

SEVENTEENTH ANNUAL REPORT

OF THE

Kentucky Agricultural
Experiment Station

OF THE

State College of Kentucky

LEXINGTON, KY.

FOR THE YEAR 1904

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LETTER OF TRANSMITTAL

To His Excellency,

HON. J. C. W. BECKHAM,

Governor of Kentucky.

SIR:—

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

Very respectfully,

M. A. SCOVELL, *Director.*

Agricultural and Mechanical College of Kentucky

BOARD OF TRUSTEES

His Excellency, Gov. J. C. W. BECKHAM, ex-Officio Chairman.

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D. F. FRAZEE, Lexington.
C. B. NICHOLS, Lexington.
JAMES, K. PATTERSON, President of the College.
M. A. SCOVELL, Director, Secretary.

Station Officers

M. A. SCOVELL, Director and Chemist.
A. M. PETER, Chemist.
H. E. CURTIS, Chemist, Fertilizers.
H. GARMAN, Entomologist and Botanist.
J. N. HARPER, Agriculturist.
W. H. SCHERFFIUS, Chemist.
R. M. ALLEN, Secretary, Food Division.
J. D. TURNER, Secretary to the Director.
J. O. LA BACH, Chemist, Food Division.
MISS M. L. DIDLAKE, Ass't Entomologist and Botanist.
S. D. AVERITT, Ass't Chemist.
G. N. KELLER, Ass't Entomologist and Botanist.

Address of the Station,
LEXINGTON, KENTUCKY.

The Kentucky Agricultural Experiment Station

In Account with the United States Appropriation.

To receipts from the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1904, as per Act of Congress, approved March 2, 1887. \$15,000.00

Expenditures:

By Salaries	\$11,961.67
Labor :.....	738.09
Publications	444.87
Postage and stationery	183.40
Freight and express	46.73
Heat, light and water	401.20
Chemical supplies	70.71
Seed, plants and sundry supplies...	296.84
Feeding stuffs	64.00
Library	474.40
Tools, implements and machinery...	43.05
Scientific apparatus	149.56
Traveling expenses	6.29
Contingent expenses	117.39
Building and repairs	1.80
	\$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, 1904; that we found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been \$15,000.00 and the corresponding disbursements \$15,000.00, for all of which

proper vouchers are on file and have been by us examined and found correct.

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

(Signed)

D. F. FRAZEE,
GEO. B. KINKEAD,
Auditors.

(SEAL)

Attest:

D. C. FRAZEE.

ANNUAL REPORT OF THE
Kentucky Agricultural Experiment Station
FOR THE YEAR 1904.

REPORT OF THE DIRECTOR.

The Station is divided into the following divisions:

Division of Chemistry.
Division of Entomology and Botany.
Division of Agriculture.
Division of Horticulture.
Division of Animal Husbandry.
Division of Fertilizer Control Work.
Division of Food Control Work.

DIVISION OF CHEMISTRY.

During the year the general work of the Chemical Division has been under the immediate charge of Dr. Peter, assisted by Mr. Averitt, and at times by Mr. W. H. Scherffius and Mr. O. M. Shedd. The analyses made in this division are classified as follows:

Soils	71
Corn and wheat	45
Potable waters	43
Mineral waters	37
A. O. A. C. samples in studying methods.....	9
Examinations in cases of supposed poisonings.....	4
Sugar beets	2
Butter in churn tests of cows	2
Clay and marl	6

Coal	7
Iron, steel and alloys for the Department of Mechanical Engineering	11
Miscellaneous	18
Total.....	255

A large number of minerals, ores and other materials have been examined and classified for persons in all parts of the State and reported upon without making a complete analysis. These are in addition to the samples above enumerated.

The Chemical Division is making an exhaustive study of the soils of the State. This work has been occupying most of the time of Dr. Peter. It will be noted that 71 soil analyses have been made. In many instances these analyses have enabled us to make valuable suggestions for the improvement of the soils by the right use of fertilizers and other means. A series of soil analyses was planned in connection with field experiments on the farm. Numerous samples were collected during the past year, but our chemical force has not been sufficient to enable us to complete this work.

There is also a constant demand for analysis of waters, both potable and mineral, minerals, ores and other materials from individuals and from the Boards of Health from various parts of the State. This work is increasing. It is now becoming a burden on the Chemical Division of the Station. Some action should be taken in regard to this matter. If the analyses are to be made free of charge, we will be compelled either to neglect more important work or another assistant must be employed. I believe a small fee for this work perhaps would be the best way to control it. Where minerals are sent in for determination, it is often found unnecessary to make an analysis, and all such work could be done without charge; but a quantitative analysis of a mineral water takes several days and such work usually benefits the person having it done only.

ENTOMOLOGICAL AND BOTANICAL DIVISION.

Prof. Garman has charge of both Entomology and Botany in the Station, assisted by Miss Mary L. Didlake and Mr. G. N. Keller.

In co-operation with the U. S. Department of Agriculture, Prof. Garman has been conducting some experiments on forage plants. For this purpose the United States Government furnishes \$600.00 to pay for actual labor expended on the work. This test will be completed July 1, 1905.

Nursery inspection has as usual been very largely done during July and August, and has since 1897, when the inspection law was enacted, been done almost single handed by the Entomologist and Botanist.

During the past year forty nurseries were examined and received certificates. Several others were examined, but could not be certificated because of diseased condition of the stock. Prof. Garman has already called attention to the need of an amendment of the inspection law, so as to give the inspector some help in making inspections.

Under the seed law passed by the last Legislature, the examination of samples of seed has been turned over to Prof. Garman. This has measurably increased the work of the division, since the examinations are exceedingly laborous and time consuming. Four hundred and seven samples have been collected in different parts of the State and are being examined as rapidly as possible. As soon as completed a bulletin will be issued on this subject.

Numerous experiments were undertaken during the year, among which may be mentioned experiments with a view to showing the effect of shade in checking certain fungus diseases of vegetables; field experiments in checking the injuries of broom-rape of hemp and tobacco; spraying experiments on cabbage; experiments with Hessian fly in Christian County, where a number of wheat plots were planted in the fall of 1904 for the purpose; experiments with clover seed from various countries in conjunction with the United States Department of Agriculture, for which purpose a number of plantings have been made in Christian County.

