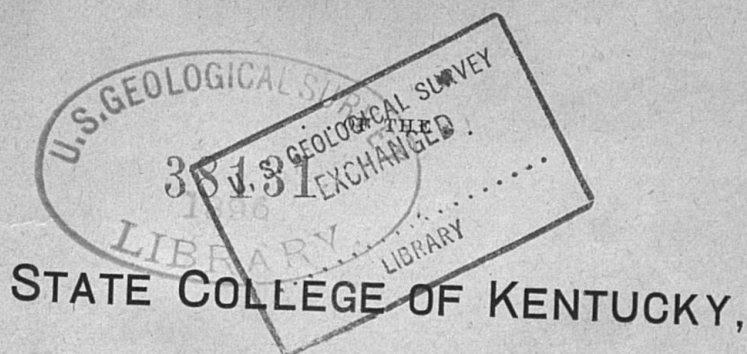


EIGHTH ANNUAL REPORT

OF THE . . .

KENTUCKY

AGRICULTURAL EXPERIMENT STATION



STATE COLLEGE OF KENTUCKY,

FOR THE YEAR 1895,

LEXINGTON, KENTUCKY.

LOUISVILLE, KY.
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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 an 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 Eighth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

M. A. SCOVELL, *Director.*

February 1, 1896.

AGRICULTURAL AND MECHANICAL COLLEGE OF KENTUCKY.

BOARD OF TRUSTEES.

His Excellency Gov. JOHN YOUNG BROWN, *ex-officio*, Chairman.

JAS. K. PATTERSON, President of the College, *ex-officio*.

JUDGE P. P. JOHNSTON Fayette county.
DR. R. J. SPURR Fayette county.
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*DR. J. D. CLARDY Christian county.
HON. J. R. HINDMAN Adair county.
JUDGE THOMAS H. HINES . . . Franklin county.
†GEO. V. GREEN, Esq. Christian county.

V. E. MUNCY, Secretary.

* Resigned.

† Elected to fill Dr. Clardy's place.

LIST OF OFFICERS.

BOARD OF CONTROL—TO JUNE.

J. T. GATHRIGHT, Chairman.
DR. R. J. SPURR.
DAVID H. JAMES.
R. A. SPURR.
ROBERT RIDDELL.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

BOARD OF CONTROL—AFTER JUNE.

DR. R. J. SPURR, Chairman, Greendale, Ky.
PHILEMON BIRD, Shelbyville, Ky.
A. P. GOODING, Mays Lick, Ky.
J. K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

STATION STAFF.

M. A. SCOVELL, Director.
A. M. PETER, } Chemists.
H. E. CURTIS. }
H. GARMAN, Entomologist and Botanist.
C. W. MATHEWS, Horticulturist.
*A. T. JORDAN, Assistant to Horticulturist.
T. S. HAWKINS, Foreman of Farm.
V. E. MUNCY, Weather Observer.
MISS ALICE M. SHELBY, Stenographer.
*Resigned March 1st.

ADDRESS OF THE STATION,
LEXINGTON, KENTUCKY.

*THE KENTUCKY AGRICULTURAL EXPERIMENT STATION IN
ACCOUNT WITH THE UNITED STATES APPROPRIATION.*

1895.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1895, as per act of Congress approved March 2, 1887 \$15,000.00

By salaries	\$9,356.66	
Labor	2,145.00	
Publications	830.83	
Postage and stationery	186.05	
Freight and express	71.56	
Heat, light and water	75.43	
Chemical supplies	106.89	
Seeds, plants and sundry supplies	516.34	
Fertilizers	2.00	
Feeding stuffs	1.00	
Library	375.60	
Tools, implements and machinery	375.50	
Furniture and fixtures	82.07	
Scientific apparatus	7.50	
Traveling expenses	58.65	
Contingent expenses	105.53	
Building and repairs	703.39	
		\$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, 1895, 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, and the corresponding disbursements \$15,000, 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,

D. H. JAMES,

A. P. GOODING,

RICH. A. SPURR,

Auditors.

Attest: JAS. G. WHITE, *Custodian.*

ANNUAL REPORT
— OF THE —
KENTUCKY AGRICULTURAL EXPERIMENT STATION
FOR 1895.

REPORT OF THE DIRECTOR.

In the work of the Station the past year no effort has been made to take up new lines of investigation. With the present funds at our disposal it has been thought best to strengthen the limited lines already undertaken rather than to take up new work.

The Staff.

Mr. A. T. Jordan, assistant to the horticulturist, resigned his position last March in order to take up horticultural work with the New Jersey Agricultural Experiment Station. The rest of the force is as it has been heretofore, namely: M. A. Scovell, director; A. M. Peter, H. E. Curtis, chemists; H. Garman, entomologist and botanist; C. W. Mathews, horticulturist; T. S. Hawkins, foreman of farm; V. E. Muncy, weather observer; Miss Alice M. Shelby, stenographer.

Equipment.

The facilities for the work of the Chemical Division have been greatly increased by the addition to the laboratory of the room used by the late Dr. Robert Peter, as the laboratory of the State Geological Survey. This is about

half the size of the main laboratory and is equipped with ventilating hoods, work tables, etc., in the same manner as the general laboratory. The equipment of our chemical laboratory is very complete.

An insectary has been built for Prof. Garman, costing \$1,000. Prof. Garman has personally superintended the construction of it. It is constructed with all the latest modern improvements, such as slate and tile benches, etc. A \$2,000 dairy-house for experimental purposes is under construction and will be ready for our experiments in 1896. It contains a cheese room, an engine room, a general work room, and a cream and butter room, and an ice-house attached.

Analysis and Inspection of Commercial Fertilizers.

In accordance with the State law we have continued the inspection and analysis of commercial fertilizers. This has taken the greater portion of the time of one of our chemists. The use of fertilizers is constantly increasing in our State, and, consequently, this work becomes greater from year to year. The revenue, however, obtained from this source fully meets the expenses incurred, but the time may come, as the farmers become more acquainted with the use of fertilizers, when so many samples may be sent in for free analysis that the funds accruing from this source may not meet the expenses incurred. The results of our analyses and inspections are given in bulletins numbers 56 and 60.

Crop Tests.

We have continued the tests of crops mainly for the purpose of studying varieties. These varietal tests have been under the charge mostly of the Horticultural Division, and may be found in the report of Prof. Mathews, herein incorporated.

Grass Plots.

Prof. Garman has continued and enlarged the tests of the different varieties of grasses, clover and forage plants.

Study of Methods of Analysis.

This feature of the Station's work has been of great usefulness. The work has reference both to the development of new and approved apparatus and adoption and use of chemical methods. The work under Prof. Peter has been confined almost entirely to the study of soil analysis. As stated last year, if a method of soil analysis can be discovered whereby we can tell the available amount of plant food to a certainty in any soil, a great problem in agricultural science will have been solved, and one which will be of incalculable value to agriculture.

The Use of Paris Green to Destroy the Tobacco Worm.

The experiments in this line have been continued on a more extensive scale than those of last year, and the results may be found in Prof. Garman's report, found elsewhere in this report.

Butter-Fat in Milk.

We have continued our experiments in the study of the variations of butter-fat in the milk of cows, and our records now cover nearly five years of continuous work. It is hoped that these results may be published in bulletin form.

Publications.

The publications of the Station since our last annual report are as follows:

- | | |
|------------------|-------------------------------------|
| Bulletin No. 54. | Notes on Vegetables. |
| Bulletin No. 55. | Field Experiments with Fertilizers. |
| | 1.—Corn. |
| | 2.—Potatoes. |
| | 3.—Tobacco. |
| | 4.—Hemp. |
| Bulletin No. 56. | Analyses of Commercial Fertilizers. |
| Bulletin No. 57. | 1.—Wheat Experiments. |
| | 2.—Oats Experiments. |

- | | |
|------------------|---|
| Bulletin No. 58. | Cutworms in Kentucky. |
| Bulletin No. 59. | Spraying Experiments in 1895. |
| Bulletin No. 60. | Analyses of Commercial Fertilizers. |
| | I. Official Analyses. |
| | II. Analyses of Farmers' and Inspectors' Samples. |

The reports from the divisions follow, after which the bulletins published during the year are incorporated in this report.

M. A. SCOVELL, *Director*.

DIVISION OF CHEMISTRY.

M. A. Scovell, Director:

Dear Sir—The work of the Chemical Division in 1895 has been of the same character as last year. The analyses of commercial fertilizers have been published in Bulletins 56 and 60. The work upon the presence of arsenic and copper in sprayed tobacco has been continued and the results will be incorporated in a forthcoming bulletin on tobacco. A brief note on the presence of arsenic and copper in sprayed apples was published in Bulletin 59 in connection with the work of Prof. Garman on the spraying of apples.

The work on methods of analysis, as usual, occupied much time and attention, especially that upon soil and ash analysis. The results obtained so far, taken in connection with those reported by other chemists at the last meeting of the Association of Official Agricultural Chemists, seem to show that the proposed method of determining the availability of potash and phosphoric acid in soils by means of dilute oxalic acid is the most promising one that has been tried, but more work is still needed on this question. A part of our results will appear in the Proceedings of the Association of Official Agricultural Chemists.

Two examinations for poison in suspected poisoning of stock have been made, in one of which strychnine was detected in the stomach.

The daily tests of fat in the milk of the Station herd have been continued as usual.

Quite a number of minerals and rocks have been identified and examined qualitatively and several sanitary analyses of water have been made, but the results are not considered of sufficient interest for publication. All the analyses that are of any general interest or deserve permanent record are given in the following pages:

Sorghum Cane.

Two lots of seed were planted at the Station farm, one of one-half acre on acre J from mixed seed of the previous year; the other of one-tenth acre on acre S being from a single head of the same cane. The variety was "Colmans." Ninety-two separate stalks were examined, taking an equal number from each acre. Each stalk was run through a hand mill and the amount of juice measured, and the specific gravity taken. If these data were satisfactory, the reducing sugars were determined by copper solution and the cane sugar by double polarization. The results are given in the following tables:

CANE JUICE, ACRE J.—MIXED SEED.

Station Number.	Date	No. C.C. of Juice	Specific Gravity.	Degrees Brix.	Reducing Sugar Per cent. . .	Cane Sugar. Per Cent.	Co-efficient of Purity . . .
3068	Sept. 23	440	1.071	17.2	2.17	12.63	73.4
3069	"	370	1.071	17.2	2.48	12.10	70.3
3087	Sept. 26	350	1.076	18.4	3.75	12.14	66.0
3088	"	300	1.076	18.4	4.07	11.80	64.1
3091	"	400	1.071	17.2	4.49	10.80	62.8
3092	"	275	1.073	17.7	4.90	11.11	62.8
3094	"	255	1.076	18.4	3.57	12.61	68.5
3109	Sept. 30	310	1.077	18.6	2.71	12.42	66.8
3110	"	290	1.087	20.8	1.72	15.13	72.7
3111	"	290	1.090	21.5	1.48	16.13	75.0
3113	"	370	1.082	19.7	2.23	13.75	69.8
3115	"	280	1.080	19.3	2.56	13.42	69.5
3128	"	390	1.077	18.6	1.97	13.06	70.2
Average		332	1.077	18.6	2.93	12.85	69.1

CANE JUICE, ACRE S.

3080	Sept. 23	370	1.077	18.6	3.25	12.72	68.4
3082	"	320	1.088	21.1	1.52	16.07	76.2
3084	"	275	1.078	18.8	2.56	13.58	72.2
3100	Sept. 26	200	1.085	20.4	2.56	14.87	72.9
3103	"	300	1.071	17.2	4.91	10.11	58.8
3105	"	240	1.078	18.8	3.57	13.22	70.3
3122	Sept. 30	330	1.083	20.0	2.90	13.35	66.8
3126	"	410	1.081	19.5	3.34	12.79	65.6
3127	"	330	1.080	19.3	3.45	12.97	67.2
Average		308	1.080	19.3	3.12	13.30	68.9

Butter.

2822. Butter brought by Mr. Bishop Clay, Lexington, Ky.

2941. Butter made at Station from milk of Jersey cow Miami's Signaldina, milkings of April 15th and 16th, 1895.

2944. Same as preceding, milkings of April 17th and 18th, 1895.

2954. Same as preceding, milkings of April 19th, 20th, and 21st, 1895.

ANALYSES.

Number.	2822	2941	2944	2954
Fat	75.15	81.83	82.99	78.98
Water	14.44	11.86	12.40	13.15
Salt and Ash	8.65	5.26	3.83	6.84
Curd	1.76	1.05	.78	1.03
	100.	100.	100.	100.

Distillers' Grains.

2979 Dried distillery slop or "dried distillers' grains" sent for analysis by Eisenman, Shallcross & Co., commission merchants, Louisville, Ky.

ANALYSIS.

	As received.	Water-free.
Water	8.66	
Crude protein	29.94	32.78
Ether extract	8.94	9.83
Nitrogen-free extract	39.29	43.01
Crude fiber	11.62	12.72
Ash	1.51	1.66
	100.	100.
Albuminoids, Stutzer's method	28.88	31.62
Total nitrogen	4.79	5.24
" phosphoric acid	.79	.86
" potash	.11	.12

Sugar Beets.

3142. Klein Wantzleben Elite, sent by H. Cordez for the Kentucky Beet Sugar Company, Bowling Green, Ky. Beets harvested October 1st. The sample beet was sent to the

Station by mail and was somewhat shrivelled when received. A determination of moisture gave 84.54 per cent.

3143. Same as the preceding. Moisture 84.33.

3149. Vilmorin Blanche, sent by same firm as the preceding. Planted April 20th; harvested October 15th. Soil, a dark loam.

3150. Same as No. 3149.

3151. Same as No. 3149.

3157. Keilholz Improved Klein Wanzleben, grown at the Station farm from seed sent by Franz G. Zimpel, 37 Beaver street, New York, sole agent for Keilholz seeds. Gathered October 23d.

3158. Same as No. 3157.

3159. Keilholz Lion, Most Saccharine, grown, etc., same as No. 3157.

3160. Same as No. 3159.

3161. Keilholz Improved Imperial, grown, etc., same as No. 3157.

3162. Same as No. 3161.

3163. Same as No. 3157, collected October 24th.

3164. Same as No. 3163.

3165. Same as No. 3159, collected October 24th.

3166. Same as No. 3165.

3167. Same as No. 3161, collected October 24th.

3168. Same as No. 3167.

3169. Klein Wanzleben, sent by H. Cordez, for the Kentucky Beet Sugar Company, Bowling Green, Ky. Planted June 23d; harvested October 20th. Soil, loamy, bottom land, manured with 125 lbs. phosphate per acre. Sample consisted of two small beets, weighing, together, 340 grams.

3170. Same as 3169, except the soil was clay loam. The two beets weighed, together, 460 grams.

3176. Klein Wanzleben Elite, sent by same firm. Planted June 23d; harvested November 6th. Soil, loamy, bottom land. Four small beets were sent, which were treated as one sample.

3178. Klein Wanzleben Elite, sent by the same firm.

Planted June 23d; harvested November 18th. Sample consisted of four beets, weighing, together, 565 grams.

3179. Same as 3178. Planted August 4th; harvested November 18th. Sample consisted of two beets, weighing, respectively, 68 and 244 grams.

In making the analyses the whole or a sufficient quantity of the sample was grated to pulp, and the juice expressed with a hand press. The specific gravity of the juice was taken with a spindle, and the direct polarization was observed after clarifying the juice with lead acetate. The results are given in the following table:

SUGAR BEETS. ANALYSES OF THE JUICE.

Station No. . . .	Name of Variety.	Weight of each Beet. Grams.	Specific Gravity of the Juice @ 20° C.	Degrees. Brix. .	Cane Sugar in the Juice. Per Cent.	Co-efficient of Purity
3142	Klein Wanzleben . . .	1060	1.055	13.6	9.33	68.6
3143	"	415	1.055	13.6	8.29	61.4
3149	Vilmorin Blanche . . .	266	1.034	8.5	5.51	64.8
3150	"	383	1.030	7.55	3.62	47.9
3151	"	1055	1.033	8.3	2.38	28.7
3157	Klein Wanzleben . . .	720	1.058	14.3	8.30	58.1
3158	"	725	1.064	15.6	9.55	61.2
3159	Lion	665	1.065	15.9	10.50	66.0
3160	"	745	1.053	13.1	8.05	61.6
3161	Imperial	915	1.042	10.4	4.90	47.1
3162	"	925	1.054	13.3	7.85	59.0
3163	Klein Wanzleben . . .	885	1.058	14.25	8.65	60.3
3164	"	1215	1.057	14.0	9.00	64.3
3165	Lion	715	1.070	17.0	11.40	67.1
3166	"	1205	1.075	18.05	10.85	59.7
3167	Imperial	920	1.053	13.1	8.35	63.8
3168	"	930	1.0525	12.95	6.90	53.3
3169	Klein Wanzleben . . .	(170)	1.0467	11.6	7.25	62.5
3170	"	(230)	1.0418	10.4	6.00	57.7
3176	"	10685	1.0685	16.7	12.2	73.1
3178	"	(141)	1.0600	14.7	11.0	74.8
3179	"	(122)	1.071	17.2	12.5	72.7

Mineral Waters.

2994. Chalybeate water sent by J. M. Armstrong, Pewee Valley, Oldham county, Ky., from a well about 1,100 feet deep. The water rises to about 12 or 15 feet of the surface. Mr. Armstrong states that the water has been freely used

and "has proven very efficacious in diabetes, chronic diarrhea, kidney and kindred diseases."

The jug in which the water was received contained a ferruginous sediment, and this was included in the analysis. The analysis shows that the water is good mild chalybeate.

3014. Sulphur water sent by W. S. Davison, Hopkinsville, Christian county, Ky., from a well 150 feet deep, located on the main street of Hopkinsville. The water rises in the well to within forty feet of the surface. The water has a strong, sweetish taste, and a strong smell of sulphuretted hydrogen. The analysis of this water is very like that of the celebrated Blue Lick water.

3015. Sulphur water sent by Wm. Adair, M. D. Canmer, Hart county, Ky., from a public well recently bored in that town. Gas was struck and it burned for some time, but the supply gradually decreased. The water smelled slightly of sulphuretted hydrogen and strongly of petroleum. There was a quantity of black sediment in the bottle, consisting of sulphide of iron, and the water might, therefore, be appropriately called a "black sulphur." The amount of iron was not determined.

✓ 3016. Water from a spring on the farm of Hon. A. P. Gooding, Mays Lick, Mason county, Ky. The spring is a small one, flowing out at the foot of a hill from shaly limestones of the Lower Hudson formation. This water has recently acquired a great reputation, having produced marvelous results in stomach and kidney troubles and in consumption. Several cases of consumption that came under Mr. Gooding's observation were benefitted in a very marked manner by the use of the water. The analysis of this water strongly resembles that of the celebrated Bethesda water of Waukesha, Wis.

3152. Chalybeate water sent by L. L. Buckner, Hopkinsville, Christian county, Ky., from a well on his property.

3153. Sulphur water sent by J. W. Applegate, West Point, Hardin county, Ky., from a new gas well 321 feet deep. The water is thrown up by natural gas. A number

of the citizens of the town have used the water with apparently beneficial results in cases of indigestion, biliousness, chronic diarrhea, kidney disease and rheumatism. The water smelled slightly of sulphuretted hydrogen and strongly of petroleum, and there was a black sediment of sulphide of iron in the bottle. This was determined and included in the analysis.

3172. Sulphur water sent by D. C. Wood, Cerulean, Trigg county, Ky. The water smelled only slightly of sulphuretted hydrogen, but was yellow when received, and tasted strongly of sulphides.

MINERAL WATERS.—Analyses stated in Grains to the Wine Gallon.

Station No.	2994	3014	3015	3016	3152	3153	3172
Carbonic acid gas	n. e.	n. e.	n. e.	n. e.	n. e.	n. e.	n. e.
Hydrogen sulphide gas . .		.60	.60			traces	.40
Carbonate of iron	.62		not'ble qu'n'ty	.052	.99	.27	traces
“ manganese					.49		
“ magnesia	6.51	3.40	.04	3.078	2.83	6.81	3.27
“ lime	8.68	21.01	10.52	12.255	21.95	15.24	8.66
“ soda				.886	1.80		
Sulphate of baryta						traces	
“ strontia		traces	traces			traces	
“ lime		77.05	24.04		3.23	.76	3.37
“ magnesia		3.52	24.33	1.831			16.42
“ potash	.51		11.75	.700			
“ soda	1.19		7.91				140.36
Chloride of calcium						22.45	
“ magnesium		62.26				17.05	
“ potassium		15.80			1.37	2.84	traces
“ sodium	.58	493.14	79.55	1.673	1.95	218.08	139.21
Sulphide of sodium		39.56	1.82			.41	8.42
Iodides		traces	traces		traces	traces	traces
Bromides		traces	traces	traces		traces	traces
Lithium compounds		traces	traces	traces	traces	traces	traces
Borates		traces				traces	
Phosphates	traces			traces			
Nitrates				traces			
Organic matters	traces	traces	traces	traces	traces		
Alumina				traces			
Silica	.70	.52	.82	.495	.76	.53	.53
Total solid matters . .	18.79	716.26	160.78	20.970	35.37	284.44	320.24

Of a number of qualitative analyses of mineral waters made this year the following are the most interesting:

2846. Chalybeate water sent by R. J. Samuel, Poplar

Plains, Ky., from the farm of P. F. Haddox, Carter county, Ky., near Aden Station. The water was found to contain:

Carbonates of iron, lime and magnesia.

Sulphates of lime and magnesia in small quantity.

Sulphate of soda.

Chloride of sodium in small quantity.

Traces of potassium and lithium compounds.

Total solid matters 43.7 grains per gallon.

When the water was received at the laboratory all the iron had separated as a brown sediment in the bottle. The amount of this was determined and was found to correspond to 4.8 grains carbonate of iron to the gallon.

2847. Salt water sent by J. H. Albright, Brodhead, Rockcastle county, Ky., from a well 137 feet deep, situated about 300 feet southwest of the R. R. depot, on his property.

The water was found to contain 1006.4 grains of solid matter to the gallon, composed, for the most part of sodium chloride, but containing also some chloride of calcium and chloride of magnesium and small quantities of the chlorides of potassium and lithium, with very notable amounts of iodides and bromides and traces of borates. The water contains no sulphates, nor was there any hydrogen sulphide present when the analysis was made. If this is absent from the water in its original condition, it would be classed as a saline water or brine. In composition it seems to resemble the medicinal brines of Kreuznach and Neuheim in Germany, and is remarkable for the comparatively large proportion of iodides and bromides it contains.

2848. Mineral water sent by J. H. Albright (see 2847) from a well 60 feet deep, situated about 900 feet west of the depot. This water contains 18.5 grains of solid matters to the gallon, composed largely of sodium chloride, but containing a notable amount of carbonate of soda, small amounts of the carbonates of lime and magnesia, traces of iron, small but relatively very notable amount of lithium and traces of borates. This water contains no sulphates and no hydrogen sulphide, though it is possible the latter

may have originally been present as the water stood several weeks in the laboratory before being examined. It is remarkable for the comparatively large proportion of lithium compounds it contains and might appropriately be called a lithia water.

2989. Sulphur water brought by Dr. J. D. Clardy, marked "No. 1, Walter Rossington, Hopkinsville," Christian county, Ky.

2990. Sulphur water brought with 2989, marked "No. 2." The bottles contained some black sediment, consisting of ferrous sulphide. The analysis showed that these two waters were similar in composition, though differing in strength. They both contain the following, showing them to be good saline sulphur waters:

Carbonates of lime and magnesia in small quantity with traces of carbonate of iron.

Sulphates of lime, magnesia and soda in considerable quantity.

Chloride of sodium, much.

Iodides, very marked.

Bromides, traces.

Borates and lithium compounds, quite marked.

Sulphides and hydrogen sulphide gas in considerable quantity.

Total solids: In 2989, 296.1 grains; in 2990, 517.8 grains per gallon.

3024. Chalybeate water brought by J. S. Burrier, South Elkhorn, Fayette county, Ky., from a small spring on his farm near that place. When received, the water was nearly clear, but deposited a brown sediment on standing. Qualitative tests showed the presence of :

Carbonates of iron, lime and magnesia in notable amount.

Sulphates and chlorides calcium, magnesium, potassium and sodium traces.

3154. Mineral water sent by J. D. Spencer, Horse Cave, Hart county, Ky. Qualitative tests showed the presence of:

Sulphates of magnesia and of alumina in moderate quantity.

Sulphates of lime, soda, potash and iron in small quantity.

Sulphates of manganese and of lithium, traces.

Chlorides and phosphates, traces.

Total solid matters, 21.5 grains per gallon.

Salt peter from Tobacco Stems

2936. Saltpeter made as a by-product in the manufacture of tobacco extract from tobacco stems. Made by Friederich Gloystein, Henderson, Ky., who expects to turn out about 50 tons per annum. The material consisted principally of small nitre crystals of brown color and smelling strongly of tobacco. It contained also a good deal of wood-charcoal, many nails and some gray lumps that looked like wood ashes. It was somewhat moist. Qualitative tests showed only traces of chlorides, sulphates and phosphates.

2942. Same material, taken from a ton lot purchased by the Station. More moist than No. 2936.

2961. Another sample of the material which Mr. Gloystein says he has recrystallized. He intends to bring it all to this condition hereafter. Smaller crystals and dryer than the previous samples and lighter colored.

ANALYSES.

Number	As received.			Dried in water-oven.		
	2936	2942	2961	2936	2942	2961
Moisture	1.09	7.96	1.37	. . .	. . .	. . .
Insoluble matters, organic . . .	. . .	1.91	. . .	. . .	2.07	. . .
“ “ mineral . . .	. . .	1.00	. . .	. . .	1.09	. . .
Potash	45.02	40.92	44.52	45.52	44.44	45.14
Nitrogen	12.64	11.59	12.90	12.78	12.59	13.08

Coals.

2842. Cannel coal sent by J. W. House, New Chapel, Ky.

2972. Cannel coal brought by Mr. Hugh Courtney, Lexington, Ky.

2977. Cannel coal sent by F. M. Sadler, Hawesville, Ky.,

from a bed on his farm, and that of Jas. Roberts, about five miles nearly west of Hawesville, Hancock county, Ky. Bed 2 to 2½ feet thick.

Number	2842	2972	2977
Moisture	.89		
Volatile combustible matters . .	34.05	40.51	34.69
Fixed carbon	36.05	30.67	25.23
Ash	29.01	28.82	40.08
	100.	100.	100.

Color of the Ash, red-brown, white, red-brown.

Iron Ore.

2978. Black band iron ore from just above the cannel coal No. 2977. Bed about 1 foot thick.

ANALYSES.

Volatile matters	39.21 per cent.
Fixed carbon	7.90 "
Ash (dark brown)	52.89 "
Total	100.
Metallic iron	30.04
Per cent. of iron in the ash	56.8

Limestones.

2955. Soft, gray, fine-grained limestone sent by J. Waller Rodes, Lexington, Ky., from his farm in Logan county, six miles from Russellville.

This limestone could probably be used in the manufacture of hydraulic cement. For comparison, an analysis by Dr. Robert Peter, of the Louisville cement rock, is here given. (See vol. IV., old series, p. 190, Kentucky Geological Survey Reports, No. 1066.)

Number	2955	1066
Lime	21.08	23.98
Magnesia	16.46	10.40
Peroxide of iron	1.60	
Alumina	2.64	6.56
Phosphoric acid	trace	.21
Sulphuric acid	n. e.	1.28
Potash	.39	.23
Soda	trace	.37
Carbonic acid		
Water and organic matters	33.56	32.07
Soluble silica	7.34	
Sand, etc.	16.55	23.98
Total	99.62	100.00

Nitre Earth.

2987. Nitre clay brought by J. W. Pryor, M. D., from the eastern part of the State, exact locality not known. Said to have been used by the mountaineers in making gunpowder and also as a fertilizer. An ochreous clay, beautifully banded, very plastic and almost free from sand. At a moderate heat it burns to a fine terra cotta color, but is easily fusible in a strong flame.

3146. Nitre earth sent by H. B. Kurtz, Cecilian, Hardin county, Ky., from the floor of a cave, about 300 yards from the mouth.

3147. From the same cave as 3146 but nearer the mouth where the earth had formerly been worked for nitre. This sample is coarser than 3146 consisting almost wholly of sand.

ANALYSES OF THE AIR-DRIED EARTH.

Number	2987	3146	3147
Total nitrogen	1.20	0.36	0.12
Nitrogen extractable by water . .	1.17	n. e.	n. e.
Equivalent to potassium nitrate .	8.45	2.60	0.87
Potash extractable by water . . .	.22	n. e.	n. e.
Phosphoric acid	trace		

White Burley Tobacco.

Some determinations of nitrogen, phosphoric acid and potash in the cured tobacco leaf, as prepared by the farmers for the market, have been made upon samples of white burley tobacco, the variety raised in Central Kentucky, as follows:

2117. From Major Phil Bird, Shelbyville, Ky.

2798. Grown at the Station farm in 1894 (experiment with fertilizers, Plot 4). Fertilized with potassium magnesium carbonate and nitrate of soda.

2799. Grown by Benj. D. Peter, Fayette county, on good land without fertilizers.

2879. From Major P. P. Johnston, Fayette county.

AGRICULTURAL EXPERIMENT STATION. XXIII

ANALYSES OF THE AIR-DRIED TOBACCO.

	2117	2798	2799	2879
Moisture	6.80	7.36	6.10	6.64
Nitrogen	3.02	3.96	4.16	3.96
Phosphoric acid	0.96	0.80	0.46	1.14
Potash extracted by boiling for half an hour with water	6.55	n. e.	n. e.	5.90
Ditto by charring with sulphuric acid, etc. (official method)	6.99	n. e.	n. e.	5.75
Ditto by incinerating and determining as in ash analysis	6.92	3.80	4.61	6.24

Tobacco Stems.

2935. Sample from a lot of 8 or 10 tons bought for the Station from Mr. Leslie Combs. Sampled from M. A. Scovell from ten bales by taking a handful from the center of each.

ANALYSIS.

	As received.	Room dry.	Dried in Water Oven.
	Per cent.	Per cent.	Per cent.
Moisture	27.53	7.82	1.11
Phosphoric acid	0.91	1.03	3.00
Nitrogen	2.44	2.77	10.11
Potash extractable by water	8.23	9.32	
“ official method, charring with sulphuric acid	8.08	9.08	9.85
“ by incineration and analysis of the ash	8.10	9.18	9.97

Tobacco Ashes.

2995. Ashes of tobacco sent by Wm. Elliott, Henderson, Ky., from the burning of his warehouse, in which was stored a large quantity of tobacco.

ANALYSIS OF THE DRY ASHES.

Total potash	5.83 per cent.
Potash soluble in water	2.15 “
Total phosphoric acid	1.85 “

Ashes of Stover.

2838. Ash of corn fodder or stover, prepared by burning a quantity of fodder from the Station farm. The ash was sifted first through a coarse sieve to remove unburnt pieces, fused ash, etc.; finally sifted on the 80-mesh sieve, and, lastly, burnt again in iron pans and bottled while still warm. This was used as the ash sample by the Reporter on Soils and Ash, for the A. O. A. C. work in 1895. The analysis following was made by Mr. B. C. Keiser in this laboratory.

ANALYSIS.

Soluble silica	15.09	per cent.
Sand, etc.	45.77	"
Carbon	1.15	"
Brown oxide of manganese	0.11	"
Lime	11.14	"
Magnesia	7.65	"
Potash	5.42	"
Soda	0.71	"
Chlorine	1.10	"
Phosphoric acid	7.62	"
Sulphuric acid	0.95	"
Carbonic acid	1.01	"
Peroxide of iron	1.96	"
Alumina	0.91	"
	100.59	

Supposed Corundum.

2980. Argillaceous sand, supposed to be corundum and said to have been used in making emery wheels. Sent by T. C. H. Vance, Louisville, Ky. A purplish, ash-colored, granular material in soft lumps easily crushed in the fingers and evidently composed of clear white sand with a little clay. It is infusible in the blow-pipe flame and burns white.

ANALYSIS.

Silica	95.21	per cent.
Alumina	1.72	"
Lime	.02	"
Loss on ignition	2.74	"
	99.69	

Cider.

2992. Cider sent by C. E. Haswell, Hardinsburg, Ky. Rather light colored and not quite clear. Smell as if were beginning to sour.

ANALYSIS.

Alcohol	7.12	(by weight) per cent.
Extract	2.64	"
Ash	.34	"
Free acid calculated as malic acid	.40	"

Phosphatic Fossil Shells.

2919. *Cyclora minuta* (?) Prof. A. M. Miller, Lexington, Ky.

The presence of a minute shell or cast having been observed very constantly in the phosphatic layers of the Trenton limestone in Kentucky and also in the Tennessee phosphates, Prof. A. M. Miller, of the State College, suggested the following experiment and assisted by separating the minute shells from the rock preparatory to their analysis. The fossils are probably a *cyclora*, perhaps *cyclora minuta*. In the Trenton limestone they were so soft and imperfect that it was impossible to separate a sufficient quantity for analysis, but by pouring molybdic reagent upon the surface of the stone, it became very evident that they were very rich in phosphates.

ANALYSIS.

	Per cent.
Phosphoric acid in cyclora from a limestone from Covington	22.7
Phosphoric acid in the Covington specimen as a whole	0.77
Phosphoric acid in cyclora from Tennessee phosphate	28.0
Phosphoric acid in the Tennessee specimen as a whole	11.9

The results seem to show that the phosphoric acid is principally in these small fossils.

ALFRED M. PETER.

A CONVENIENT MILK-SAMPLING TUBE.

BY M. A. SCOVELL.

The milk sampling tube described below has been in daily use at this Station since 1893, and it has been found so satisfactory that it is thought best to reproduce here a paper read before the Society for Promotion of Agricultural Science, and published in *Agricultural Science*:

"One of the most difficult things that we have had to contend against in introducing the Babcock test among our breeders and dairymen, is the proper sampling of the milk. Complaint has often been made that the milk of a given cow varied so greatly that little dependence could be put on the results. I have had samples of milk sent to the Station for analysis, which showed over 10 per cent. fat, and thinking that perhaps a phenomenal milk had been found, I have gone, at times, many miles to get a sample myself to verify results, and found only an average amount of fat. In a case I have in mind, I know the owner of the cow was an honest man, and wanted to know just what his cow could do in the way of making butter. He sent a sample of milk for test. The sample showed over 12 per cent. fat. I got another sample the next morning from the same cow which showed 5.1 per cent. fat. Inquiry revealed the fact that after the cow was milked, the milk was poured from one vessel to another, but then allowed to stand until the froth had settled. It happened that the fat rises very quickly in the milk of this cow, as was afterward shown. After the froth had settled, the sample was taken with the results stated above.

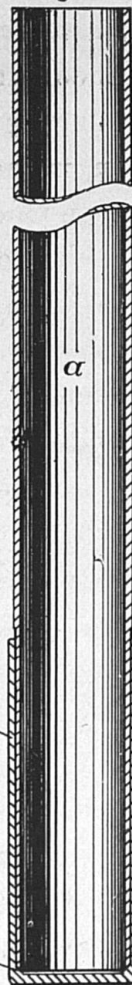
These mistakes, occurring very often, led me to consider a plan whereby a section through the milk could be taken as a sample.

As a member of the Committee on Rules for the Dairy Tests at the World's Fair, my attention was called to the importance of some good method for sampling the milk. A sample of each cow's milk in the test was to be taken at each milking and these individual tests were to be compared

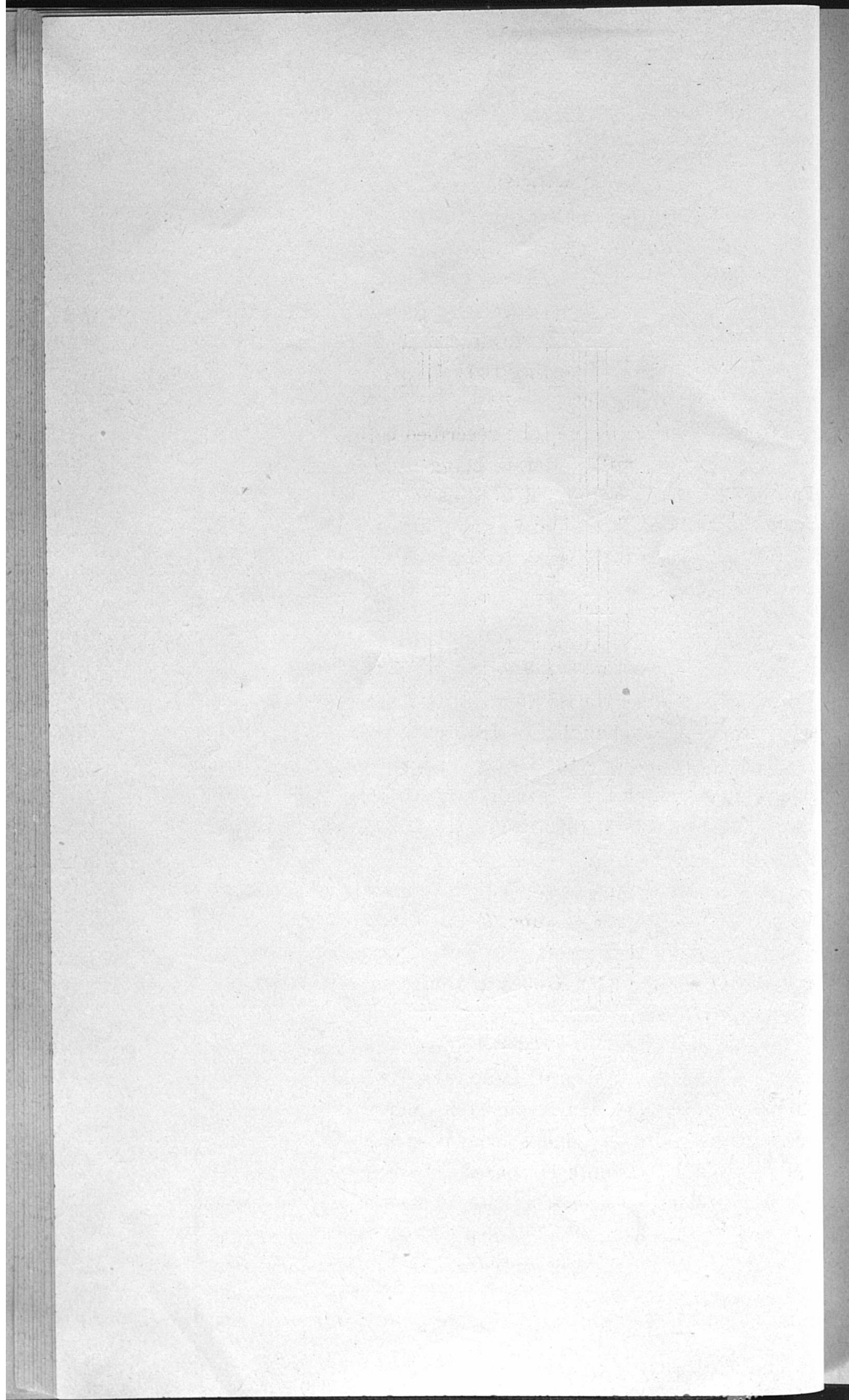
Fig. 1.



Fig. 2.



A Convenient
Milk-Sampling Tube.



with the mixed milk of each herd, and the butter-fat so found to be compared with the fat found in the butter. Later on, when it became evident to the Committee on Tests that it would be impossible to make a test of butter-fat from each milking, it became necessary to have the sample represent an aliquot of the milk, otherwise the sample would not have represented the true composition of the combined milkings. In place of testing the milk at each milking, it was tested each day only.

After several trials, the tube described below was devised for sampling the milk. Before being used at the World's Fair, it was thoroughly tried, both as to its taking a known portion of milk each time and as to getting uniform results by its use whether the milk was mixed or unmixed as it came from the cow.

Description of Milk-Sampling Tube.

Fig. 1 shows an exterior view; (a) is a tube open at both ends—the lower end sliding in short tube (b) which is closed at the bottom and has three elliptical openings—(c) at the side through which the milk is admitted. Fig. 1 shows relative position of both tubes when ready for taking sample section of milk.

Fig. 2 shows section through both tubes when tube (a) is pushed to the bottom of tube (b) the lower end of former being turned to fit the seat provided at bottom of tube (b) and shown at (d). Mr. Goodwin thus aptly describes the tube in the *Breeders' Gazette*:

"It is a brass tube of proper diameter and length made with a detachable, perforated cap b into which the tube a slides snugly. The cap is slit from each of its three oval perforations to its top edge, so that it springs lightly to admit the tube. The milk is poured into the sampling pail, which is a cylindrical can, 6.4 by 18 inches, and the tube dropped into the milk with the cap affixed so that the apertures are open. Through these holes the tube fills with

milk to the level of the milk in the can. It is then pushed down, thus closing the inlet apertures and securing a column of milk exactly the same as that in the can."

