.12	2.73	....	26.12	
....	....	....	....	10.09	0.82	10.91	2.37	2.88	2.59	....	25.95	4994
....	....	8.00	2.00	10.00	....	11.00	2.47	3.00	2.50	....	26.15	4544
....	....	....	....	9.48	0.79	10.27	2.49	3.02	2.65	....	25.57	
....	....	....	....	8.00	....	10.00	1.03	1.25	....	0.75	16.86	4578
....	....	....	....	8.52	2.15	10.67	1.65	2.00	0.85	....	19.81	
....	....	....	....	15.00	....	....	....	....	....	....	15.00	4307
....	....	....	....	17.97	1.19	19.16	....	....	....	....	17.97	
....	....	....	....	12.00	....	....	....	....	2.00	....	19.20	4308
....	....	....	....	13.14	0.70	13.84	....	....	5.19	....	24.98	
....	....	....	....	10.00	....	....	1.65	2.00	2.00	....	22.18	4309
....	....	....	....	13.33	3.20	16.53	1.06	1.29	1.43	....	25.69	
....	....	....	....	10.00	....	....	2.06	2.50	3.00	....	24.81	4310
....	....	....	....	11.24	3.20	14.44	1.97	2.39	3.43	....	28.36	
....	....	....	....	....	....	20.00	2.47	3.00	....	....	24.65	4311
21.77	....	....	....	....	....	21.77	4.01	4.87	....	....	31.46	
....	....	....	....	12.00	....	....	0.82	1.00	1.00	....	20.87	4312
....	....	....	....	14.86	1.77	16.63	0.49	0.59	0.68	....	24.23	
....	....	....	....	10.00	....	....	1.65	2.00	2.00	....	22.18	4588
....	....	....	....	11.43	1.41	12.84	1.81	2.20	2.37	....	25.89	

TABLE II—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.	In Fine Bone.
4589	National Fertilizer Company, Nashville, Tenn.	Sadler's Formula	Guaranteed	.....
			Found	.....
4810			Hopkinsville	.....
4590	Same.	National Dissolved Bone	Guaranteed	.....
			Found	.....
4591	Same.	Pure Bone Meal	Guaranteed	.....
			Found	15.83
4507	The E. Rauh & Sons Fertilizer Co., Indianapolis, Ind.	Pure Raw Bone	Guaranteed	.....
			Found	18.14
4503	Read Fertilizer Co., Charleston, S. C.	Farmers Special Manure	Guaranteed	.....
			Found	.....
4504	Same.	X X X Dissolved Bone	Guaranteed	.....
			Found	.....
4505	Same.	Read's High Grade Special Potash Mixture	Guaranteed	.....
			Found	.....
4580	Same.	Read's Wheat Grower	Guaranteed	.....
			Found	.....
4726	Same.	Matchless Acid Phosphate	Guaranteed	.....
			Found	.....
4318	The J. & F. Schroth Packing Co., Cincinnati, O.	Schroth's Special	Guaranteed	.....
			Found	.....
4319	Same.	Corn & Wheat Grower	Guaranteed	.....
			Found	.....
4672	J. F. & W. H. Singer, Nashville, Tenn.	Standard Bone Meal	Guaranteed	.....
			Found	18.53
4673	Same.	Singer's No. 2 Wheat Grower	Guaranteed	.....
			Found	.....

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.
.....	.....	.....	.....	**12.00**	.....	.....	.....	.....	**2.00**	.....	**$19.20**	4589
.....	.....	.....	.....	14.39	0.35	14.74	.....	.....	1.92	.....	22.63	
.....	.....	.....	.....	13.97	3.51	17.48	.....	.....	1.97	.....	23.68	4810
.....	.....	.....	.....	**12.00**	.....	.....	**0.82**	**1.00**	**1.00**	.....	**20.87**	4590
.....	.....	.....	.....	13.00	1.23	14.23	0.90	1.09	1.67	.....	23.97	
.....	.....	.....	.....	.....	.....	**20.00**	**2.47**	**3.00**	.....	.....	**23.46**	4591
15.83	6.66	.....	.....	.....	.....	22.49	3.87	4.70	.....	.....	30.21	
.....	.....	.....	.....	.....	.....	**22.00**	**4.00**	**4.86**	.....	.....	**30.44**	4507
18.14	6.47	.....	.....	.....	.....	24.61	3.19	3.87	.....	.....	29.56	
.....	.....	.....	.....	**10.00**	.....	**11.00**	**0.82**	**1.00**	**3.00**	.....	**20.97**	4503
.....	.....	.....	.....	9.63	2.38	12.01	0.99	1.20	3.31	.....	22.11	
.....	.....	.....	.....	**13.00**	.....	**14.00**	.....	.....	.....	.....	**13.00**	4504
.....	.....	.....	.....	12.92	2.42	15.34	.....	.....	.....	.....	12.92	
.....	.....	.....	.....	**10.00**	.....	**11.00**	.....	.....	**4.00**	.....	**19.30**	4505
.....	.....	.....	.....	11.65	1.92	13.57	.....	.....	4.48	.....	22.65	
.....	.....	.....	.....	**10.00**	.....	**11.00**	**1.65**	**2.00**	**2.00**	.....	**22.68**	4580
.....	.....	.....	.....	9.62	2.79	12.41	2.09	2.54	2.32	.....	24.97	
.....	.....	.....	.....	**12.00**	.....	**14.00**	.....	.....	.....	.....	**12.00**	4726
.....	.....	.....	.....	13.97	3.15	17.12	.....	.....	.....	.....	13.97	
.....	.....	.....	.....	**7.00**	.....	**10.00**	**1.65**	**2.00**	**1.00**	.....	**18.28**	4318
.....	.....	.....	.....	7.87	3.95	11.82	2.10	2.55	1.28	.....	21.89	
.....	.....	.....	.....	**9.00**	.....	**12.00**	**3.30**	**4.00**	**4.00**	.....	**30.45**	4319
.....	.....	.....	.....	8.61	3.62	12.23	3.91	4.75	5.01	.....	33.56	
.....	.....	.....	.....	.....	.....	**21.00**	**3.00**	**3.64**	.....	.....	**25.86**	4672
18.53	9.67	.....	.....	.....	.....	28.20	2.00	2.43	.....	.....	27.62	
.....	.....	.....	.....	**6.00**	.....	**20.00**	**2.00**	**2.43**	.....	**2.00**	**25.20**	4673
.....	.....	.....	.....	6.36	16.21	22.57	1.77	2.15	.....	1.83	25.77	