A study of the different varieties of bees and methods of handling them have also been undertaken by this division.

AGRICULTURAL DIVISION.

Under this head Prof. Harper reports as follows: "The work

of this division during the past year has been mainly a continuation of the work begun in former years. Much of the work of this division must necessarily extend through a number of years before definite results can be obtained.

"The test of commercial fertilizers and other experiments on our leading crops, as planned by yourself, has been continued.

"The work of this division has included experiments with varieties and multifarious field tests of corn, wheat, tobacco, and hemp. Experiments with cow peas, alfalfa, oats and co-operative experiments with sugar beets and wheat.

"During the year the writer has attended a number of Farmers' Institutes held in the State by the Commissioner of Agriculture, and also had charge of the installation of the Kentucky Agricultural Exhibit at the St. Louis Fair."

DIVISION OF ANIMAL HUSBANDRY.

Prof. May, in charge of Animal Husbandry, resigned in June. His place has not yet been filled. The work, however, in the dairy line has been continued directly under my charge by Mr. Nutter, the assistant in dairying.

FERTILIZER CONTROL WORK.

During the year 630 analyses of fertilizers were made. Forty-four manufacturers were authorized to sell fertilizers in the State and tags for 366 brands were issued. There were 636,284 tags printed and sent to the various firms during the year. The fertilizer fees for the year amounted to \$17,535.80, being a little less than for 1903, which amounted to \$17,782.50. For 1902 we collected \$25,331.50 for fertilizer fees. This makes a shortage of over \$15,000.00 in the last two years, a shortage which was not expected at the time the Experiment Station was planned and appropriations were made for its erection. Up to May 1 of this year, \$8,675.00 have been collected for such fees. This is a little in excess of last year's fees up to that time, which amounted to \$8,514.00, but considerably short of the spring trade two years previous, which amounted to \$11,267.50.

Mr. H. E. Curtis is in charge of the Fertilizer Control Work, and assisted by Mr. W. H. Scherffius and Mr. O. M. Shedd.

FOOD CONTROL WORK.

The work of this division is under the charge of Mr. R. M. Allen, and Mr. J. O. LaBach has charge of the chemical investigations. The microscopical examinations have been under Prof. Garman's supervision.

During the year 628 official samples have been collected for analysis. Thorough inspections have been made in Louisville, Covington, Newport, Lexington, Paducah, Henderson, Owensboro, Ashland, Catlettsburg; Shelbyville, Falmouth, Millersburg, Danville, Richmond, Mt. Sterling, Versailles, Georgetown, Cynthiana, Hopkinsville, Bowling Green, Elizabethtown and in smaller towns in all parts of the State. A systematic inspection of the milk supply has been made. Special attention has been given to feed stuffs, especially bran. A number of samples of bran have been found to be adulterated with corn cob meal. The dairymen around Louisville and Elizabethtown have co-operated with us in this work.

One hundred and forty-four violations have been reported to the County and Commonwealth Attorneys; 33 warrants were issued and 14 indictments were returned. Out of 47 prosecutions, 46 fines were imposed.

During the year over 1,000 letters have been written, as shown by the letter file, in regard to the execution of the pure food law. When the law first went into effect, we had much difficulty in enforcing it, but the grocers, jobbers and the manufacturers who opposed it at the beginning, are co-operating with us.

The Station receives the analysis fee from the State in this work, but out of such fee the chemist and laboratory expenses must be paid. The State pays directly the other employes in this department, and necessary expenses, and attorney fees, provided that the total expense, including the analysis, does not amount, in any one year, to over \$10,500.00.

The Station force, and especially Prof. Garman and Mr. Harper, spent some time in the preparation of an exhibit for the St. Louis World's Fair; Mr. Harper taking charge of the installation of the

State's exhibit in agriculture and Mr. Keller placing the Station's exhibit in position. Mr. Shobe, a graduate of the College, took charge of the State's exhibit after Mr. Harper came home. The agricultural part of the State's exhibit was sent to the Station after the close of the fair and this makes a beginning for our museum.

The Station has been active in assisting the Commissioner of Agriculture in institute work, one or more of the Station's staff being present at the institutes held. Mr. Harper attended every institute held, while Prof. Garman and the Director were present at many of the meetings.

CO-OPERATION WITH THE COLLEGE.

The Station has assisted the Agricultural Department of the College in teaching some of the more technical studies. Prof. Garman is teaching all classes in Entomology, giving an hour a day for two terms in each year. Mr. Harper taught agronomy during the winter term, one hour per day, and the Director of the Station gave lectures on the use of fertilizers and on animal husbandry. Mr. May last year gave one hour per day to students in the Agricultural Course for at least one term.

The students have the opportunity also for studying field and feeding experiments and dairying, etc. Some of the students are taking advantage of this. I have two seniors engaged in thesis work under my direction now.

PUBLICATIONS.

We have published during the year the following bulletins:

Bulletin No. 113.

Protein Content of the Wheat Kernel.

Bulletin No. 114.

Insects Injurious to Cabbage.

Bulletin No. 115.

Wheat—

Field Tests of Varieties.

Bulletin No. 116.

1. On an Injury to Fruits by Insects and Birds.
2. The Apple-tree Measuring Worm.
3. The Fall Beauty, a new Apple.

Bulletin No. 117.

Commercial Fertilizers.

The bulletins published during the year are appended herewith and then follow the analyses of the general work of the Station that are deemed of most interest. After this the meteorological data will be found.

M. A. SCOVELL, *Director.*

KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE

State College of Kentucky.

BULLETIN No. 113.

Protein-content of the Wheat Kernel.

LEXINGTON, KENTUCKY,

FEBRUARY, 1904.

KENTUCKY

Agricultural Experiment Station.

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R. C. STOLL, Lexington, Ky.
W. C. BELL, Harrodsburg, Ky.
J. K. PATTERSON, President of the College
M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

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J. O. LABACH, Chemist, Food Division.
MISS M. L. DIDLAKE, Ass't Entomologist and Botanist.
S. D. AVERITT, Ass't Chemist.
D. W. MAY, Animal Husbandman.
W. G. CAMPBELL, Ass't Co-operative Experiments.
O. M. SHEDD, Ass't Chemist.
G. N. KELLER, Ass't Entomologist and Botanist.