The following table will show the results obtained:

TABLE SHOWING THE PER CENT. OF FAT IN MILK TAKEN BY THE SAMPLING TUBE, 1ST, AFTER MIXING; 2D, AS MILKED WITHOUT MIXING; 3D, AFTER STANDING ONE HOUR AS MILKED WITHOUT MIXING.

No. of Sample.	Mixed and sampled immediately.	As Milked without mixing.	As milked, after standing one hour.		Stood over night.
	Per cent.	Per cent.	Per cent. By spoon.	Per cent. By sampler.	
1	4.4	4.4		5.8	
2	5.8			5.6	
3	5.8			5.9	
4	5.9				
5	5.9	5.9			
6	5.8	5.7			
7	4.7	4.8			
8	5.8			5.7	
9	5.5			5.5	8.5
10	5.2			5.2	
11	5.6			5.5	
12	5.4		12.0	5.4	
13	3.8	3.8			
14	5.8	5.9			
15	6.0	6.0			
16	5.4	5.4			
17	5.4	5.4			
18	5.6	5.6			
19	4.6	4.6			
20	6.0	6.0			
21	5.4		10.2	5.2	
22	6.1			6.2	
23	6.1			6.1	
24	6.3		9.4	6.3	

At the World's Fair, a cylindrical pail was used 6.4 inches in diameter into which the milk was poured from the milk bucket and then the sample was taken from this. In the 90-day test, there were over 200 samples of milk taken each day from individual cows, and 9 samples from the mixed milk.

In order to see how the amount of fat, as ascertained by the Babcock test from the mixed milk, agreed with the average daily fat found by the Babcock test from the milk of individual cows, I had a computation made in the 90-day test with the following results:

AGRICULTURAL EXPERIMENT STATION. XXIX

TABLE SHOWING PER CENT. OF FAT IN MIXED MILK, AND ALSO THE AVERAGE PER CENT. OF FAT, CALCULATED FROM THE PER CENT. OF FAT IN THE MILK OF THE INDIVIDUAL COWS IN THE WORLD'S FAIR DAIRY TESTS.

	Jerseys.		Shorthorns.		Guernseys.	
	Per cent. fat of mixed milk.	Average of individual tests. Per cent.	Per cent. fat of mixed milk.	Average of individual tests. Per cent.	Per cent. fat of mixed milk.	Average of individual tests. Per cent.
June.						
1	4.9	4.85	3.7	3.84	4.5	4.58
2	4.8	4.73	3.7	3.84	4.5	4.49
3	5.0	4.88	3.7	3.54	4.8	4.78
4	5.1	4.96	3.5	3.43	4.8	4.66
5	4.9	4.75	3.6	3.57	4.7	4.60
6	4.7	4.61	3.7	3.59	4.4	4.56
7	4.8	4.74	3.7	3.61	4.7	4.74
8	4.8	4.74	3.6	3.75	4.6	4.51
9	4.6	4.70	3.8	3.67	4.5	4.48
10	4.9	4.90	3.6	3.55	4.5	4.50
11	4.9	4.81	3.6	3.62	4.6	4.55
12	4.9	4.84	3.8	3.64	4.6	4.55
13	4.7	4.68	3.6	3.55	4.6	4.53
14	4.8	4.77	3.6	3.60	4.5	4.45
15	4.6	4.68	3.7	3.63	4.6	4.53
16	4.9	4.83	3.7	3.65	4.6	4.51
17	4.9	4.88	3.7	3.63	4.5	4.44
18	4.8	4.77	3.6	3.62	4.5	4.41
19	4.9	4.82	3.6	3.61	4.5	4.52
20	4.8	4.77	3.6	3.56	4.5	4.45
21	4.9	4.89	3.5	3.51	4.5	4.53
22	5.4	5.32	3.6	3.63	4.6	4.66
23	5.3	5.17	3.8	3.69	4.5	4.47
24	4.8	4.63	3.6	3.51	4.6	4.48
25	4.8	4.73	3.7	3.61	4.4	4.44
26	4.7	4.63	3.6	3.59	4.4	4.44
27	4.7	4.62	3.8	3.73	4.4	4.42
28	4.4	4.39	3.6	3.58	4.6	4.51
29	4.8	4.76	3.7	3.64	4.6	4.58
30	4.9	4.84	3.6	3.56	4.7	4.67
	145.4	143.69	109.6	108.55	136.8	136.04
July.						
1	5.0	4.85	3.5	3.49	4.6	4.60
2	4.8	4.78	3.7	3.69	4.6	4.55
3	4.6	4.79	3.6	3.56	4.5	4.51
4	4.8	4.77	3.7	3.71	4.5	4.49
5	4.6	4.61	3.6	3.63	4.6	4.50
6	4.5	4.52	3.7	3.75	4.5	4.40
7	4.7	4.60	3.6	3.65	4.5	4.47
8	4.6	4.56	3.6	3.61	4.6	4.34
9	4.9	4.87	3.8	3.73	4.6	4.64
10	4.8	4.85	3.6	3.60	4.6	4.53

TABLE SHOWING PER CENT. OF FAT IN MIXED MILK, AND ALSO THE AVERAGE PER CENT. OF FAT, CALCULATED FROM THE PER CENT. OF FAT IN THE MILK OF THE INDIVIDUAL COWS IN THE WORLD'S FAIR DAIRY TESTS.—*Con.*

	Jerseys.		Shorthorns.		Guernseys.	
	Per cent. fat of mixed milk	Average of individual tests Per cent.	Per cent. fat of mixed milk	Average of individual tests Per cent.	Per cent. fat of mixed milk	Average of individual tests Per cent.
July						
11	4.6	4.61	3.6	3.67	4.5	4.43
12	4.7	4.63	3.5	3.54	4.5	4.47
13	5.0	5.01	3.6	3.60	4.6	4.54
14	4.8	4.56	3.6	3.64	4.5	4.52
15	4.7	4.66	3.9	3.90	4.6	4.52
16	4.8	4.78	3.8	3.79	4.6	4.49
17	5.0	4.95	3.8	3.76	4.5	4.46
18	4.7	4.74	3.8	3.78	4.4	4.39
19	4.6	4.54	3.7	3.73	4.6	4.49
20	5.0	4.94	3.8	3.76	4.5	4.49
21	4.9	4.92	3.8	3.79	4.5	4.52
22	4.8	4.78	3.7	3.74	4.6	4.49
23	4.7	4.64	3.8	3.80	4.6	4.49
24	4.8	4.80	3.7	3.81	4.6	4.52
25	4.7	4.68	3.5	3.59	4.5	4.49
26	4.8	4.66	3.7	3.67	4.6	4.67
27	4.7	4.75	4.0	3.95	4.6	4.64
28	4.8	4.76	3.8	3.88	4.6	4.54
29	4.7	4.60	3.6	3.64	4.4	4.52
30	4.7	4.75	3.7	3.75	4.6	4.51
31	4.7	4.67	3.7	3.59	4.3	4.38
	147.5	146.63	114.5	114.80	140.8	139.60
Aug.						
1	5.0	4.82	3.8	3.79	4.5	4.42
2	4.8	4.81	3.6	3.54	4.4	4.39
3	4.7	4.59	3.6	3.64	4.9*	4.41
4	4.7	4.79	3.7	3.59	4.5	4.54
5	4.7	4.72	3.6	3.59	4.5	4.51
6	4.7	4.69	3.8	3.74	4.5	4.48
7	4.9	4.82	3.5	3.49	4.5	4.46
8	4.9	4.79	3.8	3.77	4.6	4.48
9	4.7	4.73	3.6	3.59	4.6	4.57
10	4.9	4.81	3.6	3.52	4.4	4.37
11	4.7	4.71	3.5	3.57	4.6	4.49
12	4.8	4.94	3.5	3.55	4.6	4.60
13	4.8	4.79	3.6	3.59	4.6	4.54
14	4.8	4.82	3.7	3.67	4.6	4.53
15	4.8	4.85	3.7	3.69	4.6	4.63
16	4.6	4.60	3.6	3.58	4.6	4.55
17	5.0	4.83	3.5	3.54	4.4	4.45
18	5.1	5.08	3.7	3.72	4.5	4.47
19	5.0	5.00	3.5	3.63	4.4	4.39

*Greatest discrepancy, .49 per cent. Analysis, 4.9 per cent. correct, but sample too small.

TABLE SHOWING PER CENT. OF FAT IN MIXED MILK, AND ALSO THE AVERAGE PER CENT. OF FAT, CALCULATED FROM THE PER CENT. OF FAT IN THE MILK OF THE INDIVIDUAL COWS IN THE WORLD'S FAIR DAIRY TESTS.—*Con.*

	Jerseys.		Shorthorns.		Guernseys.	
	Per cent. fat of mixed milk.	Average of individual tests. Per cent.	Per cent. fat of mixed milk.	Average of individual tests. Per cent.	Per cent. fat of mixed milk.	Average of individual tests. Per cent.
Aug.						
20	5.0	4.87	3.6	3.66	4.6	4.61
21	4.9	4.93	3.8	3.84	4.7	4.61
22	5.0	4.91	3.7	3.65	4.6	4.57
23	5.0	4.95	3.6	3.60	4.6	4.33
24	4.9	4.91	3.7	3.68	4.6	4.63
25	4.8	4.69	3.6	3.50	4.4	4.44
26	4.8	4.74	3.5	3.50	4.4	4.28
27	4.5	4.53	3.3	3.33	4.1	4.12
28	4.9	4.52	3.4	3.44	4.1	4.16
29	5.0†	4.70	3.5	3.53	4.5	4.36
	140.4	139.34	104.6	104.53	130.9	129.39
MONTHLY AVERAGES.						
June	4.85	4.79	3.65	3.62	4.56	4.54
July	4.92	4.90	3.82	3.83	4.69	4.65
Aug.	4.68	4.65	3.49	3.48	4.36	4.31
TOTAL AVERAGE.						
	4.81	4.77	3.65	3.64	4.54	4.50

†Greatest discrepancy excepting above, .30 per cent.

The advantages claimed for the tube are:

1st. That it is simple of construction and samples of the milk can be easily taken with it.

2d. That it is easily cleaned.

3d. That it will take a fair average sample of the milk as milked from the cow, without mixing, or even after standing some time.

4th. That by using cylindrical pails, it takes an aliquot of the milk and by its use a better representative sample of the milk representing several days' milking can be obtained than by taking a certain quantity each time, regardless of the amount given by the cow. The mechanical department

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sample

of the State College, Lexington, Ky., made the tubes for the "World's Fair Tests," and to Prof. F. P. Anderson, in charge of the department, much credit is due for the mechanism of the tube. From the description and diagrams these tubes can be easily made at any machine shop. They are made from drawn copper tubes of convenient size. For ordinary use I prefer a tube $\frac{3}{4}$ inch internal diameter. Dairy supply companies make and sell these tubes.

DIVISION OF ENTOMOLOGY AND BOTANY.

M. A. Scovell, Director:

Dear Sir: In the spring of 1895 experiments and studies in the following lines were undertaken:

1. With reference to checking the rotting of apples on the trees.
2. With reference to checking codling-moth injury to apples.
3. With reference to checking potato scab.
4. With reference to the use of arsenites on tobacco.
5. With reference to forage plants.
6. With reference to checking the injuries of the cabbage worm.
7. With reference to the broom-rape of hemp and tobacco.
8. With reference to cut-worms.
9. With reference to the chinch-bug and the fungus which destroys it.
10. With reference to aphides which attack chrysanthemums and cosmos.
11. With reference to the destruction of the harlequin cabbage bug.
12. With reference to the mealy bug of hot houses.
13. On miscellaneous insects collected by myself or sent in by correspondents.

In Bulletin No. 58 is published some of the results of the work on cutworms. These insects were exceptionally common last spring and did an immense amount of mischief. I believe that by the general employment of remedies suggested in this bulletin, much of this injury can be avoided. An interesting discovery made in the course of rearing the worms to maturity is, that they are subject to a fungus parasite that may be cultivated and possibly utilized for their destruction.

Bulletin No. 59 contains some of the results of experiments with apple rot and codling-moth. I propose to continue this work next season, with some changes of procedure which I think warranted by my past experience.

A third bulletin on potato scab experiments is well under way, and I have in hand material for a fourth on tobacco spraying, which I hope may be published before spring.

During the season of 1895 I made several trips to different sections of the State for the purpose of studying farm pests and of making collections for the Station Herbarium and Insect Collections. The herbarium has been materially increased in value by additions collected on these trips. The seed collection has been more than doubled in extent and value by collections made by me last season in Fayette, Jessamine, Mercer, Spencer, Powell, Lee, Pendleton, Rockcastle, Whitley, Logan, Todd, Christian, Hopkins and McCracken counties. It is desirable that the fruit of all our flowering plants be represented in this collection, as a basis for the study of this feature of our flora and for future use in writing bulletins.

A feature of entomological work that is of growing interest is the destruction of farm pests through the controlled agency of their natural insect and fungus enemies. Experiments on an extensive scale have recently been made in Illinois and Kansas on the fungus enemies of noxious pests; and some very valuable work was done with insect enemies of the cottony cushion scale insect by the Division of Entomology at Washington, working in conjunction with the

State authorities of California a few years ago. We have done some work in this direction at this Station during the past summer, and shall continue it next season. Through the kindness of Chancellor Snow, of Kansas State University, and Prof. Forbes, State Entomologist of Illinois, I received specimens of the chinch-bug *Sporotrichum* used by them for distribution to farmers, and subsequently propagated it on chinch-bugs brought by me from Pendleton county. While I can not at this stage of the work claim that the fungus is an unfailing remedy for chinch-bug injury, there is good evidence showing that it will destroy the bugs, under some circumstances, in great numbers, and on the strength of this, it seems to me well worth a thorough test in this State. The chinch-bug is at present injurious chiefly in the counties along the Ohio River, but its injuries in Tennessee last summer show that we can not hope to be always exempt from this pernicious enemy of corn and oats. In case it is again injurious in Kentucky, I have made arrangements to supply the parasitic fungus to those who may apply for it.

Some interesting results have been obtained from an examination of hemp seed as a means of detecting the seeds of broom-rape among it, and I find that one familiar with the minute broom-rape seeds can, with the microscope, detect them in samples obtained from seedsmen, without difficulty. Unquestionably, this is the manner by which this pest is being disseminated, and I feel sure that farmers can protect themselves from having the pest introduced on their farms by having the seed they propose to plant examined.

The work of my division is now in possession of ample quarters for indoor experiments on growing plants and living enemies of crops. A vivarium has been erected during the past year and is now in use. It is constructed in the form of a conservatory, is 50 feet long, with stone and brick foundation, the part above ground having a one-inch air space to prevent loss of heat, with arrangements for top and side ventilation. The tables and benches with which it is

equipped are as good as any in use in any country, so I am informed by one who ought to know. The former have solid slate tops and iron frame-work. The benches have iron-frame-work and tile bottoms. So constructed, they will last almost indefinitely, and for convenience and suitability for experimental work, such as they are intended for, I fail to see how they could be improved. Like the insectaries of the University of Illinois and Cornell University, our vivarium is divided into two compartments. In one of these it is proposed to keep the conditions as nearly like those prevailing out of doors as possible, so that we can watch under lock and key the natural changes and habits of the pests, just as they occur in nature. In the other compartment it is proposed to place a small hot-water heater next year, so that work requiring growing plants may be carried on during freezing weather. No head-house has been built in connection with the insectary, for the reason that it was thought best to equip the essential part of the establishment in a thoroughly creditable manner, rather than cover a great deal of ground in a slipshod fashion. It may sometime be desirable to place a small house at the front of the structure now built, but I would advise that when this is done a good architect be consulted, so that it will exemplify, as far as possible, the taste and skill which one has a right to expect in Government buildings. As it stands, the vivarium will compare very favorably with any other I have seen in the country.

The library of my division has overrun the bookcase now in use, and another should be added to accommodate extra books now on hand, and such as may be secured during the coming years. The liberality which has always hitherto been shown with regard to building up this essential accessory to profitable scientific work leads me to hope that our library facilities may be greatly increased during the next year or two. One of the most galling disadvantages of the Western scientific worker is the general deficiency in respect to library facilities. The literature relating to the entomol-

ogy and botany of this country should be as completely represented in our library as it is possible to make it. Another case is needed also for my division to accommodate the seed collection. This has been added to during 1895 to such an extent that one of our tables has to be given up to it, and I respectfully request that the herbarium case be extended to the side of the room, and that the extension be furnished with suitable shelves and wooden trays to receive the jars and vials containing the collection.

I have but one other suggestion to make. During the summer of 1895 I have had my field experiments, which I consider a necessary part of the work of my division, attended to in part by men regularly employed on the Experiment Farm. The work has been done as well as could be expected under this arrangement, and I have nothing but good words for those who have assisted me by caring for the grass plots and applying fungicides and insecticides. To Mr. Martin of the Farm, I am under special obligations for the care and faithfulness he has shown. But it could be much better done if some one could be assigned to my division, as in the case of the division of horticulture, whose time would be at my command, and who would, from practice, learn the purpose of my experiments, and know the importance of a prompt and careful attention to them. With the vivarium to care for, this need of assistance with a certain degree of practice becomes greater, and I should be gratified if some arrangement could be made of the sort suggested.

Yours respectfully,

H. GARMAN,

Entomologist and Botanist.

ENTOMOLOGICAL NOTES FOR 1895.

BY H. GARMAN,
Entomologist and Botanist.

The notes presented below relate only to such insects as attracted special attention in 1895, because of injuries committed or because of their capacity for mischief.

CUTWORMS.

Very early in spring there was a good deal of complaint because of cutworm injury to strawberries, and in some instances to the young and tender shoots of raspberries. Because of their disposition to travel about these worms were sometimes taken for the army-worm, an insect belonging to the same family, but of a very distinct genus. I have recently published a bulletin (No. 58 of the Station series) on this outbreak with recommendations as to checking such injuries, and so need not consider the matter here further than to state that those who have not already received the bulletin can get it by sending names and addresses to the Station at Lexington.

THE SCURFY BARK LOUSE

(*Chionaspis furfurus*).

In April we received at the Station a complaint of injury to three-year-old apple trees by a scale insect that proved to be the scurfy bark-louse (*Chionaspis furfurus*) a species not likely to do very serious mischief except when trees are utterly neglected. It is a near relative of the oyster-shell bark-louse of apple trees, and is to be checked by the same treatment, namely, scraping the bark in winter and giving it a thorough brushing (a scrubbing brush is useful for the purpose) with a solution of soft or whale oil soap (one quart of the former or one-half pound of the latter, dissolved in two or three quarts of water.) If this treatment is followed in spring by an application of coal-oil emulsion to the leaves so as to destroy the young lice that may have escaped the

winter treatment, the insect can be got under control in all ordinary cases of attack. In the case of attack of a few small trees in a nursery the quickest and surest means of preventing further spread of such pests may be the destruction of the trees by burning, or else their exposure to hydrocyanic acid gas, as recommended in one of our bulletins.

THE SAN JOSE SCALE

(*Aspidiotus perniciosus*).

I suspect that the person who sent me this insect thought it was the notorious San Jose scale, now present in the Eastern and some of the Middle United States. This scale is one of the most destructive of the group, and it would be a misfortune to fruit growers should it become established in Kentucky. Its introduction has been traced to certain Eastern nurseries. Should any one suspect its presence at any time on his fruit trees I shall be glad to examine the suspected trees for him. It will prove much easier and less costly to keep it from becoming established than it will be to check its injuries once it becomes abundant. This is a matter of more than ordinary importance to fruit growers in Kentucky, and they should keep a close watch for the pest during the next year or two. The scale is very flat, nearly round and less than an eighth of an inch in diameter. It attaches itself to bark, leaves, or fruit, and attacks nearly or quite all of our cultivated fruit trees.

A STRAWBERRY SNOOT BEETLE

(*Epicaerus imbricatus*).

Under date April 30th, Mr. G. F. Eberlein, of Horse Cave, wrote to the Station sending for determination one of the snout beetles (*Epicaerus imbricatus*) which he found on his strawberries, two or three on a plant. The insect is a relative of the strawberry crown-borer, but is not a common strawberry insect, though capable of some injury to the leaves. It passes the winter among rubbish, in its adult stage. For its injury to foliage no doubt an application of Paris green would prove effective. The insect has long been

known, but has not proved especially injurious anywhere, so far as I know. The same curculio was sent to me later (May 11th) from Franklin, by Mr. J. W. Stringer, who found, as he stated, a lot of them with cutworms about dock in one of his fields. As an adult it feeds on a variety of plants, pear, pigeon grass (*Setaria*), corn, cabbage, fuchsias, etc. Eggs were observed by Forbes to be placed on pear leaves, two leaves being fastened together for their protection.

THE NORTHERN JUNE BUG

(*Lachnosterna*).

May 2d, G. M. Lane, of Boyle county, sent us specimens of two species of leaf-chafers, the brown beetles known at the North as June bugs, and reported them doing very serious harm by eating the leaves. Five hundred of these beetles were found by him beneath two small plants, just beneath the surface of the ground. The young of these Northern June bugs are known as white-grubs, and are common in soil supporting rank growths of grasses or weeds. When such land is plowed up and put in some crop the roots and leaves of the latter are likely to suffer, the one from the depredations of the grubs, the other from the adult beetles, such as were sent to the Station. For the injury to the leaves there is nothing better than spraying with whitewash containing Paris green. The injury to the roots subsides in a season or two without treatment. It can not well be checked once the crop is planted.

THE SOUTHERN JUNE BUG

(*Allorhina nitida*).

The common green June bug is always more or less troublesome in Kentucky. The adult beetles attack fruit, and sometimes eat into unripe corn ears. The grubs are not distinguished by most people from the common white grubs of compost. But the grub of the June bug feeds upon the living roots of grasses, strawberries, and other plants, and never, as far as I can learn, eats dead vegetable matter. It is a more active grub than the other white grubs, and has

the singular habit of turning over on its back when it creeps, instead of shuffling along on its side. When placed on a smooth surface it moves in this way with considerable speed, and hence is capable of leaving land when food becomes scarce and going where it is more abundant. The insect was very injurious at Lexington to strawberries. The natural haunt of this insect is grass-land. When it is proposed to use such land for strawberries it may be well to turn swine in for a time that they may destroy as many as possible. They are known to be very fond of the grubs. The common mole is also an inveterate enemy of the grubs, and when its hills are seen in meadows and pastures it is good evidence that the grubs are present. The mole has been known to follow along potato rows when white grubs were working on the tubers and destroy every grub. It has been accused of following along the rows of newly-planted corn for another purpose. If this accusation is well founded, its grub-destroying habit may be set against it. I do not know of other means of fighting this insect than by the encouragement of these enemies, and by avoiding infested land until the insects leave. It can be recognized among our white-grubs by the peculiar method of progression already mentioned.

THE IMPORTED CURRANT WORM

(*Nematus ventricosus*).

The imported currant worm (*Nematus ventricosus*) was common about May 17th at Lexington and elsewhere in the State, and did its accustomed mischief of stripping the bushes of their leaves. The insect can be easily destroyed by the use of powdered white hellebore in water. It is sometimes claimed that the fruit is rendered poisonous by these worms, but without any foundation in fact. The insects eat only the leaves, sometimes leaving the fruit completely exposed, but no one need hesitate to eat such fruit on the score of its having an injurious effect on the system.

THE BLACK PEACH APHIS

(*Aphis persicae-niger*).

I was sorry to read a letter from J. M. Samuels, dated July 4th, stating that he had found what I take to be the black peach aphid abundant in Bullitt county. Over a thousand small trees, he wrote, had been destroyed by it. The insect is one of the troublesome pests in Eastern peach-growing regions. It infests both the roots and twigs, the root-infesting form being the most troublesome, and sometimes giving trees the appearance of having the yellows. The use of tobacco has been recommended for infested trees, the stems being dug into the soil about the roots.

THE GRAPE PHYLLOXERA.

July 16, 1895, Mr. F. B. Threlkeld, Visalia, Ky., complained of an injury to his Delaware and Wyoming grapes, that proved to be caused by the phylloxera in galls on the leaves. The insect is not often destructive in this country, and when abundant can, usually, be dealt with by plucking off and burning the galled leaves. The winter is passed on the roots of grape vines, and in France this root-infesting form is the one most feared. Our American stocks being less subject to attack are now employed by French vineyardists to avoid injury. Bisulphide of carbon injected into the soil about infested roots is used quite extensively and successfully by Frenchmen.

THE FRUIT BARK-BEETLE

(*Scolytus rugulosus*).

D. C. Haycraft, of Elizabethtown, wrote September 21st, stating that the insect was at work on wild-goose plum trees on his place, and had killed a couple of trees. The insect is a minute, compactly-built brown beetle, which has only comparatively recently been noted as injurious in the Middle States. These beetles work into the bark of peach, cherry, and apple trees, and place their eggs along the burrow. From the burrow the young hatching from the eggs make tortuous channels under and in the bark. When mature

they cut their way out through the bark leaving numerous small round "pin holes," very characteristic of their attack. From my observation of the insect I am disposed to think it attacks only trees that are not strong. It is especially fond of young peach trees suffering from the injuries of the peach-tree borer. But while probably usually getting started in wood that is nearly or quite dead, it is found in the living wood also, and, no doubt, hurries the destruction of trees which might otherwise recover. The cutting away of all dead branches and the burning of dead trees is a practice to be recommended where this pest is at work. The grubs are in the wood in the fall and winter, and at this time, therefore, the work of destroying them can be best performed.

THE ZEBRA CATERPILLAR OF CABBAGE

(*Mamestra picta*).

A rather stout, smooth-bodied worm of a pale yellow color, with markings of black, arranged on the sides as more or less evident up and down stripes, is often encountered in Kentucky on cabbage, peas, cauliflower, mangel wurzel, and related plants. The most recent complaints as to its injuries came to me from our Experiment Farm, where it was detected eating into the heads of cauliflower. The insect belongs to the same order as the cabbage butterfly and is to be treated in the same way.

The worms may be seen here on cabbage in June, and again in September. A brood of young was observed in 1890, on September 23d. Fully-grown worms may be found during the early part of October, when they hide away in the earth and change to pupae, in which condition they pass the winter.

The fore wings of the moth are of a rich brown color, the hind wings mainly white. The wing expanse of an example measures 1.48 inch. The eggs are laid in clusters on the leaves, and the young worms are, consequently, associated in colonies, but later they scatter. If they can be taken before they scatter, it is possible to destroy them with little

trouble. Later it is necessary to dust infested plants with insect powder and ashes (one part of powder to four of ashes) or else to spray the plants with a mixture of kerosene, soap, and water. If young plants are attacked the worms can be got rid of by spraying with Paris green water. They are not as difficult to deal with as the ordinary cabbage worm, because they live exposed most of the time, having very little of the disposition to creep in between the leaves.

A CORN FLY

(*Chetopsia wnea*).

While examining some corn July 9, 1895, I found among some dwarfed plants a stalk gnawed and mined at the base underground, and on stripping off the bases of the blades revealed a number of small yellowish maggots, about one-fourth inch long and a twenty-fifth inch in diameter, at work on the injured plant. They were placed in a vial with some corn and reared to maturity. The adult is a very pretty little fly, about one-fifth inch long, of a shining green color, with the whitish wings crossed with three dark bands, the outermost at the tip.

Heretofore I have known only the adult of this insect. It is always very common in the latter part of April and fore part of May on young wheat, where scores may be collected by a few strokes of a collecting net against the plants. It disappears before the end of May, probably having first placed eggs in soil for a brood of young. The adults which I reared in the latter part of the summer must represent a second brood. The insect lives on corn, wheat, oats, and probably other grains, and from its abundance here is capable of a great deal of mischief. This is the first time, however, that I have encountered it on corn, and from the great numbers of the fly, which occur on young wheat in spring, it is probable that it does much of its mischief among small grain. On May 6, 1890, it was noted as so abundant on wheat that one could perceive examples as he passed along the edges of the plots on the Experiment Farm. On May 8,

1891, dozens were collected from young wheat by the use of a net. But on May 21st when the wheat was "heading out" not a single one could be found. The distribution of the insect is given by Osten Sacken, one of our most eminent authorities on this group of insects, as extending from Canada through the Atlantic States to Florida, Cuba, and the Bermudas. With its wide distribution it is surprising that it has not more generally made itself known as an injurious species. It was bred from corn by Professor Gillette, in Iowa, in 1889. The insect forms the subject of an illustrated article in *Insect Life*, volume 7, p. 352; 1895, where it is stated that it injures sorghum and oats as well as the plants named above.

THE HARLEQUIN CABBAGE BUG

(*Murgantia histrionica*).

Of late complaints have reached the Station concerning the depredations of a flat bug, marked with red or orange, which punctures the leaves of cabbage, radishes, mustard, kale and other plants belonging to the same family as these. Whether the insect has been in the State longer than two years I am not able to say, but it has at any rate only given rise to complaints from gardeners since 1894. During the season of 1895 it was reported to us by the following gentlemen: D. C. Haycraft, Elizabethtown; Edward Hoke, Jeffersontown; W. C. Morris, Adairsville; Rogers, Bassett & Co., Leitchfield.

On April 13, 1895, I found examples at work on wild Crucifere along Dix River, in Mercer county. May 8th, the first complaint of injury to cultivated plants reached the Station. During the summer no complaints came in, but in September the pest was again the subject of communications received from the southern part of the State, where it seemed to be most active.

The harlequin cabbage bug, or calico-back, as it has been aptly called, came to us originally from some southern country, probably from Central America, or even farther south.

It has been observed at least as far south as Guatemala. It attracted attention in Texas in 1866, or earlier, and since then has been observed from time to time in widely-scattered localities—Mississippi, Louisiana, North Carolina, Wisconsin, New Jersey, etc.—and hence has not improbably been present in Kentucky for some years. Why under these circumstances it should not make itself known before is something difficult to explain, the more especially since it seems to be very free from bird and insect enemies. Possibly our northern winters are too severe for it, and if this be true it may have made its way into the State repeatedly only to be destroyed by the cold.

It is a glossy handsome insect about $\frac{3}{8}$ -inch long, and a trifle less than $\frac{1}{4}$ -inch in width. The adults has two pairs of rather large wings, which, when not in use, it carries folded on the back. The immature bugs are wingless. It feeds at all stages of growth from the time it hatches from the egg by inserting its slender beak in the leaves and sucking their sap. The beak is kept close along the under side of the body between the bases of the legs when the bug is not feeding, but can be lowered so as to bring its point in contact with the leaf when in use.

It places its eggs, which are of large relative size, in two rows side by side on the leaves of plants. They are somewhat barrel-shaped, each with a dark band about the upper end and a faint line and dot near the attached extremity. These marks vary, however, a good deal, and may be wanting, while often extensive blotches appear, as represented in the two right-hand eggs of my figure. When the young hatch they push out a round lid, already formed, at the free end of the egg.

The calico-back spends the winter as an adult among the rubbish of gardens and fields, and comes out very early in spring to feed upon the first plants of the cabbage and mustard family to appear. Several broods develop during the season. It does not seem to have any special preferences within the family, but does not give trouble commonly by

attacking plants of other kinds. It is known, however, to feed upon peas, grapes and even corn at times when its other food becomes scarce from any cause.

The effect of the puncturing of plants by these insects appears to be somewhat like that of the tarnished plant bug (*Lygus pratensis*). One of my correspondents writing of its injuries to kale says that the attacked plants look as if they had been scalded. Another says of cabbage that the leaves turn brown and the heads then rot and fall off. I am not sure that the bugs are responsible for all of the latter injury, since we have in Kentucky a cabbage rot, which, under some conditions of weather does a good deal of mischief, and it is probable that this disease was under way in the field observed by this gentleman. All agree, however, that it is a most pernicious pest in the garden and that it is a very difficult one to combat.

REMEDIAL TREATMENT.

It is frequently claimed that the insecticides commonly employed in destroying puncturing insects such as this are not effective against the harlequin cabbage bug. I think this must be due to the difficulty of reaching the insects rather than to any natural immunity which they enjoy from the effects of these substances. Both pyrethrum and kerosene can be made to destroy the pests, as I find by experiment in the laboratory.

On September 28, 1895, at 10:45 a. m., an example was dusted with pure pyrethrum. At 11:30 a. m., it was still alive, but lay on its back. At 11 a. m., September 29th, it still lay on its back. On September 30th, it was noted as lying in the same position, but still was capable of moving its legs, and continued in this condition for several days, when it finally died.

On the same date, at 11:15 a. m., an example was moistened with kerosene emulsion, prepared by the commonly employed formula, diluted with ten parts of water. At 11:30 it was moistened again as the first application was not effective. This latter also failed, and at 11:35 a. m., its

body was wetted thoroughly with the diluted emulsion, and the bug was killed instantly.

At 11:40 a. m., September 28th, a second bug was thoroughly wetted with the diluted emulsion, and it also was killed at once.

At 11:45 a. m., September 28th, a bug was dusted with Leggett Brothers' Mexican Red Ant Powder. At 12 m., it was on its back. 2 p. m., it was still alive, but on its back. 11 a. m., September 29th, it continued in the same condition, and, subsequently, died without righting itself.

At 11:50 a. m., September 28th, dusted an example with powdered white hellebore, with the same result as in the preceding. It lay on its back at 2 p. m., and continued so on September 29th, and subsequently, until it died.

While, therefore, the powders were not as quickly effective as the kerosene emulsion they accomplished in the end the same result, and I am disposed to think that the failure of powders in the hands of others may have been in some cases due to the use of poor material.

The breathing pores of the cabbage bug are very small and are placed on the under side of the body. Hence an application of kerosene might not reach the pores and would, consequently, be of no avail. When thoroughly applied so as to reach the pores, even though greatly diluted as above, it is surprisingly quick in destroying the life of these insects. They drop, the legs draw up convulsively to the under side of the body, and there is no further movement. I believe it is safe to say that diluted kerosene emulsion will destroy these bugs if the difficulty of reaching them in their concealment among the leaves can be overcome.

The employment of a crop to entice the bugs in a garden to one spot where they can be destroyed by hot water or kerosene has been recommended of late and has been claimed to be very effective. A plot of radishes or mustard is planted before the regular crop is ready, and as soon as the bugs gather on the bait they are destroyed together with the plants they infest, thus leaving the subsequently-planted crop free

from them. The insects move about very readily, however, and such treatment can not be expected to rid gardens of the pest permanently. But it may be made to save a crop, which is more often the immediate and pressing desideratum with gardeners.

THE REGAL WALNUT MOTH

(*Citheronia regalis*).

An insect which is everywhere rather rare, but attracts special attention from the bizarre appearance and large size of its larva when it does occur, seemed to be not uncommon last summer, if I may judge by the number which were sent to the Station by correspondents. The adult moth is one of our handsomest species, with a spread of wing of a trifle over six inches. Its colors are orange and yellow, with obscure lines of slate-color on the fore wings. The insect is less often seen as an adult than it is when in the worm, or larva stage, and all those sent me were immature. These worms when fully grown and ready to go into the ground are about four and a half inches long and three-fourths inch through, the general color dull olive-green, with markings of black and orange. They are rendered very formidable in appearance by rough stout spines scattered over the body, of which eight long and slightly curved ones on the divisions of the body immediately following the head are especially conspicuous.

In its worm stage it feeds upon the leaves of black walnut trees, upon persimmon, sumach, hickory and white walnut. One of my correspondents found the example he sent to the Station under a sycamore tree, but possibly it had left a walnut or hickory tree in the neighborhood, and was wandering about searching for a suitable place to enter the ground for pupation. The pupa is very dark in color, and is formed in a cell made by compacting soil. The winter is spent in this condition, the moths coming out in spring to lay their eggs.

The insect is never common enough to injure trees severely, and hence, its interest to most of us exists in the singular appearance of the worm, and the extraordinary beauty of the moth into which it finally changes.

THE THROAT BOT-FLY OF THE HORSE

(Gastrophilus nasalis).

Since publishing in our last report an account of the horse bot-flies which occur in this country, I have taken pains to observe more closely with reference to the abundance of the above species in this region, and find it much more common than I supposed; indeed, but few of the animals which I examined in pastures were free from the eggs under the throat. The eggs were not always concealed, but could be seen without disturbing the hairs, when one approached sufficiently near. They are fastened farther down towards the bases of the hairs, however, than are the eggs of *G. equi*. They are scattered irregularly in the region between the lower jaws, sometimes well back towards the neck and in other cases not more than two inches from the mouth. I did not observe any evidence of swelling or soreness about the throat, such as Mr. Ericson describes. As many as a dozen eggs may be attached on the throat of one horse.

A fresh specimen of the fly before me shows the living colors better than the alcoholics from which my notes were drawn. The head is rust-brown, but becomes dusky between the eyes above, and is clothed with brown pubescence, especially abundant below, so that the mouth-parts are concealed. Antennæ brown. Eyes very dark brown. Thorax above clothed with rust-brown pubescence, with a silken gloss; before and behind the wings is a whitish tuft. Wings completely hyaline, the veins yellow, the front one darker. The white scale behind wings heavily fringed with silken white hairs. Femora dark; tibiæ dark outside, but becoming evidently brown towards their tips, the hind ones being most decidedly brown. Tarsi brown. Abdomen black, shining; above with a cross band of long whitish pubescence at base, then with a division which looks as if naked, except at the sides, but which is really clothed with short erect black pubescence.* The division next following this one is

*The appearance of this segment is most deceptive, and I do not remember having encountered anything just like it in other insects. Looking directly down on it one gets the impression of a completely naked shining surface with short pubescence at the sides, but with the insect held up to the light so that it can be viewed from the side it is apparent that the surface is thickly clothed with short black pubescence, as described above.

clothed with whitish pubescence like that at the base, while the three more slender terminal ones are very nearly naked, bearing only a few slender hairs with a slight rusty tinge. Beneath, the abdomen is clothed mainly with long whitish hairs, those behind becoming somewhat rust-colored. The dart-like ovipositor appears to be always exerted.

Mr. Ericson informs me that a piece of cloth fastened to the rings of the bit in front and to the throat-latch behind effectually prevents the placing of eggs on horses in harness. Animals in pasture can perhaps be best relieved of the eggs by rubbing the throat from time to time with a little dilute coal-oil emulsion.

THE COMMON HORSE FLY

(*Stomoxys calcitrans*).

A letter came to the Station dated August 13, 1895, from Truman Drury, of St. Vincent, Ky., complaining of the attacks of what seemed to be the common horse fly on horses which were used for breaking wheat ground. The flies were reported so bad that the horses would rear and plunge from the pain in such fashion that it was difficult to work them. I had some of the flies sent me and found them to be the species that is common in summer everywhere about cattle and horses. For some reason they were exceptionally common and persistent in their attacks in Mr. Drury's neighborhood.

The fly resembles the house fly so much that it is sometimes claimed to be the same fly. The horse fly does sometimes come into the house and may attack man by thrusting its beak through his clothing, but it is not a constant visitor in dwellings. October 20, 1890, it was observed to be common about Lexington both indoors and out. At this time hundreds could be seen sunning themselves on the sides of buildings. It is gray in general, and may be distinguished from the house fly by the color of the abdomen, which is gray with obscure round dusky spots, three of which are

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ranged along the middle, the rest toward the side.* In the house fly the abdomen is yellow at the side and dark at the middle. They can be distinguished also by their mouth-parts, the horse fly having a sharp beak with which it punctures the skins of animals, the house fly having a snout with a widened tip, for lapping. The house fly never "bites." The horse fly feeds on nothing but blood. The early stages of the two flies are much alike. Both are maggots and feed upon vegetable matter. The treatment to be recommended for such insects is rubbing the parts liable to attack with oil containing a very little carbolic acid. Coal oil can perhaps be used to advantage, since it does not leave the animal in such condition that he is not fit for riding, or driving to the buggy. The heavy oils and greases may be used on farm animals where appearance does not count so much. Ordinary lard, with a little insect powder worked in, or carbolic acid to give it an odor, has sometimes been used with fair success. Mr. Drury found equal parts of lard oil, petroleum and tar especially effective, but complains of the mixture because of the unkempt appearance in which the coats of treated animals are left by it.

*The following is taken from notes made from fresh specimens collected August 13, 1891, when they were common at Lexington on cattle, which they usually attacked about the legs. Length of large examples .25 inch. Color in general black. Thorax with four longitudinal stripes of black above, gray between and outside. Abdomen above largely gray, with three median spots of black at bases of segments, and a pair on each side of the series, one of each pair at the hind edge of the second and the other at the hind edge of the third segment. Abdomen beneath flesh-color, with a median series of four spots, the hindmost being largest. Legs plain black, yellow at extreme tips of femora and at bases of tibiae. Eyes dark brown. A fine silken pubescence at sides of the proboscis extends up along the eyes, inside and out. Proboscis black. Antennae blackish brown; bristle black, clothed with black hairs. Wings a trifle smoky, with a decided brownish cast on the basal two-thirds; strongly iridescent. Veins blackish brown. Variable, the spots on the abdomen and stripes on the thorax being very distinct and well defined on some examples, while on old ones they are very obscure.