TABLE II—Continued.

Station Number.	Name and Address of Manufacturer.	Name of Brand.	Analysis.
4500	Southern Fertilizer Co., Rome, Ga.	Greer's Compound Fertilizer...	Guaranteed
			Found.....
4515	Standard Guano & Chemical Mfg. Co., New Orleans, La.	Pure Ground Bone......	Guaranteed
			Found.....
4303	Swift & Company, Chicago, Ill.	Ground Steamed Bone........	Guaranteed
			Found.....
4304	Same.	Bone and Potash 3 per cent...	Guaranteed
			Found.......
4305	Same.	Bone Tankage and Potash 3 per cent...	Guaranteed
			Found.....
4306	Same.	Potato and Tobacco Grower	Guaranteed
			Found.....
4379	Same.	Raw Bone Meal.............	Guaranteed
			Found.....
4831			Caneyville.
4380	Same.	Bone Tankage...............	Guaranteed
			Found...
4381	Same.	Superphosphate	Guaranteed
			Found...
4445	Tennessee Chemical Company Nashville, Tenn.	Ox Ammoniated Bone.........	Guaranteed
			Found.......
4446	Same.	Ox Alkaline Bone...............	Guaranteed
			Found ....
4969			Bowling Green....
4660	Same.	Bone Meal....................	Guaranteed
			Found.......

December 31st, 1898. M. A. Scovell, Director.

SIS.

	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.
teed	......	......	9.00	3.00	12.00	......	14.00	......	.....	2.00	....	$20.20	4500
....	......	......	....	......	14.93	2.39	17.32	....	.. ..	2.21	......	24.75	
teed	......	......	.....	....	......	.....	20.00	3.09	3.75	......	......	25.35	4515
....	15.10	8.75	......	......	......	.....	23.85	4.04	4.90	......	....	31.47	
teed	.....	.....	......	....	......	.....	23.75	3.28	4.00	......	.....	30.07	4303
.....	24.18	2.25	.....	......	.....	....	26.43	2.95	3.58	......	......	31.02	
teed	.....	.....	....	......	.....	....	24.50	2.05	2.50	.....	3.00	30.59	4304
......	23.02	2.00	.....	......	.....	......	25.02	2.73	3.31	.....	3.49	34.07	
teed	......	.....	.....	.....	.....	.....	17.00	4.92	6.00	.....	3.00	34.56	4305
.....	14.24	2.24	.....	......	.....	....	16.48	5.40	6.56	.....	1.70	34.01	
teed	.....	.....	8.00	2.00	10.00	.....	12.00	3.28	4.00	....	5.00	33.48	4306
.....	.....	.....	.....	.. ..	9.41	3.26	12.67	3.23	3.92	.....	4.84	32.89	
teed	.....	.....	.....	.....	.....	.....	23.00	3.70	4.50	....	......	30.08	4379
.....	18.15	6.92	....	......	....	.....	25.07	3.90	4.73	......	......	32.32	
ville.	14.47	10.48	.....	.....	.....	.....	24.95	4.03	4.89	.....	.....	31.98	4831
nteed	.....	.....	.....	......	.....	....	17.00	4.92	6.00	.....	....	30.38	4380
....	15.69	2.37	.....	.....	......	.....	18.06	5.17	6.28	.....	.....	32.07	
teed	.....	.....	6.00	2.00	8.00	.....	10.00	2.46	3.00	......	2.00	23.61	4381
l....	.....	. ..	.....	.....	9.31	2.78	12.09	2.64	3.20	.....	1.42	25.65	
nteed	.....	.....	6.00	4.00	10.00	.....	11.00	1.65	2.00	2.00	.....	22.68	4445
l.......	.....	.....	.....	.....	10.62	2.53	13.15	1.97	2.39	2.54	.....	26.09	
nteed	.....	....	9.00	3.00	12.00	.....	13.00	....	....	2.00	....	19.70	4446
l	.....	.....	.....	.....	10.74	2.67	13.41	.....	.....	2.58	.....	19.48	
Green....	.....	.....	....	.....	13.01	1.55	14.56	....	....	1.96	.....	21.34	4969
nteed	.....	.....	.....	.....	.....	.....	23.00	2.47	3.00	....	.....	26.74	4660
l.	25.69	1.87	.....	......	.....	......	27.56	2.11	2.56	.....	.....	29.06	

r.

A. M. Peter, H. E. Curtis, Chemists.

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