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. 113.

Studies on the Relation between certain Physical Characters
of the Wheat Kernel and its Chemical Composition,
and a Proposed Method for Improving Wheat by the
Selection of Seed.

By J. N. HARPER and A. M. PETER.

It is a recognized fact that plants are not absolutely fixed in their characteristics, but are subject to more or less pronounced variations, especially when a change is made in their environment. Wheat grown in one locality when planted in another is subject to influences which may produce variations in the physical and chemical characters of the grain. The influences believed to be most potent in inducing such changes are food supply, water, light, temperature, altitude, physical properties of the soil or growth in maritime or saline regions.

Flinty wheats tend to become softer. In the series of experiments conducted at this Station during a long term of years with many different varieties of wheat, we have noticed that when seed wheat brought from other parts of the country is grown in Kentucky, the grain produced contains a larger proportion of mealy-looking or starchy kernels than the original seed, and this change seems to go on from year to year, to some extent. In other words, hard wheats from elsewhere tend to get softer by being grown in our climate, a fact generally accepted by our farmers. But in the experiments at this Station, extending over periods of three to ten years, in which the seed grown each season was planted the next, this change has not been complete in any of the varieties planted.

Some flinty grains always present.—Upon examining any lot of any pure variety of wheat that has been grown in Kentucky, including more particularly those grown at this Station with every precaution to keep them pure, we have found that the individual kernels are not uniform in color, outline and general appearance. Some of the kernels will be flinty, angular in outline, semi-translucent and of a dark amber color, while others will be plump, starchy in appearance and light in color. (See Figure 1.) The dark, flinty kernels are distinctly harder than the light, starchy-looking ones and contain more protein, as shown by our analyses. (See table I.) The proportion of the hard, flinty kernels to the starchy ones differs greatly in the different varieties of wheat examined.

Flinty kernels are the more nitrogenous.—To ascertain the exact difference in chemical composition between these two types of kernels, we selected by their appearance from each of the varieties of wheat grown at the Station, enough kernels of each class for chemical analysis. These analyses show that in every instance the flinty kernels contained more protein than the starchy ones. (Compare columns 5 and 6 in table I.) An examination of table I shows that the variation in the percentage of protein between the starchy and flinty kernels was greatest in the variety Pootung, the difference being 5.88 per cent. This variety has been grown at this Station for three years. The seed came from Shanghai, China, through the United States Department of Agriculture. There were two varieties in the seed received, a bearded and a smooth one; the wheat analyzed was the bearded variety. The variation in the per cent. of protein was least in the variety Rudy which has been grown at the Station for five years, the difference being only 1.00 per cent. Of the nineteen varieties tested, five, namely: Beechwood Hybrid, Jersey Fultz, Pearl Prolific, Improved Rice and Pootung, show a difference of more than 4 per cent. of protein. The first two of these have been grown for five consecutive years at this Station, the second two for four and the last one for three years. The highest percentage of protein found was in the flinty kernels from the Pootung wheat, which contained 16.55 per cent.

The Improved Rice ranks next highest, with 15.17 per cent. protein. Next this variety follow Beechwood Hybrid, with 14.95 per cent., Extra Early Oakley, 14.68 per cent. and Jersey Fultz with 14.66 per cent. The varieties ranking lowest in the per cent. of protein found in the flinty kernels were Rudy, containing 11.63 per cent., Turkish Red, containing 11.85 per cent., and Gold Coin, containing 12.33 per cent. The widest variation in the percentage of protein between any two samples analyzed was found between the flinty kernels of Pootung and the starchy kernels of Dawson's Golden Chaff, namely, 7.44 per cent.

The large kernels richer in protein than the small ones.—Table III gives analyses of kernels graded according to relative size as well as appearance. Judging from the results shown in this table, the small, flinty kernels do not contain as much protein as the large and medium sized flinty ones. This variation in the per cent. of protein between flinty kernels of different sizes in the same variety probably depends upon the difference in the composition of grains from the middle and the ends of individual heads of wheat.

The analyses of grains taken from different parts of a single head of Pootung wheat (see table IV) show that the small kernels near the base and tip do not contain as large a percentage of protein as the larger kernels in the center of the head. We also conclude from our observations that pollinization takes place first in the middle of the head, which may account for the larger gains being in the middle of the head.

All the kernels of any one head are of the same type.—By examining the kernels from a large number of separate heads, we find that there is very little difference in the physical appearance of the individual kernels composing any one head of any variety examined, except in respect to size. We have observed also that the grains from the several heads of any one stool were sensibly alike in appearance, that is to say they were all either flinty or starchy, but the grains from different stools often differed materially, some being flinty, others starchy.

The flinty kernels are not unripe.—The stage of maturity of

wheat at the time of harvesting affects the per cent. of protein in the kernels. Wheat cut when fully ripe contains more protein than that cut while in the milk or dough stage. In the course of this investigation the question was raised whether the flinty, nitrogenous grains were not unripe grains in which the starch had not yet fully developed. To study this problem, we examined a number of separate heads of Turkish Red wheat some of which had been gathered on June 16, 1903, before it was quite ripe, and others gathered a week later from the same plot when fully ripe. In the case of some of these heads, it was difficult to decide whether the grain should be classed under the flinty or starchy type, but upon making the distinction as carefully as possible, putting all the grains of each head into one or the other class, there was obtained from the wheat gathered June 16, 49.4 per cent. of flinty, and 50.6 per cent. of starchy kernels, and from that gathered June 23, 47.6 per cent. of flinty and 52.4 per cent. of starchy kernels. These results are practically identical, within a reasonable limit of error, and do not show any material diminution in the proportion of flinty grains during the last stage of ripening. Upon analysis of the wheat thus separated, it was found that the flinty grains gathered June 16, contained 10.23 per cent. of protein, calculated on the water-free sample, while those gathered June 23 contained 11.26 per cent., showing an increase of protein by ripening. The starchy grains of June 16 contained 10.49 per cent. of protein and those of June 23, 10.23 per cent., showing but little change. These figures give no support to the supposition that the flinty grains are unripe.