THE BLACK CARPET BUG

(Attagenus piceus).

On April 17, 1895, Miss S. F. Price, of Warren county, sent me two small, brown, cylindrical larvæ, about 0.36 inch long, which she reported injurious to carpets. One of the insects sent me was preserved in alcohol, and the other kept in a vial with some woolen cloth until it became adult. It emerged May 25th, as a small black beetle 0.18 inch long, which proved to be the above insect. The insect is very different in appearance from the buffalo bug or spotted carpet bug (*Anthrenus scrophulariæ*). Its larva is more slender and the hairs on the surface are not erect. The beetle is much more slender, and plain back, the adult fo the buffalo bug being broad and flattened, its body coated with whitish and yellow scales arranged in more or less evident cross lines.

The remedies found effective for these insects are the use of benzine on parts of fabrics attacked, and the cleaning and stopping crannies in floors and base boards, which afford the larvæ lurking places. A persistent employment of these precautions for a season is generally sufficient to exterminate the pest in a dwelling. Fortunately the spread of the insect is not very rapid, and hence a knowledge of its nature, and prompt treatment when it appears in a locality, may sometimes prevent its getting a foothold. Both of the carpet beetles attack a variety of fabrics, and are known to infest and injure collections of insects, birds, and the like. When the object attacked is of a size such that it can be put in a tight box, perhaps the use of bisulphide of carbon for the destruction of the insect is the most convenient treatment that can be employed. Even carpets when not very large can be treated in this way.

AN INJURY TO TOBACCO, POSSIBLY THE WORK OF WIRE-WORMS.

Immediately after tobacco was planted last spring it suffered on some land from an injury which looks much like that caused by the mining of wire-worms. Dr. R. J. Spurr, President of the Board of Trustees, called my attention to it first, and in company with him I visited the farm of the Madden Brothers, at Donerail, where I saw the injured tobacco in the field. In places on this farm the plants were much smaller than they should have been, in fact, appeared to have grown but little after planting. Some of these dwarfed plants had a mine running down the tap root, others showed a number of scored regions, though the insect had not penetrated to any great depth. On a number of plants brought home with me for examination I found no trace of injury of any sort. In none of the plants was there a living insect, the mines having been deserted, judging by their appearance, some time earlier. The only facts elicited from the examination, which may serve to throw light on the matter, are the presence of these mines and the fact, reported to me, that parts of the field in which the plants were worst had been allowed to grow up in weeds during some weather unfavorable to farm work earlier in the season. The fact that a considerable number of the plants showed no insect injury at all leads me to think that an examination made earlier in the season might have shown the retarded condition of the plants to be caused by something else. The same injury was reported to the Station by Agricultural Commissioner McDowell as occurring at Versailles, in Woodford county. I shall be under obligations to any tobacco grower who will notify me at once in case of future injury of this sort in his fields.

THE CHINCH-BUG*(Blissus leucopterus).*

This pest of corn and small grains is confined in Kentucky mainly to the counties along the Ohio River. It is not as destructive anywhere in the State during most seasons as it is in the great corn-growing sections north of us, but now and then gives us a genuine exhibition of its capacity for mischief. Such was the case last summer when complaints came to the Station from correspondents residing in counties near Cincinnati and others scattered along the Ohio River westward to its junction with the Mississippi. The chinch-bug is not, however, confined to this strip, but may be found in small numbers wherever wheat and corn are raised in the State. It became destructive last summer even in Tennessee, a fact which shows that no part of Kentucky can be expected to be at all times exempt from its depredations.

THE CHINCH-BUG FUNGUS.

It is probable that our mild winters, with a great deal of moisture in spring, encourage the development of the parasitic fungi which attack and destroy the chinch-bug, and hence answer as a natural check upon its permanent occurrence in destructive numbers. The false chinch-bug and other species of the same order are in Kentucky especially subject to attacks of this sort, as one can demonstrate by keeping them confined indoors. Hence, it seems improbable that the insect will ever become a persistently injurious species with us.

A visit to Pendleton county which I made in July last summer showed the bugs to be working on corn in this county in great numbers. A field on the place of Mr. J. T. Mardis, near Falmouth, contained millions of them, at that time gathered on the lower part of the stalks so thickly that this part of the corn appeared black as one saw it while driving along the road. They had invaded the corn in this

instance from a field of oats adjoining, having been driven from the latter by the harvesters. A quantity of these chinch-bugs was brought to the Station by me, and from material received from Professor Forbes, of Illinois, and Chancellor Snow, of Kansas, the fungus was cultivated, so that we now have a supply from which farmers who may be troubled with the insect in 1896 can be furnished.

A few words concerning the nature of this material and method of using it may properly be given here:

The parasite is a plant somewhat like the molds that appear upon spoiled fruit and other animal and vegetable matter exposed to the air in damp situations. But it seems to be restricted to the bodies of insects. Since it grows best, like most other plants of its nature, in a moderately damp atmosphere, it is most effective in destroying insects when the weather is damp. And it spreads most rapidly among those insects which live on the ground and are disposed to be of social habit, just as epidemic diseases of man are most destructive in densely populated localities, and for a similar reason. Because of the importance of moisture in helping the spread of this fungus, it is not prevalent during very dry seasons, and at such times it is much more difficult to start its growth by artificial means. This is a fact to be kept in mind while handling the fungus, since it explains some of the instances of failure in making the infection material catch.

Chinch-bugs which have been killed by the fungus show a white powdery growth covering their bodies so that at length but little or nothing of the insect can be seen, the whole looking like a mass of white powder. If one transfers some of this powdery material to the stage of the microscope at the proper time, he will find the mass made up of very minute threads, some of which bear at their extremities exceedingly small spores or seeds. Now, if one can, by artificial means, grow these seeds and scatter them abroad in fields where chinch-bugs are at work he may start the development of the fungus in their bodies, and so, perhaps, rid

the field of chinch-bugs. This is the object of the work done by Chancellor Snow and others in the chinch-bug regions. Small boxes are sent out to those applying, each containing less than half a teaspoonful of the fungus, which the farmer puts in a large shallow box with a large quantity of living bugs to which the fungus is thus transferred and is then carried to the field to be spread among the bugs there at work.

The box used for this purpose may be made about two feet long, by eighteen inches wide, and six inches deep. But the exact size is a matter of no great consequence. It is made with very close-fitting joints, and is provided with a cover so fitted that the bugs can not get out. The bottom of the box is first covered with a layer of clean moist earth upon which the fungus is scattered, and then, after putting a layer of corn or wheat over the soil, the living bugs are turned in and the box closed. When the food-plant becomes brown a fresh supply is put in and the old is removed, since it is important that the contents of the box be kept clean. It may be several days after the insects are confined in such a box before evidence of disease appears among them. When a considerable number of dead ones are present, with bodies coated with the fungus, a part of the soil on the bottom of the box, together with some dead and some living bugs, is carried to a field where the bugs are gathered thickest and is scattered among them. After replacing the soil removed with fresh and putting in a fresh lot of bugs, the box is allowed to stand some time longer and then another portion of the soil and some of the dead and diseased insects are distributed in the field, and so on. The box thus serves as a source from which material can be drawn constantly.

At the Experiment Station I found a large glass culture-dish, such as is used everywhere for the culture of bacteria in laboratories, very convenient for growing the fungus. When one desired to keep the air in the dish moist, he could do so by putting on the cover. Much of the time the dish was simply covered with a piece of cloth gauze secured by

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EXPLANATION OF FIGURES.

Fig. 1. The San Jose Scale. Natural size. (From the Division of Entomology, U. S. Department of Agriculture.)

Fig. 2. The female San Jose scale. The enclosed line at the right of figure shows natural size. (From U. S. Division of Entomology.)

Fig. 3. The male San Jose scale. (From U. S. Division of Entomology.)

Fig. 4. The adult strawberry snout beetle (*Epicærus imbricatus*). About $2\frac{4}{5}$ times natural size.

Fig. 5. The Southern June Bug. A, adult beetle; B, the pupa in its earthen case, one side of which has been broken away; C, a pupa removed from its case, dorsal view; D, ventral view of pupa; E, side view of the grub. About $1\frac{4}{5}$ times natural size.

Fig. 6. The harlequin cabbage bug, about twice natural size. A, a cluster of eggs, about three times natural size.

Fig. 7. Chinch-bugs. A and B, young; C, adult. About three times natural size.

Fig. 8. Chinch-bugs as they appear when destroyed by the parasitic fungus. *Sporotrichum*. Enlarged.

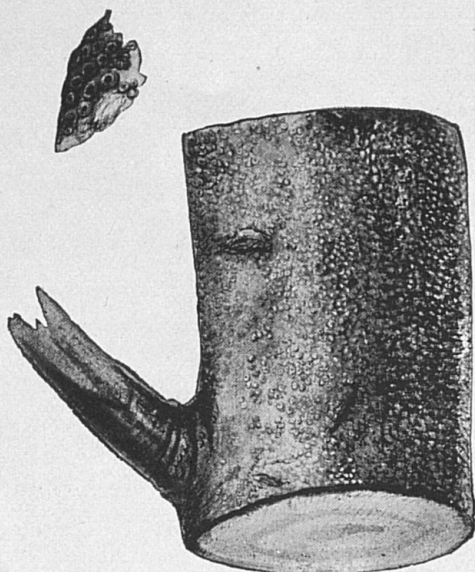


Fig. 1.

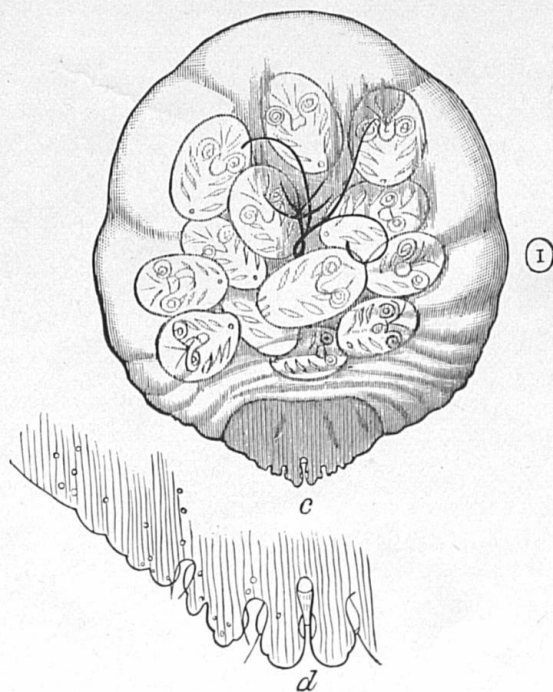
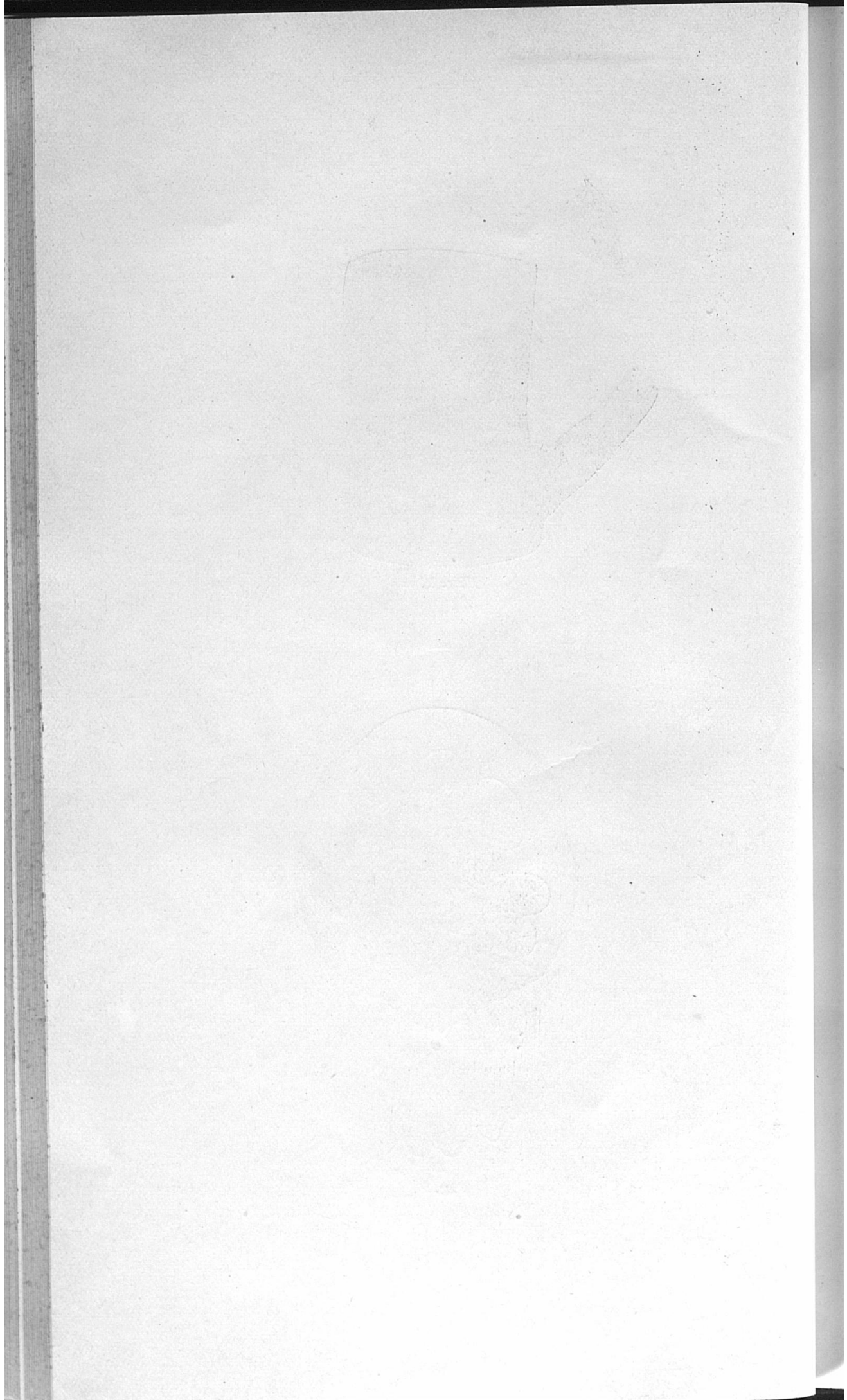


Fig. 2.



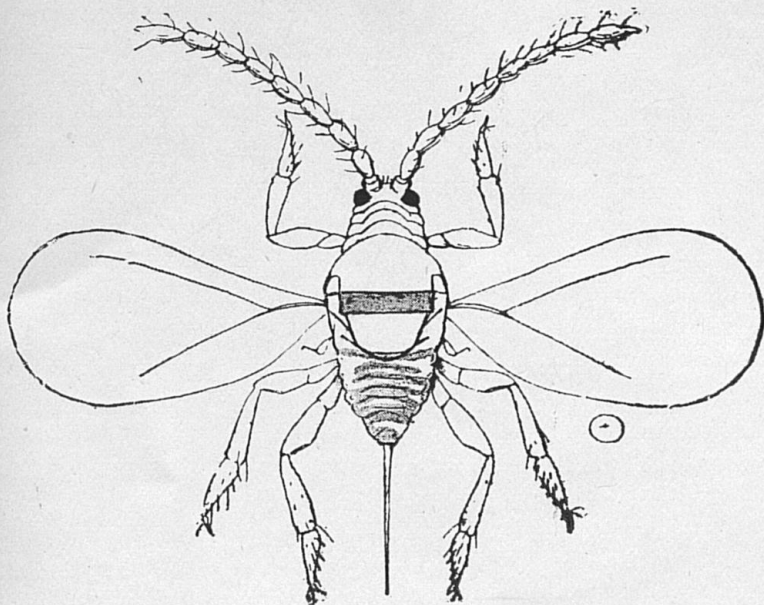


Fig. 3.



Fig. 4.



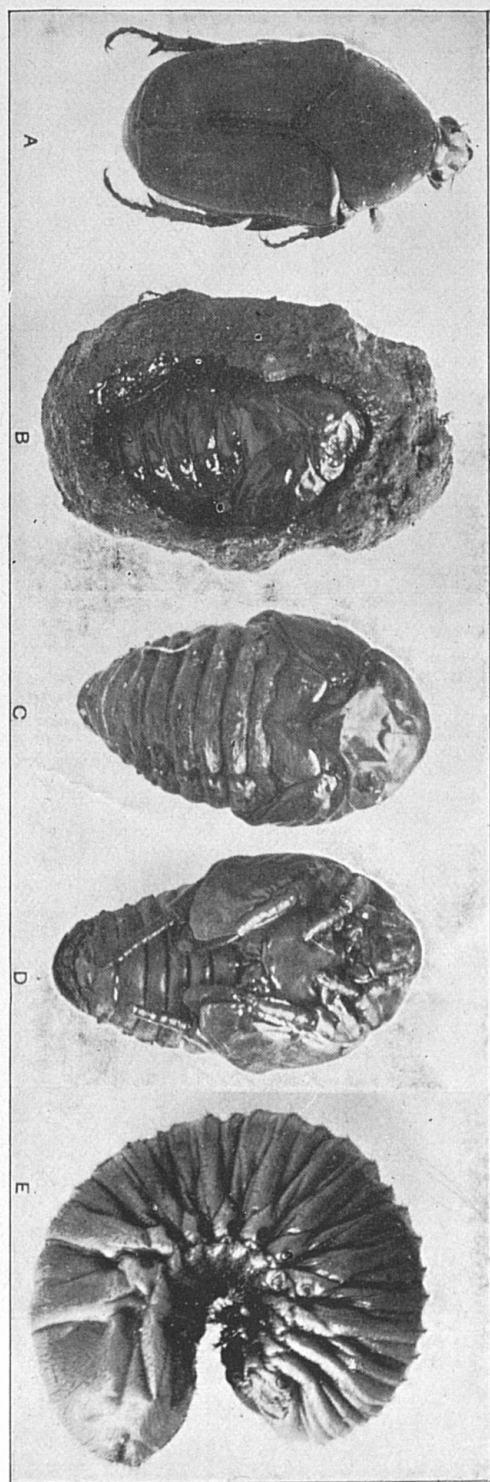
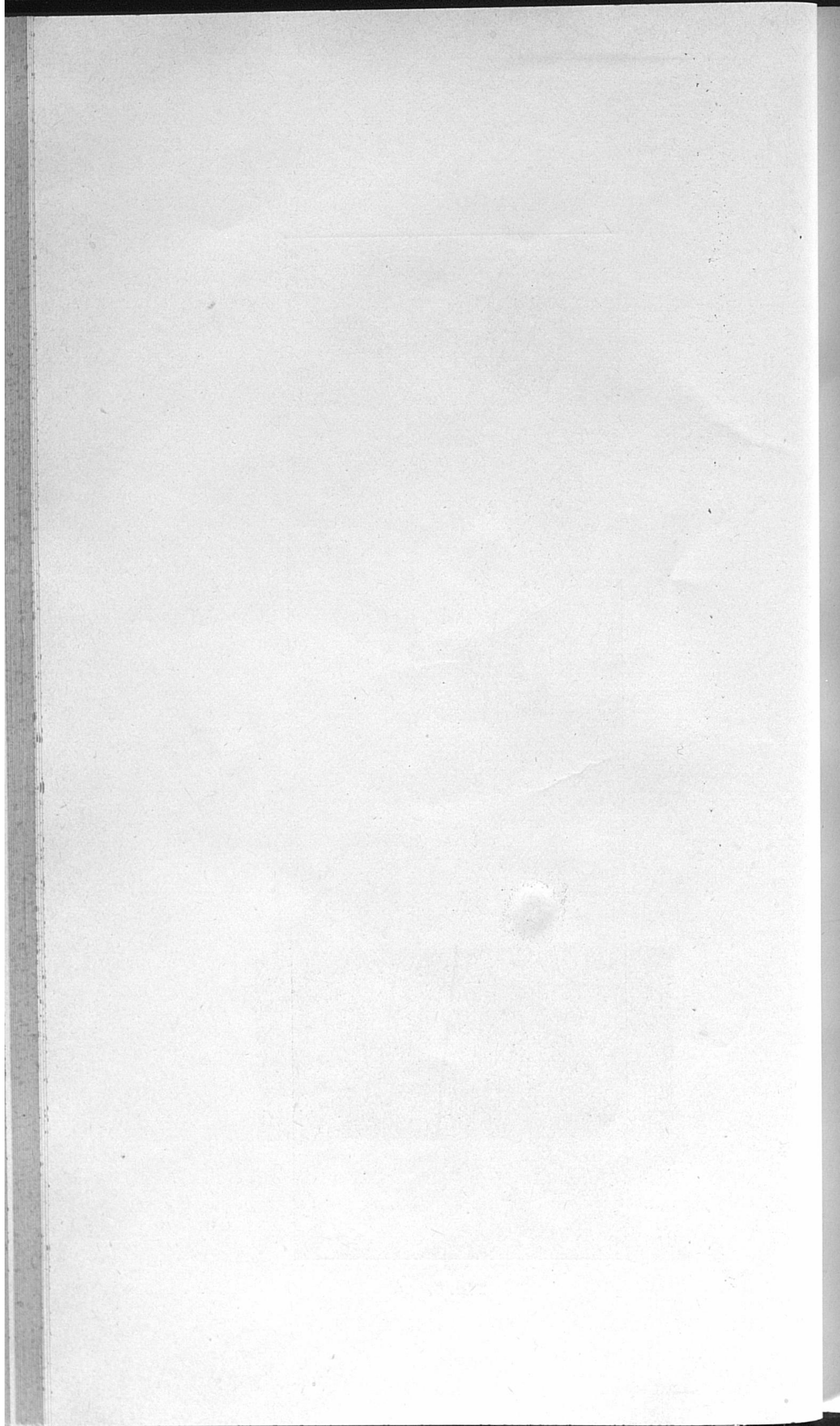


Fig. 5.



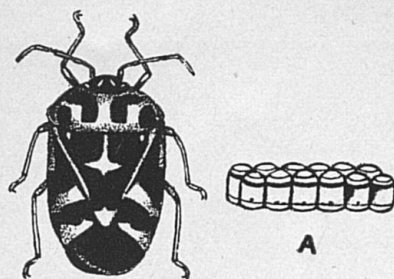


Fig. 6.

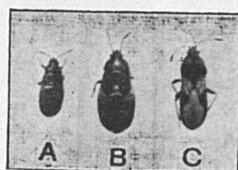


Fig. 7.

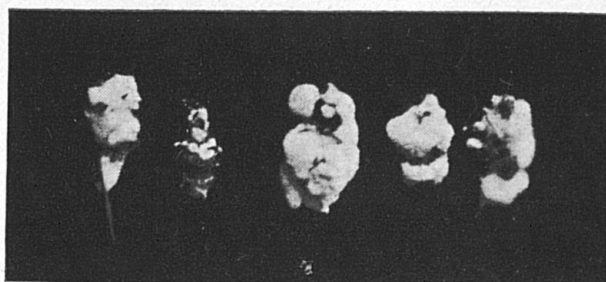
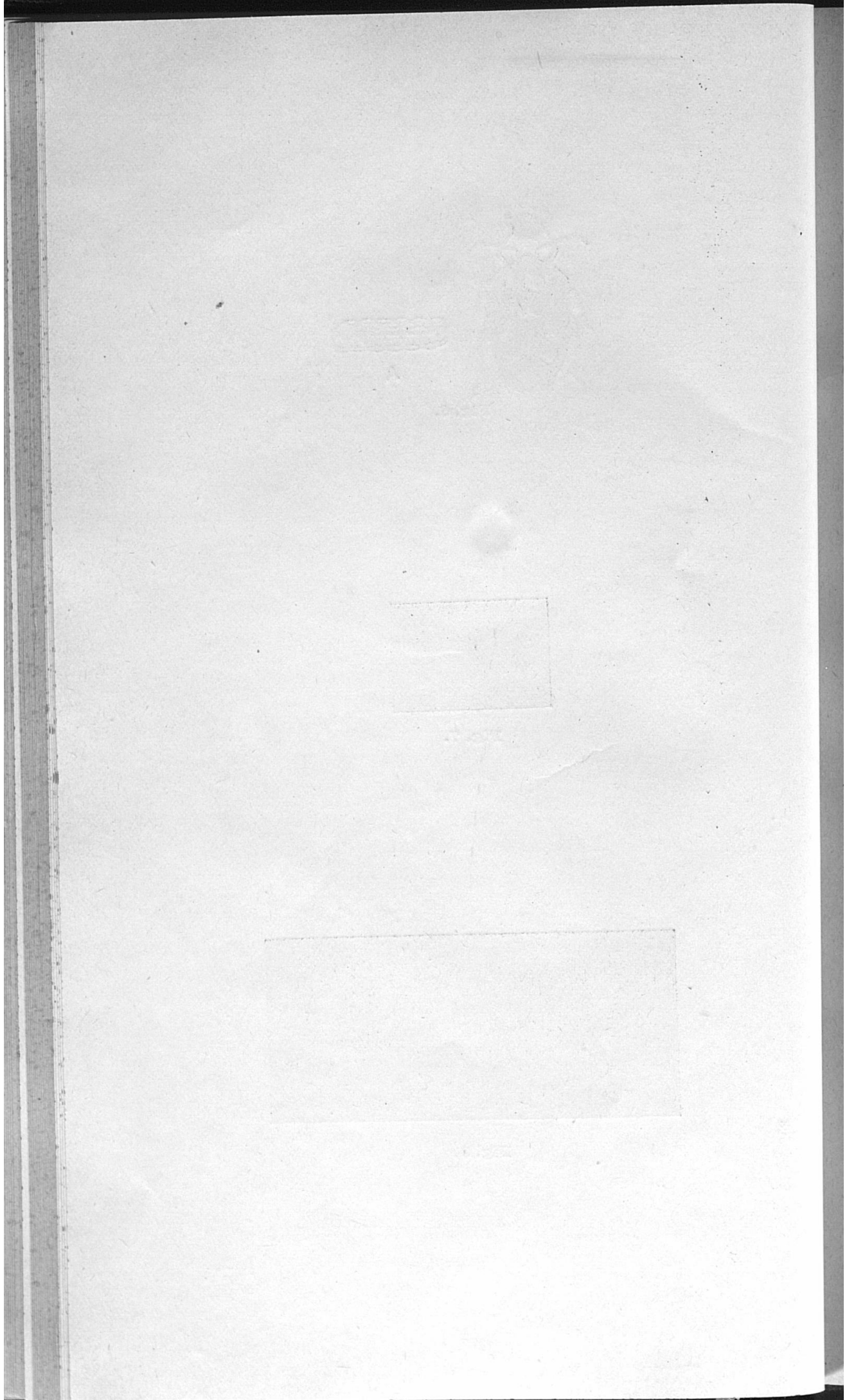


Fig. 8.



rubber elastics which went around the outside of the dish. Anything of this sort will do provided it is tight enough to keep the bugs from escaping. It is just as well, however, to make a box of considerable size when a large quantity of the fungus is wanted, and extra precautions in the way of close joints and well-fitted covers are needed to keep the bugs from escaping, as any one will testify, who has had experience in propagating the fungus. Prof. Forbes chinks the inside of his infection boxes above the soil and this keeps the bugs from creeping up the sides. By renewing the chalk frequently it is possible by its means to keep the chinch bugs from getting out without employing a cover.

When the conditions are kept just right it requires but little of the material to set the fungus at work on bugs so confined. The boxes sent out are only about one inch in diameter and about one-fourth inch thick. They can, consequently be sent by mail, so that no one need be deterred from getting material because of its cost. The Station will, in the future, furnish the fungus in such packages free to those who will agree to follow directions in using it and will report their results, whether they are successful or not, to the Station. We must insist on holding every one who gets material for a test to this requirement, and wish to have it understood beforehand that we shall be just as well satisfied with reports of those who have not succeeded as with those who have, provided, of course, they have followed directions faithfully. We want the exact truth even if every test proves an utter failure, so far as destroying the chinch-bug is concerned.

DIVISION OF HORTICULTURE.

M. A. Scovell, Director:

Dear Sir:—I submit herewith a report of the horticultural division of the Experiment Station for the past year.

The work of the year has included a variety of subjects, among them a comparison of various cultural methods with vegetables, a study of varieties of vegetables, extensive variety tests of potatoes and of strawberries, and during the winter season the forcing of vegetables under glass.

The past season has been fairly favorable to most of our work, although the exceedingly dry weather of August, September and October gave a decided check to late-maturing crops.

The strawberry crop was about an average one in yield and the plot under test included over sixty varieties, old and new, several of the latter giving promise of becoming valuable sorts.

The young experiment vineyard contains about sixty varieties of grapes, and has made a very satisfactory growth during the year. It is proposed to extend this vineyard as new varieties of promise appear, and it is believed that this will become one of the most interesting features of our horticultural work.

The vines upon which experiments in methods of pruning and training have been undertaken, are also in good condition, and during the coming season will be trained to the trellises, which have been provided for them.

The test of varieties of potatoes included nearly 250 kinds which were grown upon a half acre of ground at the Experiment Farm, and the results will soon appear in a joint bulletin with the Farm division and the division of Entomology and Botany, the latter divisions treating of the relations of fertilizers and fungicides to potato growing.

The new Experiment greenhouses which were completed in November, 1894, have, for a second season, proven their perfect adaptability to the work of the division.

In addition to the growing of vegetable plants in spring for field setting, they have been run to their full capacity at other times in forcing vegetables, particularly radishes, lettuce, and tomatoes for the winter market. While doing this, a study of the varieties best adapted to greenhouse culture has been made, and experiments have also been carried on with various methods of culture, looking to the most economical and profitable management of such houses.

Our results suggest the probability that in many places in Kentucky, accessible to markets, the winter forcing of vegetables may be extended with profit. In our own experience, the demand for such vegetables as lettuce and radishes has constantly exceeded the supply, and in fact the supply has repeatedly in a short time created demand far greater than we could meet.

This class of vegetables is the most easily raised of any of the forcing crops, requiring the minimum amount of heat, and this heat can be furnished by Kentucky coal in many parts of the State at an exceedingly low price, while in a mild winter like the present there are many days in which fires can be allowed to go out altogether, thus reducing the cost of production still more.

The work of the year past has been rendered somewhat more difficult than in the preceding season by the absence of any experienced assistant in horticultural work. Mr. A. T. Jordan, who filled this position very capably until last spring, left the Station at that time to accept a more advanced position with the New Jersey Experiment Station, and the duties of the writer as a teacher in the college have prevented at times that close personal supervision of details which field experiment requires.

A bulletin (No. 54) upon cultural experiments with vegetables and notes upon varieties was issued in March, and

others relating to the work of the past season are now nearly ready.

It is proposed in 1896 to continue several of the classes of experiments already outlined, and, I believe, it is also desirable to make a field study, if the season should prove favorable, of certain kinds of fruit largely grown in the State, particularly the peach.

This industry is assuming considerable proportions in some parts of Kentucky, and it is believed that a thorough study of the subject in the peach-growing centers would well repay the time and expense involved, and would afford the Station valuable data for dissemination through its bulletins to all parts of the State.

Respectfully submitted,

(Signed),

C. W. MATHEWS.

DIVISION OF METEOROLOGY.

M. A. Scovell, Director:

Dear Sir: I submit herewith a brief meteorological summary for the year 1895.

Very respectfully,

V. E. MUNCY, *Observer.*

ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—STATION, LEXINGTON, KY.
TEMPERATURE.

[illegible]

ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—Continued.

BAROMETRIC PRESSURE.

(Corrected for temperature and instrumental error only.)

Elevation of barometer cistern above mean sea level on December 31, 989 feet.

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

MONTHS.	Monthly	Highest observed.	Date	Lowest observed.	Date	Absolute range
	Inches.	Inches.		Inches.		Inches.
January	28.97	29.36	8	28.24	25	1.12
February	29.07	29.42	26	28.60	28	.82
March	28.97	29.28	17	28.51	1	.77
April	28.93	29.33	11	28.54	7	.79
May	29.02	29.24	22	28.70	26	.54
June	29.02	29.28	7	28.82	12	.46
July	28.99	29.21	3	28.68	7	.53
August	28.95	29.11	23	28.77	17	.34
September	29.03	29.20	21	28.83	3	.36
October	29.05	29.39	30	28.73	7	.66
November	29.08	29.42	27	28.49	25	.93
December	29.00	29.34	17	28.57	26	.77
		a.	a.	a.	a.	
Sum	348.08	Highest.	Date.	Lowest.	Date.	8.09
Mean	29.01	29.42	Nov. 27	28.24	Jan. 25	.67

ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—Continued.

PRECIPITATION.

(Amount in inches and hundredths.)

Elevation of top of gauge above ground, December 31, 2 feet.

MONTHS.	Total Amount.	GREATEST AM'T IN ANY 24 CONSECUTIVE HOURS.		No. of days on which 1 inch fell	No. of days on which no rain except "Trace" fell	No. OF CONSECUTIVE DAYS WITHOUT RAIN.
		Am't.	Date.			
	Inches.	Inches.				
January	5.60	1.49	6 7	1	15	from 17 to 19 inc.
February	.52	.18	6 7	0	20	from 19 to 28
March	2.79	.61	13	0	17	{ from 21 to 24 from 26 to 30
April	3.17	1.01	Mar. 31 1	1	18	{ from 17 to 21 from 23 to 25 from 28 to 5
May	4.05	1.31	6 7	0	20	{ from 17 to 24 from 27 to 3
June	2.93	1.53	4 5	0	24	{ from 6 to 19 from 25 to 29 from 2 to 5
July	5.07	1.34	24	1	17	{ from 9 to 14 from 17 to 19 from 31 to 4
August	1.56	.53	24	0	21	{ from 12 to 19
September	.33	.09	16	0	24	from 17
October	1.28	.53	11 31	0	24	{ to 6 from 13 to 24
November	2.52	.98	9	0	21	{ from 1 to 7 from 10 to 18
December	5.50	2.50	25 26	1	20	from 9 to 19
Sum	35.32	a.	a.	a.	a.	
Mean	a.	a.	a.	a.	a.	

Normal rainfall for April, 3.82 inches.

Normal rainfall for May, 3.43 inches.

Normal rainfall for June, 4.25 inches.

Normal rainfall for July, 4.78 inches.

Normal rainfall for August, 3.56 inches.

Normal rainfall for September, 2.54 inches.

ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—Continued.

SUNSHINE AND CLOUDINESS.

MONTHS.	NUMBER OF DAYS.			MEAN CLOUDINESS. (0 to 10.)		
	Clear . . .	Partly cloudy .	Cloudy . . .	8 a. m. . . .	8 p. m. . . .	Monthly . . .
January	3	8	20	8.1	6.0	7.8
February	5	8	15	5.9	5.2	6.8
March	12	5	14	6.3	5.2	6.1
April	5	11	14	5.1	5.9	6.6
May	4	13	14	5.5	5.6	6.5
June	9	15	6	3.7	5.7	5.3
July	6	16	9	6.5	6.2	5.9
August	12	10	9	5.1	5.1	5.2
September	15	5	10	2.9	3.1	4.7
October	16	8	7	2.5	3.3	3.6
November	6	5	19	6.6	6.0	7.0
December	2	4	25	8.4	7.1	8.5
Sum	95	108	162	66.6	64.4	74.0
Mean	a.	a.	a.	5.6	5.4	6.2

ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—Continued.

WIND.

Elevation of anemometer cups above ground December 31, 122 feet.

MONTHS.	Prevailing direction	MAXIMUM HOURLY VELOCITY DURING MONTH.			No. of days with gales (h) . . .	No. of calms . .
		Miles.	From.	Date.		
January	S.	60	S. W.	26	4	0
February	W.	48	S.	20	1	0
March	S. W.	50	N. W.	8	3	0
April	N. E.	44	S. E.	13	3	1
May	S.	48	W.	13	2	0
June	S. W.	48	S.	4	1	2
July	S. W.	40	N.	30	1	0
August	S. W.	46	S. W.	24	1	1
September	S. W.	34	S. W.	18	0	0
October	W.	36	S.	11	0	1
November	S.	62	S.	26	2	0
December	S.	60	S. W.	26	2	0
Sum	a.	a.	a.	a.	20	5
Mean	S. W.	a.	a.	a.	a.	a.

ESS.

Monthly . . .

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ANNUAL METEOROLOGICAL SUMMARY FOR 1895.—Continued.

NUMBER OF DAYS.

MONTHS.	Thunder- storms.	Snow.	Hail.	Fog.
January	0	9	0	0
February	0	8	0	0
March	1	3	0	0
April	2	0	1	1
May	4	0	1	0
June	3	0	0	0
July	2	0	0	0
August	3	0	0	1
September	3	0	0	0
October	1	0	0	0
November	0	0	0	0
December	0	4	0	0
Sum	19	24	2	2
Mean	a.	a.	a.	a.

KENTUCKY

Agricultural Experiment

STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 54.

NOTES ON VEGETABLES.

LEXINGTON, KY.

MARCH, 1895.

KENTUCKY Agricultural Experiment Station.

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J. S. TERRILL, Assistant to Entomologist and Botanist.
A. T. JORDAN, Assistant to Horticulturist.
V. E. MUNCY, Weather Observer.
T. S. HAWKINS, Foreman of the Farm.
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. 54.

NOTES ON VEGETABLES.

TOMATOES. PEAS. BEANS. POTATOES.

The vegetable tests for 1894 were conducted upon land at the experiment farm, instead of upon the college grounds as heretofore, and it has therefore been possible to secure greater accuracy in the report upon any experiments where the productiveness was concerned.

The climatic conditions of the season in Kentucky, as well as in adjoining States, were rather extraordinary. Spring opened earlier than usual, and the weather was mild and pleasant up to March 23, when there followed ten days of very cold weather for the time of year, which destroyed to a great extent the young growth upon trees and shrubs, and either destroyed or greatly injured in many cases young plants in plant beds. Growing crops of the more tender kinds were again considerably injured by an untimely snowfall of several inches upon May 20. The drought during the midst of the growing season further added to the unfavorable conditions. After a rainfall of about 2 inches on June 25 to 27, the total rainfall up to August 10, a period of six and a half weeks, was only 0.87 inches.

As a consequence of these conditions of the weather, the experiments with vegetables have in many cases not been as decisive as they would otherwise have been, and the results of some have been so uncertain as to be almost valueless.

The vegetable tests have, for the most part, been under the charge of Mr. A. T. Jordan, assistant in horticulture, and the taking of notes, as well as this report, have been largely his work.

The names and addresses of the seedsmen whose names

appear in the following tables are as follows: W. Atlee Burpee & Co., Philadelphia, Pa.; Henry A. Dreer, Philadelphia, Pa.; J. A. Everett, Indianapolis, Ind.; D. M. Ferry & Co., Detroit, Mich.; Frank Ford & Sons, Ravenna, Ohio; J. J. H. Gregory & Co., Marblehead, Mass.; Harris Seed Co., Moreton Farm, Monroe Co., N. Y.; Peter Henderson & Co., New York; Johnson & Stokes, Philadelphia, Pa.; D. Landreth & Sons, Philadelphia, Pa.; A. W. Livingston's Sons, Columbus, Ohio; W. H. Maule, Philadelphia, Pa.; A. M. Nichols, Granville, Ohio; Northrup, Braslan & Goodwin Co., Minneapolis, Minn.; J. M. Thorburn & Co., New York; F. B. Van Ornam, Lewis, Iowa; J. C. Vaughan & Co., Chicago, Ill.; James Vick's Sons, Rochester, N. Y.

Tomatoes.

VARIETIES. The seeds of fifty-six varieties of tomatoes for our test were sown in shallow seed boxes in the greenhouse on March 3. Most of the newer introductions obtainable are included in this collection, as well as a considerable number of the old standard varieties which are retained for comparison.

In accordance with our practice heretofore, in order to obtain uniform conditions for the varieties, the plants, after removal from the seed boxes, were grown in pots. On March 23 the seedlings were transferred to 2½ inch pots, and on April 12 were again shifted to 3 inch pots (the rose pots, so-called, which are 4 inches deep), in which they remained until set in the field, May 5. Upon this date the plants were vigorous and stocky, and since in pot culture the roots are not mutilated in setting, they continued to grow without much check.

The plot upon which they were grown received a fair coat of stable manure before plowing, and a few days after the plants were set a good supply of a complete fertilizer was sown broadcast, and hoed and cultivated

into the soil, and again on June 6 a light application of fertilizer was made and cultivated in.

Ten plants of each variety were used in the test, and were placed in rows 5 ft. apart and 4 ft. apart in the rows. The soil was frequently stirred with a horse cultivator and hand hoes until the vines had completely occupied the ground.

The tender growth of the tips of the vines was somewhat injured in the snow of May 20th, but in a short time the plants were again growing vigorously. Owing to the excessively hot and dry weather of July and August, the tomatoes ripened very slowly during that time, and were also rather small for the same reason.

As the fruits ripened they were picked, counted, and weighed. Owing to the fact that during previous seasons the tomato rot had been quite prevalent, and in order to determine if certain varieties had greater immunity from rot than others, accurate records were also made of the number and weight of rotten fruits, and the ratio between the weight of rotten fruits and the weight of perfect fruits will be found in the table which gives a detailed record of the variety test.

VARIETY.	SEEDSMAN.	First ripe fruits.	Product up to Aug. 1.		Total product ripe fruits.		Number of ripe fruits.	Average weight per fruit.		Weight of fruit unmarketable because of tomato rot.		Proportion of rotted fruits to marketable fruit by weight.		Weight of green fruit marketable after killing frost.	
			lbs.	oz.	lbs.	oz.		oz.	lbs.	oz.	lbs.	oz.	1:	2.1	lbs.	oz.
Acme	Ferry	June 28.	19	6	76	10	576	2.1	22	2	1:	3.5	11	8	
*Allen	M. J. Allen	July 26.	4	12	66	4	390	2.7	14	1	1:	4.7	12		
Atlantic Prize	J. & S.	July 2.	25	1	77	7	495	2.5	8	6	1:	9.2	5	4	
Beauty	Livingston	" 2.	14	13	79	4	501	2.5	24	11	1:	3.3	3		
Brandywine	J. & S.	" 2.	6	8	49	8	320	2.5	23	8	1:	2.1			
Brinton's Best.....	J. & S.	June 29.	9	13	79	10	479	2.7	21		1:	3.8	11	4	
Buckeye State.....	Livingston	July 7.	13	11	84	2	408	3.3	11		1:	7.6	25		
Cardinal	Maule	June 28.	17	14	97	13	593	2.6	10	6	1:	9.4	11	12	
Conqueror	Ferry	July 2.	17	14	102	5	880	1.9	9	5	1:	11	2		
Crimson Cushion.....	Henderson	" 7.	4	14	101	5	302	5.4	14	3	1:	7.1	34		
Cumberland Red	J. & S.	June 28.	8	9	82	15	512	2.6	28	7	1:	2.9	15	4	
Dwarf Aristocrat	Livingston	" 28.	14	11	62	14	494	2.	3	10	1:	17.3	4		
Dwarf Champion	Thorburn	July 2.	13	5	56	11	386	2.3	8	2	1:	7	7		
†Early Cluster	Landreth	" 2.	17	3	83	9	493	2.7	9	1	1:	9.2	3	8	
Early Market Champion.....	J. & S.	June 28.	9	12	71	12	581	2.	26	8	1:	2.7	5		
Early Ruby.....	Harris	" 28.	26		107	11	595	2.9	7	5	1:	14.7	9	8	
Essex Hybrid	Ferry	" 28.	16	5	69	10	547	2.	26	1	1:	2.7	14	8	
Favorite.....	Henderson	" 28.	8	13	79	14	508	2.5	24	10	1:	3.2	5		

Notes on Vegetables.

Early Ruby	28.	16	5	69	10	547	2.	20	1	1.	2.	5
Essex Hybrid	"	28.	8	13	79	14	508	24	10	1:	3.2	5
Favorite	"	"										
Landreth	July 7.	7	7	84	11	449	3.	10	5	1:	8.2	4
Burpee	June 28.	17	4	71	6	554	2.1	26	12	1:	2.7	16
Livingston	"	25.	13	82	14	1447	.9	23	13	1:	102.	6
Ferry	July 19.	7	11	82	14	543	2.4	31	6	1:	3.5	9
Ferry	"	2.	6	55	3	328	2.7	23	4	1:	1.8	8
Ignotum												
Thorburn	June 28.	11		76		573	2.1	23	15	1:	3.2	4
J. & S.	July 7.	11	13	84	13	557	2.4	27	10	1:	3.7	10
Thorburn	June 28.	14	14	76	14	607	2.	27	1	1:	2.8	10
Rawson	July 2.	12		66		510	2.1	27	14	1:	2.4	6
Maule	"	19.	14	50	11	188	4.3	11	5	1:	4.5	20
Burpee	"	2.	10	86	6	505	2.7	29	3	1:	3.	3
Vick	June 28.	15	8	80	2	527	2.4	25	8	1:	3.1	8
Ferry	"	25.	10	85	14	666	2.	25	3	1:	3.4	13
Dreer	July 2.	5	8	58	2	241	3.9	14	3	1:	4.1	8
J. & S.	"	2.	10	86	9	570	2.4	20	7	1:	4.2	8
A. M. Nichol	"	2.	6	74	4	406	2.9	19	12	1:	3.8	6
Thorburn	"	2.	10	9	7	306	3.1	4	10	1:	13.1	3
Ferry	June 28.	11	3	66	6	565	1.9	13	1	1:	5.1	10
Livingston	July 2.	9		61		446	2.2	26	12	1:	2.3	8
Livingston	June 28.	13		67	8	469	2.3	26	15	1:	2.5	12
Dr. R. J. Spurr	July 7.	7	11	82	6	455	2.9	20	14	1:	3.9	12
Henderson	June 28.	5	6	72	15	224	5.2	9	5	1:	7.8	8
Maule	"	28.	10	77	11	600	2.1	30	11	1:	2.5	8
Dreer	Aug. 1.			78	1	185	6.75	7	4	1:	10.8	19
Livingston	July 2.	8	11	76	5	423	2.9	23	3	1:	3.3	6
Livingston	"	19.	3	68	4	390	2.8	26	4	1:	2.6	12
Henderson	"	2.	26	8	108	384	4.5	20	5	1:	5.3	12
Landreth	June 28.	13	9	90	8	674	2.1	17	13	1:	5.1	3
Thorburn	July 7	10	12	86	8	825	1.7	8	13	1:	9.8	

*Seed sown March 28; set in field May 17. †Nine plants only. ‡Yellow varieties.

VARIETY.	SEEDSMAN.	First ripe fruits.	Product up to Aug. 1.		Total product ripe fruits.		Number of ripe fruits.	Average weight per fruit.		Weight of fruit unmarketable because of tomato rot.		Proportion of rotted fruits to marketable fruits by eight.	Weight of green fruit marketable size after killing frost.
			lbs.	oz.	lbs.	oz.		oz.	lbs.	oz.			
Trophy	Henderson	June 28.	13	3	96	8	551	2.8	30	8	1: 3.2	9	8
Turner Hybrid	Maule	July 26.	16	5	74	14	283	4.2	16	5	1: 4.6	14	8
Volunteer	Vaughan	"	10	3	85	1	569	2.4	29	12	1: 2.8	19	8
† Yellow Peach	Vaughan	"	7	14	78	9	1257	1.	6	5	1: 12.4	19	8

† Yellow varieties.

As has been noted before in discussing varieties of vegetables, the list of fifty-one named kinds in the above table does not by any means indicate that there were fifty-one distinct varieties in our experiment plot. Many of these kinds are so much alike that the closest inspection fails to reveal any distinguishing characters, so that in many cases the different names indicate at the most only different strains of the same variety.

It will be observed from the table that the varieties which were first to ripen fruit were the Essex Hybrid, Gold Ball, and Michigan, which showed ripe fruit on June 25, nearly two weeks earlier than the first ripe fruits upon any variety of the preceding year, although the seed was sown only four days earlier than in 1893. This greater earliness must have been due chiefly to differences in the two seasons, as all other conditions of growth were as nearly alike as they could be made.

The fact that one or two fruits ripened upon each of three varieties three days earlier than upon a considerable number of other varieties which commenced to ripen June 28, should not be considered proof that these three are as a whole earlier varieties, since these ripe fruits were found only upon one or two of the lot of ten plants. Of the three varieties mentioned, the Gold Ball is a small yellow kind which is only suited to special uses, and cannot be considered a general purpose variety.

In considering the quality of earliness in a tomato, it is evidently important to select varieties, whether for home use or for market, that will produce a considerable number of fruits early in the season while prices are high, rather than one which will produce merely the earliest ripe fruit. From this standpoint several other varieties are more valuable as producers of early fruit than the three varieties mentioned above.

Among those producing the most fruit before Aug. 1 are the ten plants of Table Queen, 26 lbs. 8 ozs. (although

not ripening its first fruits until July 2); Early Ruby, 26 lbs.; Atlantic Prize, 25 lbs. 1 oz.; Acme, 19 lbs. 6 ozs.; Conqueror, 17 lbs. 14 ozs.; Fordhook First, 17 lbs. 4 ozs., and Early Cluster, 17 lbs. 3 ozs.

The most productive varieties up to the time of killing frosts are,—Table Queen, 108 lbs. 10 ozs.; Early Ruby, 107 lbs. 11 ozs.; Conqueror, 102 lbs. 5 ozs.; Crimson Cushion, 101 lbs. 5 ozs.; Cardinal, 97 lbs. 13 ozs.; Trophy, 96 lbs. 8 ozs., and Ten Ton, 90 lbs. 8 ozs.

The largest varieties in the list are,—Ringleader, average weight, 6.75 ozs.; Crimson Cushion, 5.4 ozs.; Ponderosa, 5.2 ozs.; Table Queen, 4.5 ozs.

The varieties showing the smallest proportion of rotten to perfect fruits are,—Gold Ball, 1 to 102; Dwarf Aristocrat, 1 to 17.3; Early Ruby, 1 to 14.7; Northern Light, 1 to 13.1; Ringleader, 1 to 10.8.

In examining the table it will be seen that in several instances the earlier varieties are among the list of largest producers, and this is in some cases doubtless *because* they are earlier, so that they can ripen all, or nearly all, their fruit before the first killing frost in the fall.

The following additional notes upon certain varieties, which from one cause or another have received special notice, may be of interest.

ATLANTIC PRIZE, J. & S. Plants are of medium size, rather slender and open in growth. Fruit red, of medium size and generally smooth, although a few were angular and ribbed, quite firm and one of the largest producers in the first six weeks.

BEAUTY, Livingston. One of the purple tinged standard varieties. Fruit round, smooth, firm, of medium size, ripens evenly and fairly productive.

BUCKEYE STATE, Livingston. Introduced 1893. A vigorous grower, producing a good quantity of large crimson fruit (av. weight 3.3 oz.) Ripens well at stem, smooth and firm. An excellent late variety.

CARDINAL, Maule. Plant vigorous. Fruit red, smooth, ripening well around the stem, of fair size and productive. A good standard variety.

CONQUEROR, Ferry. One of the earliest and most productive varieties. Fruit rather small, and somewhat irregular and ribbed.

CRIMSON CUSHION, Henderson. A vigorous grower, crimson color, ripening well at stem, firm, but considerably ribbed. A heavy producer. Much like Ponderosa in general characters, and with us more productive.

DWARF ARISTOCRAT, Livingston. Plant short and stocky, with a tendency to grow erect, although not self-supporting. Fruit has a purple tinge, is very smooth, firm and ripens evenly. Not very productive as compared with individual plants of other sorts, but its habit of growth allows closer planting. Freer from rot than any other variety of standard size. Superior for the home garden.

EARLY RUBY, Harris. Plants slender and of open growth. Fruit smooth and firm, ripening well at the stem. One of the three most productive, both in first six weeks and in the entire season, and also one of those producing the least rotten fruit.

ESSEX HYBRID, Ferry. One of the earliest in ripening. Fruit smooth and firm.

FORDHOOK FIRST, Burpee. Vigorous grower. Fruit red, smooth, ripening well up to stem, but not very solid. Ripens a good proportion of its fruit the first six weeks. With us seems to possess no special merit.

GOLDEN QUEEN, Ferry. A standard yellow variety, ripens evenly, smooth and firm.

IGNOTUM, Ferry. A variety which in many places has been pronounced one of the best general purpose varieties, but with us during the past season has not been productive, and was more subject to rot than any other variety grown.

LEMON BLUSH, Thorburn. As grown here, this yellow variety is almost identical with the Golden Queen and has shown no marked superiority over that variety except that it ripened three weeks earlier.

MANSFIELD TREE, Maule. A vigorous grower, but no more tree like than some other strong grower. Fruits rather larger and firm, but considerably ribbed, and only moderately productive.

MICHIGAN, Ferry. Plant vigorous, producing a red, firm and smooth fruit, which ripens well to the stem, and is among the earliest.

NICHOL'S NO. 5, A. M. Nichol. Plant of the potato leaf type. Fruit purplish red in color, ripening evenly, round, smooth and solid. An excellent variety of its class.

NORTHERN LIGHT, Thorburn. A dwarf, strong-growing sort, of recent introduction. Fruit slightly purple tinged, smooth and firm. Very much like the Dwarf Aristocrat, and like that variety, is comparatively free from the rot.

RINGLEADER, Dreer. Plant large and vigorous. Fruit red, very large and solid, but showing some tendency to irregularity in shape.

TABLE QUEEN, Henderson. A vigorous grower, with large crimson fruit; solid, but somewhat ribbed and angled. The most productive variety in our plot, both in first six weeks and through the entire season.

POT GROWN VERSUS "FLAT" GROWN PLANTS.

This experiment was undertaken to determine which of the two methods of growing plants would give the best results, growing them in seed flats,—shallow boxes of any convenient size (those used by us are 14x20 in. and about 3 in. deep), or in pots. When grown in pots the plants can be transferred to the open ground without disturbing the roots, thus avoiding any check to the growth of the plant. Will the results of this method of

handling pay for the extra labor, and expense for pots which is involved? To test this question, seeds of Livingston's Favorite and Perfection tomatoes were sown for both lots in a seed flat, March 3. When the seedlings had their "second leaves," 15 plants of each were set in seed flats 4 in. apart, and at the same time an equal number of plants were set in 2½ in. pots, and later on shifted to 3 in. rose pots (4 in. deep).

Both lots of plants were set in the field May 5, and the results are shown in the table below.

NAME.	Date of first ripe fruits.		Average number of fruits per plant		Average weight per plant		Average weight of individual fruits.	
	FLAT.	POT.	FLAT.	POT.	FLAT. lbs. oz.	POT. lbs. oz.	FLAT. lbs. oz.	POT. lbs. oz.
Favorite	July 26	July 26	51	53	7 6	8 5	2 5	2 8
Perfection ...	July 30	July 26	38.5	52.3	7 3	8 10	3	2 10

It will be seen by the above table that the gain in yield per plant by pot growing is quite decided; in the case of the variety Favorite, being 15 ozs. per plant, and with Perfection 23 ozs., or almost 1½ lbs. per plant. The effect upon the earliness of ripening and the size of the fruit seems to be very slight, if any, as the results in the two varieties do not agree.

Experiments of this kind need several repetitions to establish trustworthy conclusions, but the evidence so far obtainable seems very favorable to pot grown plants. While the expense and extra labor of this method would probably preclude its adoption in tomato growing upon a large scale, it is probable that in the home garden it would be found a very desirable plan.

EARLY VERSUS LATE SEED-SOWING.

In order to determine the most favorable time for starting tomatoes to secure the best results, seeds of Livingston's Favorite tomato were sown in seed boxes at intervals of ten days, beginning Feb. 7, until eight consecutive sowings had been made.

The plants were grown in pots, and the first four lots required transplanting three times, and the remaining lots twice, before finally setting in the field. The first five lots were set in the field at the same time as the plants of the variety test, May 5, lot 6 on May 17, while lots 7 and 8 were not placed in the field until June 13. Fourteen plants were used in each lot, and the following table gives the detailed results of the experiment:

Lot.	Date of sowing	Date of first ripe fruit	Average number of fruits per plant	Average weight of individual fruits		Average product per plant of ripe fruits, entire season.		Average product per plant of green fruit, marketable size, after killing frosts.		Product per plant up to middle of August.	
				oz.	lbs. oz.	oz.	lbs. oz.	oz.	lbs. oz.	oz.	lbs. oz.
1	Feb. 7.	June 28.	49.3	2.5	7 12	21	3 2	21	3 2	21	3 2
2	" 17.	July 26.	41.6	2.6	6 11	16	2 14	16	2 14	16	2 14
3	" 27.	" 26.	43.4	2.6	7 6	28	3 3	28	3 3	28	3 3
4	Mar. 9.	" 20.	47.4	2.5	7 6	21	3 3	21	3 3	21	3 3
5	" 19.	" 30.	39.5	2.6	6 3	26	2 5	26	2 5	26	2 5
6	" 29.	" 26.	47.3	2.5	7 5	22	2 14	22	2 14	22	2 14
7	Apr. 8.	Aug. 3.	23.4	3.3	4 13	12	1 10	12	1 10	12	1 10
8	" 18.	" 14.	20.7	3.2	4 2	14	1 10	14	1 10	14	1 10

The first ripe fruits were from lot 1, almost a month ahead of any other lot, but these ripe fruits were only two in number, and no other picking was made from this

or any other lot until near the last of July. It seems that the drought interfered with this experiment somewhat, especially in regard to earliness, as when rain came, all except the last two lots began to ripen their fruit very near together. By the middle of August, approximately four weeks from the earliest picking in July, lot 3, sown Feb. 27, was a little in advance of any other lot in productiveness, but the results taken as a whole are not very decisive, and the experiment will be repeated. It appears, however, that considering the extra labor and care involved in starting plants very early, there is no advantage to be gained, under ordinary conditions, in sowing tomato seed before the first of March in this climate.

TRANSPLANTED VERSUS THICKLY GROWN OR "DRAWN" PLANTS.

An idea seems to be prevalent among gardeners in this as in other States, that plants grown unthinned and close together in hot beds or cold frames, and consequently very slender or "leggy," give just as good results as though they were transplanted early and given room sufficient to develop into strong and stocky plants. Even among those who acknowledge the superiority of stocky plants, it is thought by many that the increased productiveness of such plants will not pay for the extra labor and the cost of extra sash required to produce them.

In order to throw light upon this question, if possible, seeds of the Stone and Longkeeper varieties of tomato were sown in a cold frame in rows four to five inches apart on April 9. A few days after germination the seedlings were thinned to $\frac{1}{2}$ - $\frac{3}{4}$ inches apart, and the plants remained at this distance until set in the field. A portion of the same plants when in the "second leaf" stage were set in another portion of the bed, four inches apart each way, and being given sufficient room, developed into strong, stocky plants.

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Twenty plants of each of the four lots were set side by side at the usual distance of 4 x 5 feet apart.

	VARIETY.	Average weight of individual fruits.	Average weight per fruit ripe fruit per plant	Average weight rotted fruit per plant.	Per cent. of rotted fruit.
		oz.	lbs. oz.	oz.	
Transplanted	Stone	3.4	6 2	16	14
	Longkeeper	4.5	6 11	13	11
	Average of two varieties	3 95	6 6.5	.....	12½
Thickly Grown or "Drawn" Plants	Stone	3.	3 8	11	16
	Longkeeper	3.4	4 11	6.5	8
	Average of two varieties	3.2	4 1.5	.....	12

As will be noted in the table above, there was in this experiment a decided gain in the size of fruit and in productiveness, as a result of securing strong, stocky plants. This gain is especially noteworthy in the product, which is 1 lb. 5 oz. greater per plant in the stocky plants than in the slender plants of the second lot, a gain, which at the usual distance apart of setting (4 feet by 5 feet) would amount to the very considerable total of 47 bushels per acre, or nearly a ton and a half. As there is very little difference in the proportion of rotted fruit in the two lots, it would appear from this single experiment, combined with the results of the variety test, that the rotting of the fruit does not depend so much upon the lack of vigor in the individual plant as it does upon the want of power of resistance in certain varieties.

CUTTING BACK PLANTS AT TIME OF SETTING.

The experiment was tried of cutting back a number of plants of three varieties when set in the field, in comparison with a similar lot of plants untrimmed.

Ten plants each of Favorite, Acme and Buckeye State were set in the field, June 2. Five plants of each variety were trimmed severely, leaving only three leaves above the surface of the ground, while a corresponding set of plants which were uncut were set beside them. The varieties Acme and Buckeye State were pot grown plants, while the Favorite was grown in the ordinary soil of a cold frame.

	VARIETY.	First ripe fruit.	Average product per plant.		Average weight individual fruit.	Average number of fruits per plant.
			lbs.	oz.	oz.	
Untrimmed..	Acme	July 30.	7		2.4	47.2
	Favorite	" 30.	7	11	3.4	36.4
	Buckeye State..	Aug. 14.	7	11	4.	30.8
Trimmed. ...	Acme	Aug. 2.	6	13	2.7	39.2
	Favorite	" 14.	7	13	3.1	40.8
	Buckeye State..	" 14.	7	10	3.8	31.8

The figures given show practically no difference in the productiveness of the two lots of plants, the average product of all the untrimmed plants being a small fraction over 7 lbs. 7 ozs. per plant and that of the trimmed plants being slightly under 7 lbs. 7 ozs. There is, however, a slight difference in the earliness of first ripening of the fruit, the Acme (untrimmed) being 3 days and the Favorite 15 days earlier than the corresponding lots of trimmed plants.

TOMATO ROT.

An experiment was made to determine the practical value of the Bordeaux mixture in preventing rot, but from some unknown cause the results were very conflicting in duplicate experiments, so that they are not considered worthy of publication, but the experiments will be carefully repeated in the hope that some definite conclusions may be reached. The use of this fungicide and the ammoniacal carbonate of copper has been reported elsewhere as very effective.*

Peas.

Our test of peas the past year has included 37 varieties. All were planted on good loamy soil April 6 and throughout the season given uniform care,—ordinary field culture without support for the vines.

Twelve ounces of peas were sown in 56 ft. of row, giving for the tall and large growing varieties 20, and for the smaller growing varieties 30 peas to the foot. Full rows were obtained of each variety with the following exceptions: Telegraph, Telephone, Duke of Albany, Pride of the Market, Everbearing, and Champion of England.

In order to obtain accurate data for estimating productivity, etc., 5 ft. of the most uniform part of the row of each variety was carefully thinned, leaving 12 plants to each foot of row, except in three or four cases,—as noted in the table,—where it was impossible on account of irregularity in germination.

The peas from these vines were carefully picked, shelled, and weighed, and the following table gives in detail the results of the test thus made.

* U. S. Dept. of Agriculture Report 1889, 418; Cornell University Experiment Station Bulletin 28, 1891, 59.

The column headed "Days to edible maturity" refers to the number of days from date of planting to the day when the very first pods were found sufficiently filled to pick, although such pods might be very few in number. The next column refers to the date,—usually several days later,—when a sufficient number of peas were matured to make it profitable to pick for market. The scale of productiveness is based upon the actual weight of peas in the pod, from corresponding lengths of row, the most productive being rated as 10, and less productive varieties proportionally lower. The column headed "Ratio, etc." is intended to give an approximate indication of how well the pods are filled with peas, as this is an important point, especially to canning factories, and growers for them, where the product is sold by weight. In the case of "American Wonder," for instance, the ratio 1 to 3.3 indicates that from a lot of peas (in the pod) weighing 3 and 3-10 pounds only 1 pound of shelled peas could be taken. This rule would probably not apply very exactly when peas are taken by measure.

VARIETY	SEEDSMAN.	Wrinkled or smooth.	Days to edible maturity.	Date of market- able maturity.	Product. Scale 10.	Average length of pod. inch's	Average number peas to pod.	Ratio weight of peas to the combined weight of peas and pods.	HABIT. Under 24 in.... Dwarf. 24 to 36 in.... Medium. Over 36 in Tall.
American Wonder.....	Vaughan.....	W	60	9	7	2 3/4	4 1/2	1 to 3.3	Dwarf.
Best Extra Early.....	Burpee.....	S	57	5	7	2 3/4	4 1/2	1 to 3.5	"
Bliss Abundance.....	Dreer.....	W	71	19	9	2 1/2	6	1 to 2.9	Medium.
Blue Beauty.....	Thorburn.....	S	60	11	9	3	4	1 to 3.4	"
Blue Peter.....	".....	S	59	8	6	3	3	1 to 3.4	Dwarf.
Champion of England....	Vaughan.....	W	74	23	6	3	5	1 to 2.9	Tall.
Duke of Albany.....	Burpee.....	W	74	22	8	3 1/2	6	1 to 3.3	"
Everbearing.....	Dreer.....	W	74	23	8	3	5	1 to 3.	Medium.
Fillbasket.....	Thorburn.....	W	74	23	9	3 1/2	6	1 to 3.	"
Heroine.....	Henderson....	W	74	23	7	4	7	1 to 3.1	"
Horsford's Market Garden	Vaughan.....	W	71	23	8	2 3/4	4	1 to 3.2	Medium.
Improved Dan'l O'Rourke	Burpee.....	S	57	5	6	2 1/2	4	1 to 3.2	"
John Bull.....	Thorburn.....	W	74	23	5	3	7	1 to 3.	Tall.
King of Dwarfs.....	Vick.....	W	60	11	7	2 3/4	5	1 to 3.7	Dwarf.
Laxton's Alpha.....	Dreer.....	W	69	19	7	2 3/4	4	1 to 2.6	Tall.
Little Gem.....	Thorburn.....	W	59	9	10	2 1/2	4	1 to 3.1	Dwarf.
McLean's Advancer.....	Vaughan.....	W	64	12	10	3	4	1 to 3.5	Medium.
Melting Sugar.....	".....	S	71	21	6	2	4	1 to 2.6	Tall [edible pods.]
New Exonian.....	Thorburn.....	W	57	5	7	2 1/2	4	1 to 3.5	Medium.

New Station.....	Thorburn	W	52	2	6	2½	4	1 to 3.4	Medium.
Nott's Excelsior 1.....	Ferry	W	48	16	7	3	6	1 to 3.4	"
Little Gem 2.....	N. B. G. Co....	W	50	19	9	2½	3½	1 to 3.	Dwarf.
Paragon.....	Vaughan.....	W	71	19	8	3	4	1 to 3.	Tall.
Pride of the Market.....	"	W	73	23	8	4	7	1 to 3.3	Medium.
Prince of Wales.....	Thorburn	W	71	19	9	2¾	3½	1 to 3.1	Medium.
Quality	Burpee.....	W	69	19	8	2¾	4	1 to 2.7	"
Quantity.....	"	W	69	19	9	2¾	4	1 to 2.7	"
Queen 3.....	Henderson....	W	78	26	7	4	5	1 to 3.5	Tall.
Rural New Yorker.....	Thorburn	S	53	2	5	2½	4	1 to 3.4	Dwarf.
Sapphire	N. B. G. Co....	W	60	9	7	2¾	5	1 to 3.2	Medium.
Shropshire Hero.....	Burpee.....	W	74	23	8	3½	7	1 to 3.2	"
Stratagem	Dreer	W	74	22	8	3½	6	1 to 3.	"
Sunol	Vaughan.....	S	57	5	6	2½	5	1 to 3.	"
Telegraph (Culverwell's) 4..	Dreer	W	74	23	7	3½	5	1 to 3.5	Tall.
Telephone 5	Burpee.....	W	74	23	5	3¾	5	1 to 3.7	Tall.
Vick's Charmer	Vick.....	W	74	21	7	3	6	1 to 2.8	"
Yorkshire Hero	Burpee.....	W	71	21	8	3	3	1 to 3.1	Medium.

1 Sown April 27.

2 Sown April 27 with Nott's Excelsior, to test comparative earliness of the latter.

3 21 plants only to 5 ft. of row.

4 46 plants only to 5 ft. of row.

5 10 plants only to 5 ft. of row.

Among the varieties worthy of some special mention the following may be noted :

NEW STATION, Thorburn. The earliest variety grown here ; slightly wrinkled. Vine 20 inches high, pod round and full, of medium size, but not very productive.

RURAL NEW YORKER, Thor. A smooth variety one day later than New Station. Pod nearly round ; small to medium in size ; only moderately productive.

BLUE BEAUTY, Thor. A somewhat later smooth sort. Pods round and full. Peas large.

MCLEAN'S ADVANCER, Vaughan. Maturing for market a week or ten days later than the earliest varieties. With the Little Gem, the most productive varieties in our list. Pods of medium size, well filled with peas of superior quality. A standard variety which is still one of the best.

NEW EXONIAN, Thorburn. An early wrinkled variety. Vine 2 ft. in height. Pod of fair size, round and full. One important point in favor of this variety is that it matures nearly all its pods at one time. At the first picking of the full row about 15 lbs. were picked ; three days later a little over 1 lb., and nearly a week after about 1½ lbs. were picked. None of these pods were too old for use when picked.

LITTLE GEM, Thorburn. A well-known early dwarf, wrinkled variety. One of our largest producers the past year, and of superior quality.

LAXTON'S ALPHA, Dreer. This variety had the smallest ratio between weight of peas and weight of pod of any variety grown. Pod of medium size, attractive in appearance, and well filled with large peas of excellent quality.

HORSFORD'S MARKET GARDEN, Vaughan. An intermediate variety in date of maturity and size of vine. Pod round and filled with good sized peas. Quite productive and of good quality.

QUALITY AND QUANTITY, Burpee. Very little difference between them. Medium sorts in earliness and size of vine. Pod round and well filled with good sized peas. Quite productive.

NOTT'S EXCELSIOR, Ferry. Vine from 15-18 in. tall and well filled with pods. Pod of good size. Peas large and crowded together, averaging six in a pod; of fair productiveness here.

SAPPHIRE, N. B. G. Co. An early wrinkled variety. Vine 2 ft. tall. Pods are well filled with good sized peas. Quite productive.

BLISS' ABUNDANCE, Dreer. A late variety here, about 30 in. tall. Pod of moderate size, round and full of large peas crowded together. Very productive.

PRINCE OF WALES, Thorburn. A rather late variety. Vine 3 ft. tall. Pod of medium size, but peas are quite large. Productive.

FILLBASKET, Thor. A late variety, growing about 30 in. tall. Pod of medium length and filled with peas of good size. A good producer.

SHROPSHIRE HERO, Burpee. A productive variety with long attractive pods, well filled with large peas, and of superior quality.

YORKSHIRE HERO, Burpee. A productive variety with medium sized pods which are very closely packed with peas of good size, and one of the best in quality.

THICKNESS OF PLANTING.

What thickness of planting—one seed every three inches or three seeds every inch—will give us the best results? Are we generally buying and planting more seed than we need to, or are we not? With a view to answering this question, the following experiment was planned, using as varieties a tall growing, a medium, and dwarf growing sort, viz., Champion of England, Horsford's Market Garden, and American Wonder. The ex-

periment was made in duplicate, with the exception that Little Gem was substituted for American Wonder in the duplicate lot.

The rows were divided into 16 ft. lengths, and nine of these lengths were planted with each variety in the duplicate tests on April 16. The first 16 ft. received 1 oz. of seed, the second 16 ft. 2 oz., the third 3 oz., continuing in like manner up to 9 oz. to the 16 ft., all the seed being distributed as uniformly as possible.

One ounce of seed gave for American Wonder 8 or 9 peas to the foot, for Horsford's Market Garden 9, and for Champion of England 6 to the foot.

Very little if any difference could be observed in the germination, growth, time of blossoming, or in the number of blossoms in the different 16 ft. lengths. There was, however, as would be expected, some difference in the character of the plants, the thin sown lots having strong, stocky vines, while the thicker planted lots were somewhat "drawn" or spindling, and spread over more space than the thin planted.

Amount of seed 16 ft. row. oz.	American Won- der. Total yield. lbs.	Little Gem. Total yield. lbs.	Horsford's Market Garden. Total yield.		Champion of England. Total yield.		Total yield of four varieties. lbs.
			Original.	Duplicate.	Original.	Duplicate.	
			lbs.	lbs.	lbs.	lbs.	
1	82	70	90	91½	42	64	439½
2	79	94	77	123½	52	69	494½
3	95	105½	84	84	79½	64½	512½
4	77½	106½	99½	111	60	75½	530
5	99	121	76	136½	68½	78	579
6	111½	113	110½	128½	61½	76	601
7	94	77½	92	84	67	61½	476
8	91	77½	106	101½	70½	77½	524
9	109	89	114½	106½	88½	67	567½

While the results are somewhat variable, as is usual in such experiments, yet the general average of the results

as shown in the column of total yields, indicates quite clearly that the best average results can be obtained with 5 to 6 ounces of seed for this length of row, or at the rate of one quart to 80 or 90 ft. of drill.

Bush Beans.

The varieties of Bush Beans were planted in drills May 5, twenty feet of drill being allowed for each variety. Plenty of seed was used to insure a stand and after the young plants were well started they were thinned to about 4 inches. Like many other vegetables, the beans suffered a severe check from the snow of May 20, losing many of their leaves, but recovered their normal condition in two or three weeks. The table shows results.

VARIETY.	SEEDSMAN.	First blossom.	First edible.	First marketable.	Product oz.	Average length of pod inches.	Average weight of pod. oz.
Bismarck Black Wax.....	Dreer.....	June 18	June 28	July 5	18	4½	.14
Boston Favorite.....	Vaughan.....	" 25	".....	" 12	6	4½	.09
Challenge Black Wax.....	".....	" 18	June 28	" 3	12	3	.145
China.....	Thorburn.....	" 20	" 28	" 1	38½	4½	.11
Cylinder Black Wax.....	Henderson.....	" 18	" 28	" 3	48½	4	.16
Dwarf Horticultural.....	Henderson.....	" 18	" 28	" 3	26	3½	.12
Extra Early Refugee.....	Vaughan.....	" 19	".....	" 3	65	4	.15
Flageolet Victoria.....	Henderson.....	" 22	July 3	" 12	60½	6½	.14
Giant Yosemite Wax.....	Vaughan.....	" 19	" 3	" 12	3½	5½	.13
Golden Eye Wax.....	".....	" 21	" 1	" 7	39	4½	.11
Improved Golden Wax.....	Henderson.....	" 18	June 28	" 3	40½	3½	.17
Improved Valentine.....	Vaughan.....	" 22	".....	" 3	98½	3½	.10
Marvel of Paris.....	Thorburn.....	" 22	June 28	" 3	57½	4½	.12
Mohawk.....	Henderson.....	" 16	" 28	" 3	61	5	.15
Pride of Newtown.....	Thorburn.....	" 20	" 29	" 3	53½	5½	.11
Prolific German Wax.....	Vaughan.....	" 22	".....	" 5	43	4½	.13
Refugee Wax.....	Henderson.....	" 18	June 28	" 5	46½	4½	.11
Saddleback Wax.....	Burpee.....	" 19	" 28	" 5	19	4	.13
Speckled Wax.....	J. & S.....	" 22	July 3	" 12	80	4½	.11
Stringless Green Pod.....	Burpee.....	" 22	June 28	" 5	32	5	.13
Wardwell's Kidney Wax.....	Thorburn.....	" 20	" 28	" 3	38½	4	.11
Warren.....	Vaughan.....	" 18	" 28	" 3	39½	4	.18
Warwick.....	Henderson.....	" 16	" 25	June 28	35	4	.16
White Wax.....	Dreer.....	" 22	July 3	July 12	12½	3	.11

The earliest variety was the Warwick. The three most productive varieties were—

Improved Valentine.....	98½ oz.
Speckled Wax.....	80 "
Extra Early Refugee	65 "

The following brief notes on a few of the best varieties may be of interest.

EXTRA EARLY REFUGEE, Vaughan. Pod round, light green, resembling Valentine, free from rust, attractive in appearance, but slightly stringy.

FLAGEOLET VICTORIA, Henderson. A long, slender, flattish green pod, slightly rusted and a very little stringy. Uniform in size.

GIANT YOSEMITE WAX, Vaughan. Pods are a bright yellow color, nearly round and quite strongly curved. It is nearly free from rust, very fleshy, and has no stringiness.

GOLDEN EYE WAX, Vaughan. Pods are a bright yellow color, rather flat and wide, and practically free from rust. Somewhat stringy.

IMPROVED VALENTINE, Vaughan. Handsome, round green pods, uniform in size. Free from rust or spots, and comparatively free from strings. The most productive variety on the list.

MARVEL OF PARIS, Thorburn. A green, slender, roundish pod. Quite uniform in size, slightly rusted.

MOHAWK, Henderson. A flattish, green pod of medium size. Uniform in size and shape. Somewhat stringy. A good producer.

PRIDE OF NEWTOWN, Thorburn. Handsome, long, green, flattish pods. Slightly rusted and quite stringy.

PROLIFIC GERMAN WAX, Vaughan. Bright yellow, and similar in size and shape to a Valentine. Slightly rusted, stringless.

REFUGEE WAX, Henderson. Handsome, light yellow pods, considerably curved and quite free from imperfections. Uniform in size.

STRINGLESS GREEN POD, Burpee. Roundish, green pod, similar to Valentine, but somewhat larger in diameter. Slightly rusted, but free from strings.

SPECKLED WAX, Johnson & Stokes. A roundish, yellow, fleshy pod. Somewhat irregular, yet attractive. Rusting a little, slightly stringy, and second in productiveness this year.

WARWICK, Henderson. Similar to Mohawk, but rather more fleshy. Considerably rusted, somewhat stringy. The earliest variety of the list.

Bush Lima Beans.

Considerable attention has recently been paid to this class of beans, and to carefully test the principal kinds advertised by seedsmen, we obtained the five varieties given in table, planting them in the garden May 26. A row 56 ft. in length was used in each case, 10 ft. of which was set apart, and from the plants of this lot the pods, when beans were of edible size, were carefully picked, counted and weighed. The number and weight of shelled beans was also recorded. The table gives details.

VARIETY.	SEEDSMEN.	Amount of first picking, August 20, in oz.	PRODUCT.		Average weight of pod as picked.	Average weight of beans.	Average number of beans per pod.	Length of pod.
			PODS.	BEANS.				
Henderson's Bush Lima	Henderson	14½	118	47½	.15	.03	2.3	3
Jackson Wonder	Dreer	32	91½	34	.15	.035	2.3	3
Thorburn's Dwarf Lima	Thor	14½	53½	12	.22	.038	1.8	2½-3
Dreer's Bush Lima	Dreer	6	55	17½	.22	.051	2.	3
Burpee's Bush Lima	Burpee	4	50	14½	.26	.046	1.8	3½-4

The general characters of Henderson's Bush and Jackson Wonder are practically the same. Plant a vigorous grower, with dark green foliage, rather small leaflets, fruit-bearing stalks numerous. Pods are somewhat curved, regular, thin and narrow. Bean is small, but all seem to fill out well. Slightly earlier than the other varieties.

The general characters of Thorburn's Dwarf and Dreer's Bush Lima are also much alike. In both the plant is vigorous, but more dwarf than the other varieties, bearing leaflets of medium size. Fruit-bearing stalks are fairly abundant, but not so many as in Henderson's Bush Lima and Jackson Wonder. Pods are straight, thick and wide, many being irregular in shape. Bean is of good size, even large and thick, with some irregularity in filling out.

Burpee's Bush is a large and vigorous grower, with light green foliage, leaflets large, and a good number of fruit bearing stalks. Pod is somewhat curved, wide and thick, but a good many were small and irregular. Bean is very large, fleshy, and also rather irregular in filling out.

Pole Beans.

The pole varieties of beans were planted May 29 in drills, 20 feet being allowed for each variety. A trellis was made as follows. Strong posts were set at either end of the row, and good stakes were driven every 20 feet in the row. Two wires—ordinary fence wire—were tightly strung between the posts, one about 4 feet and the other 6 inches from the ground. Cheap hempen twine was wound over and under these wires six to eight inches apart, up which the vines grew. The results appear in the following table.

VARIETY.	SEEDSMAN.	Date of first blossom.	Date and amount of first picking in pod. ing in oz., full sized beans	Total product.		Average weight of a pod.		Average length of pod.		REMARKS ON THE PODS.
				lbs. oz.	inch's	oz.	inch's			
Lazy Wife's	Burpee.....	.....	Sept. 13. 45	4 1½	5					Green, flattened, thick and fleshy.
Horticultural Cranberry	Vaughan ..	July 17	Aug. 9. 2½	3 4	4	.17		5		Green, speckled, flattish.
Creaseback	" ..	" 17	" 9. 30	5 14½	4	.10		4		Green, roundish, uniform.
Golden Wax	Henderson .	" 20	" 9. 28	3 3½	4	.17		4		Small, flat, irregular.
Mammoth Carmine Podded ..	Gregory . .	" 20	" 9 2	2 14	4	.18		4		Green, speckled, rounded, fleshy.
Yardlong	Burpee.....	" 17	" 9. 3½	6 17½	12-27	.25		12-27		Light green, thin walls.
French Yardlong	Thorburn ..	" 17	" 9. 2	5	12-27	.24		12-27		
White Zulu	Burpee.....	" 17	" 9. 1½	1 10½	6	.18		6		Yellowish green, thick and fleshy.
Golden Champion	Henderson .	" 17	" 9. 17	11 2½	8	.11		8		Yellow; germinated poorly.
Kentucky Wonder	Ferry	" 17	" 9 36	15 3		.25				Green, thick and fleshy; irregular.
Golden Cluster Wax	Burpee	" 20	Sept. 6. 5½	1 8½	4			4		Yellow, flattened, fleshy.
Dutch Caseknife	Thorburn ..	" 17	Aug. 21. 3½	7 5	4	.22		4		Dark green, flattish.