The flinty grains contain more moisture.—Another interesting feature of flinty and starchy wheats shown by our analyses is that, in most of the samples analyzed, the flinty kernels contained more moisture than the starchy ones. The figures in Table III are not to be considered in making this comparison, because the starchy kernels, in this case, were prepared for analysis at a different time from the flinty ones and may have been exposed to a more moist atmosphere. In most of the samples reported upon in Table I, however, the

flinty and starchy kernels were prepared and analyzed upon the same days. These figures indicate that the flinty kernels retain more moisture when the wheat is stored in a dry place than do the starchy ones, and that starchy wheat absorbs moisture more rapidly, in moist air, than flinty wheat.

Early wheats richer in protein.—It has been heretofore observed that early maturing varieties of wheat contain more protein than do late varieties. The results of our tests confirm this observation. In examining Table II and especially Table V, it will be seen that every variety of wheat ripening before June 20, except one, contained over 14 per cent. of protein in the flinty kernels, while those varieties ripening after June 22, contained less than 13.12 per cent. Of the nineteen varieties tested the nine that ripened before June 20 averaged 14.70 per cent., whereas the six varieties that ripened after June 22 averaged only 12.41 per cent. protein in the flinty kernels. The remaining four varieties were ripe by June 22 and averaged 13.19 per cent. protein. The composition of the starchy kernels was more uniform but the averages show a similar falling off in protein in the later maturing kinds.

Wheats rich in protein are the more valuable.—In this discussion, it is assumed that wheats high in protein are also high in gluten. Gluten being that constituent of wheat which gives to flour its property of being leavened by yeast in bread making, flours containing a high percentage of gluten, other conditions being equal, are preferred by bakers, and in some markets such flours sell at a higher price. Protein is also the more valuable constituent of wheat from a food standpoint. Therefore, both from a baker's standpoint and as a food product, wheats rich in protein are to be preferred. It is important, therefore, in selecting and developing a variety of wheat to take into consideration the content of nitrogen as well as the yield, milling qualities, etc.

Method suggested for selecting seed.—Our results lead us to believe: First, that the flinty kernels in any given variety of wheat, and preferably those from the middle of the head, should be selected for planting in order to develop a high

protein type of wheat. Second, that the early maturing varieties, if equally good in other respects, are to be preferred for this purpose.

Device for testing the hardness of wheat.—To test the relative hardness of the kernels, we have devised a machine to measure the pressure required to cut a kernel transversely. (See Figure 2.) The figures in columns 9 and 10 of Table II were obtained by the use of this machine. They show that the flinty grains are distinctly harder than the starchy grains, in the same variety, and some varieties are very much harder than others, but in comparing different varieties, there appears to be no definite relation existing between the percentage of protein and the pressure required to cut the grains in two. This device for testing the hardness of wheats appears to us to be superior to those that measure the pressure required to crush a kernel. The wheat tester figured was made at the Mechanical Department of the Kentucky State College. The construction is simple and may be fully understood from the figure.

Acknowledgement.—Credit should be given here to Mr. W. H. Scherffius who made the chemical analyses reported in this bulletin.

TABLE I.

No. of Variety.	Name of Wheat.	Moisture Per Cent.		Protein in the Moisture- free samples Per Cent. (N. x 6.25)		Difference in Per- centage of Protein between Flinty and Starchy Kernels.	Per Cent. of Flinty Kernels in the Wheat.
		Flinty Kernels.	Starchy Kernels.	Flinty Kernels.	Starchy Kernels.		
		3.	4.	5.	6.	7.	8.
3	Beechwood Hybrid.....	8.45	8.50	14.95	10.79	4.16	31
5	Indiana Swamp.....	8.62	7.54	12.77	10.54	2.23	47
9	Kansas Mortgage Lifter	8.82	9.43	14.04	10.83	3.21	35
11	Rudy	8.15	8.32	11.63	10.63	1.00	43
13	Turkish Red	7.69	7.55	11.85	10.75	1.10	54
14	Lancaster Red	8.55	8.42	13.26	10.85	2.41	29
15	Fulcaster	8.58	8.28	14.01	11.04	2.97	51
16	Harvest King	7.56	7.15	14.06	11.10	2.96	42
17	Fultz.....	7.44	7.25	14.25	11.05	3.20	23
18	Jersey Fultz	8.74	8.23	14.66	10.49	4.17	20
19	Extra Early Oakley	7.66	8.03	14.68	11.08	3.60	34
22	Harvest Queen.....	8.74	8.52	13.01	10.25	2.76	19
25	Gold Coin	8.79	7.97	12.33	9.44	2.89	15
29	Canadian Hybrid.....	8.94	8.85	12.50	9.19	3.31	16
33	Dawson's Golden Chaff	10.47	10.54	12.63	9.11	3.52	20
34	Pearl Prolific	10.57	10.54	13.91	9.52	4.39	21
35	Improved Rice Wheat	7.36	7.26	15.17	10.92	4.25	36
36	Hungarian Wheat.....	7.60	7.54	13.12	10.27	2.85	56
37	Pootung	7.54	7.54	16.55	10.67	5.88	34
	Averages	8.43	8.28	13.65	10.45	3.20	33
	Highest	10.57	10.54	16.55	11.10	5.88	56
	Lowest.....	7.36	7.15	11.63	9.11	1.00	15

TABLE II.