The two most productive varieties are Kentucky Wonder and Yardlong.

YARDLONG and FRENCH YARDLONG, received from different seedsmen, are identical. The foliage is dark green in color and vigorous. Pods are round and very long, with thin walls. They contain very few beans. A curiosity.

KENTUCKY WONDER, Ferry. The favorite late market bean of this locality. Pods are green, long, considerably twisted and irregular, thick and fleshy. Very productive.

GOLDEN CLUSTER WAX, Burpee. The most productive yellow-podded variety. Pod somewhat flattened and quite fleshy.

POLE LIMA BEANS.

The pole Limas were planted the same day, in the same manner, and received the same care and culture given the common pole beans. The table gives only the comparative earliness and productiveness.

VARIETY.	SEEDSMAN.	Date of first blossom.	Date and amount of first picking in ounces.	Total Product.	
				lbs.	oz.
Ford's Mammoth...	Dreer	July 20	Sept. 5, 2½	14	3
Large White	Henderson ...	" 17	" 5, 8	14	15
Sieva	"	" 20	" 5, 9	11	7
Large Select	Vaughan	" 20	" 5, 14	14	3
Willow Leaf	Burpee	Aug. 4	Aug. 22, 9	10	11
Early Black	"	July 20	" 22, 78	11	—
Jersey Extra Early	Henderson ...	" 17	Sept. 5, 7	7	12
Horticultural	Ferry	" 20	Aug. 21, 1½	5	3
King of the Garden	Vaughan	" 20	Sept. 5, 2½	11	2

The most productive varieties are Large White, Ford's Mammoth and Large Select. Of these, Large White is the most productive and one of the very best large Lima beans.

THICK AND THIN PLANTING OF BUSH BEANS.

The beans for this experiment were planted May 8 as follows: 12 ft. of row was used for each lot; $\frac{1}{2}$ oz. of seed, carefully weighed, was evenly drilled into the first 12 ft. Succeeding 12 ft. received in order 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$ and 6 ounces of seed evenly distributed and uniformly covered. This would give for the different sections of row approximately 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44 and 48 beans respectively to each foot of drill. Two varieties were used in this test, Improved Valentine and Golden Eye Wax. The $\frac{1}{2}$ oz. lot in each case was rather irregular in germination, having some vacancies. The results are found in the table.

Thickness of planting. oz. per 12 ft.	Improved Val- tine. Product in oz.	Golden Eye Wax. Product in oz.	Totals for the two varieties.
$\frac{1}{2}$	$30\frac{1}{2}$	$10\frac{1}{2}$	41
1	$58\frac{1}{2}$	32	$90\frac{1}{2}$
$1\frac{1}{2}$	$86\frac{1}{2}$	$53\frac{1}{2}$	140
2	$64\frac{1}{2}$	$52\frac{1}{2}$	117
$2\frac{1}{2}$	70	57	127
3	53	$59\frac{1}{2}$	$112\frac{1}{2}$
$3\frac{1}{2}$	62	$39\frac{1}{2}$	$101\frac{1}{2}$
4	$68\frac{1}{2}$	46	$114\frac{1}{2}$
$4\frac{1}{2}$	59	$40\frac{3}{4}$	$99\frac{3}{4}$
5	55	56	111
$5\frac{1}{2}$	$64\frac{1}{2}$	$62\frac{1}{2}$	127
6	$61\frac{1}{2}$	$54\frac{1}{2}$	116

Careful examination revealed practically no difference in earliness of blossoming or in maturity, while in size of pods those of the thickest lots seemed to be a little shorter.

The results, while not perfectly uniform throughout, seem to indicate that there is no gain in using the larger quantities of seed, as the best return of all was obtained from the $1\frac{1}{2}$ ounce lot of seed planted in 12 ft. of drill.

This would be equivalent to 1 quart of such beans as the Valentine to 240 ft. of drill.

Since, however, one of the varieties in the experiment gave a better yield with 3 and even with $5\frac{1}{2}$ oz per 12 ft., it would seem to be safer—since in many cases the germinating power of seed is not known,—to plant a somewhat larger proportion of seed than indicated. Completely trustworthy results in an experiment of this kind can only be secured after several repetitions of the experiment and averaging the results of all.

Potatoes.

Sixty-four varieties were grown this year. They were planted in drills, using six pounds of seed to 87-ft. of row in nearly every case, and in those cases where a smaller amount of seed was used, it was planted in a row of proportional length. Three pounds of a complete fertilizer was applied to each 87 ft. and worked into the soil. The planting was commenced Apr. 18, but the work was delayed by a sudden storm and could not be resumed until two days later. A few varieties, including Van Ornam's Superb and the six varieties from Messrs. Everett & Co., could not be planted until Apr. 27.

The season of planting, which was rather late for this section, combined with the severe drought of the early summer, resulted in a very small total yield, and also in a small per cent. of potatoes of marketable size, as the drought commenced just at the time the tubers were forming.

VARIETY.	SEEDSMEN.	Total yield per acre.	Market- able tubers per acre.	Per cent. of market- able potatoes.
		BU.	BU	
Molly Stark	Ford	163	57	35
King of Roses	"	153	77	50
Extra Early Vermont	Landreth	152	74	48
Woodbury White	Ford	145	79	54
Puritan	"	142	57	40
Summit	Vaughan	138	72	52
Lee's Favorite	Ford	138	58	42
Dakota Red	Landreth	135	60	44
Tonhocks	Ford	132	57	43
Reed's "'86"	Vaughan	128	29	23
Burbank Seedling	Ford	127	45	35
Iron Clad	"	122	45	37
New Queen	"	122	52	42
Polaris	Vaughan	119	40	34
Garfield	Landreth	116		
Snowflake	"	113	25	22
Crown Jewel	Dreer	110	39	35
Columbus	Ford	109	45	41
Green Mountain	"	109	39	36
Vaughan	"	109	39	36
Dandy	"	106	43	41
Acme Seedling	Vaughan	100	42	42
Halo of Dakota	Ford	99	40	40
Burpee's Extra Early	Burpee	96	33	34
Mount Carbon	Ford	96	36	38
Red Ohio	Vaughan	95	29	31
Early Rose	Ford	92	42	46
Golden Harvest	Landreth	92	28	30
Arizona	Vaughan	90	43	48
American Wonder	Ford	90	58	64
Standard	Dreer	85	26	31
Early Norther	Henderson	84	18	21
Chautauqua	Ford	84	24	29
Munroe Seedling	"	84	42	50
Burpee's Superior	"	82	32	39
Freeman	Gregory	82	27	33
Alexander's Prolific	Ford	81	31	38
Penn Manor	J. & S.	79	25	32
World's Fair	Vaughan	76	23	30
Brownell's Winner	Ford	76	23	30
Thorburn	Thor.	75	25	33
Rural New Yorker	Ford	74	29	40
Early Pearl	"	74	33	45
Early Rochester	"	73	36	49
Harbinger	"	72	15	21

VARIETY.	SEEDSMAN.	Total yield per acre.	Market- able tubers per acre.	Per cent. of market- able potatoes.
		BU.	BU.	
Early Norther.....	Gregory	69	33	48
Hamden Beauty.....	Ford.....	68	22	32
Maggie Murphy.....	Vick	65	45	69
Empire State	Burpee	63	22	35
Farmers' Alliance.....	Landreth.....	60	31	52
Early Ohio	"	59	17	29
Chas. Downing	"	58	10	17
Star Seedling	Ford	55	22	40
Great West.....	"	54	22	40
State of Maine	Landreth	53	24	45

With the following small lots of potatoes, the actual product is given in each case, as the amount of seed was so small that an estimate of the yield per acre based upon such a small area, would be liable to great error.

VARIETY	Amt of seed, lbs.	SEEDSMAN.	Date of plant- ing.	Total yield, lbs.	Marketable potatoes, lbs.	Per cent. market- able potatoes,
Carman	1	Thorburn ..	Apr. 20	4½	2¾	60
Superb	2	Van Ornam.	" 27	9½	4	43
Green Mountain..	1	Everett	" 27	3⅝	2	55
Everett's Colossal.	1	"	" 27	6½	2¾	44
Rural New Yorker	1	"	" 27	10½	6½	61
Everett's Six						
Weeks Market...	1	"	" 27	5¾	3½	61
Everett's Heavy						
Weight	1	"	" 27	1 9-16	¾	48
Early Everett	1	"	" 27	4⅝	2¾	60
The Great Divide.	1	Burpee	" 20	6½	2½	39

C. W. MATHEWS.

A. T. JORDAN.

NOTICE.—This Station has no seeds for sale or distribution.

M. A. SCOVELL, Director.

KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN No. 55.

FIELD EXPERIMENTS WITH FERTILIZERS.

- 1.—CORN.
- 2.—POTATOES.
- 3.—TOBACCO.
- 4.—HEMP.

LEXINGTON, KENTUCKY.

APRIL, 1895.

KENTUCKY

Agricultural Experiment Station.

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LEXINGTON, KY.

BULLETIN NO. 55.

FIELD EXPERIMENTS WITH FERTILIZERS.

- 1.—CORN.
- 2.—POTATOES.
- 3.—TOBACCO.
- 4.—HEMP.

Experiments in Detail.

THE SEASON.—The season of 1894 was unfavorable for all crops, with the exception of wheat, principally on account of the dry weather and the very backward spring. The following table gives the summary of rainfall, the mean temperature and the average per cent. of sunshine during the time specified:

MONTH.	Rainfall. Inches.	Degrees Mean Temperature.	Per cent Sunshine
April.....	4.19	54.0	40
May.....	3.81	62.4	41
June.....	4.44	74.6	47
July.....	0.87	75.6	45
August.....	3.67	76.	52
September.....	4.05	71.	47
October.....	1.40	57.6	55

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.

1.—Corn Experiments.

The field used for the fertilizer experiments was the same as that used for the experiments heretofore. The plots receiving no fertilizers the past years received none this year, and likewise the plots receiving fertilizers during the past years received the same kind in each case this year. The field in question is nearly level, slightly sloping lengthwise of the plots. Size of plots, one-tenth of an acre.

The plots were treated exactly alike except as to fertilizers, care being taken to plow the entire acre the same day at every working. The hills were thinned to two stalks, and were $3\frac{1}{2}$ feet each way.

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 1—Showing fertilizers applied and per cent of ingredients.

NUMBER.	FERTILIZERS USED.	Number 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.
2	No Fertilizer.....	.....	.....	.....	.....	.....	.....	.....
3	Acid Phosphate.....	140	57	80	25.6	12.4	17.	5.5
	Muriate of Potash....	160						
	Nitrate of Soda.	160						
4	Acid Phosphate.....	140	57	80	0	12.4	17.	0
	Muriate of Potash....	160						
	Soil.....	160						
5	Acid Phosphate.....	140	57	0	25.6	12.4	0	5.5
	Nitrate of Soda.....	160						
	Soil.....	160						
6	Muriate of Potash....	160	0	80	25.6	0	17.	5.5
	Nitrate of Soda.....	160						
	Soil.....	140						
7	No Fertilizer.....	.....	.....	.....	.....	.....	.....	.....
8	Muriate of Potash....	160	0	80	0	0	17.	0
	Soil.....	300						
9	Acid Phosphate.....	140	57	0	0	12.4	0	0
	Soil.....	320						
10	Nitrate of Soda.	160	0	0	25.6	0	0	5.5
	Soil.....	300						

By reference to the table, it will be seen that acid phosphate containing 40.7 per cent. of available phosphoric acid was used to supply that ingredient, muriate of

potash containing 50 per cent. of potash, for potash and nitrate of soda containing 16 per cent. of nitrogen to supply nitrogen.

Field Notes.

All plots were planted the same day, May 4. Observations on May 14th showed the corn to be up in all plots. The snow storm of May 20th retarded the growth of the corn for some time.

PLOT 2. June 1st, growth fair. July 15, very poor. July 24, beginning to tassel. August 1, growth short. September 15, poor. Cut October 10th.

PLOT 3. June 1, very good. July 24, tasseling. August 1, fair. September 15, ears rather large.

PLOT 4. June 1, fair. July 24, tasseling. August 1, fair.

PLOT 5. June 1, fair. July 24, tasseling. August 1, short growth. September 15, poor.

PLOT 6. June 1, fair. July 24, tasseling. September 15, looking well.

PLOT 7. June 1, fair. July 24, barely tasseling. August 1, very small. September 15, not looking well; very small ears.

PLOT 8. June 1, fair. July 24, tasseling. August 1, height fair. September 15, very fair.

PLOT 9. June 1, looking well. July 15, poor. July 24, barely tasseling. September 15, very poor.

PLOT 10. June 1, very fair. July 15, poor. July 24, tasseling. August 1, very irregular in height. September 15, very small ears.

TABLE 2.—Showing results of fertilizers on corn.

NO. PLOT.	FERTILIZER USED.	No. of lbs of Ferti- lizer ap- plied per acre.	Yield of Ear Corn per Acre in Bushels of 70 lbs.	Yield of Fodder in pounds per Acre	Increased Yield of Corn in Bushels per Acre.	Increased Yield of Fodder in pounds per Acre.
2	No Fertilizer.....		13.3	1650	.....	.....
3	Nitrate of Soda.....	160	35.4	2980	21.2	1210
	Acid Phosphate.....	140				
	Muriate of Potash..	160				
4	Muriate of Potash..	160	30.1	2830	15.9	1060
	Acid Phosphate.....	140				
5	Nitrate of Soda.....	160	15.4	2030	1.2	260
	Acid Phosphate.....	140				
6	Muriate of Potash...	160	35.1	3130	20.9	1360
	Nitrate of Soda.....	160				
7	No Fertilizer.....		15.0	1890	.....	.....
8	Muriate of Potash...	160	30.4	3650	16.2	1880
9	Acid Phosphate.....	140	13.1	1770	0	0
10	Nitrate of Soda.....	160	17.6	2220	3.4	450

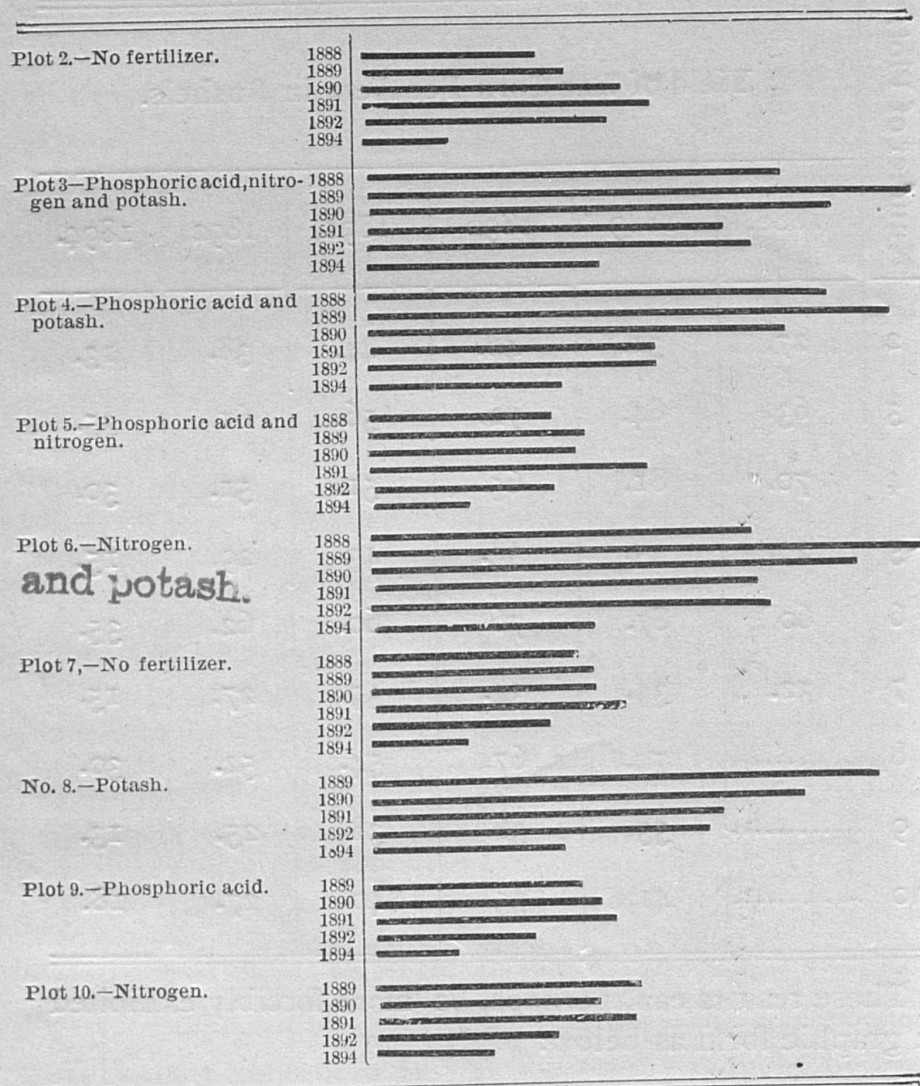
While the yield of corn was materially reduced by the unfavorable season, yet about the same proportionate yield is maintained on the several plots as in former years.

The table below is given to illustrate this point. Unfortunately our records in 1893 were lost by fire:

TABLE 3.—Showing effect of fertilizers on corn.

Number of Plot.	Yield of Ear Corn Per Acre in Bushels.					
	1888.	1889.	1890.	1891.	1892.	1894.
2	27.	31.	40.	44.	38.	13.
3	63.	84.	72.	56.	61.	35.
4	70.	81.	65.	51.	51.	30.
5	29.	35.	33.	43.	29.	15.
6	60.	87.	76.	60.	62.	35.
7	32.	34.	34.	39.	27.	15.
8	.....	79.	67.	54.	52.	30.
9	.....	33.	36.	38.	25.	13.
10	.....	41.	35.	40.	27.	18.

These results can, perhaps, be more forcibly exhibited in graphic form as below:

Relative yield of Ear Corn.**Financial Results, 1894.**

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 corn is rated at 40 cents per bushel:

TABLE 4.—Showing Financial Results.

FERTILIZER USED.		Cost of Fertilizer used per Acre.	Value Corn per Acre.	Value of Increased Yield of Corn per Acre.	Profit or Loss.
2	No Fertilizer.....		\$5 32		
3	Nitrate of Soda..... Acid Phosphate..... Muriate of Potash.....	\$10.50	14.16	\$8.48	\$2.02*
4	Muriate of Potash..... Acid Phosphate.....	6.90	12.04	6.36	.54*
5	Nitrate of Soda..... Acid Phosphate.....	6.90	6.16	.48	6.42*
6	Muriate of Potash..... Nitrate of Soda.....	7.20	14.04	8.36	1.16
7	No Fertilizer.....		6.00		
8	Muriate of Potash.....	3.60	12.16	6.48	2.88
9	Acid Phosphate.....	3.30	5.24		3.30*
10	Nitrate of Soda.....	3.60	7.04	1.36	2.24*

* Loss.

These results show that in an unfavorable season the chances of enhanced profits by the use of fertilizers are greatly lessened or altogether wiped out. There is this much to be said, however—the greater portion of the phosphoric acid and potash applied is retained in the soil, and is available to future crops.

2.—Potato Experiments.

The plots used in studying the effect of fertilizers on potatoes in 1894 were the same as have been used for this purpose heretofore.

The surface of the ground is comparatively level and the soil of the same general character as that on which the corn was grown. Size of plots one-tenth acre each. Potatoes used for seed were Northern grown Early Rose, and were planted 14 inches apart in the row, and rows three feet apart. After the ground was well prepared with plow and harrow, the rows were marked out with a small plow. Fertilizers used were scattered in the row by hand and afterwards slightly mixed with the earth by a brush. The fertilizers were applied and the potatoes planted April 7th. The season was very unfavorable.

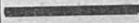
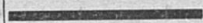
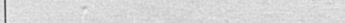
The nitrate of soda, superphosphate, and muriate of potash were the same as used on corn. See table 1 on page 42.

TABLE 5.—Field Notes.

	Date of Observation.							
	April 25.	May 7.	June 1.	Color of Vines.	June 15.	July 1.	July 15.	Aug. 1.
Plot 1.	Com'g up.	Up.	Looking well	Dark Green	Looking well.	Vines beginning to die.	Vines nearly all dead.	Vines all dead.
Plot 2.	do.	do.	do.	Light Green	Vines large and th'ifty	do.	do.	do.
Plot 3.	do.	do.	do.	do.	do.	do.	do.	do.
Plot 4.	do.	do.	do.	do.	do.	Vines th'ifty Not dying.	Vines beginning to die.	Nerly all dead.
Plot 5.	do.	do.	Vines large.		Vines very good.	Vines most all dead.	Vines nearly all dead.	All dead.

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

TABLE 6 —Effect of Fertilizers on Potatoes.

No. of Plot.	FERTILIZER USED	Amt. per acre, pounds.	Yield per acre, bushels.	Comparative Scale.
1	No Fertilizer. ....	.....	39.5	
2	Nitrate of Soda.....	160	66.1	
3	Acid Phosphate.....	140	48.4	
4	Muriate of Potash...	160	82.7	
5	No Fertilizer .....	.....	48.6	
6	Nitrate of Soda.....	160	75.6	
	Acid Phosphate.	140		
7	Nitrate of Soda.....	160	92.7	
	Muriate of Potash...	160		
8	Acid Phosphate.....	140	121.4	
	Muriate of Potash..	160		
9	Nitrate of Soda.....	160	126.7	
	Acid Phosphate.....	140		
	Muriate of Potash...	160		
10	No Fertilizer.....	.....	65.2	

The yield of potatoes on these plots for the past five years is given in the table which follows:

TABLE 7.—Effect of Fertilizers on Potatoes.

No. of Plot.	Yield of Potatoes Per Acre in Bushels.				
	1888.	1889.	1891.	1892.	1894.
1	72	87	76	72	40
2	82	104	85	72	66
3	86	87	96	61	48
4	127	158	144	102	83
5	89	143	113	77	49
6	73	161	130	66	76
7	117	268	173	110	93
8	133	287	195	125	121
9	126	319	210	165	127
10	.....	136	114	86	65

3.—Tobacco Experiments.

The experiment was made on five 1-10 acre plots. The soil is of the same character as the other soil. In 1888 the land was sown to timothy. In 1889 it received a top dressing of tobacco stems at the rate of one ton per acre. In the spring of 1891 the timothy was ploughed up and the ground was sown to millet. In the fall of 1891 it was again sown to timothy. In 1892 tobacco stems were put

on at the rate of 1,000 lbs per acre. In the fall of 1893 the timothy sod was broken.

The object of selecting this particular piece of ground was to try the effect of the fertilizers on the richest ground we had.

Field Notes.

Experiments on w. $\frac{1}{2}$ of acre G.

Each plot 1-10 acre, except 5a. and 5b., which were 1-20 each, plot 5 being divided through the middle cross-ways.

Tobacco plants set out May 23.

June 1. All plots looking well.

July 1. All plots looking about alike and in fine condition.

August 1. Fireing somewhat for want of rain, plot 1 being affected more than any of the other plots in this respect.

September 7. All plots cut.

Here follows a table showing the kind and amount of fertilizer used and the yield of tobacco, calculated to the acre, for each plot:

TABLE 8.—Effect of Fertilizers on Tobacco.

No. Plot.	FERTILIZERS USED.		Yield of Tobacco in Pounds Per Acre.			
	NAME.	Amount per acre.	Long Red.	Short Red.	Trash.	Total.
1	None.		610	480	455	1545
2	Nitrate of Soda.....	160	640	540	515	1695
	Double Superphosphate.....	140				
3	Carbonate of Potash & Magnesia..	300	655	525	455	1635
	Double Superphosphate.....	140				
4	Carbonate of Potash and Magnesia....	300	635	510	505	1650
	Nitrate of Soda....	160				
5 ^a	Carbonate of Potash and Magnesia....	300	740	440	620	1800
	Nitrate of Soda.....	160				
	Double Superph'ate	140				
5 ^b	Muriate of Potash...	160	790	470	550	1810
	Nitrate of Soda.....	160				
	Double Superphosphate.....	140				

4.—Hemp Experiments.

The experiment was made on ten 1-20 acre plots. The land had been in English blue-grass (*Festuca elatior*) in 1889-91, in 1892 in corn, 1893 potatoes. The hemp was planted April 19th.

The following gives a summary of the field notes:

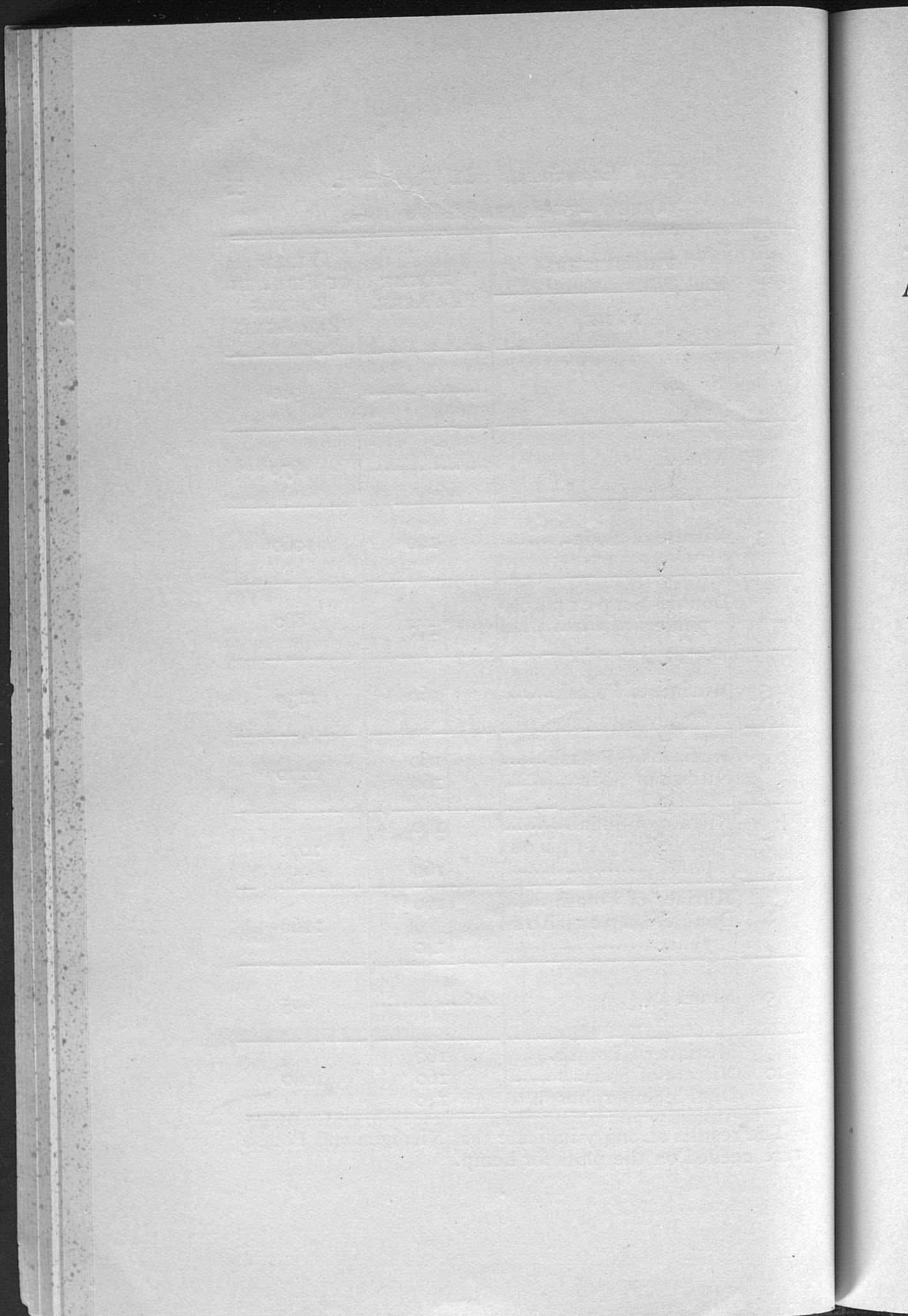
	May 1.	May 15	June 1.	July 1.	Aug. 1.	Sept. 1.
Plot 1.	1½ inch high.	6 inch	2 feet.	5 feet.	5¾ feet.	Good.
Plot 2.	Looking well.	6 inch.	15 inch.	Nearly 5 feet.	5 feet.	Good.
Plot 3.	do.	6 inch.	28 inch	5½ feet.	6½ feet.	Fine.
Plot 4.	do.	6 inch.	15 inch	3½ feet.	4½ feet.	.....
Plot 5.	do.	6 inch.	21 inch.	5 feet.	.....	Good.
Plot 6.	do.	6 inch.	24 inch.	5½ feet.	6½ feet.	Good.
Plot 7.	do.	6 inch.	22 inch.	5½ feet.	6½ feet.	Good.
Plot 8.	do.	6 inch.	21 inch.	5 feet.	6½ feet.	Good.
Plot 9.	do.	6 inch.	12 inch.	4½ feet.	5 feet.	Fair.
Plot 10.	do.	6 inch.	23 inch	5½ feet	.....	Good.

The following table gives the kind and amount of fertilizer used and the yield of fiber:

TABLE 9. —Effect of Fertilizers on Hemp.

No. of Plot.	FERTILIZERS.	AMOUNT PER ACRE.	YIELD OF FIBER IN POUNDS PER ACRE.
	NAME,		
1	None.	.....	960
2	None.	.....	670
3	Nitrate of Soda.....	160	1060
4	Double Superphosphate.....	140	860
5	Muriate of Potash.....	160	1130
6	Muriate of Potash..... Nitrate of Soda.....	160 160	1170
7	Nitrate of Soda..... Double Superphosphate.....	160 160	1070
8	Muriate of Potash..... Double Superphosphate.....	160 140	1160
9	None.	.....	665
10	Muriate of Potash..... Nitrate of Soda..... Double Superphosphate	160 160 140	1080

The results strongly indicate that Nitrogen and Potash were needed on the plots for hemp.



KENTUCKY
Agricultural Experiment Station

—OF THE—

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 56.

Analyses of Commercial Fertilizers.

LEXINGTON, KENTUCKY.

AUGUST, 1895.

KENTUCKY

Agricultural Experiment Station.

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KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

BULLETIN No. 56.

ANALYSES OF COMMERCIAL FERTILIZERS.

For the more important principles on which the intelligent use of fertilizers depends, and for information in regard to the materials of which commercial fertilizers are made, we refer the reader to Bulletins Nos. 41, 46 and 51. This bulletin contains all the "official analyses" for the year 1895 up to the present date, with only such brief explanations as may be necessary for the right understanding of the figures.

Explanations in Regard to the Tables.

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

Table I. contains ground bones.

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 phosphoric acid in each

separately in the tables; because, 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 given under "soluble," "reverted" and "insoluble" phosphoric acid, the sum of these representing the total amount of phosphoric acid present. 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 the sulphate of potash is somewhat more costly than the muriate, it is thought best to give the form in which the potash is found in the fertilizers analyzed.

The "Estimated Value Per Ton."

The fertilizer law requires that the Director shall give, along with the analysis of each fertilizer, "the money value of such fertilizer computed from its composition, as he may determine." This is the "estimated value per ton" given in the last column of the tables.

The words of the law, "the money value of such fertilizer, computed from its composition" define as nearly as possible what these "estimated values" are intended to represent; that is, they are intended to show what the phosphoric acid, nitrogen and potash in a ton of each fertilizer is actually worth in dollars and cents. In other words, they are intended to show about how much the raw materials necessary to furnish the same quantity of "essential ingredients" as is found by the analysis would cost if purchased separately and then combined. It is important to note, however, that on account of the differences in the prices of the different materials which may be used to furnish phosphoric acid, nitrogen and potash, and differences in the price of the same material at different times, as well as differences in rates of freight to different points in the state, it is practically impossible to make these "estimated values" represent exactly the money value of the fertilizers. At best they are only relatively correct.

In order to calculate these values from the analysis, the Director assigns each year a certain price per pound for each of the "essential ingredients" of fertilizers. These prices are based upon the New York prices of the principal materials of which fertilizers are made, and include an allowance for freight from New York and for cost of mixing and loss in handling.

The framers of the fertilizer law evidently intended these estimated values to be an index that would show at a glance whether the purchaser was getting the worth of his money, and in a general way they do serve this purpose. Thus, when the "estimated value per ton" is very much below the price at which a ton of the fertilizer is sold, it shows that the purchaser at this price is paying high for the plant food it contains. But the estimated value alone is not a sufficient guide in purchasing fertilizers; it is necessary to consider the analysis also.

Importance of the Analyses.

In purchasing fertilizers it is of the first importance to consider the analyses, either in the tables of this bulletin or on the tags which should always be found attached to each sack; for by the analysis only can we tell whether we are getting, in the fertilizer, the plant food that we want to supply to our crop. If we were selecting a fertilizer for corn, for instance, to be used on a soil that was rich in phosphates but deficient in potash, we certainly would not buy a so-called "Corn Grower" that contained no potash, even if it was offered at a price much lower than the "estimated value."

Let us illustrate this farther by example. Suppose that a farmer, desiring to purchase a fertilizer for his corn crop, is offered by his merchant either of two "corn growers" at \$25 per ton. The price, fortunately, does not help him to decide in this case. He next looks at the tags attached to the sacks, and finds that the Director has estimated the value of each fertilizer at \$25.20 per ton. He next looks at the

analyses and finds Fertilizer No. 1 to contain :

Soluble Phosphoric Acid,	}	12.0 per cent.
Reverted		
Potash		None.
Nitrogen		2.4 per cent.

And Fertilizer No. 2 to contain :

Soluble Phosphoric Acid,	}	6.0 per cent.
Reverted		
Nitrogen.....		2.4 per cent.
Potash, from muriate		7.0 per cent.

He is now able to judge which of the two fertilizers to purchase. If his soil needs phosphoric acid, he will quickly decide on No. 1, for he will get twice as much for the same money, while did he purchase No. 2 he would get only half as much phosphoric acid which he needs and would be paying for potash which he does not need. But if he is in doubt whether his land needs one or all the elements of a fertilizer, or if he knows that his land needs potash, he will be wise in purchasing No. 2. For should his soil need potash, or all three of the essential elements to produce a large corn crop, and should he purchase No. 1, it is doubtful whether he would receive any benefit from it.

Values Used

The following are the values per pound adopted for use during the year 1895 :

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

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

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

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

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

TABLE I.—Raw Bone Manures.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	POUNDS IN THE HUNDRED.						Estimated Value Per Ton.
			PHOSPHORIC ACID.			Total.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.
			In Fine Bone.	In Medium Bone.	In Bone.				
2824	Armour & Co., Chicago, Ill.....	Bone Meal	25.54	1.89	27.43	59.90	2.83	3.44	\$31.47
2829	Same	Raw Bone Meal	11.12	13.21	24.33	53.14	3.98	4.83	30.76
2945	Cincinnati Desiccating Co., Cincinnati, Ohio.....	Pure Raw Bone Meal.....	14.14	10.50	24.64	53.81	3.76	4.56	30.77
2946	Same	Fine Ground Bone.....	15.80	5.05	20.85	45.54	3.11	3.78	26.56
2913	Dunn & Backer, Troy, Ind.....	Clover Leaf Brand Butcher Raw Bone and Tankage Mixture..	16.82	3.50	20.32	44.37	3.99	4.84	29.53
2914	Same	Clover Leaf Brand Pure Raw Bone Meal	18.34	7.02	25.36	55.38	3.83	4.65	32.29
2997	Empire Carbon Works, St. Louis, Mo.....	"Excelsior"—A Pure Bone Meal	21.75		21.75	47.50	3.67	4.46	30.25
3020	Globe Fertilizer Co., Louisville, Ky.....	Globe Bone Meal.....	13.92	10.13	24.05	52.53	3.67	4.46	30.07
2997	Hudson & Logan, Eminence, Ky.	See Empire Carbon Works....							
2817	J. B. Jones, Louisville, Ky.....	Pure Raw Bone Meal.....	11.20	11.21	22.41	48.95	4.01	4.87	29.73
2818	Same	Pure Ammoniated Bone Meal.	11.15	2.79	13.94	30.45	3.75	4.55	23.72

TABLE I.—Raw Bone Manures. (Concluded).

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	POUNDS IN THE HUNDRED.							Estimated Value Per Ton.
			PHOSPHORIC ACID.			Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.		
			In Fine Bone.	In Medium Bone.	Total.					
3007	J. B. Jones, Louisville, Ky.	Ammoniated Bone Meal	11.94	3.19	15.13	33.05	3.95	4.80	\$25 29	
2821	Jones Fertilizing Co., Cincinnati, Ohio	Fine Ground Bone.....	14.28	6.78	21.06	45.99	3.30	4.01	27 04	
2998	Same	Pure Raw Bone Meal	7.88	14.07	21.95	47.95	3.89	4.72	28 36	
2999	Same	Ammoniated Bone Meal	11.66	3.56	15.22	33.25	4.67	5.67	27 82	
2993	Michigan Carbon Works, Detroit, Michigan	Desiccated Bone	23.42	7.16	30.58	66.78	1.72	2.09	29 06	
2866	North-Western Fertilizing Co., Chicago, Ill	Horse Shoe Brand Fine Raw Bone.....	16.05	7.69	23.74	51.86	4.05	4.92	31 63	
2867	Same	Horse Shoe Brand Ralston's Bone Meal.....	11.24	6.16	17.40	38.00	4.03	4.89	26 80	
2876	Same	Horse Shoe Brand Pure Ground Bone.....	19.10	4.34	23.44	51.19	2.78	3.37	27 61	
2896	Ohio Valley Fertilizing Co., Owensboro, Ky	Corn, Wheat and Tobacco Grower, Pure Raw Bone Meal	6.02	16.80	22.82	49.84	3.99	4.84	28 87	
2920	Wm. Skene & Co., Louisville, Ky.	Skene's Pure Raw Bone Dust or Meal	9.46	13.18	22.64	49.45	4.08	4.95	29 76	
3030	The Standard Guano & Chemical Mfg. Co., New Orleans, La.	Pure Ground Bone.....	10.05	10.62	20.67	45.15	4.04	4.90	28 55	

TABLE II.—Complete Fertilizers, Superphosphates, Etc.

POUNDS IN THE HUNDRED.											
Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	PHOSPHORIC ACID.				Nitrogen.	Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.
			Soluble.	Reverted.	Insoluble.	From Sulphate.			From Muriate.		
2825	A. D. Adair & McCarty Bros.	See Furman Farm Improve ment Co.	.....	8.13	4.75	6 13	7.44	.....	.....	\$35 22	
2826	Armour & Co., Chicago, Ill..	Bone and Blood.....	2 99	6 03	3 68	2 37	2.88	1.51	.....	24 88	
2827	Same	Ammoniated Bone and Pot- ash	1.84	6 86	3 66	2 98	3.62	6.77	.....	33 92	
2828	Same.....	White Burley and Black To- bacco .....	....	8 43	4 93	4 28	5 20	8.27	.....	40 83	
2947	Same.....	Bone Blood and Potash	2 80	10.06	6.23	3.94	4.78	.....	.....	34 91	
2948	Cincinnati Desiccating Co. Cincinnati, Ohio	Pure Acidulated Bone.....	3.35	5.81	2.34	3.06	3 71	.....	2.37	27 54	
2951	Same	Gilead Phosphate.....	9.98	2 60	0 38	.....	.....	.....	.....	12 58	
2952	Same.....	Gold and Silver Phosphate. Tobacco and Potato Fertil- izer.....	3 02	5.79	3 39	4.30	5.22	5.36	.....	36 58	
2953	Same	Kentucky and Tennessee Tobacco Grower.....	0.93	8.24	3 15	1.85	2.25	.....	3.51	25 11	
2984	Same.....	Ohio Valley Phosphate	6.26	2.85	1.19	1.96	2.38	.....	2.03	22 65	

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

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	POUNDS IN THE HUNDRED.							Estimated Value Per Ton.
			PHOSPHORIC ACID.			Nitrogen.	Equivalent to Ammonia.	POTASH.		
			Soluble.	Reverted.	Insoluble.			From Sulphate.	From Muriate.	
2985	Cincinnati Desiccating Co.	Phoenix Phosphate	4.26	3.49	1.41	1.99	2.42	.....	1.12	\$19 87
2923	Cincinnati, Ohio. Cleveland Dryer Co., Cleve- land, Ohio	Buckeye Ammoniated Bone Superphosphate.	5.19	5.99	2.35	3.03	3.68	.....	0.25	27 74
2924	Same	Square Bone	4.25	10.53	6.19	3.04	3.69	.....	.....	34 43
2925	Same	Ohio Seed Maker	5.64	5.95	2.98	1.64	1.99	.....	.....	23 46
2926	Same	Phospho Bone	7.23	3.52	3.85	0.83	1.01	.....	1.08	21 19
2927	Same	White Burley Tobacco Fer- tilizer	7.91	2.62	2.52	2.84	3.45	.....	3.44	30 07
2928	Same	Ammoniated Dissolved Bone	7.42	4.00	2.10	1.64	1.99	.....	.....	22 78
2833	Crocker Fertilizer and Chem- ical Co., Buffalo, N. Y.	Crocker's Kentucky Tobac- co Fertilizer.	7.82	2.99	1.41	2.06	2.50	.....	3.57	27 33
2834	Same	Crocker's Special Kentucky Tobacco Fertilizer.	9.34	0.76	0.63	3.83	4.65	.....	5.70	34 71
2835	Same	Crocker's New Rival Am- moniated Superphosphate	7.62	3.21	1.23	1.46	1.77	.....	1.76	23 00

2836	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.....	Crocker's Ammoniated Practical Superphosphate	5.69	3.44	1.41	1.13	1.37	.....	1.59	\$19 36
2839	Same	Exposition Corn Grower....	5.99	2.64	2.90	1.22	1.48	.....	1.72	19 86
2840	Same	Exposition Tobacco Grower	5.67	2.63	2.79	2.03	2.46	.....	2.05	22 59
3009	Same	Crocker's General Crop Phosphate	2.57	4.69	2.80	1.02	1.24	.....	1.19	16 56
3022	Same	Crocker's Universal Grain Grower	4.45	2.82	1 01	1 07	1 30	...	3.13	18 20
2902	Currie Fertilizer Co., Louisville, Ky	Currie's Dissolved Bone....	4.87	3.19	2.03	1.36	1.65	3.64	.....	22 16
2903	Same	Currie's Corn Grower.....	5 88	2.50	3.95	2.04	2.48	2 35	1.06	25 41
2904	Same	Currie's Black Diamond Phosphate	8 52	2.65	0.96	0.78	0 95	2.71	.....	22 64
2905	Same	Currie's Tobacco Grower...	6.84	2.71	3.13	2.23	2.71	7.90	.....	33 81
2906	Same	Currie's Golden Leaf Tobacco Grower	7.18	2.65	2.90	1.51	1 83	4.44	.....	26 72
2907	Same	Currie's Kentucky Phosphate	8.12	2.52	1.22	0.79	0.96	2.02	.....	21 11
2908	Dunn & Backer, Troy, Ind ..	Clover Leaf Brand Acidulated Bone Phosphates....	13.62	4 15	1.39	.....	.....	.....	.....	17 77
2909	Same	Clover Leaf Brand Ammoniated Superphosphates....	8.74	3 63	4 21	1.60	1.94	.....	.....	25 03
2910	Same	C. L. B. Ammoniated Superphosphates and Potash ...	8 23	3 26	3 98	1 27	1.54	.....	3 70	26 97
2911	Same	C. L. B. Super-Phosphates and Raw Bone Mixture...	7.93	4.54	10.22	1 79	2.17	..	.....	28 84
2912	Same	C. L. B. Super-Phos., Raw Bone and Potash Mixture.	8 70	3.43	8.39	1.29	1 57	....	2.98	29 28
2973	Furman Farm Improvement Co., Atlanta, Ga.....	Furman High Grade Fertilizer	6.65	2.83	2.58	2.43	2 95	.....	2.59	26 18

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

Station Number.	NAME AND ADDRESS OF MANUFACTURER	NAME OF BRAND.	POUNDS IN THE HUNDRED.							Estimated Value per Ton.
			PHOSPHORIC ACID			Nitrogen.	Equivalent to Ammonia.	POTASH.		
			Soluble	Reverted	Insoluble.			From Sul- phate.	From Mu- riate.	
2974	Furman Farm Improvement Co., Atlanta, Ga.	Buffalo Bone Fertilizer..	6.18	2.52	2.92	2.06	2.50	.....	2.63	\$24 01
2975	Same	Furman Soluble Bone with Am. and Potash ..	7.28	2.82	1.93	1.08	1.31	.....	2.50	21 89
2976	Same	Farish Furman Formula	7.69	4.82	1.56	....	.....	.....	2.90	21 77
2885	Globe Fertilizer Co., Louis- ville, Ky	Globe Potato Grower ...	6.26	1.40	2.47	4.50	5.46	4.46	.....	33 95
2886	Same	Kentucky Standard Tob- acco Grower.....	8.29	0.70	2.28	2.67	3.24	3.26	.....	27 64
2887	Same	Big Four Tobacco Grower	8.12	1.13	2.17	1.59	1.93	2.32	.....	22 86
2888	Same	Eagle Fertilizer—Corn and Wheat Grower..	8.93	1.54	2.76	1.40	1.70	1.20	.....	22 62
2890	Same	Globe Bone Dust.....	8.84	1.96	2.21	0.70	0.85	0.68	.....	19 63
3005	Same	Golden Harvest Bone Meal.....	9.30	1.65	2.66	2.37	2.88	1.25	.....	26 71
3006	Same	Progress Corn and Wheat Grower.....	9.89	0.94	1.77	1.12	1.36	1.34	.....	21 85

3013	Globe Fertilizer Co., Louisville, Ky	Globe Wheat Grower.....	9.47	1.54	2.61	2.09	2.54	1.11	....	25 59
2819	J. B. Jones, Louisville, Ky ..	Bromophyte.....	0.55	2.21	0.68	1.12	1.36	0.20	....	8 40
2820	Same	Tobacco and Potato Grower	1.38	5.29	2.39	2.78	3.37	4.72	....	26 88
2937	Same	Kentucky Phosphate.....	1.55	3.83	4.14	3.64	4.42	....	2.95	25 88
3008	Same	Kentucky Phosphate.....	1.29	4.29	3.72	3.20	3.88	....	2.56	23 94
3000	Jones Fertilizing Co., Cincinnati, Ohio.....	Acidulated Bone.....	2.25	6.92	6.05	4.74	5.75	....	....	32 46
3002	Same	Miami Valley Phosphate...	1.82	4.87	2.64	3.19	3.87	....	2.51	24 87
3003	Same	Jones' Reliable.....	0.86	4.94	2.64	2.74	3.33	....	1.56	20 90
3017	Same	Tobacco and Potato Grower	1.42	5.20	4.55	4.12	5.00	6.03	....	34 41
2857	S. Kaufman & Son, Indianapolis, Ind.....	Celebrated Potash Fertilizer	....	0.46	0.49	....	....	0.99	....	2 28
2858	Loudenback Fertilizer Co., Urbana, Ohio.....	Urbana Prize Potato and Tobacco Grower.....	7.28	2.43	2.65	2.31	2.80	3.58	3.07	31 70
2859	Same.....	Urbana Ammoniated Bone	4.77	4.19	3.28	2.27	2.76	1.43	2.58	27 23
2860	Same.....	Urbana Sweepstakes Bone..	3.21	5.18	3.67	1.46	1.77	1.81	2.37	24 07
2861	Same.....	Urbana Bone Phosphate and Potash.....	2.20	5.73	3.67	1.47	1.78	....	3.48	22 27
2851	P. B. Mathiason & Co., St. Louis, Mo.....	Increscent Acidulated Bone Meal with Potash.....	2.37	8.25	6.78	2.35	2.85	1.59	....	28 72
2852	Same.....	Increscent Tobacco Grower.	3.15	6.64	4.61	4.22	5.12	5.79	....	38 90
2856	Michigan Carbon Works, Detroit, Mich.....	Homestead Vegetable Grower	4.64	0.61	0.24	5.81	7.05	7.67	....	38 55

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

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	POUNDS IN THE HUNDRED.							Estimated Value Per Ton.
			PHOSPHORIC ACID.			Nitrogen.	Equivalent to Ammonia.	POTASH.		
			Soluble.	Reverted.	Insoluble.			From Sulphate.	From Muriate.	
2929	Michigan Carbon Works, De troit, Mich	Homestead Corn and Wheat Grower	8.61	2 61	1.88	2.44	2.96	2.43	.....	\$28 59
2930	Same	Homestead Potato Grower..	8 67	1.38	1.14	2.22	2.70	4 13	.....	28 19
2931	Same	Homestead Tobacco Grower	9.27	0 96	0.68	3.53	4.29	4.07	....	32 72
2932	Same	Jarves' Drill Phosphate....	7.66	2.24	1.59	1.62	1.97	.....	.....	20 33
2933	Same	Jarves' Tobacco Fertilizer..	6 79	1.31	1.39	2.03	2 46	.....	1.85	21 37
2956	Same	Homestead Tobacco Grower	9.40	0.14	0.90	3.73	4.53	.....	5.61	33 60
2897	National Fertilizer Co., Nash- ville, Tenn	Acid Phosphate with Potash	9 95	3.97	7.38	.....	.....	.....	2.65	26 36
2898	Same	Corn Grower	10.23	3.25	1.46	0 94	1.14	.....	1.33	24 49
2899	Same	Tobacco Grower	6.88	2 59	1.61	1.82	2.21	.....	2.25	23 15
2917	Nolte & Dolch Fertilizer Co., St. Louis, Mo.....	Bone Black Crop Multiplier	5.80	3.74	2 92	2.57	3.12		2.02	26 24

Analyses of Commercial Fertilizers.

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		0.87	5.65	2.41				1.61	\$12 27
2922	Nolte & Dolch Fertilizer Co., St. Louis, Mo.....								
2868	North-Western Fertilizing Co., Chicago, Ills.....	6.40	2.41	2.88	3.53	4.29	3.17		30 57
2869	Same	6.54	2.18	3.65	2.95	3.58	2.84	.....	28 35
2870	Same	4.32	2.18	4.41	1.89	2.29	1.02	.....	19 36
2871	Same	4.23	2.11	4.53	1.80	2.19	0.97	.....	18 81
2872	Same	4.35	2.33	4.12	2.45	2.97	1.99	.....	22 78
2873	Same	5.03	2.58	3.80	3.02	3.67	2.51	.....	26 63
2874	Same	4.73	2.04	4.95	1.26	1.53	.....	0.58	17 07
2877	Same	3.40	4.54	7.55	3.09	3.75	0.60	.....	26 56
2878	Same	5.51	2.50	3.12	3.62	4.39	4.52	.....	31 77
2916	Same	5.09	2.97	5.97	2.31	2.80	1.05	.....	23 83
2996	Same	11.49	5.96	0.41	....	.....	.....	.....	17 45
2915	Jno. S. Reese & Co., Balti- more, Md.....	3.91	5.63	2.43	1.77	2.15	.....	1.19	22 21
2921	Wm. Skene & Co., Louisville, Ky.....	3.36	2.86	3.26	1.96	2.38	.....	5.08	23 29
2960	Same	1.85	5.00	3.90	3.27	3.97	12.34	.....	40 27
2900	Thompson and Edwards Fer- tilizer Co., Chicago, Ill.....	.....	3.61	6.10	4.37	5.31	8.60	0.75	36 34
2810	S. W. Travers & Co., Rich- mond, Va.....	6.05	1.97	1.10	3.46	4.20	.....	4.61	29 42
	Capital Tobacco Fertilizer..								
	Phosphate and Potash.....								
	Horse Shoe Brand Tobacco Grower								
	Horse Shoe Brand Challenge Corn Grower								
	Horse Shoe Brand Twenty- six Dollar Phosphate.....								
	Horse Shoe Brand Prairie Phosphate								
	Horse Shoe Brand Ky. Corn and Tobacco Grower.....								
	Horse Shoe Brand Potato Grower								
	Horse Shoe Brand Ky-Ana Phosphate.....								
	Horse Shoe Brand Raw Bone and Phosphate Mixture...								
	Horse Shoe Brand High Grade Truck Manure.....								
	Horse Shoe Brand National Bone Dust.....								
	Horse Shoe Brand Acid Phosphate								
	Reese's Pacific Guano.....								
	Skene's Louisville Super- phosphate.....								
	Skene's Compl'e Pl't Food or Perfect Tob. & Pot. Grower								
	World of Good Raw Bone Corn Grower.....								

TABLE II.—Complete Fertilizers, Superphosphates, Etc. (Concluded).

Station Number.	NAME AND ADDRESS OF MANUFACTURER,	NAME OF BRAND.	POUNDS IN THE HUNDRED.							Estimated Value Per Ton.
			PHOSPHORIC ACID.			Nitrogen.	Equivalent to Ammonia.	POTASH.		
			Soluble.	Reverted.	Insoluble.			From Sulphate.	From Muriate.	
2811	S. W. Travers & Co., Rich- mond, Va.....	National Tobacco Fertilizer	5.01	2.68	1.69	1.89	2.29	.....	3.98	\$23 02
2812	Same	Beef Blood and Bone Fer- tilizer	4.95	2.90	1.42	1.86	2.26	.....	2.08	20 71
2813	Same	Travers' Dissolved Bone Phosphate	12.63	1.97	0.75	.....	.....	.....	.....	14 60
2814	Same	Capital Dissolved S. C. Bone	9.58	2.33	1.33	.....	.....	.....	.....	11 91
2853	Same	Champion Corn Grower....	7.23	1.75	1.15	1.04	1.26	.....	3.74	21 28
2854	Same	Capital Bone-Potash Com- pound	4.31	5.17	0.79	.....	.....	.....	2.95	17 21
2884	Same	Orchilla Guano .....	.....	5.02	11.07	.....	.....	.....	.....	11 66

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

AUGUST 10, 1895.

KENTUCKY
Agricultural Experiment Station

—OF THE—

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 57.

1. Wheat Experiments.
2. Oat Experiments.

LEXINGTON, KENTUCKY.

SEPT., 1895.

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. 57.

1. Wheat Experiments.

2. Oat Experiments.

I. WHEAT EXPERIMENTS.

The experiments cover—

1. *Test of Varieties.*
2. *Methods of Seeding.*
3. *Test of Fertilizers.*

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

THE SEASON.—The season was unfavorable to the wheat crop. The wheat was "winter killed" fully 15 per cent. The latter part of the season was quite unfavorable—so much so that the heads did not fill well. All the varieties rusted badly. The English sparrows, although kept off as much as possible by a watchman with a gun, were so destructive as to greatly diminish the yield and to impair, to some extent at least, the accuracy of the results obtained.

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

MONTHS 1894-1895.	Per Cent. Sunshine.	Clouds.	Amount of Rainfall— Inches.	TEMPERATURE. Degrees.		
				Mean.	Highest.	Lowest.
September	47.0	53.0	4.05	71.0	92	43
October	55.0	45.0	1.40	57.6	83	33
November	41.0	59.0	1.38	41.3	70	15
December	23.0	77.0	3.45	37.4	65	-6
January	22.0	78.0	5.60	27.7	61	-12
February	32.0	68.0	.52	23.4	68	-13
March	39.0	61.0	2.79	42.7	83	20
April	34.0	66.0	3.17	55.8	82	30
May	35.0	65.0	4.05	62.3	91	33
June	47.0	53.0	2.93	75.5	94	50

TEST OF VARIETIES.

Sixteen varieties were under test. Each variety was planted on 1-20 acre, in drills seven inches apart. Time of planting Oct. 5th. Fall growth of all varieties only fair.

The table which follows gives a summary of field notes:

TABLE 2.—Notes.

	NAME OF VARIETY.	APPEARANCE.			Ripe	Head—S, Smooth; B, Bearded.	Color of Grain.
		April 1.	June 1.	June 15.			
1	Democrat	Damaged by cold winter.	Fair, headed.	Rusting.	June 24	B	White
2	Red Poole.....	Fair.	Looking well.	Fair.	24	S	Red
3	Gold Coin.....	Slightly damaged.	Headed, fair.	Very fair.	25	S	White
4	Early Red Clawson	Damaged.	Headed, fair.	Very fair.	23	S	Amber
5	Jones' Winter Fife.....	Slightly damaged.	Headed, looking well.	Looking fair.	26	S	Amber
6	Lancaster's Lit Red.....	Fair.	Headed, very fair.	Very good.	24	B	Red
7	Fulcaster	Damaged.	Very fair.	Only fair.	23	B	Red
8	Giant Square-head	Damaged.	Stand thin, fair.	Too thin.	26	B	White
9	Red Wonder	Damaged.	Headed, fair.	Poor.	23	B	Red
10	Improved Fultz..	Damaged.	Headed, fair.	Fair.	24	S	Amber
11	Jones' Winter Fife.....	Damaged.	Fair.	Fair.	25	S	Amber
12	Red Clawson.....	Greatly damaged.	.....	.....	23	S	Red
13	No Name	Damaged.	Fair.	Very fair.	25	B	Red
14	Ger. Emperor...	Slightly damaged.	Fair.	Fair.	26	S	Amber
15	Egyptian.....	Damaged.	Only fair.	Fair.	23	S	Amber
16	Red Beauty	Damaged.	Only fair.	Only fair.	25	S	Amber

Here follows the yield of each variety and the weight of wheat per bushel:

TABLE 3—Wheat—Yield of the Varieties.

No. of Plot.	NAME OF VARIETY.	YIELD PER ACRE.		Weight Per Bushel.
		Wheat, Bushels.	Straw, Pounds.	
1	Democrat.....	16.8	2360	59
13	Unnamed.....	16.8	1912	60
6	Lancaster L. Red.....	15.0	1576	59
5	Jones' Winter Fife.....	14.6	911	57
2	Red Poole.....	13.9	968	57
4	Early Red Clawson.....	13.9	1530	56
14	German Emperor.....	13.4	1552	56
11	Jones' Winter Fife (Wilson).....	13.2	1462	56
3	Gold Coin.....	13.1	900	56
7	Fulcaster	12.0	1192	59
15	Egyptian	11.6	1440	57
10	Improved Fultz.....	11.25	900	60
16	Red Beauty.....	11.25	750	56
12	Red Clawson.....	10.8	1260	54
9	Red Wonder.....	8.25	1340	57
8	Giant Square Head	7.5	1012	56

The season was so unfavorable and the yield so unsatisfactory that the results are valuable only for future reference.

DIFFERENT METHODS OF SEEDING.

Deep vs. Shallow Planting—Thick vs. Thin Seeding—
The German Emperor was the variety planted in these experiments. The land adjoined that on which the varieties were grown. Planted Oct. 5. Plots 1-20 acre each.

The results follow :

TABLE 4—Amount of Seed and Depth of Planting.

Plot.	Seed Used Per Acre, Pecks.	Depth Planting, Inches.	Yield of Wheat, Bushels.	Yield of Straw, Pounds.
1	3	1	9.3	1238
2	4	1	11.6	1216
3	5	1	15.4	1890
4	6	1	13.1	1575
5	7	1	13.1	1686
6	8	1	18.3	2020
7	6	1	11.2	2040
8	6	1½	11.2	1240
9	6	2	13.4	1664
10	6	3	18.0	1732

TEST OF FERTILIZERS.

As will be shown in the tables which follow, the use of fertilizers had little, if any, effect on the yield of wheat. This has been our experience each year since we began these experiments on the Experiment Station grounds: Although corn, tobacco, potatoes and hemp readily respond to potash fertilizer, no appreciable effects can be noticed on the yield of wheat. Whether this is true for all the blue-grass region, similar experiments on the

various farms alone can tell. It is known that in many parts of the State fertilizers materially increase the yield of wheat.

The field used for the experiments is the same as that use for the past six years for fertilizer experiments on wheat. The field is quite level, and is divided off into 1-10 acre plots, with paths of three feet between each plot. The wheat was drilled in Oct. 3, at the rate of $1\frac{1}{2}$ bushels per acre. The Egyptian wheat was used in the test.

The accompanying diagram shows the amount and the distribution of the fertilizers;

DIAGRAM 1—Showing Fertilizers Applied.

1	No Fertilizer.
2	Double Superphosphate 14 lbs.
3	Air-slaked Lime 4 bushels.
4	Muriate of Potash 16 lbs.
5	Nitrate of Soda 16 lbs.
6	No Fertilizer.
7	Double Superphosphate 14 lbs. Muriate of Potash 16 lbs.
8	Double Superphosphate 14 lbs. Nitrate of Soda 16 lbs.
9	Muriate of Potash 16 lbs. Nitrate of Soda 16 lbs.
10	Nitrate of Soda 16 lbs. Muriate of Potash 16 lbs. Double Superphosphate 14 lbs.

These experiments were planned for the purpose of ascertaining whether fertilizers would be beneficial to wheat on this particular field, and if so, to learn what essential ingredient or ingredients of the fertilizer were needed for the wheat crop. If potash only was needed, plot 4 would show it. If phosphoric acid was the ingredient wanted, then plot 2 would show it. If nitrogen, plot 5 would demonstrate it. If the soil needed a combination of any two of these ingredients, then plots 7, 8 or 9 would show which combination was needed; or, if all the ingredients were essential, No. 10 would prove it. Plots 1 and 6 were left blank for comparison. These plots have not received any kind of fertilizer since the wheat experiments began six years ago.

The following table gives the yield of the different plots:

TABLE 5—Effects of Fertilizers on Wheat.

No. of Plot.	FERTILIZERS APPLIED.	Amount in pounds used per acre.	Yield of Wheat, bushels.	Yield of Straw, pounds.
1	No Fertilizer.....	.....	13.0	1450
2	Double Superphosphate.....	140	14.2	1540
3	Slaked Lime.....	400	12.0	1500
4	Muriate of Potash.....	160	12.1	1190
5	Nitrate of Soda	160	11.2	1440
6	No Fertilizer.....	.....	13.4	930
7	{ Double Superphosphate..... Muriate of Potash.....	{ 140 160 }	11.4	1030
8	{ Double Superphosphate..... Nitrate of Soda	{ 140 160 }	9.6	970
9	{ Muriate of Potash..... Nitrate of Soda	{ 160 160 }	12.8	1260
10	{ Double Superphosphate..... Muriate of Potash..... Nitrate of Soda	{ 140 160 160 }	13.5	1320

The fertilizers were applied at the time of planting the wheat.

But little difference in the growth of the wheat, on any of the plots, could be noticed in the fall. The growth on those plots receiving potash was a little stronger than on the others. No difference could be noted in the spring growth.

2. EXPERIMENTS WITH OATS.

1. *Test of Varieties.*2. *Test of Fertilizers.*

Thirty-one varieties were tested; 1-40 of an acre was used for each variety. The seed were drilled in at the rate of $1\frac{1}{2}$ bushels per acre on March 30th.

The growing season was too dry when the oats were heading for a favorable yield of oats.

Here follow the names of the different varieties in the order of their yield:

TABLE 6—Oats—Yield of Varieties.

No. of Plot.	NAME OF VARIETY.	YIELD PER ACRE.		Wt. per bushel.
		Grain, bushels.	Straw, pounds.	
9	Droghead Irish Imported.....	49.2	2115	38
10	Early Archangel.....	42.2	1980	37
7	Badger Queen.....	39.4	1755	36
1	American Banner.....	38.0	2070	31
5	Australian	36.5	1575	35
14	Hopetown.....	35.2	2385	40
19	Negro Wonder.....	35.2	1755	32
4	American White.....	35.1	1845	34
31	Yellow German	35.1	1800	34
11	Giant Yellow French.....	35.1	1800	31
23	Race Horse.....	33.8	2250	34
30	White Russian.....	33.7	1890	32
3	American Triumph.....	33.7	1440	34
24	Rust Proof	32.4	1575	30

TABLE 6.—Continued.

No. of Plot.	NAME OF VARIETY.	YIELD PER ACRE.		Wt. per bushel.
		Grain, bushels.	Straw, pounds.	
25	Wide Awake.....	32.4	1620	32
29	White Maine.....	32.3	1890	33
6	Banner.....	32.3	1530	33
16	Improved Welcome.....	32.3	2340	33
17	Lincoln.....	31.0	1750	33
2	American Beauty.....	30.9	1440	34
8	Clydesdale.....	28.1	1395	32
20	New American.....	28.1	1710	32
21	Pringle's Progress.....	28.1	1440	32
22	Probsteier.....	28.1	1935	38
13	Green Mountain.....	26.7	2115	34
28	White Belgian.....	26.7	1575	32
26	White Baltic.....	25.3	1440	33
12	Golden Giant Side.....	25.3	2025	32
15	Imported Black Tartarian.....	18.3	1800	32
27	Clydesdale.....	16.9	1530	33
18	Mammoth Cluster.....	15.5	1620	31

TEST OF FERTILIZERS ON OATS.

The same general plan was followed out in these tests as in the wheat experiments.

The experiments were conducted on the ground used heretofore for fertilizer experiments for potatoes. Six successive crops of potatoes had been raised prior to these experiments. The plan of applying the fertilizers was the same as had been adopted in the potato experi-

ments. Those plots which had received no fertilizer in the potato experiments received none in the oat experiments, etc.

The following table gives the kind and amount of fertilizers used on the different plots and the yield of grain and straw calculated per acre:

TABLE 7.—Effect of Fertilizers on Oats, 1895.

No. of Plot.	FERTILIZERS.		YIELD PER ACRE.	
	Kind Used.	Amount in Pounds Used Per Acre.	Bushels Grain.	Pounds Straw.
1	None.....	.....	43.8	3200
2	Nitrate of Soda.....	160	40.3	2200
3	Double Superphosphate.....	140	45.6	2300
4	Muriate of Potash.....	160	52.2	2280
5	None.....	.....	46.9	2250
6	{ Nitrate of Soda..... Double Superphosphate.....	{ 160 140 }	44.3	2380
7	{ Nitrate of Soda..... Muriate of Potash.....	{ 160 160 }	48.8	2390
8	{ Muriate of Potash..... Double Superphosphate.....	{ 160 140 }	59.4	3050
9	{ Nitrate of Soda..... Muriate of Potash..... Double Superphosphate.....	{ 160 160 140 }	50.9	2820
10	None.....	.....	36.8	1920

The results are interesting, but further investigation must be made before conclusions can be drawn. From the results obtained it would appear that nitrate of soda has no beneficial effect, but was rather injurious to the best results, while both muriate of potash and double superphosphate each seemed to produce increased yields.

KENTUCKY
Agricultural Experiment Station

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 58.

Cutworms in Kentucky.

LEXINGTON, KENTUCKY.

NOV., 1895.

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. 58.

CUTWORMS IN KENTUCKY.

BY H. GARMAN.

The spring of 1895 was marked in Kentucky by an extraordinary abundance of cutworms in gardens and fields, and numerous complaints appeared in the papers published throughout the State concerning their attacks upon hemp, tobacco, corn, cabbage, tomatoes, strawberries, and almost everything else valued as a crop by farmers. Hemp especially suffered in Jessamine county. Garden truck of all kinds was cut down to such an extent that in some localities people became discouraged and hopeless of securing a stand.

As is usual when these insects become exceptionally common there was some migration of the worms from one piece of ground to another, which led correspondents to assume that an outbreak of the notorious army-worm was in progress, a mistake encouraged also by the fact that some of the cutworms which appeared were marked with stripes.

It was more than once explained to correspondents of the Station at the time of the outbreak that the true army-worm had nothing to do with the mischief then being done. It was not more common during the season in Kentucky, as far as I could learn, than it is usually. Almost any season a few of these worms can be found in damp meadow land among grasses, while adult army-worm moths are always rather common during the

summer. Only at long intervals do they assume the marching habit, and so far as my observations enable me to judge, they have not proved destructive here during the past five years. The injuries of last spring were solely the work of cutworms, of which two different kinds were especially abundant, while at least six other species had more or less to do with the injuries, some prevailing in one locality, others in another.

It was apparent as early as February that the worms were more than ordinarily common. At that time they could be found on warm days gathered together under boards and stones at the edges of plowed fields, and in pastures and meadows. In March they could be collected in large numbers in such situations, and with the starting growth of grasses and weeds they began to feed upon these, often cutting them away in the vicinity of their retreats to such an extent that their presence under boards might be detected by the gnawed condition of the vegetation about them. The common weed known as as shepherd's purse (*Capsella bursa-pastoris*), blue-grass, and clover, seemed to be favorite food-plants.

When crops were planted farmers everywhere set up a shout of alarm and execration, for the lurking foes, which had not hitherto been observed by them, came out from their places of concealment and rapidly cut down the tender growths. They invaded even tobacco beds to destroy the plants before they were transplanted. Woody plants did not escape attack. The new growth of raspberry and blackberry canes were sometimes cut off. Onions were relished by some of the species. Potatoes, though not commonly subject to attack by cutworms, suffered a good deal in some localities.

Under date April 24, 1895, D. S. Dickinson, of Trenton, Todd Co., wrote to the Station:

"I send by to-day's mail a new pest to this section. This worm appeared in this locality about the 10th of April, and has been very destructive to corn and young

clover, also destroying young tobacco plants. They resemble the cutworm in looks and otherwise, also the armyworm in some respects, yet we think them neither."

In sending a second lot of cutworms to the Station, April 29, Mr. Dickinson wrote:

"I think they are disappearing gradually now, for in getting a second lot for you I have been unable to find any on tobacco plant beds. The injury from these worms so far has been more serious from loss of young clover than otherwise, as it is still time enough for a corn and tobacco crop. Around this section they are worse in certain places, even on the same farm, but I hear complaint from nearly every farmer."

With a package of cutworms sent to the Station, April 30, Mr. Halbert Rust, of Fairmount, Jefferson Co., wrote:

"Enclosed you will find a few examples of a worm that is now here in unlimited numbers. They are especially destructive to clover fields, and revel on green peas, onions, and garden vegetables, not overlooking strawberry plants, newly set, as well as old."

Through the kindness of Mr. J. E. Younglove and Mr. A. D. Webb, of Bowling Green, I received numerous examples of cutworms from Warren county. On May 6 Mr. Webb sent me over two hundred worms which he wrote me were collected by him in a few minutes.

The President of the State Horticultural Society, Mr. M. F. Johnson, wrote from Fern Creek, Jefferson Co., May 9:

"I send you by to-day's mail some cutworms which are devastating this region. I caught these specimens around my onions. They are cutting down my young potatoes, destroying many of the spring-set strawberry beds, and are now working in my older strawberry plant beds; are also cutting down the young raspberry and blackberry shoots. We have done a good deal of ditching, but, while we have caught large numbers, I have

little faith in the ditch, for it seems to me to be a spontaneous uprising from the earth everywhere."

An old student of the State College, Mr. W. F. Nichols, wrote from Clarkson, Grayson Co., May 13:

"Can you give me any information with regard to the pests known as cutworms and army-worm? We are wonderfully infested with them this year, and any information concerning their nature and remedies for them will be a godsend to our people."

From Mr. J. Speed, of Elk Creek, Spencer Co. I received on May 20 a package of wheat infested with Hessian fly, and with it some of the cutworms. He wrote concerning the latter as follows:

"In the package with the wheat you will find two boxes. One marked 'traveling cutworms' contains the fellows that were taken to be army-worms. There are very few left now, and they are not moving, but are mainly under the largest mulleins. The other box contains the common sort we dig out of the corn hills; they are rarely seen on the surface."

All of the worms sent to the Station by these gentlemen and all of those observed by me at work on crops in this vicinity were true cutworms, and not a single genuine army-worm was found among them. The greater part of the material sent in, probably 90 per cent., represented but two distinct kinds, both of which can be found among growing plants in spring any season. So there was nothing very anomalous about the appearance of the pests except their unusual abundance and the marching habit, which latter, however, they never exhibited with the unanimity of purpose and persistence of the true army-worm. The latter march in bodies which devour nearly every green herb before them and occur in such numbers that they sometimes creep over each other in their eagerness to get forward. The species which was most active in migrating is known in its adult condition (See plate, fig. C, enlarged $\frac{3}{4}$) as a small gray moth (*Fel-*

tia gladiaria), and in its larva stage as the clay-backed cutworm (Plate, figs. D and E). It is the "traveling cutworm" of Mr. J. Speed's letter, quoted above. It constituted three-fourths of those sent to the Station by Mr. Webb, of Bowling Green, a large part of those sent in by Mr. Dickinson, of Trenton, and was among those received from President Johnson of the Horticultural Society. It was also one of the most abundant species here at Lexington.

1. The Traveling Cutworm

(*Feltia gladiaria*).

When fully grown and ready to retire into the ground, this cutworm measures 1.34 inch in length and has a diameter of 0.25 inch. The general color is dull greenish or brownish gray. A rather wide area along the middle of the back generally contrasts sharply with the general tint, and is some shade of brown or yellow, varying from light straw-yellow in some examples to dark brown in others. In the middle of this area one can generally make out a narrow pale line, often more clear because it is accompanied on each side by a faint dusky line. Outside the brown area along the back on each side is a couple of very narrow pale lines similar to the one in the middle of the back. The general tint on the side is commonly darker than that on the back, this being especially noticeable in the young. Beneath, the general color is obscure dull green, in life. The breathing pores (spiracles) along the sides are black; they form groups with certain brown dots which occur on the sides of the segments. The head is yellowish brown, with a pair of arcuate brown bands which start from the mouth and are accompanied by a fine network of brown lines on the sides of the head. A black eye-spot is present. A triangular region on the front of the head is brown like the cheeks.

The antennæ and the feelers (palpi) attached to the

lower lip are white, but with a hand magnifier one may see brown rings upon them. Just behind the head on the division next following is a smooth brown plate, across the middle of which passes the narrow pale line of the back. A similar but smaller plate is present on the last division of the body. The legs, of which there are eight pairs, including the slender jointed ones on the three divisions of the body behind the head with the soft fleshy legs along the hind part of the body, are all pale and not noticeably different from those of other cutworms; their arrangement and general character is the same also as in the true army-worm. Figures D and E of the plate give a good general idea of the worm.

Most of our cutworms are active during the spring when plants are coming up, and then go into the ground for their second change, and from July to September emerge as adult moths which lay eggs in the fall for the next season's brood. The traveling cutworm shows a peculiarity in its development that is worth mentioning here. My examples went into the ground like the other kinds, but remained worms, without eating, for a considerable period. On June 19, when I supposed those kept in breeding jars had changed to pupæ, I found them lying unchanged in the soil kept in the jars. Professor Forbes, of Illinois, observed the same peculiarity, and states that his confined examples continued as worms until August 6. I suspect that some individuals feed now and then during this time, for I heard during July complaints of injury to strawberry plants, and received a mutilated cutworm, which seemed to be this species, taken among injured strawberry plants August 4. In the breeding jars at the Station, however, they did not come out to get the food provided for them. It would seem that they underwent a sort of æstivation similar to the torpid hibernating condition of many animals, and only changed to pupæ towards fall. Just when this latter change occurs I am unable to say, for after taking the

worms from the earth several times I decided not to disturb my breeding cage examples again, lest by doing so I might prevent them from becoming moths—a matter of some importance, since the species could not be determined positively without the adult.

The first moth to mature came out of the ground at the Station on September 17, and the last one to emerge on October 1. The period during which it is abroad here thus appears to coincide very closely with that observed by Professor Forbes in Illinois, who records in his fifth report September 15 to October 13, as its time of appearance.

Moths reared by me at the Experiment Station measure about 1.34 inch in spread of wings. The general color is sooty blackish. The markings of the front wings are small and very obscure. The hind wings are sooty outwardly, and become paler toward the base. Both front and hind wings have a small central black mark beneath. The appendages and body are gray.

2. The Dingy Cutworm

(*Feltia jaculifera*).

With the traveling cutworm most of our correspondents sent in another worm which appears to have done a good deal of injury in some localities. It does not seem so much inclined to travel about during the day as does the other, and while occurring everywhere in the State was not so generally injurious last spring. In structure and size the two are much alike. Some slight differences of color will enable one to distinguish the dingy cutworm. It has the same broad clay-colored or yellowish brown area along the back, but on each division of the body from each margin of the area above mentioned an oblique blackish line extends forward into the area. Each of these lines, sometimes very faint, passes through two small bristle-bearing dots. At each side of the area

is a broken longitudinal black stripe, represented in the traveling cutworm by a nearly continuous brown shade. By the side of each breathing pore is a black dot, which is a little more conspicuous than corresponding dots on the related species. The pale longitudinal lines, quite characteristic of the traveling worm, are here only imperfectly represented. The markings of the two worms are otherwise similar, the head having the dark curved bars, the black eye-spot and the network of brown lines on the cheeks. This worm is a common garden pest every year, and does a large share in cutting off newly set plants. It constituted more than half of the cutworms sent to the Station by Mr. Dickinson from Todd county. The moth is quite different from the adult of the traveling cutworm. It is shown at A in the plate enlarged one-sixth. It begins to come out of the ground in August, my records showing it abroad at Lexington from August 27 until September 23. During this time it is frequently seen about our lamps at night, and large numbers can be secured by brushing trees with sweetened mixtures, such as molasses and stale beer, or vinegar. It is also common about rotting apples and the refuse from cider mills.

3. The Dingy Cutworm

(*Feltia subgothica*).

We have another cutworm moth in the State so much like the above that the two are very likely to be confounded. This moth is represented at B in the plate. A comparison of A and B will give a fair idea of the differences. A noticeable difference among others is the more extensively pale hind wings in B, in which also the dark marginal area begins more abruptly. The cutworms from this moth appear with the others in spring. The adult moth may be seen abroad from July 10 until September 25.

4. The Greasy Cutworm

(*Agrotis ypsilon*).

This worm measures 1.50 to 1.60 inch in length when outstretched. Its general color is dull gray or brown, sometimes approaching black. Markings not decided, but commonly a couple of obscure, pale lines are apparent on the sides just above the breathing pores. Head brown, darker above. The adult moth is represented at G in the plate, enlarged about one-sixth. The worms appear in May and continue until the latter part of June (June 21 is my latest date), when the last of them go into the ground. The adults have been observed at Lexington from June 25 until September 23. Freshly emerged adults have been noted as common on June 29; on July 12 I have recorded them as very common; from this on they become less abundant, but are frequent among the moths which enter dwellings as late as September 1.

This cutworm is especially destructive in Kentucky to newly set tobacco plants and to corn. It has been observed cutting off young tomato plants in other States.

5. The Variegated Cutworm

(*Peridroma saucia*).

Length of fully grown worm about 1.50 inch. General color dull sooty brown, mottled with gray; a series of yellow spots along the middle of the back; a black blotch on the next to the last segment of the body; a series of crescent-shaped black marks along the sides at the breathing pores, and beneath the pores a yellow stripe. The moth is of about the same size as that of the greasy cutworm. It is shown at F in the plate, enlarged one-sixth. It is a very variable species, and in addition to the form represented in the plate another one with a yellowish brown shade along the front margin of the fore wings, is common.

The worms are active during April and May, then go into the ground during the early part of June, and begin to come out as moths about the middle of the latter month. Freshly emerged examples are common during the latter part of June, and examples continue to be frequent from this month until fall. My latest recorded capture at Lexington was taken October 25. The species passes the winter as an adult, in part at least.

The worms are very indiscriminate feeders, attacking among other things corn, clover, timothy, strawberries, tomatoes and sweet potatoes.

6. The Green Cutworm

(*Peridroma incivis*).

This is a green worm about 1.25 inch long, with a white stripe along each side of the body. It was observed to be common last spring at Bowling Green by Miss Sadie F. Price. I have not encountered the worm at Lexington, but the adult moth is common, occurring from June 9 to September 9. Prof. G. H. French, of Illinois, secured the worms in August and September, and a moth from one of them emerged on October 8. The species thus appears to be double brooded. The moth itself is of an ash-gray color, with velvety collar and a dark purple area along the outer ends of the front wings.

7. The Spotted Cutworm

(*Noctua bicarnea*).