Number of Variety.	NAME OF WHEAT.	DATE WHEN RIPE.					Protein Per Cent.	Number of Ker- nels in 100, cut under a pressure of 4 lbs.	
		1899	1900	1901	1903	Average For Four Years.		Flinty Kernels.	Starchy Kernels.
3	Beechwood Hybrid.....	3. June 16	4. June 21	5. June 26	6. June 15	7. June 19.5	8. 14.95	9. 76	10. 78
5	Indiana Swamp	" 19	" 19	" 27	" 20	" 21.2	12.77	56	60
9	Kansas Mortgage Lifter	" 19	" 19	" 24	" 15	" 19.2	14.04	56	84
11	Rudy.....	" 24	" 23	" 28	" 23	" 24.5	11.63	40	56
13	Turkish Red.....	" 24	" 23	" 28	" 23	" 24.5	11.85	68	96
14	Lancaster Red	" 19	" 21	" 26	" 20	" 21.5	13.26	76	96
15	Fulcaster	" 19	" 21	" 26	" 20	" 21.5	14.01	46	68
16	Harvest King	" 16	" 21	" 24	" 15	" 19.	14.06	70	90
17	Fultz	" 19	" 19	" 24	" 15	" 19.2	14.25	75	98
18	Jersey Fultz	" 19	" 19	" 24	" 15	" 19.2	14.66	80	94
19	Extra Early Oakley	" 19	" 19	" 23	" 15	" 19.	14.68	55	66
22	Harvest Queen	" 24	" 23	" 28	" 23	" 24.5	13.01	96	98
25	Gold Coin	" 24	" 23	" 28	" 23	" 24.5	12.33	94	98
29	Canadian Hybrid.....	" 24	" 23	" 28	" 20	" 24.	12.50	78	86
33	Dawson's Golden Chaff.....	" 24	" 23	" 27	" 15	" 22.	12.63	68	92
34	Pearl Prolific	" 19	" 19	" 23	" 15	" 19.	13.91	68	86
35	Improved Rice Wheat.....	" 19	" 19	" 23	" 15	" 19.	15.17	66	92
36	Hungarian Wheat	" 23	" 23	" 28	" 23	" 24.7	13.12	80	96
37	Pootung	" 23	" 23	" 23	" 15	" 19.	16.55	50	70

TABLE III.
Analyses of Kernels of Different Sizes.

Number of Variety.	Name of Wheat.	Size of Kernel.	Moisture Per cent.		Protein per cent in moisture-free samples		Wt. of 100 Kernels, Grams.
			Flinty Kernels	Starchy Kernels	Flinty Kernels	Starchy Kernels	
		3	4	5	6	7	8
9	Kansas Mortgage Lifter	Large	3.63	10.31	13.82	10.65	4.5687
	" " "	Medium	8.82	10.80	14.04	10.20	3.6419
	" " "	Small	7.32	10.62	13.48	10.06	3.0364
	" " "	Slightly starchy, Large	7.91	9.43	13.57	10.83	
19	Extra Early Oakley	Large	9.16	9.23	15.68	9.84	
	" " "	Medium	8.89		15.15		
	" " "	Small	8.47		14.19		
	" " "	Slightly starchy, Large	8.54	9.23	14.90	9.84	

TABLE IV.
Protein in Grains from Different Parts of a Head of Pootung Wheat.

Part of the Head from which the grains were taken.	No. of Grains.	Ave. wt. of one Grain Grams	Per Cent of Protein in the Grains
Lowest pair of Spikelets	4	.0515	12.75
Second " " "	"	.0473	13.31
Third " " "	"	.0523	13.06
Fourth " " "	"	.0527	14.50
Fifth " " "	"	.0518	13.44
Sixth " " "	"	.0502	12.56
Seventh " " "	5	.0456	12.25
Tip of the Head	3	.0430	12.93

TABLE V.
Per Cent. of Protein in the Water-free Grain.

Number of Variety.	IN THE FLINTY GRAINS.			IN THE STARCHY GRAINS.		
	Average Date of Ripening.			Average Date of Ripening.		
	Before June 20.	June 20 to 22.	After June 22.	Before June 20.	June 20 to 22.	After June 22.
3.....	14.95	.....	.....	10.79	.....	.....
5.....	.....	12.77	.....	.....	10.54	.....
9.....	14.04	.....	.....	10.83	.....	.....
11.....	.....	.....	11.63	.....	.....	10.63
13.....	.....	.....	11.85	.....	.....	10.75
14.....	.....	13.26	.....	.....	10.85	.....
15.....	.....	14.10	.....	.....	11.04	.....
16.....	14.06	.....	.....	11.10	.....	.....
17.....	14.25	.....	.....	11.05	.....	.....
18.....	14.66	.....	.....	10.49	.....	.....
19.....	14.68	.....	.....	11.08	.....	.....
22.....	.....	.....	13.01	.....	.....	10.25
25.....	.....	.....	12.33	.....	.....	9.44
29.....	.....	.....	12.50	.....	.....	9.19
33.....	.....	12.63	.....	.....	9.11	.....
34.....	13.91	.....	.....	9.52	.....	.....
35.....	15.17	.....	.....	10.92	.....	.....
36.....	.....	.....	13.12	.....	.....	10.27
37.....	16.55	.....	.....	10.67	.....	.....
Average	14.70	13.19	12.41	10.72	10.38	10.09
Highest	16.55	14.10	13.12	11.10	11.04	10.75
Lowest..	13.91	12.63	11.63	9.52	9.11	9.19
Range...	2.64	1.47	1.49	1.58	1.93	1.56

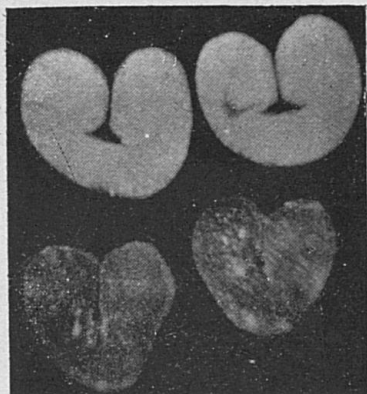


FIG. 1.—Transverse section of wheat kernels, enlarged about five diameters. The upper row shows the starchy kernels, the lower the flinty ones. Photographed by J. N. Harper.