Length of fully grown worm 1.25 inch. Dark gray, with two series of black spots on the back, wanting on the three first divisions, gradually larger toward the hind end of the body. The usual network of lines on the sides of the head is very distinct. The winter is spent in the worm state and the moths begin to come from the ground in May. From these moths a second brood of worms appears in July. At Lexington moths may be

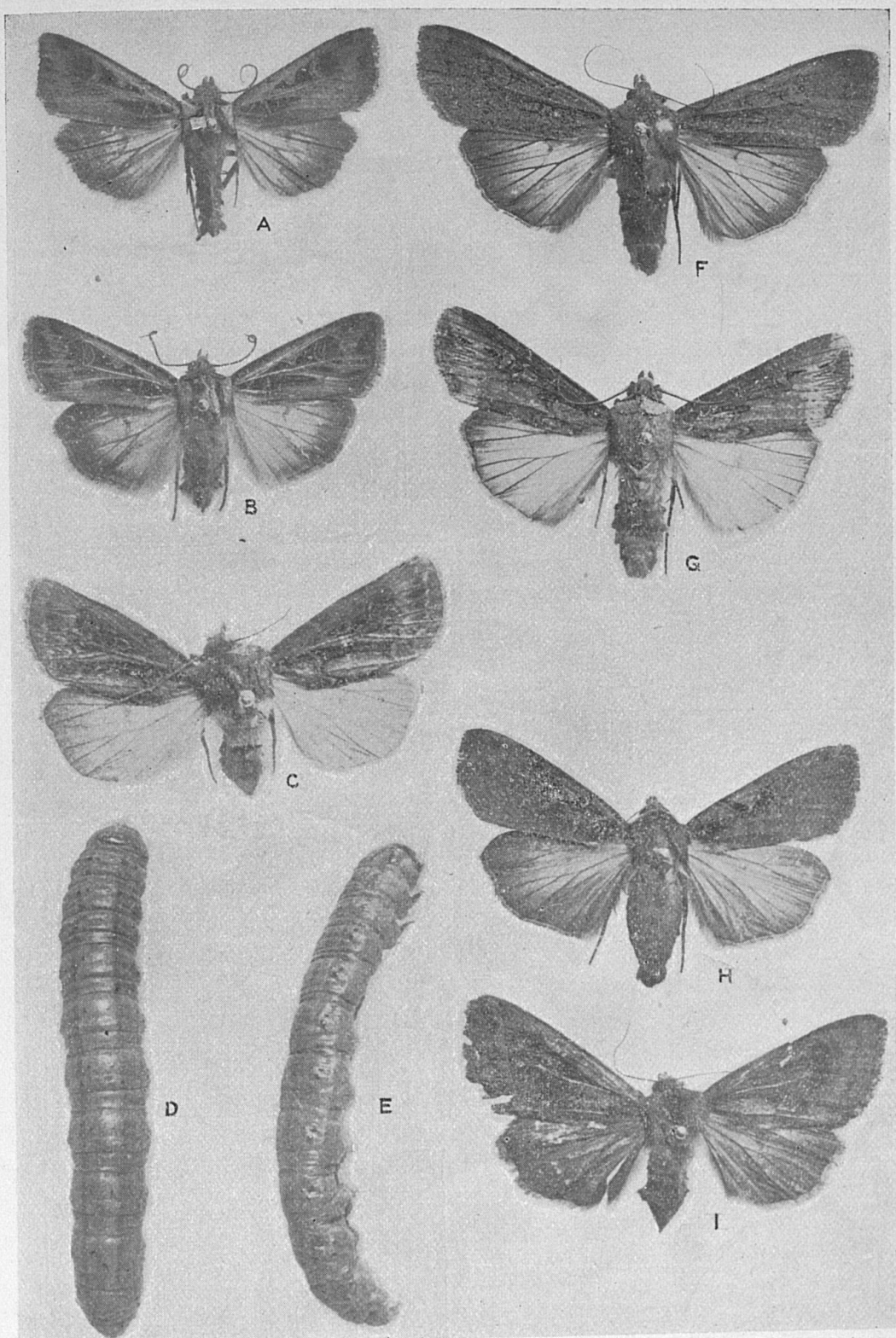
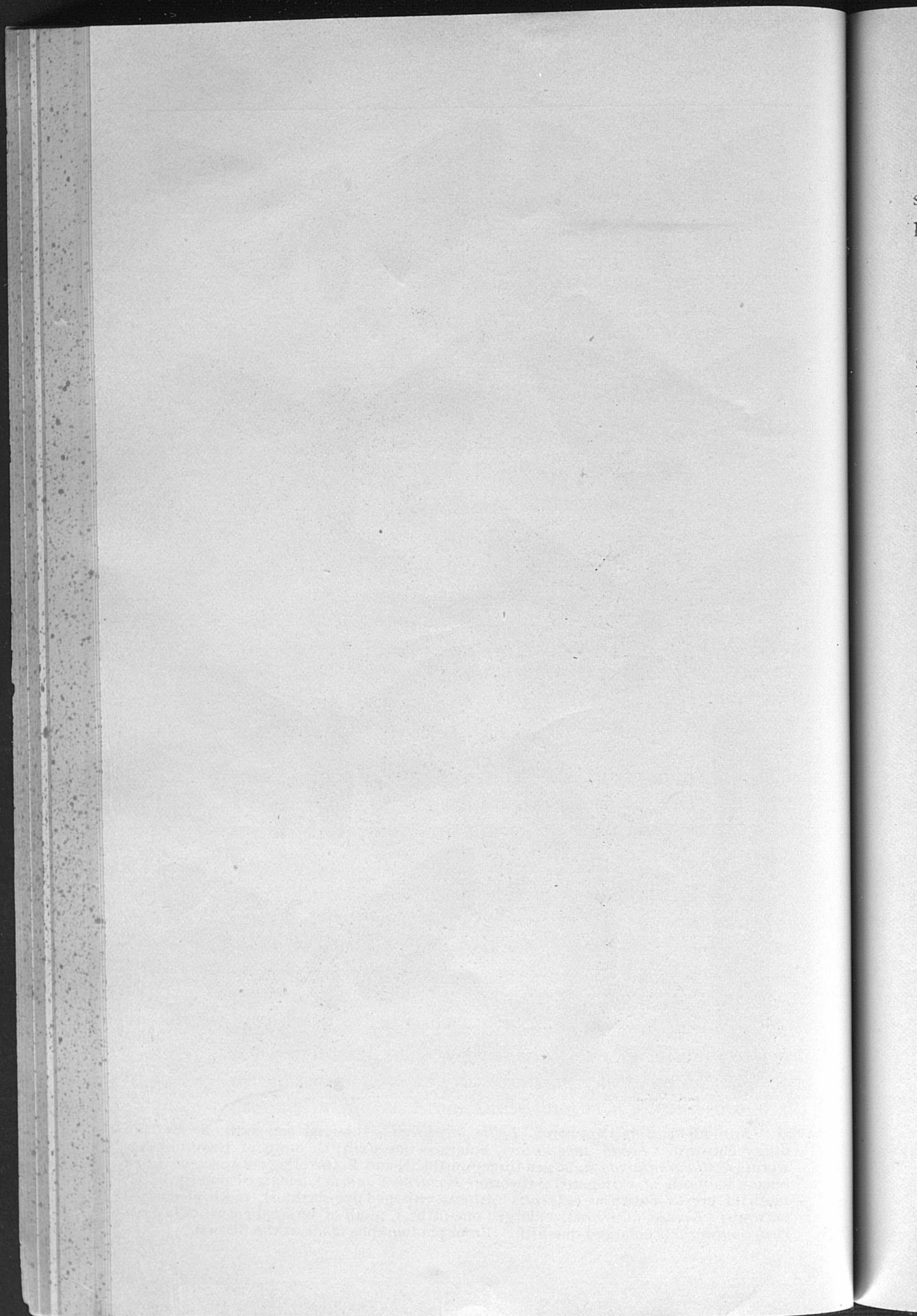


PLATE 1.—A, moth of dingy cutworm (*Feltia jaculifera*), enlarged one-sixth; B, moth of dingy cutworm (*Feltia subgothica*), enlarged one-sixth; C, moth of traveling cutworm (*Feltia gladiaria*), enlarged three-fourths; D and E, traveling cutworm, enlarged once; F, moth of variegated cutworm (*Peridroma saucia*), enlarged one-sixth; G, moth of greasy cutworm (*Agrotis ypsilon*), enlarged one-sixth; H, moth of spotted cutworm (*Noctua bicarnea*), enlarged one-fifth; I, moth of bronzed cutworm (*Nephelodes minians*), enlarged one-fifth. From photographs made at the Station.



seen until September. The moth is shown at H in the plate, enlarged one-fifth.

8. The W-marked Cutworm

(*Noctua clandestina*).

Length of grown worm about 1.15 inch. Color gray, speckled and mottled with dusky. Marked with four rows of black spots, the outermost row of each side along the row of breathing pores. The two series on the back have been represented as giving the appearance of a letter W on each segment, hence the common name; but the resemblance is not always evident. The worms appear very early in spring and soon go into the ground for pupation. They are abroad during April and May, and the moths appear in June. The only examples of the species which have come to my notice are two worms sent to the Station by Mr D. S. Dickinson, of Todd county, captured April 23 with other cutworms taken among corn, clover and tobacco. The species is said by Dr. C. V. Riley to feed on cabbage, beans, buckwheat young pumpkin plants, and other succulent vegetation.

9. The Granulated Cutworm

(*Feltia annexa*).

This is a common species in Kentucky, the moths being very often attracted to sweets at night. The worm has not thus far been encountered here, but is known to have the cutworm characteristic of eating almost any vegetation. It is especially fond of knot-weed. Professor G. H. French has given a full account of its stages in the Canadian Entomologist (Vol. 14, p 207). The following characters are taken from his description of the fully grown cutworm: Length 1.35 inch. Color above to near the breathing pores blackish gray, with a yellowish drab oblique mark on each segment, each mark broadest behind and mottled a little with the ground color. A

line just beneath the row of breathing pores on the side pale gray, slightly yellowish. Head pale greenish gray, slightly brownish on some, more or less drab brown on the cheeks, this mottled outside. Beneath pale greenish gray. I have observed the moths as early as June 29 at Lexington. By the 12th of July they are frequent, and continue abroad until September 1. The moths reared by Professor French came forth in October. The species is thus two brooded.

10. The Bristly Cutworm

(*Mamestra renigera*).

This is a small cutworm, measuring only about an inch in length. Its general color is yellowish gray. Along each side is a distinct black stripe, tapering at each end. The common name has reference to rather stiff black and yellow bristles, which are scattered over the body. The moth is dark brown, with some touches of white, gray, and green on the fore wings, together with a more or less conspicuous black spot. The wings expand only a trifle over an inch. The worms are found in gardens and pastures. Two broods appear annually, one in early spring, the other towards fall. The adult moths have been observed at Lexington from April 4 to June 29, and again from August 8 until September 24.

11. The Glassy Cutworm

(*Xylophasia devastatrix*).

As the name signifies this cutworm is of a translucent whitish color. It lacks all evident markings, except a bluish line along the back. Head red. I have not thus far found this species common in Kentucky. In States further north it is sometimes very destructive in corn land recently in sod. An example taken by me November 25, 1889, emerged as an adult during the following April.

12. The Bronzed Cutworm

(*Nephelodes minians*).

Among the cutworms found about cultivated lands one sometimes encounters a rather large striped species measuring about 1.75 inch in length. The stripes are seven in number on each side, four wide brown ones, and alternating with these three narrower yellow stripes. The head is yellowish gray. It is very fond of blue grass, but feeds also on corn and knot-weed. A single brood appears each year, the winter being spent as worms, and the moths coming out mostly in the late fall, when they sometimes enter dwellings at night, attracted by the light. My dates of capture are August 13, September 1-23. The moth is shown at I in the plate, enlarged one-fifth.

Cutworms in General.

Here are twelve distinct species of cutworms occurring in Kentucky. There are others that could be added to the list. Some are one-brooded, others two-brooded, and altogether it would seem that there was no crop exempt and no time of the year when one cutworm species or another was not engaged in its destructive work. But most of them are noticeably active only in the spring, and they are noticeable then chiefly because of their injuries to newly set plants and young growths. The later broods, when such occur, find an abundance of food everywhere. Garden truck is too far advanced to be checked perceptibly by them. If we can prevent the injuries of the early spring brood, therefore, we need not ordinarily concern ourselves about cutworms the rest of the summer.

The eggs of the majority of our cutworms are placed by the moths among grasses or weeds, sometimes on trees, in the fall. The young worms which hatch at this time must have food, and the moths will not place their eggs on land that does not provide this for them. This

fact explains why corn planted on sod land is generally badly injured by cutworms the first spring. By plowing under the grass the worms present in the field are deprived of their natural food, and are forced to feed upon the corn. The fact explains also the reason why cutworms are often worst along the edges of gardens. The young worms fed the preceding fall on a neglected strip along the fence, or, it may be, came into the garden from an adjoining meadow or pasture, where the moths placed the eggs the preceding fall.

Remedial Treatment.

Early fall plowing to destroy growths of grass or weeds likely to harbor cutworms during the winter is a lesson taught by the above facts in the life-history of these insects. Fire, too, can sometimes be employed in burning over land that is to be cultivated. All grasses along fences should be destroyed in the fall, winter, or early spring, but preferably in the fall, when cutworm injury threatens. By so doing the young are deprived of food and must either starve or go elsewhere. In the fields already in cultivation it is necessary in cutworm years to keep down all volunteer vegetation, both before the crop is planted and afterward. Clean culture will do much to guard against injuries. The worms invade an unkempt garden by preference. Scattered boards, bricks, stones and other rubbish afford them lurking places. These should be removed.

Enclosing the plants with paper or tin.—One of their most annoying habits is that of cutting off newly set plants. For thirty years or more intelligent gardeners have employed cylinders of stiff brown paper placed about newly set cabbage or tomato plants as a means of keeping the worms from them. The cutworms are unable to climb up a smooth, vertical surface, and consequently a cylinder of paper about a plant with loose earth drawn up about its lower edge so that the worms cannot

creep under is an effective protection so long as it is not wet from rain, and can often be made to keep the worms away until the enclosed plant is too large to be injured. Cylinders of tin about 5 or 6 inches high can be used in the same way, and while costing something at the beginning, can be put away when the cutworm season is past, for use another season. Some one has suggested that such cylinders may be made of strips of tin with the two ends folded so that they will hook into each other when brought together.

Small apple and other fruit trees are sometimes injured by what are known as climbing cutworms, which ascend the trunks by taking advantage of the roughness of the bark, and eat the buds. A tin cylinder secured about the trunk of a tree has been found an effective protection against such species. I have not thus far witnessed injury of this sort in Kentucky, but it has been observed in adjoining States and is liable to occur here.

The use of poisoned bait.—Precautionary measures, such as fall plowing, clean culture, removal of rubbish, and the like, are always to be employed in dealing with cutworms if possible. But where the worms are in the soil before their presence is recognized the only thing to do is to employ the cylinders, take them from about plants each morning by hand, or else to use bait that will destroy them. Professor C. V. Riley some years ago, in one of his reports as United States Entomologist, suggested the use of Paris green on bundles of clover or other plants relished by cutworms placed at intervals among newly set plants. Bundles about as large as one's fist are dipped into Paris green water (a table spoonful of Paris green in a bucket full of water) and placed about the infested land in the evening. The worms feeding upon this bait may not be killed at once, but it requires very little to make them so sick that they will not eat other vegetation, and probably none of those eating the poison become mature. This fact is to be borne in mind

in testing the remedy. I have sometimes heard it stated that worms which fed upon weak mixtures of Paris green were not killed, and the inference was drawn that such mixtures were useless. Worms may remain alive for several days after eating leaves poisoned with the mixture used for ordinary spraying (1 pound to 160 gallons of water), but I find by experiment with the tobacco-worm that such worms take very little or no food, and finally die. A small worm is more quickly killed than a large one.

I make these statements in the interest of a fair test of this remedy by gardeners. Because some cutworms found about the poisoned bundles are alive is not good evidence that the bundles are not doing their work.

It is claimed on first-class authority that land can be cleared of cutworms before the crop is up by employing these poisoned bundles.

Cutworm Diseases.

Like the chinch-bug the cutworms are subject to diseases which appear to be caused by attacks of bacteria and other parasitic fungi. A good many of the cutworms sent me from Bowling Green last spring were affected in this way, and so many of them died that it was difficult to get adults from some of my breeding jars. Those affected with the trouble would often go into the ground as if to change to pupæ, but instead died, became flaccid and discolored, and when recently dead were filled with a clear yellowish fluid, in which were large numbers of bacilli,* some of them in active motion.

*For the economic entomologist I will add that these bacteria stain solidly in gentian violet; are oval in shape, and were seen only in couples. A drop of fluid obtained from the mouth of a sick worm contained many bacteria of several kinds, some in long rods, others shorter and in couples; also a great many micrococci. In the blood of this worm, obtained by snipping off a proleg with sharp scissors, I could find no bacteria, from which I infer that those found in the fluids of dead worms came primarily from the alimentary canal.

On May 25, 1895, in a lot of cutworms sent me by President Johnson of the Horticultural Society I found an example dead and rigid, with scattered white powdery masses of various sizes scattered over it. At this time these pustular masses were white, but by May 28 most of them had become sage-green and were so thickly placed as to cover most of the body. These growths had at first exactly the appearance of the fungus used in Illinois and Kansas for the destruction of the chinch-bug. With a view to learning if this was a parasite of the cutworm and could be made to destroy healthy worms I prepared on May 28 three jars with earth in the bottom, and put six worms obtained at Lexington in each, then cut in two the dead worm on which the fungus appeared and put a part in each of two jars leaving the third without. The following are the records made on these lots:

1. Treated lot. May 29, one worm dead and flaccid. May 30, remainder alive. June 3, remainder alive. June 11, two worms dead and showing same fungus growth as one used for infecting. June 19, remainder dead and with fungus growth on body.

2. Treated lot. May 29, all alive. June 3, all alive. July 11, three worms dead of the fungus disease. June 19, all the remainder dead of same disease.*

3. Not treated. May 29, one dead (no fungus growth). May 30, remainder alive. June 3, all remainder alive, some preparing to change to pupæ. June 11, one pupa formed and one worm dead of the fungus disease. June 19, remainder alive. August 30, two adult moths emerged (*Feltia jaculifera*). September 22, an adult moth emerged this morning (*Feltia gladiaria*). October 1, an adult of *Feltia gladiaria* out to to-day.

*These worms were left on the earth of the jar until July 31, when they were covered with a profuse white growth having every appearance of being the same as that used for chinch-bugs. Spores taken from the sage-green growth that appeared first were elongated, just a trifle constricted at the middle. The spores of the later growth were small and round, agreeing in size (.004 mm. or a trifle less) and shape with the fungus described as *Sporotrichum globuliferum*.

The above test indicates that the disease is communicable, and if this is true we may yet be able to employ the fungus in destroying cutworms out of doors. It will be observed that one of the worms of the untreated lot showed the fungus growth on June 11, from which it appears probable that the disease was widespread and that this worm was affected at the time it was put into the jar.

From the large proportion of cutworms that failed to complete their changes last spring it is probable that they will be less abundant in the spring of 1896. But if they are again troublesome the Station is prepared to furnish to those applying, packages of *Sporotrichum* with which to make a field test. Those wishing to make a trial of the fungus must agree to follow directions given them and report results to the Station.

Cutworm Enemies.

Birds, chickens, turkeys and pigs are very fond of cutworms and may under some circumstances be utilized for their destruction. The common bluebird is known to have a special fondness for them, and is with us during February, March and April. When cutworms are abroad it will do us valuable service in field and garden if left unmolested. Actual examination of the contents of the stomachs of ten bluebirds shot during February showed that 30 per cent. of the food consisted of cutworms during this month. During March also its food has been found to contain a large percentage of these insects.*

Of insect enemies the cutworms have many. Some of them are small, four-winged flies which, in the grub

*When farmers generally are aware of the very great value of our native birds as checks upon injurious insects they will see to it that laws are passed, and afterward enforced, prohibiting shooting them or destroying their nests. There has been a marked decrease in the numbers of birds in the Middle States in the past twenty years, and at the same rate of diminution some of our most valuable insect eating species will disappear in some sections during the next two decades. It falls to the agriculturist to check their destruction if possible.

state, live in their bodies. But parasites of this sort are not so useful for cutworms as for insects which live exposed during the day. Prof. Lawrence Bruner, of Nebraska, has, however, observed a fly (one of the two-winged sort) placing its eggs in large numbers on the granulated cutworm, which during 1889 was in his State so abundant that it came from its retreats to feed during the day, when clouds obscured the sunlight.

The True Army-Worm

(Leucania unipuncta).

In order that the army-worm may be recognized when it appears again in the State, I give below a brief account of it. It is a member of the same family as the cutworms.

The worm is of a dull clay color, with distinct dusky stripes. The back is very finely mottled with black, the mottling so close as to form a dusky median stripe, divided on the first three segments behind the head. A dark stripe on upper part of side and another wider one along the breathing pores, the front pores being included in it, and those towards the rear situated at its lower edge. Fleshy legs of the middle of the body, with a dark spot outside. Body pale beneath. Head with fine network of brown lines, and two stripes on the front which nearly meet above, and then diverge to the back of the head.

These worms occur every season on grasses in meadows, and are especially common among neglected blue-grass on low ground. On the experiment farm they occur each year on volunteer English blue-grass along the fences. They form armies only when very common, and ordinarily live like cutworms, hidden about the roots of grasses during the day and coming up to feed at night. The winter is spent in the worm stage. The most mischief is done by the brood which begins to appear in June.

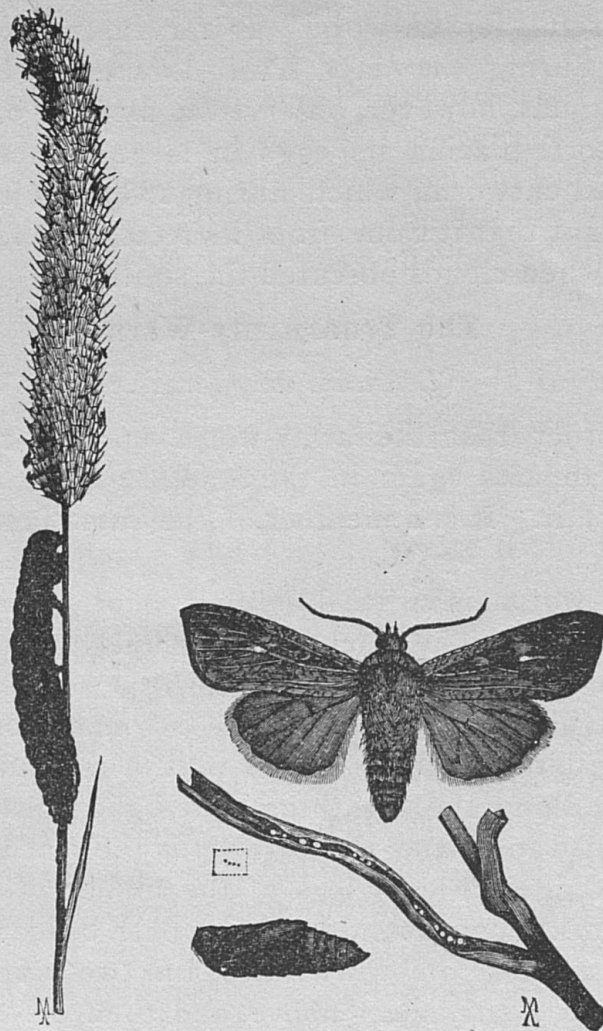


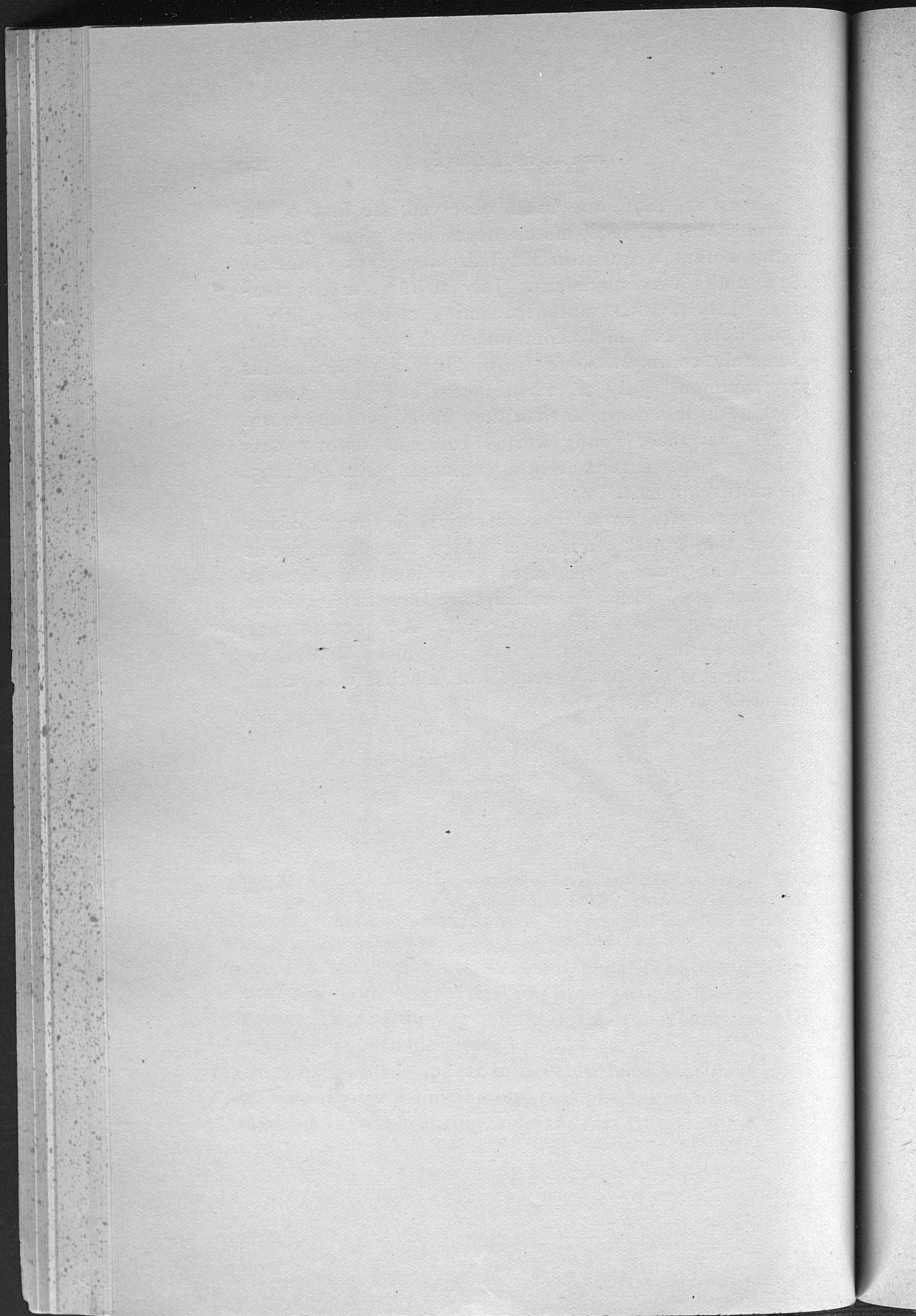
Fig. 1. Showing worm, pupa, moth and eggs of the army-worm. The eggs are represented as attached to grass. Their size is shown by dots in the small square. Figures are of natural size.

The moth is common about electric lights in summer and frequently enters dwellings, where it does not attract the attention it might if its true character and capacity for mischief were known.

Three broods appear to develop here yearly, as may be seen by the following observations taken from notes made at intervals during several years.

April 17, 1891, one moth observed, the first of the season. May 24, 1890, moths occasional. June 2, 1892, young worms frequent in English blue-grass. June 29, 1892, moths very abundant. July 1, 1891, moths common. July 4, 1890, moths becoming common. July 5, 1890, moths extremely common, fresh. July 10, 1891, extremely common, some fresh. July 25, 1890, moths very common. July 28, 1889, moths at light. Aug. 5, 1891, moths less common than they have been, and worn. August 14, 1889, young worms common among oats stubble. Sep. 1, 1892, moths common. Oct. 26, 1895, one moth captured.

The remedy for army-worm injury is the use of fire during the winter on land on which the worms are at work. One piece of neglected grass land on a farm is generally the center in which they develop and from which they spread to adjoining crops. An acquaintance with the worm, so that it can be recognized in time to apply the remedy, would seem to be all that is required in dealing with this pest.



KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 59.

SPRAYING EXPERIMENTS IN 1895.

LEXINGTON, KENTUCKY,
DECEMBER, 1895.

KENTUCKY

Agricultural Experiment Station.

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KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

BULLETIN NO. 59.

EXPERIMENTS FOR CHECKING APPLE ROT AND CODLING MOTH, IN 1895.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

The experiments reported in this bulletin continue tests made during former seasons with a view of finding a practicable remedy for the rotting of apples on the trees and for the injuries inflicted by the codling moth. The insect it is known can be kept from the fruit to a considerable extent by the use of Paris green; and it has been shown in earlier bulletins from the Station that copper sulphate and lime with water sprayed upon leaves and fruit diminishes the number of rotting apples and renders the final yield of better quality. It is desirable that both purposes be accomplished at the same time, with the same machinery and labor. It is desirable also that the best time for applying the preparations and the number and strength of applications requisite to their most effective and economical employment be more exactly determined. With these objects in mind ten apple trees were kept under observation during the summer of 1895, five of which were sprayed and the remainder reserved for comparison. As in preceding experiments of this sort, the trees employed were paired, a treated tree and a check, a pair consisting of two trees of the same variety

and as nearly alike in size as it was possible to select. The results of the examination and comparison of the trees of each pair will be first presented, and general results and conclusions will follow.

I used this year 32—33 gallons of water in the Bordeaux mixture, instead of 22, the proportions of the ingredients being as follows:

Bluestone, $6\frac{1}{2}$ lbs.

Fresh lime, $3\frac{1}{2}$ lbs.

Water, 32—33 gallons.

This change was made to avoid the delays sometimes occasioned by the clogging of nozzles or pumps when the proportion of solid matter is greater.

Experiment 501.

This is a tree of moderate size, which has been sprayed in previous experiments. The old shriveled apples clinging to the twigs were removed before the leaves were out, on April 4, 1895. The subsequent treatment for the season was the following:

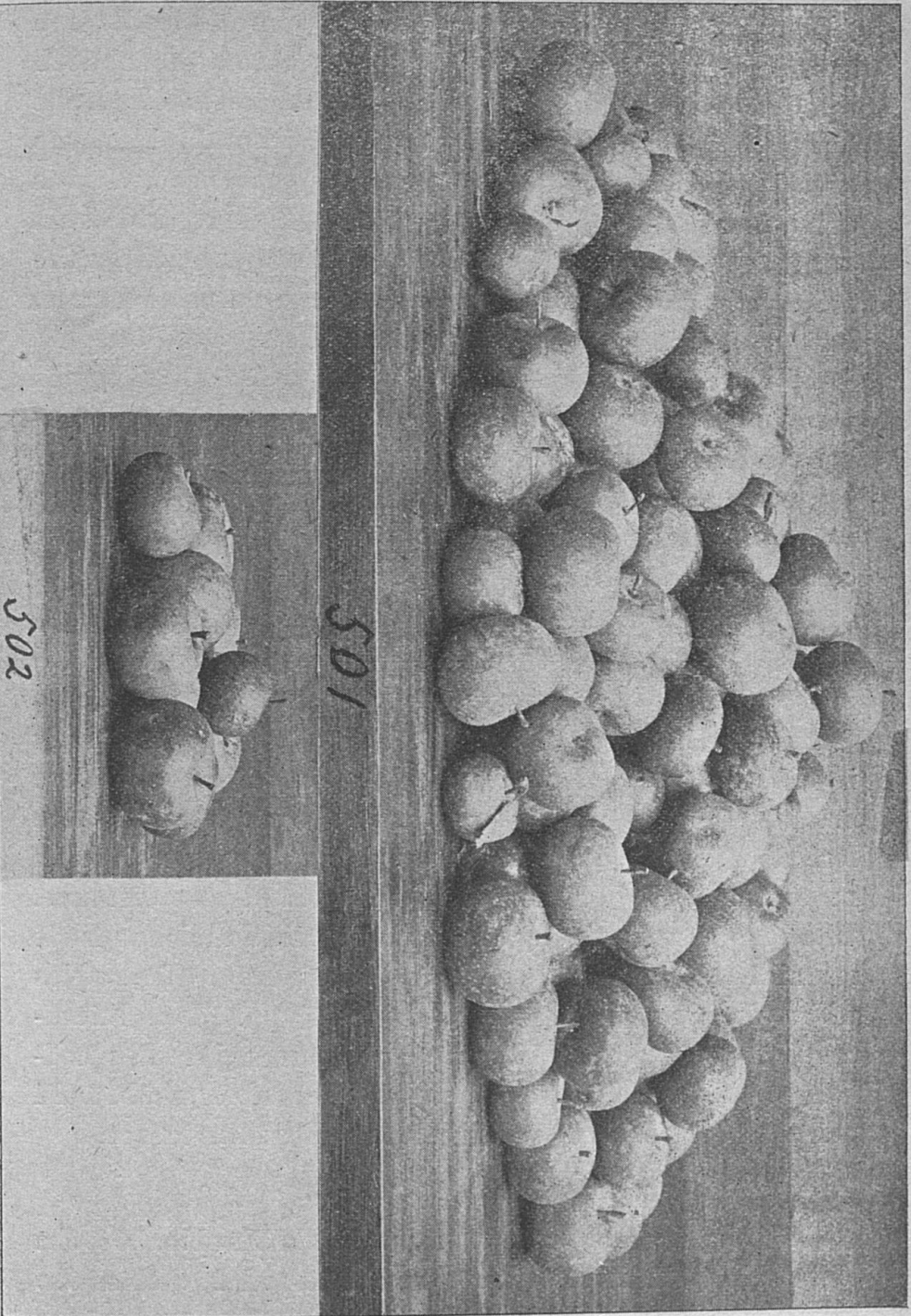
April 4. Sprayed the twigs and branches with Bordeaux mixture, using 4 gallons.

May 6. Sprayed leaves and young fruit with Bordeaux mixture, to which was added Paris green, $\frac{1}{4}$ lb. to each 40 gallons of water, or 3.2 ounces for 32 gallons of the mixture.

May 8. A heavy rain set in immediately after the spraying of May 6 and washed most of the mixture from the trees, hence it was decided to spray again with the same mixture, of which $3\frac{1}{2}$ gallons were used.

May 29. Four gallons of the Bordeaux mixture, containing Paris green, were sprayed upon the tree.

July 12. Sprayed $3\frac{1}{2}$ gallons of Bordeaux mixture on tree, the mixture this time containing $\frac{1}{4}$ pound of Paris green in 33 gallons.



501

502

501.—Apples picked from sprayed tree. Weight 26½ pounds.
502.—Apples picked from cheek tree. Weight 1½ pound.

The tree was in better condition as respects its leafage throughout the summer than its check, number 502. The leaves were larger, more abundant, and showed but few of the brown spots which were so abundant on the check tree as to give it an unsightly appearance. It was examined with special reference to its leafage and fruit June 8, and again August 6. On the former occasion the fruit averaged about the same in size on the two trees, but on the latter date was larger on the sprayed tree.

The apples were picked on September 19. The apples which were not rotting weighed $26\frac{1}{2}$ pounds and numbered 229; 30 (13 per cent.) of this number were injured by codling moth. 208 of the apples taken from the tree showed more or less trace of rot, and of these 128 (61 per cent.) showed codling moth injury.

Experiment 502

(CHECK ON 501).

The tree is larger than 502. The leaves were badly injured by the spot disease already mentioned and were smaller than those of the sprayed tree. The foliage looked thin, the branches being clearly perceptible in many places when the tree was viewed at a distance. The rot was very destructive to the fruit, and but little remained September 19, the time of picking. The apples which were not rotting weighed just $1\frac{1}{2}$ pound and numbered 10, of which 7 (70 per cent.) were injured by codling moth. The rotting apples numbered 19, and 16 (84 per cent.) of these showed the burrows of the insect.

Experiment 503.

This was a russet tree. It was treated like No. 501, the old shriveled fruit being removed on April 4, before the leaves were out. The treatment during the season was as follows:

April 4. Four gallons of Bordeaux mixture were applied to the naked branches.

May 6. Sprayed with Bordeaux mixture and Paris green, but a rain came on immediately after the application was made and made necessary another spraying which was accomplished on the following date.

May 8. Applied four gallons of Bordeaux mixture and Paris green.

July 12. Applied $3\frac{1}{2}$ gallons of Bordeaux mixture containing Paris green in proportion of $\frac{1}{4}$ pound to 33 gallons of fluid.

The tree was examined carefully on June 8, when it was noted as looking well, with large leaves, and sound apples about one inch in diameter. When examined again on August 6, it was found to be in excellent condition, with a fine load of fruit, mostly sound, the leaves almost entirely free from spot disease.

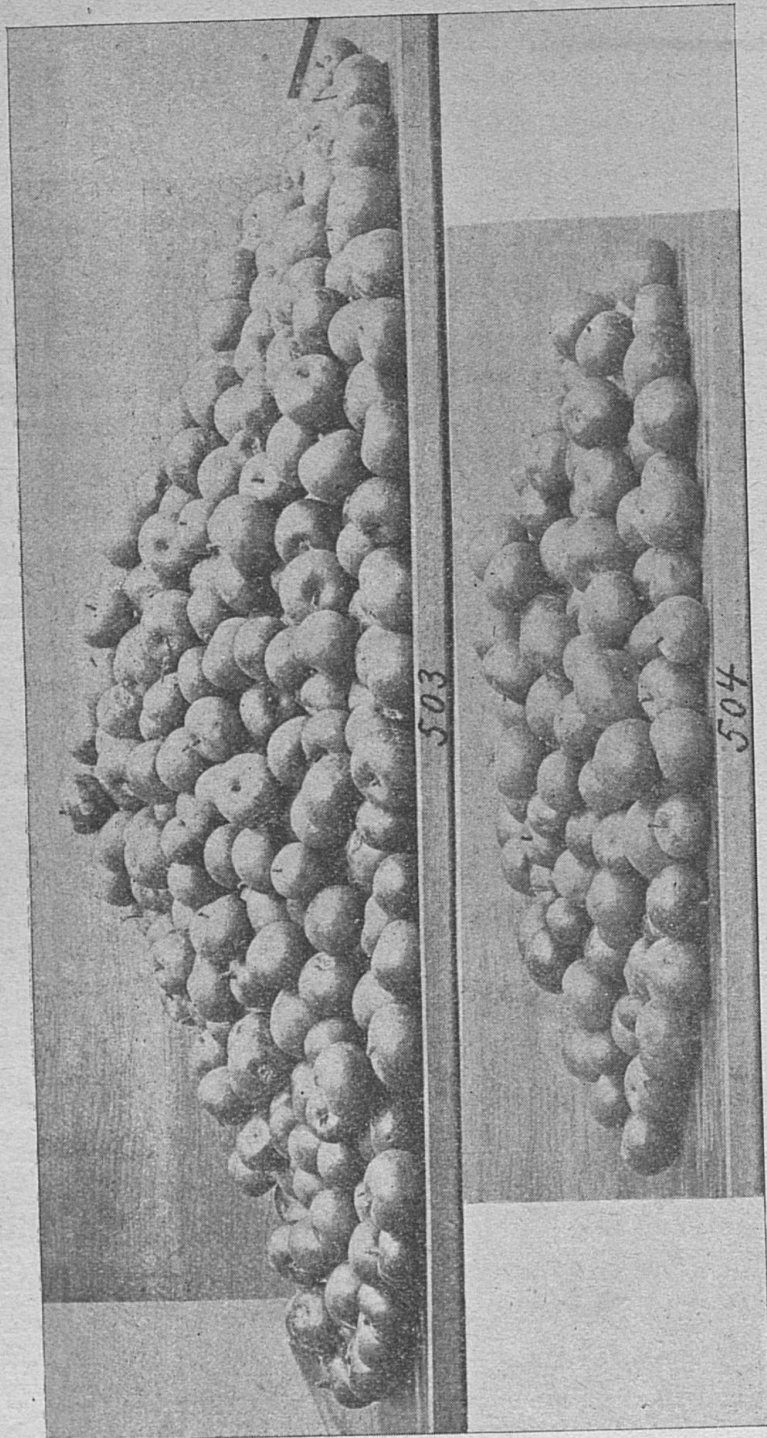
The weight of the apples, which were not rotting taken from this tree September 21 was 88 pounds; the number of these apples was 876, of which 144 (16 per cent.) were injured by codling moth.

The rotting apples numbered 236, of which 115 (49 per cent) were injured by the insect.

Experiment 504

(CHECK ON 503).

In size and shape this russet tree was almost identical with the sprayed tree, and stood next to it in the same row. When examined June 8 its fruit averaged about the same in size, and the quantity was as far as could be judged about the same. Its leaves were smaller and much spotted. The crop of fruit was noted again on August 6 as fair, but with some evidence of the presence of codling moth. The leaves were badly marred by the spot disease.



503.—Apples picked from sprayed tree. Weight 88 pounds.
504.—Apples picked from check tree. Weight 31 pounds.

The picked apples not rotting taken from the tree September 20 numbered 276 and weighed 31 pounds; 110 (39 per cent.) showed the mines of the codling moth. The rotting apples taken from the tree at the same time numbered 109, and 71 (65 per cent.) were injured.