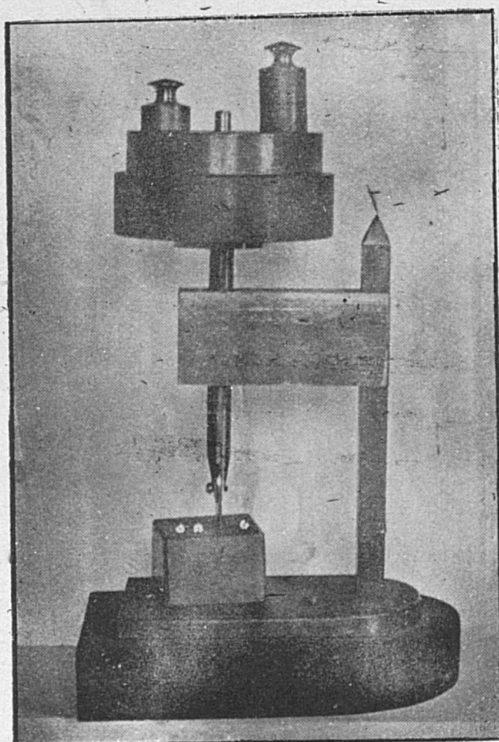
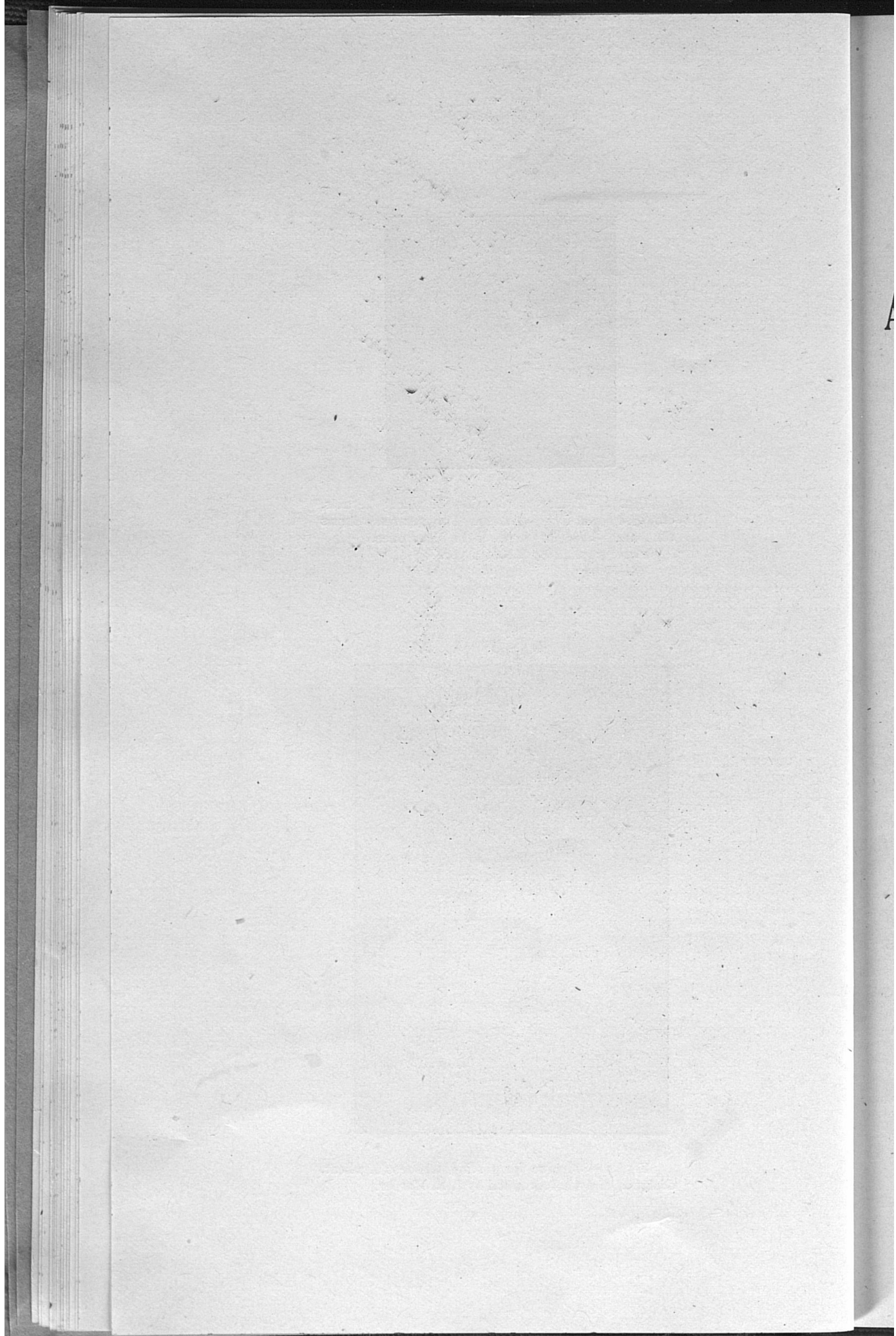


FIG. 2.—Machine for testing hardness of wheat, designed and photographed by J. N. Harper.



KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 114.

INSECTS INJURIOUS TO CABBAGE.

LEXINGTON, KENTUCKY,

JUNE, 1904.

KENTUCKY

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ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

BULLETIN NO. 114.

INSECTS INJURIOUS TO CABBAGE.

BY H. GARMAN,

Entomologist and Botanist of the Station.

Several cases of supposed poisoning from eating sprayed or dusted cabbage have been reported in local papers, which call attention to a danger that we had supposed was fully appreciated by every intelligent grower of garden stuff. It is a danger that must always attend the use of poisons on parts of plants that are to be eaten—the danger from ignorance or heedlessness on the part of help. Experimenters have, I am sure, kept this danger in mind, and it has deterred most of us from unreservedly recommending the use of arsenites on cabbage, though it has long been evident that spraying with some form of arsenic is one of the most effective known means of preserving plants from injury.

The reports, whether well founded or not, have, I trust, served a useful purpose in giving emphatic warning to those who grow cabbage concerning the dangerous nature of some of the substances used to destroy cabbage worms.

The first case reported was that of two young girls, daughters of Mrs. Minnie Hornsby, of Winchester, Clark County, Ky. On the evening of April 11, 1903, these children, aged seven and five years, respectively, ate the raw outer leaves from cabbage bought by their mother from a colored huckster, Jerry Sullivan. One of them was soon taken sick, and said later that she quit eating the cabbage because it burned her mouth.

The second girl became ill a few hours later. Supposing the trouble was not of a serious nature the mother employed simple household remedies at first, and a physician was not called until twenty-four hours had elapsed. By this time the one who had eaten most of the cabbage was very ill, and Dr. J. W. Johnson who attended the girls informed me, nearly lost her life.