Experiment 505.

This is a Ben Davis of medium size, a very thrifty tree in appearance, a trifle smaller than its check. Its treatment was about the same as that of trees already mentioned.

April 4. It received $3\frac{1}{2}$ gallons of Bordeaux mixture. The leaves were not yet out.

May 6. It was sprayed with the combination of Bordeaux mixture and Paris green, but because of rain following immediately after was, like the others, sprayed again on the following date.

May 8. The tree received $3\frac{1}{2}$ gallons of the mixture.

May 29. Sprayed 4 gallons of the mixture on the leaves.

July 12. Used in spraying $3\frac{1}{2}$ gallons of the mixture, the Paris green being this time in the proportion of one-fourth pound in 33 gallons.

1351 apples, not rotting, and weighing 135 pounds, were picked from the tree September 20; 248 (18 per cent.) were mined by codling moth. Of rotting apples 335 were taken from the tree, and 130 (39 per cent.) of these were injured.

Experiment 506

(CHECK ON 505).

This Ben Davis tree was much like the other in appearance, a very thrifty tree. It bore more apples than the sprayed tree, but lost most of them before picking time. During the fore part of the season its leaves and

fruit remained in better condition than that of other unsprayed trees and I thought the fruit looked better for a time than that of its sprayed companion. On June 8 its leaves were unspotted and its apples sound. By August 8 the leaves showed some brown spots, and these became so abundant and large at a later date as to give the foliage a draggled appearance.

The fruit continued to look well until August 8, when the branches were bending with the load they carried. The fruit fell from the tree largely from the middle of August until the middle of September, when we experienced at Lexington an excessive drought.

The picked apples, which showed no rot, taken from the tree on September 19, weighed 43 pounds and numbered 416. 201 (48 per cent.) of these had been attacked by codling moth. The rotting apples numbered 117, of which 75 (64 per cent.) were injured.

Experiment 507.

This is a small Janet tree that was used for experiment in 1894. The old dried fruit was removed April 4, at which time the naked branches received the first application. The following is the treatment for the season.

April 4. 3 gallons of Bordeaux mixture were applied.

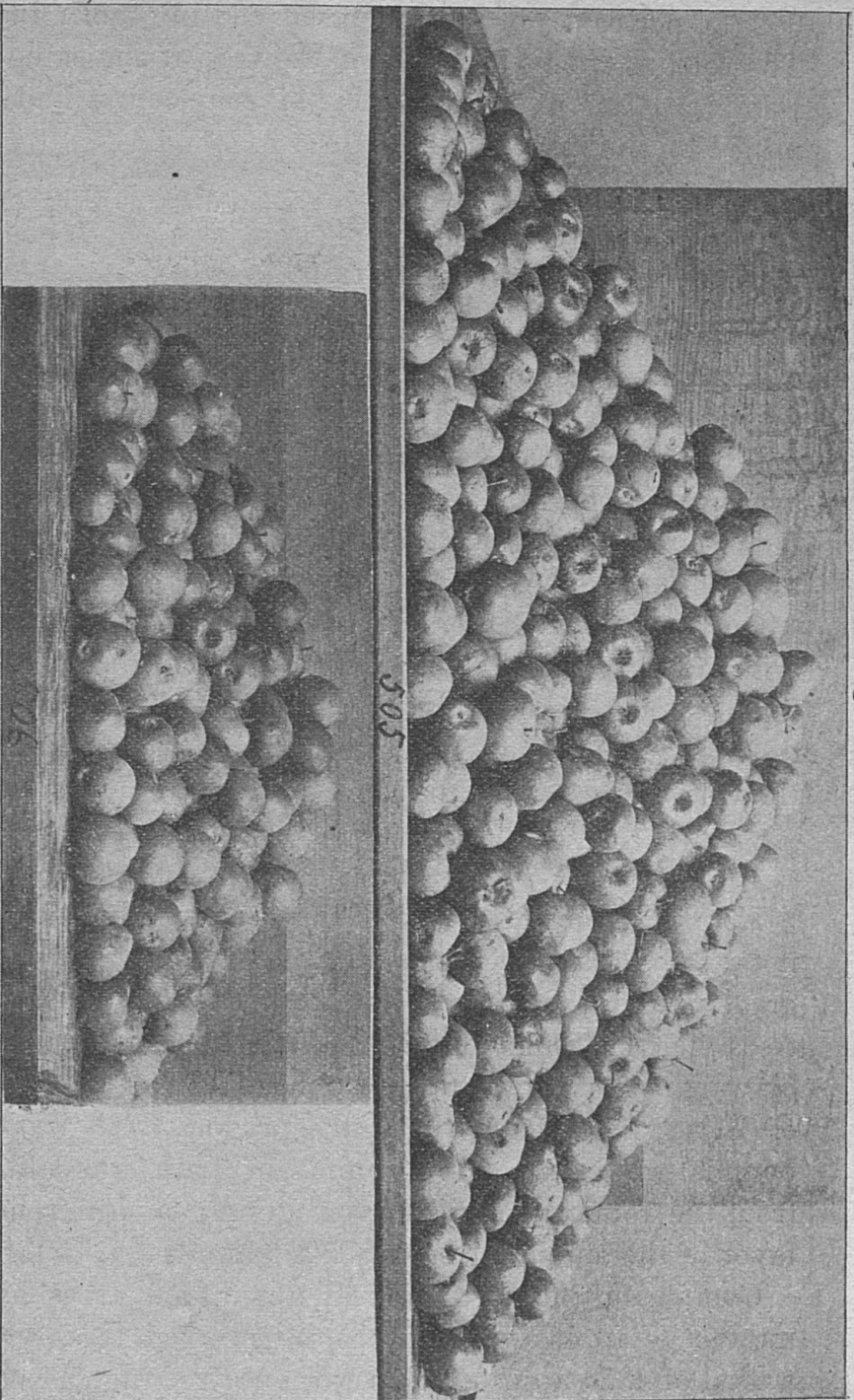
May 8. $3\frac{1}{2}$ gallons of Bordeaux mixture and Paris green combination were applied to the leaves and young fruit.

May 29. 3 gallons of the same combination were used on the tree.

July 12. $3\frac{1}{2}$ gallons of the mixture were used with the Paris green in the proportion of one-fourth pound to 33 gallons of fluid.

The leaves were almost entirely free from the spot disease and were of larger size than those of the check tree.

The apples which were not rotting taken from the tree September 21, numbered 1870 and weighed $218\frac{1}{4}$ pounds ;



505.—Apples picked from sprayed tree. Weight 135 pounds.
506.—Apples picked from check tree. Weight 43 pounds.

642 (34 per cent.) of them showed codling moth injury. The rotting apples taken from the tree at the same time numbered 727 of which 320 (44 per cent.) had been mined by the insect.

Experiment 508

(CHECK IN 507).

The check tree of this pair showed the same defects as others that were not sprayed. The noticeable difference during the early part of the season was the smaller size and badly spotted leaves and towards the last the smaller average size of the apples. It dropped its fruit also much more freely than the sprayed tree during August and September.

On the 21st of September the apples were picked, and only 350, weighing 40 pounds were obtained. 121 (24 per cent.) showed the work of the moth. 424 rotting apples, including 279 (63 per cent.) wormy ones were taken from the tree at the same time.

Summary of Experiments 501--508.

It will have been observed that the weight of apples not rotting taken from the sprayed trees is in every case greater than that from the check tree. The sprayed trees yielded from about 2.8 to 17.6 times as much fruit by weight as their unsprayed checks. The total weight of these apples from the four sprayed trees was $467\frac{3}{4}$ pounds, while only $115\frac{1}{2}$ pounds of fruit was obtained from the four unsprayed trees, giving a difference in favor of the sprayed trees of $352\frac{1}{4}$ pounds.

Comparing the sprayed and unsprayed trees by the number of apples we find that the sprayed trees yielded a total of 4326 apples, which were not rotting, as against a total of only 1052 from the check trees; that is to say

the sprayed trees yielded more than four times as many apples as the unsprayed checks.

When comparison is made with reference to the injury of codling moth it appears that in every case the percentage of injured apples is lower on the sprayed than on the unsprayed trees. The difference in this respect, however, between numbers 507 and 508 is so slight as not to be worth considering, these two trees showing a difference of only one-sixth of one per cent. in favor of spraying. The records for the remaining three trees show the codling-moth injury reduced 23, 30 and 57 per cent. respectively.

The influence of spraying in keeping the apples of all sorts from falling is shown by the fact that a total of 5832 apples were picked from the four sprayed trees as against 5082 which had fallen, while from the four check trees only 1721 apples were picked as against 5626 which had fallen.

The rotting of the fruit was not reduced as much as I expected, but still there was in every case a smaller percentage of rotting apples on the treated trees.

No. 501 yielded 437 apples, 208 ($47\frac{1}{2}$ per cent.) of which showed the rot.

No. 502, the check, yielded a total of 29, of which 19 ($65\frac{1}{2}$ per cent.) were rotting.

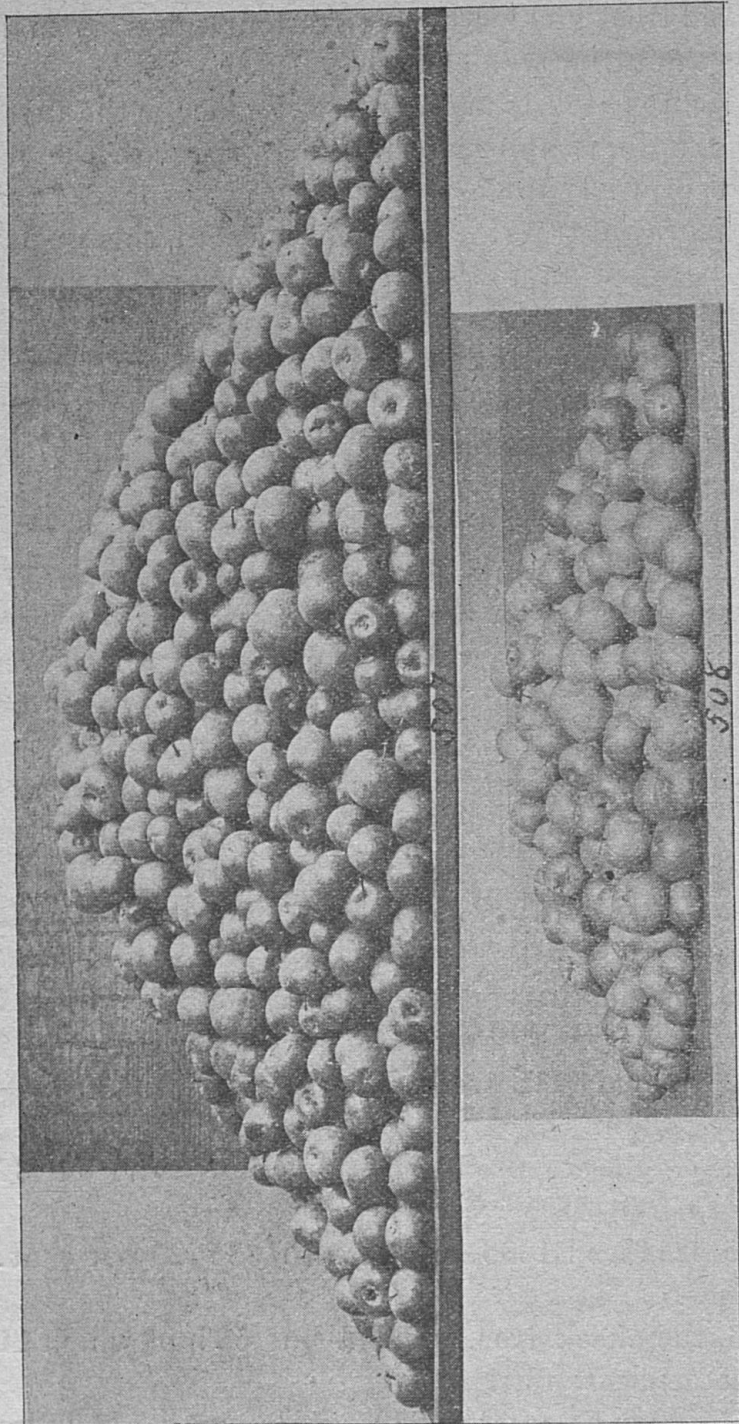
No. 503 yielded 1112 with 236 ($21\frac{1}{2}$ per cent.) rotting ones among them.

No. 504, its check, produced at picking time but 385 apples, with 109 (28 per cent.) rotting ones.

No. 505 produced 1686 apples, with 335 (20 per cent.) rotting ones.

No. 506, the check tree, yielded but 533, of which 117 (22 per cent.) were rotting.

No. 507 yielded a total of 2597 apples, with 727 (28 per cent.) rotting.



507.—Apples picked from sprayed tree. Weight 218½ pounds.

508.—Apples picked from check tree. Weight 40 pounds.

No. 508, the check on 507, produced, but 774 with 424 (55 per cent.) of these showing rot.

The number of apples which fall from a tree during the summer is astonishing to one who observes the matter closely. Of course a tree can only mature well a certain number of apples, depending on its size, condition, and to a great extent, I find, on the weather. Apple trees require an immense quantity of water, and a drought such as we experienced at Lexington during August and September, this year, weakens them to such an extent that the fruit is dropped with great rapidity. On August 23, last summer, I examined 955 apples which had fallen from a single unsprayed tree. The total number which fell from August 10 to September 19 from the tree was 1995, as against only 533 which remained to be picked.

Spraying can not be expected to counteract entirely the bad effects of such exceptional weather as then prevailed, but that it will do something is shown by the fact that the sprayed tree of the same pair yielded more picked fruit than had fallen from it during the summer, whereas its check lost more than three times as many as it retained.

The Use of Iron Sulphate in Place of Copper Sulphate for Apple Spraying.

Iron sulphate is much cheaper than copper sulphate, costing 3 cents per pound or less, according to the quantity purchased, to 8 cents per pound for the copper. It occurred to me that it might be substituted for the more costly substance if it could be applied to leaves so as to avoid its very caustic action on the latter. It was made up with lime and water in 1894 and used on several grape vines to settle this matter, and it was found that the lime used with it prevented injury to the leaves. This year I tested it on an apple tree, giving the tree

the same number of sprayings and about the same quantity of fluid as on those sprayed with Bordeaux mixture.

April 4. Four gallons of mixture, consisting of 6 pounds of iron sulphate, 3 pounds of lime and 22 gallons of water, were applied to the branches after removing the old dried up fruit.

May 8. Five gallons of the same mixture were applied to leaves and young fruit, together with Paris green in the proportion of one-fourth pound to 40 gallons of mixture.

May 29. Four gallons of same mixture used on May 8 were applied.

July 12. Used $4\frac{1}{2}$ gallons of mixture consisting of iron sulphate $6\frac{1}{2}$ pounds, lime $3\frac{1}{2}$ pounds, Paris green $\frac{1}{4}$ pound, water 33 gallons.

The condition of the two trees remained about the same throughout the summer, but the fruit of the check tree became marked with blackish spots which in some cases were so abundant as to cover much of the surface. It seems to be a form of scab*, but does not penetrate the cuticle of apples and does no readily perceptible injury beyond marring their looks. The sprayed fruit was entirely free from this trouble. The percentage of rotting apples on the sprayed tree was $59\frac{1}{2}$ as against 68 per cent. on the unsprayed tree. The apples injured by codling moth on the sprayed tree constituted 59 per cent. of

*The fungus causing this trouble has been described as *Spilocæa pomi*, but is now considered by Saccardo (*Sylloge Fungorum*, 4, p. 345) and other botanists as a form of the common scab fungus (*Fusicladium dendriticum*). The latter was scarce last summer on trees of all sorts, and although these trees have been at times badly infested with it none was then observed on their fruit. The form above mentioned, on the contrary, was common on light colored varieties, such as janets and greenings. Greenings seem especially subject to it, as I find by recent examination of apples brought to our market from the north. I am inclined to think the iron will prove useful in checking both forms of the fungus.

those examined, while 75 per cent. of the apples from the unsprayed tree had been attacked.

The sprayed tree yielded at picking time only 155 pounds of apples which were not rotting, while the unsprayed tree yielded 413½ pounds, nearly three times as many, a difference due in part at least to the fact that the unsprayed tree was very much larger than the other.

I do not consider this test satisfactory in all respects and am not prepared either to recommend or condemn the treatment. It is my impression now that it will prove less effective in checking the rot than Bordeaux mixture, but will give it another trial next season.

The Fungi Causing the Rot.

The fungus causing most of the rot of fruit on these trees is *Sphærospis malorum*. It occasions a brown rot, which quite generally starts at the eyes of apples, and often produces concentric alternating light and dark rings as it spreads. It appears to attack fruit only when in the orchard, but if rotting apples are gathered with the others continues its work for a time among the stored fruit. It has sometimes been confounded with the bitter rot fungus (*Glæosporium versicolor*). The latter produces black spots scattered irregularly over the surface of apples. The two fungi vary in relative abundance in Kentucky with season and locality. In addition to these two, a third fungus (*Monilia fructigena*) sometimes works on Kentucky apples, though its chief injury is done to stone fruits. The rot of the latter is brown, but does not present the ringed appearance of that caused by *Sphærospis*, and when an apple has been completely invaded by it the color often changes from brown to a uniform coal-black, a change not observed in the other brown rot. These rots again must not be confounded with rot due to sunburn. When we have a period of extremely hot,

bright weather, apples on the ground and those not protected by leaves on the trees are scorched by the sun's heat, and pale brown spots gradually fading out at the margins are formed, which subsequently spread. The rot in this case is the result of the killing of the tissue on the exposed sides of the apples by the heat, and decomposition due to ordinary bacteria spreads from the dead tissue to that not directly affected by the sun.

The Copper and Arsenic Left on the Fruit.

We used a great deal of Paris green and copper sulphate in our spraying, and I have been curious to know if any injurious quantity remained on the apples when they were picked. Dr. A. M. Peter, of the Station, kindly examined 6 apples taken from the sprayed tree number 507, September 21, 1895, and reports that the traces of both copper and arsenic detected by chemical analysis are exceedingly small and are not calculated to be injurious. The copper found by him amounts to .006 grain, while of the arsenic he found a trace so small as not to be measurable. His statement follows:

DIVISION OF CHEMISTRY, December 9th, 1895.

Prof. H. Garman:

DEAR SIR: The six apples, labeled "Exp. 507, Sept. 21, 1895," were examined as follows:

The apples were first peeled and the core removed. The peelings and cores together were treated for arsenic and copper by customary methods after digestion with hydrochloric acid and potassium chlorate. The fleshy part of the apples was treated in exactly the same way. The following results were obtained.

Weight of the six apples, 420 grams ($14\frac{3}{4}$ ozs.)

Copper oxide in the peelings and cores .0004 gram (.006 grain).

Copper oxide in the flesh, a minute trace.

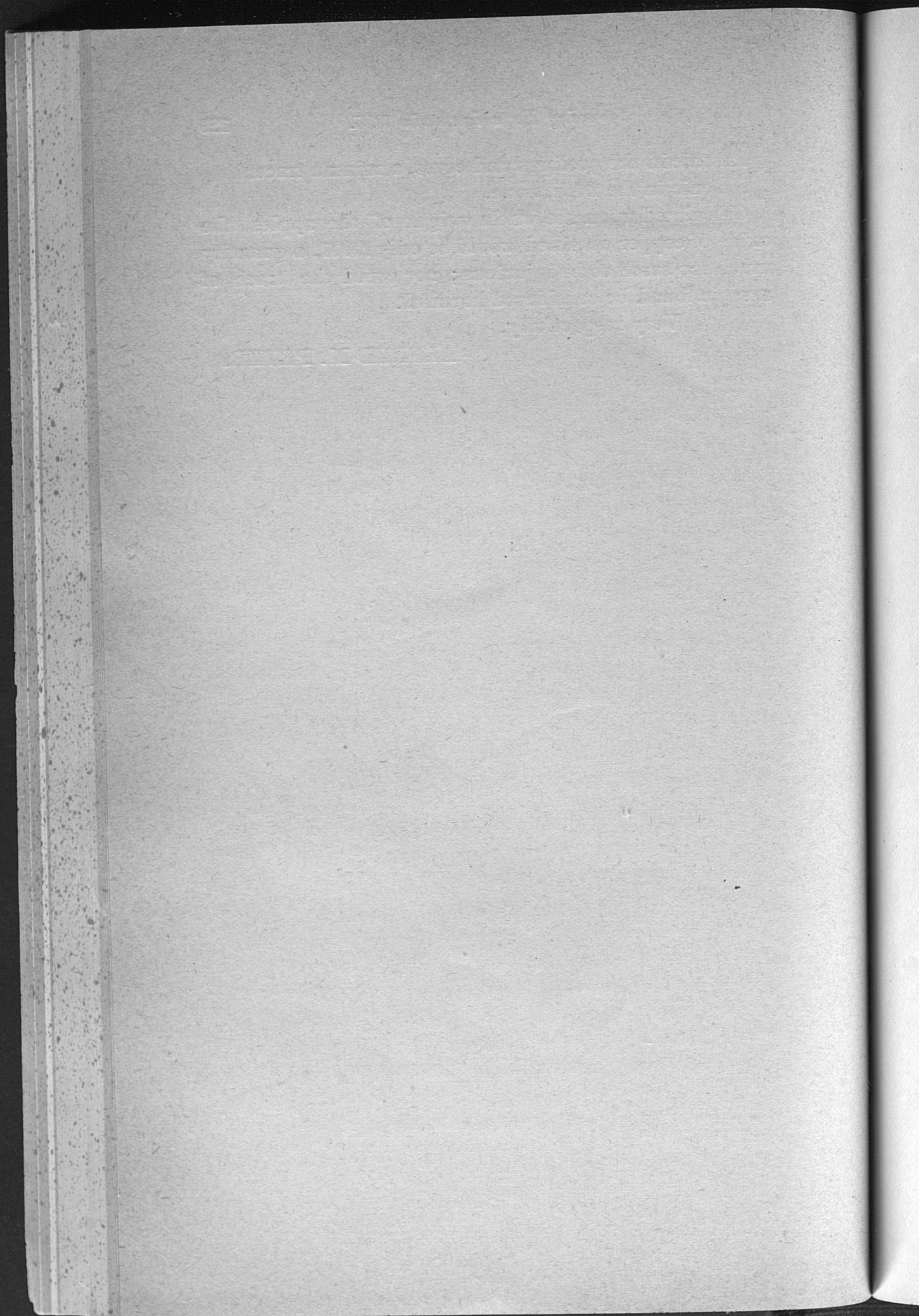
Arsenic in the peelings and cores, a minute trace.

Arsenic in the flesh, none.

Calculated upon the whole weight of the apples, the oxide of copper obtained would be only .0001, a quantity much too small to be injurious; nor could the trace of arsenic found be considered harmful.

Very respectfully,

ALFRED M. PETER.



KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE
STATE COLLEGE OF KENTUCKY.

BULLETIN No 60.

ANALYSES OF COMMERCIAL FERTILIZERS.

- I. Official Analyses.
 - II. Analyses of Farmers' and
Inspectors' Samples.
-

LEXINGTON, KENTUCKY.
DECEMBER, 1895.

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. 60.

COMMERCIAL FERTILIZERS.

I. OFFICIAL ANALYSES.

Since the publication of Bulletin No. 56, the following analyses have been made for manufacturers in compliance with the fertilizer law, and these fertilizers are now legally on sale in the State, in addition to those reported in the bulletin referred to above, except numbers 3185 and 3186, entered by the Chemical Co. of Canton, Baltimore, Md., for the year beginning Jan. 1st, 1896

The values for the "essential ingredients" for 1896 have not been changed and are 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.

TABLE I.—Raw Bone Manures.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	NAME OF BRAND.	POUNDS IN THE HUNDRED.						Estimated Value per Ton.
			Phosphoric Acid.			Equivalent to Bone Phos- phate.	Nitrogen.	Equivalent to Ammonia.	
			In Fine Bone.	In Medium Bone.	Total.				
3041	Akin Fertilizer Co., Evansville, Ind.	Pure Raw Bone	12.36	7.73	20.09	43.87	3.65	4.43	\$27.31
3036	Currie Fertilizer Co., Louisville, Ky.	Currie's Raw Bone Meal.....	7.92	16.31	24.23	52.92	4.14	5.03	30.62
3035	R. H. Hoskins, Louisville, Ky.....	Champion Raw Bone Meal.....	22.36	.....	22.36	48.84	3.70	4.49	30.84
3038	A. B. Mayer Mfg. Co., St. Louis, Mo.	Anchor Brand Pure Bone Meal.	13.21	8.51	21.72	47.44	3.96	4.81	29.54
3032	National Fertilizer Co., Nashville, Tenn.....	Pure Bone Meal.....	8.89	13.50	22.39	48.90	4.00	4.86	29.21
3106	Ohio Valley Fertilizing Co., Owens- boro, Ky.....	Corn, Wheat and Tobacco Grower.....	19.18	2.62	21.80	47.61	2.58	3.13	25.94
3037	J. F. & W. H. Singer, Nashville, Tenn.....	Standard Raw Bone Meal.....	13.57	9.05	22.62	49.40	3.84	4.66	29.73
3138	Swift & Co., Chicago, Ill.....	Pure Raw Bone Meal.....	18.31	7.30	25.61	55.94	3.90	4.73	32.68

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.			Nitrogen.	Equivalent to Ammonia.	Potash.			
			Soluble.	Reverted.	Insoluble.			From Sulphate.	From Muriate.		
3033	Baltimore Guano Co., Baltimore, Md.....	Dissolved Bone Phosphate and Potash	7.55	3.30	1.41	.....	.....	.....	4.31	\$ 21.07	
3034	Currie Fertilizer Co., Louisville, Ky.....	Currie's Falls City Bone Meal	6.96	4.81	5.18	1.13	1.37	.....	1.93	25.35	
3044	Goulding Fertilizer Co., Ltd., Pensacola, Fla.....	Goulding's Bone Compound	7.55	1.71	1.00	1.72	2.09	.....	1.12	20.82	
3039	A. B. Mayer Mfg. Co., St. Louis, Mo.....	Anchor Brand Wheat Grower Standard Home Mixture Guano .....	.....	7.54	7.75	4.22	5.12	.....	.....	29.21	
3040	Meridian Fertilizer Factory, Meridian, Miss.....	Guano	7.74	2.44	0.63	1.88	2.28	.....	2.65	24.33	
3042	Mobile Phosphate & Chemical Mfg. Co., Mobile, Ala.....	Mobile Standard Guano	7.89	2.59	1.30	2.12	2.57	.....	1.73	24.82	
3107	National Fertilizer Co., Nashville, Tenn	National Dissolved Bone.....	9.24	3.72	4.58	1.12	1.36	.....	1.85	26.57	
3173	Nolte & Dolch Fertilizer Co. St. Louis, Mo.....	No. 27 Bone Black Fertilizer	5.48	2.69	2.52	1.83	2.22	.....	.....	19.11	
3043	Southwestern Phosphate Co., Nashville, Tenn.....	Ground Phosphate Rock .....	.....	1.84	27.02	.....	.....	.....	.....	12.65	

II.—ANALYSES OF FARMERS' AND INSPECTORS' SAMPLES.

The law regulating the sale of commercial fertilizers in this State provides (Sec. 7) that: "Any agriculturist, a purchaser of any commercial fertilizer in this State, may take a sample of the same, under the rules and regulations of the Director of the said Experiment Station, and forward the same to the Experiment Station for analysis, which analysis shall be made free of charge." In the same section the Director is authorized, "In person or by deputy, to take samples for analysis from any lot or package of any commercial fertilizer which may be in the possession of any dealer in this State." Under these provisions, a number of samples have been analyzed from time to time and the results of these analyses are published in the following pages.

An examination of the table of analyses will show that most of the fertilizers sampled by farmers or by the Inspector are fairly represented by the samples sent to the Station by the manufacturers. Some are better than the official samples, while a few fall below them—not, however, to such an extent as to show any intention of fraud or gross carelessness on the manufacturers' part. Altogether the results are far more satisfactory than those of last year.

Here follows, first, a brief description of each sample; and, second, the analyses in tabular form. For convenience of reference, the "station number" of each sample is given, and all brands of the same manufacturer are arranged together. The names of the manufacturers are placed in alphabetical order in the description of the samples, and following each manufacturer's name are the brands of his make that were analyzed.

It is necessary to compare the analysis of each sample with the "official analysis" on the tags attached to the

sacks from which the sample was taken, because it is not possible for manufacturers to make the same fertilizer perfectly uniform from year to year, and any fertilizer is therefore liable to vary somewhat in composition; also, because the values assigned to the "essential ingredients" in calculating the "estimated value per ton" are subject to change from time to time. This is the reason why a tag from one of the packages sampled must be sent with each sample for analysis.

Description of Samples.

A. D. ADAIR & McCARTY BROS., Atlanta, Ga., general agents for the Furman Farm Improvement Co.

No. 2958. Farish Furman Formula, sent by Winston Henry, Casky, Ky. Tag sent corresponded to No. 2482.

No. 2959. Furman High Grade Fertilizer, sent by B. W. Williams, Oak Grove, Ky. Tag sent corresponded to No. 2257.

ARMOUR & Co., Chicago, Ill.

No. 2962. Bone, Blood and Potash, sampled by M. A. Scovell, Director, from stock of Forbes & Bro., Hopkinsville, Ky. Tag corresponded to No. 2828.

No. 2963. Bone Meal, sampled, etc., from same. Tag corresponded to No. 2477.

No. 3012. White Burley and Black Tobacco, sent by W. L. Thurman, Sonora, Ky. Tag sent corresponded to No. 2827.

THE CINCINNATI DESICCATING Co., Cincinnati, O.

No. 3156. Gilead Phosphate, sent by Robt. T. Marshall, Mt. Carmel, Ky. Tag sent corresponded to No. 2398.

THE CURRIE FERTILIZER CO, Louisville, Ky.

No. 2939. Currie's Tobacco Grower, sent by J. Crit. Alexander, Bowling Green, Ky. Tag sent corresponded to No. 2333.

No. 2967. Same brand, sampled by M. A. Scovell, Director, from stock of S. P. Smith & Co., Trenton, Ky. Tag corresponded to No. 2333.

No. 2968. Currie's Kentucky Phosphate, sampled, etc., from same. Tag corresponded to No. 2907.

FURMAN FARM IMPROVEMENT CO., Atlanta, Ga., see A. D. Adair & McCarty Bros.

GLOBE FERTILIZER CO., Louisville, Ky.

No. 2971. Big Four Tobacco Grower, sampled by M. A. Scovell, Director, from stock of Winfree Bros. & Co., Hopkinsville, Ky. Tag corresponded to No. 2887.

No. 3175. Globe Wheat Grower, sent by W. M. Darby, Cave Spring, Ky. Tag sent corresponded to No. 3013.

THE LOUDENBACK FERTILIZER CO, Urbana, O.

No. 2940. Urbana Prize Potato and Tobacco Grower, sent by J. R. Rogers, Paris, Ky. Tag sent corresponded to No. 2858.

No. 2969. Same brand, sampled by M. A. Scovell, Director, from stock of Winfree Bros. & Co., Hopkinsville, Ky. Tag corresponded to No. 2858.

No. 2970. Urbana Bone Phosphate and Potash, sampled, etc., from same. Tag corresponded to No. 2861.

MICHIGAN CARBON WORKS, Detroit, Mich.

No. 2964. Homestead Corn and Wheat Grower, sampled by M. A. Scovell, Director, from stock of Forbes & Bro., Hopkinsville, Ky. Tag corresponded to No. 2432.

No. 3174. Same brand, sent by W. M. Darby, Cave Spring, Ky. Tag sent corresponded to No. 2929.

NATIONAL FERTILIZER CO., Nashville, Tenn.

No. 2957. Bone Meal, sent by J. S. Reeder, Franklin, Ky. Tag sent corresponded to No. 2599.

NORTH-WESTERN FERTILIZING CO., Chicago, Ill.

No. 2965. Horse Shoe Brand Kentucky Corn and Tobacco Grower, sampled by M. A. Scovell, Director, from stock of Forbes & Bro., Hopkinsville, Ky. Tag corresponded to No. 2427.

No. 2966. Horse Shoe Brand Tobacco Grower, sampled, etc., from same. Tag corresponded to No. 2868.

No. 2986. Horse Shoe Brand Raw Bone and Phosphate Mixture, sent by S. H. Wisdom, Edmonton, Ky. Tag sent corresponded to No. 2877.

WM. SKENE & CO., Louisville, Ky.

No. 3031. Skene's Complete Plant Food or Perfect Tobacco and Potato Grower, sent by Jas. D. Wallace, Princeton, Ky. Tag sent corresponded to No. 2457.

SWIFT & Co., Chicago, Ill.

No. 3141. Pure Raw Bone Meal, sent by Levi Collins, Pewee Valley, Ky. Corresponds to No. 3138.

S. W. TRAVERS & Co., Richmond, Va.

No. 2982. National Tobacco Fertilizer, sent by Wesley Vicroy, Maysville, Ky. Tag sent corresponded to No. 2811.

No. 2983. Champion Corn Grower, sent by same. Tag sent corresponded to No. 2853.

Explanations in Regard to the Table.

In the following table we have given in the first column the name of the brand; next, where the sample was taken; then the "station number," and, lastly, the analysis and valuation. The same order is preserved in the table as in the description of the samples, hence it is not necessary to repeat the name of the manufacturer. In the case of each brand, the official analysis is first given in *bold faced type*, for comparison. This official analysis is the same as the analysis that was on the tag attached to the sack from which the sample was taken.

M. A. SCOVELL, *Director*.

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

December 31st, 1895.

TABLE III.

NAME OF BRAND.	WHERE SAMPLED.	Station Number.	POUNDS IN THE HUNDRED.								Estimated Value Per Ton—dollars.	
			Phosphoric Acid.				Nitrogen.	Equivalent to Ammonia.	Potash.			
			In Fine Bone.	In Medi- um Bone.	Available.	Insoluble.			Total.	From Sulphate.		From Muriate.
Farish Furman Formula.	Official, 1894.....	2482	.....	.....	11.27	2.19	13.46	.....	.....	.....	2.94	22.66
	Casky.....	2958	.....	.....	11.52	0.95	12.47	.....	.....	.....	4.75	24.61
Furman High Grade Fertilizer.	Official, 1893.....	2257	.....	.....	9.50	1.46	10.96	2.24	2.72	.....	2.83	28.29
	Oak Grove.....	2959	.....	.....	10.55	1.10	11.65	2.45	2.97	.....	3.45	31.37
Bone, Blood and Potash.	Official, 1895.....	2828	.....	.....	8.43	4.93	13.36	4.28	5.20	8.27	.....	40.83
	Hopkinsville.....	2962	.....	.....	9.16	4.58	13.74	3.99	4.84	7.00	.....	38.88
Bone Meal.	Official, 1894.....	2477	22.43	4.05	.....	.....	26.48	2.46	2.99	.....	.....	33.27
	Hopkinsville.....	2963	21.34	3.27	.....	.....	24.61	1.77	2.15	.....	.....	28.91
White Burley and Black Tobacco.	Official, 1895.....	2827	.....	.....	8.70	3.66	12.36	2.98	3.62	6.77	.....	33.92
	Sonora.....	3012	.....	.....	8.10	4.62	12.72	2.94	3.57	6.00	.....	32.34
Gilead Phosphate.	Official, 1894.....	2398			10.31	3.75	14.06	2.23	2.71		2.37	30.14
	Mt. Carmel.....	3156			5.26	2.12	7.38	3.49	4.24		2.88	26.90

Commercial Fertilizers

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Currie's Tobacco Grower.	Official, 1894.....	2333			8.06	3.67	11.73	1.55	1.88	9.59		35.33
	Bowling Green.....	2939			9.53	3.48	13.01	2.54	3.08	7.61		38.57
	Trenton.....	2967	.....	.....	9.78	3.70	13.48	2.60	3.16	6.45	.....	37.58
Currie's Kentucky Phosphate.	Official, 1895.....	2907	.....	.....	10.64	1.22	11.86	0.75	0.96	2.02	.....	21.11
	Trenton.....	2968	.....	.....	10.63	0.95	11.58	0.57	0.69	1.50	.....	19.46
Big Four Tobacco Grower.	Official 1895.....	2887	.....	.....	9.25	2.17	11.42	1.55	1.93	2.32	.....	22.86
	Hopkinsville.....	2971	.....	.....	7.87	2.20	10.07	2.38	2.89	2.13	.....	23.43
Globe Wheat Grower.	Official, 1895.....	3013	.....	.....	11.01	2.61	13.62	2.09	2.54	1.11	.....	25.59
	Cave Spring.....	3175	.....	.....	11.51	1.51	13.02	1.98	2.40	1.41	.....	25.77
Urbana Prize Potato and Tobacco Grower.	Official, 1895.....	2858	.....	.....	9.71	2.65	12.36	2.31	2.80	3.58	3.07	31.70
	Paris.....	2940	.....	.....	10.39	2.97	13.36	2.31	2.80	3.00	3.90	33.01
	Hopkinsville.....	2969	.....	.....	10.53	1.19	11.72	2.27	2.76	2.85	3.49	31.47
Urbana Bone Phosphate and Potash.	Official, 1895.....	2861	.....	.....	7.93	3.67	11.60	1.47	1.78	.....	3.48	22.27
	Hopkinsville.....	2970	.....	.....	8.37	4.78	13.15	1.51	1.83	.....	3.51	23.61
Homestead Corn and Wheat Grower.	Official, 1894.....	2432	.....	.....	9.33	1.42	10.75	2.34	2.84	1.91	.....	27.87
	Hopkinsville.....	2964	.....	.....	9.62	0.88	10.50	2.23	2.71	2.86	.....	29.04
	Official, 1895.....	2929	.....	.....	11.22	1.88	13.10	2.44	2.96	2.43	.....	28.59
	Cave Spring.....	3174	.....	.....	9.22	0.49	9.71	2.03	2.46	2.78	.....	24.16
Bone Meal.	Official 1894.....	2599	24.05	.....	.....	.....	24.05	3.69	4.48	.....	.....	36.41
	Franklin.....	2957	7.38	14.85	.....	.....	22.23	3.89	4.72	.....	.....	34.08

TABLE III.—Continued.

NAME OF BRAND.	WHERE SAMPLED.	Station Number.	POUNDS IN THE HUNDRED.										Estimated Value Per Ton—dollars.
			Phosphoric Acid.					Nitrogen.	Equivalent to Ammonia.	Potash.			
			In Fine Bone.	In Medi- um Bone.	Available.	Insoluble.	Total.			From Sulphate.	From Muriate.		
Horse Shoe Brand Ken- tucky Corn and To- bacco Grower.	Official, 1894.....	2427	.....	.....	9.42	2.67	12.09	1.67	2.03	1.60	.....	25.49	
	Hopkinsville.....	2965	.....	.....	6.55	3.99	10.54	1.80	2.19	1.01	.....	21.20	
Horse Shoe Brand To- bacco Grower.	Official, 1895.....	2868	.....	.....	8.81	2.88	11.69	3.53	4.29	3.17	.....	30.57	
	Hopkinsville.....	2966	.....	.....	8.47	3.79	12.26	2.89	3.51	2.93	.....	27.98	
Horse Shoe Brand Raw Bone and Phosphate Mixture.	Official 1895.....	2877	.....	.....	7.94	7.55	15.49	3.09	3.75	0.60	.....	26.56	
	Edmonton.....	2986	.....	.....	7.56	7.42	14.98	2.80	3.40	1.49	.....	26.18	
Skene's Complete Plant Food or Perfect To- bacco & Potato Gro'r.	Official, 1894.....	2457	.....	.....	8.24	1.02	9.26	3.25	3.95	13.30	.....	46.64	
	Princeton.....	3031	.....	.....	7.63	3.90	11.53	2.67	3.24	15.19	.....	47.63	
Pure Raw Bone Meal.	Official, 1895.....	3138	18.31	7.30	.....	.....	25.61	3.90	4.73	.....	.....	32.68	
	Pewee Valley.....	3141	12.45	13.49	.....	.....	25.94	3.95	4.80	.....	.....	31.88	
National Tobacco Fer- tilizer.	Official, 1895.....	2811	.....	.....	7.69	1.69	9.38	1.89	2.29	.....	3.98	23.02	
	Maysville.....	2982	.....	.....	8.70	1.47	10.17	2.01	2.44	.....	3.43	24.08	
Champion Corn Grower.	Official, 1895.....	2853			8.98	1.15	10.13	1.04	1.26		3.74	21.28	
	Maysville.....	2983			9.22	1.22	10.44	1.07	1.30		2.11	19.80	

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1.26	1.30	1.07	1.04
10.13	10.44	1.22	1.15
8.98	9.22	2853	2983
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