I have received letters from several Winchester people concerning this case, and taking the testimony afforded by all together there can be little doubt but that these children were poisoned by arsenic in some form, and the evidence points to the cabbage as the source of it. The symptoms were vomiting, purging, cramps, convulsions, fever, and a final collapse, from which both girls rallied and very gradually recovered, though from Mrs. Hornsby's account, written shortly after the case occurred, one of them seemed likely for a long time to feel the effect of the illness.

Unfortunately, the cabbage from which the leaves were eaten could not be secured for analysis. Mr. Stephenson, who sold it, bought it of M. P. McCann & Company, 249 East Jefferson St., Louisville, Ky. In a letter from this firm I was informed that it was impossible to say positively where the cabbage came from, but that the firm was then receiving most of its supply from New York State. Here the matter rests at present.

The second case is that of a gentleman residing in Lexington, who was taken sick after eating cabbage bought of a Lexington grocer, April 18, 1903. The illness in this case appears never to have been very serious, and the symptoms were not so unmistakably those of poisoning with arsenic as in that first mentioned. Furthermore, the family of this gentleman, consisting of a wife and two children, ate of the same cabbage and were not made ill. The trouble was, however, attributed in a newspaper item to sprayed cabbage, and it was thought worth while to investigate it.

Half of the head of cabbage used by this family was secured for analysis. It was of the purple variety. Mr. M. A. Robinson, who sold it, bought it with other cabbage in a barrel of the Butner Produce Company of Lexington, and Mr. Butner informs me that the lot came from Western New York.

The half head secured tasted much like other cabbage, and by ordinary examination it would have been impossible to say that anything was wrong with it. The outer leaves had been removed. Dr. A. M. Peter, who made the analysis at my request, could not get a perfectly satisfactory test for arsenic. The crystals secured were very minute, and could not be made to show clear and unmistakable outlines. But the presence of copper, of which a satisfactory test was secured, is in itself positive evidence that the cabbage had been sprayed. His report on the analysis reads as follows:

AGRICULTURAL EXPERIMENT STATION OF THE STATE COLLEGE
OF KENTUCKY.

CHEMICAL DIVISION, LEXINGTON, May 9, 1903.

PROF. H. GARMAN,

Dear Sir:—I have carefully tested the half head of purple cabbage which you handed me some days ago for copper and arsenic. It contained a minute trace of copper, but my test for arsenic failed to give a positive result. If the cabbage contained any arsenic it was much too small in quantity to have produced any effect upon the person eating the cabbage.

Very respectfully,

[SIGNED]

ALFRED M. PETER.

If the gentleman who ate part of this head of cabbage was poisoned by it he must consequently have chanced upon a portion to which the poison had more thickly adhered than to the half secured for analysis.

Perhaps no further comment on these cases is necessary. Either taken alone might be regarded as not positive proof of danger from spraying cabbage with arsenites. Taken together, they support and strengthen each other as evidence, and should at least enjoin upon gardeners care in using poisonous preparations on such crops as cabbage.

Experiments in the Use of Arsenites on Cabbage.

Yet it may be said that arsenites such as Paris green can be used on cabbage without leaving a trace sufficient for recogni-

tion by the chemist, and very much too small, therefore, to affect in any way the human body.

The experiments recorded below are intended to show to what extent poisons used on cabbage for the destruction of gnawing insects are retained on the leaves when the cabbage is brought to the table. Similar experiments on a more extended scale have been made at the New York Station (Geneva), but my chief purpose here was to keep everything so under control that it would be possible in the end to fix upon a treatment that would not only be effective but at the same time as little as possible calculated to leave dangerous quantities of poison on the plants.

No. 1.

Two rows of cabbage plants were sprayed four times with Paris green, lime and water, beginning August 19, 1901. The mixture consisted of 140 gallons of water, 1 pound of Paris green, and 2 pounds of lime. Four and a fourth pints in all were used on these plants, as follows: August 19, 1 pint; September 2, 1 pint; September 6, 1.25 pint; September 13, 1 pint.

On November 16, forty-nine pounds of cabbage were taken from these rows.

No. 2.

One row of cabbage was sprayed twice with the same mixture as No. 1 (water, Paris green and lime), as follows: Aug. 24, one-half pint; Sept. 13, one-half pint.

On November 16, twenty-seven and a half pounds of cabbage were taken from the row.

No. 3.

Two rows like those of preceding tests were sprayed four times with arsenate of lead in water, two pounds in 100 gallons, as follows: Aug. 19, 1 pint; Sept. 2, 1 pint; Sept. 6, 1.25 pint; Sept 13, two-thirds pint; giving a total of about 3.91 pints of fluid.

November 16, the rows yielded fifty-three pounds of cabbage.

No. 4.

One row was sprayed twice with arsenate of lead and water (2 pounds in 100 gallons); one-half pint being applied Aug. 24, and one-third pint on Sept. 13.

November 16, thirteen and a half pounds were taken from the row.

No. 5.

For this and No. 6, a lime-resin preparation, recommended by the New York Station was employed. One of the difficulties in dealing with insects on cabbage is that of making watery preparations stick. The lime-resin mixture is intended to solve this difficulty and appears to answer the purpose well enough. It is prepared as follows:

Lime-resin Mixture.—Pulverized resin, 5 pounds; concentrated lye, 1 pound; fish oil, 1 pint; water, 5 gallons. Put resin, oil and 1 gallon of water in an iron kettle and heat until soft, then add the lye, stirring well. Finally add 4 gallons of water and boil several hours, until it produces a clear, yellow liquid. Add water from time to time to keep the original quantity. This makes a stock solution. For use, add to one gallon of the stock solution, 16 gallons of water, 3 gallons of whitewash, and one-fourth pound of Paris green. It does not keep well and must be made as wanted.

Two rows of cabbage were sprayed four times with this mixture, as follows: Aug. 19, one-half pint; Sept. 2, 1 pint; Sept. 6, 1 pint; Sept. 13, 1 pint; making three and one-half pints in all.

November 16, fifty-six pounds of cabbage were taken from the rows.

No. 6.

Two rows of cabbage were sprayed with the lime-resin mixture twice, once Aug. 24, and again Sept. 13, using three-fourths pint the first time and 1 pint the second.

November 16, forty pounds were harvested from the rows.

No. 7 (check).

Two rows like those used in the preceding experiments were left untreated, and yielded on Nov. 16, twenty-two pounds of cabbage.

No. 8.

Experiments 8 to 14, inclusive, were made in 1902, and repeat the ones made in 1901, numbered 1 to 7, inclusive.

Four rows were sprayed with Paris green, lime and water, using the same proportions as in No. 1. Four applications were made on the following dates: Aug. 20, $\frac{1}{2}$ gallon; Aug. 23, $\frac{1}{2}$ gallon; Sept. 3, $\frac{1}{2}$ gallon; Sept. 23, 1 gallon, making in all $2\frac{1}{2}$ gallons.

Yield, Nov. 29, 111 pounds.

No. 9.

Four rows were sprayed with the mixture used in No. 8, but only two applications were made, on Aug. 20, one-half gallon, and on Sept. 23, one gallon of the mixture being employed.

72 pounds of cabbage were obtained from the rows, Nov. 29.

No. 10.

Four rows were sprayed with arsenate of lead in water, using two pounds in 100 gallons. The spraying was done as follows: Aug. 20, $\frac{1}{2}$ gallon; Aug. 23, $\frac{1}{2}$ gallon; Sept. 3, $\frac{1}{2}$ gallon; Sept. 23, 1 gallon.

Yield, November 29, 110 pounds.

No. 11.

Four rows were sprayed with the arsenate of lead mixture used in No. 10, but only two applications were made, as follows: Aug. 20, $\frac{1}{2}$ gallon; Sept. 23, 1 gallon.

Yield, November 29, 96 pounds.

No. 12.

On the four rows of this experiment the lime-resin-Paris green mixture of experiments 5 and 6 was used. Two and a

half gallons of the mixture were applied as follows: Aug. 23, $\frac{1}{2}$ gallon; Sept. 3, $\frac{1}{2}$ gallon; Sept. 23, 1 gallon.

Yield, November 29, 104 pounds.

No. 13.

This lot of four rows was sprayed only twice with the lime-resin-Paris green mixture, as follows: Aug. 20, $\frac{1}{2}$ gallon; Sept. 23, 1 gallon.

Yield November 29, 116 pounds.

No. 14 (check).

Two check lots were reserved, each of four rows. This one yielded, Nov, 29, 79 pounds of cabbage.

No. 15 (check).

Yield, November 29, 89 pounds.

In both 1901 and 1902 the untreated lots of cabbage were more freely gnawed by the worms than were the treated lots. Over a month elapsed both years after the last spraying before the cabbage was cut, and at the last some of the outer leaves of sprayed lots were gnawed somewhat freely, but the injury done at this time was of little importance, since heads were already formed. The spraying undoubtedly in some of the experiments benefited the cabbage when the plants were young, at which time, indeed, if not cared for they are likely, in this State, to be so injured as to be of little value.

Two sprayings were generally less effective (judging by the product) than four, but in the case of the lime-resin-Paris green mixture used in 1902, the first, treated but twice, yielded 12 pounds of cabbage more than the lot of the same size sprayed four times. This was probably merely an accident due to soil influence, or to better plants in one lot than in the other. It was partly to get a check on such chances that the experiments were repeated in 1902. Yet it is to be supposed that the lime-resin-Paris green mixture lasts longer than the others, and that consequently a few sprayings may answer the same purpose as a larger number. The results show that four sprayings with either of the other mixtures give about the same result as four

spraying with the resin mixture. Since the number of rows is not alike for all the lots, this will become more clearly apparent by getting the average yield per row of cabbage for the two years. It is shown below :

Paris green-lime,	4 sprayings,	26.66 pounds per row.			
" " "	2 "	19.90	"	"	"
Arsenate of lead,	4 "	27.33	"	"	"
" " "	2 "	21.90	"	"	"
Lime-resin-Paris green,	4 "	26.66	"	"	"
" " "	2 "	26.00	"	"	"
Checks,		19.08	"	"	"

The outer leaves of all the heads were removed in the field in 1901 and in 1902, though not as completely as is done by Lexington marketmen. Several members of our Station force, including the writer, used the sprayed cabbage in their families in both 1901 and 1902, and experienced no ill effects from it. In 1901 the analysis made by Dr. Peter of the Division of Chemistry, showed traces of poison present, but in quantities so small, as to be scarcely measurable, and certainly too small to do harm. His report is as follows :

The samples consisted of a single head of each kind, from which the outer leaves had been removed, labeled as shown below. To prepare the material, the stalk was first trimmed off close to the head. The heads were then separately weighed and chopped fine, and a portion from each weighed out for analysis.

8818.—Labeled "Paris green and lime, 2 sprayings," Weighed 2 lbs., 12 ozs.

8819.—Labeled "Paris green and lime, 4 sprayings," weighed 3 lbs., 8 ozs.

8820.—Labeled "Arsenate of lead, 2 sprayings," weighed 2 lbs., 13 ozs.

8821.—Labeled "Arsenate of lead, 4 sprayings," weighed 3 lbs., 15 ozs.

8822.—Labeled "Lime-resin-Paris green, 2 sprayings," weighed 2 lbs., 15 ozs.

8823.—Labeled "Lime-resin-Paris green, 4 sprayings," weighed 1 lb., 11 ozs.

The following results were obtained :

	8818	8819	8820	8821	8822	8823
Arsenious acid						
Per cent.	0.0004	0.0004	0.0006	0.0003	0.0005	0.0012
Grains per pound.	0.028	0.028	0.042	0.021	0.035	0.084
Grains in each head.	0.08	0.10	0.12	0.08	0.10	0.14
Copper oxide						
Per cent.	0.0001	0.0002			0.0002	0.0003
Grains per pound.	0.007	0.014			0.014	0.021
Grains in each head.	0.02	0.05			0.04	0.04
Lead oxide						
Per cent.			0.0003	0.0002		
Grains per pound.			0.021	0.014		
Grains in each head.			0.06	0.05		

The quantities of metals present were so small that accurate determination could not be expected; it is probable, however, that the figures obtained are larger than the true ones. There seems to be little correspondence between the amounts of metals obtained and the number of sprayings, but it is likely that the amount of metals received and retained by different heads in the same plot of sprayed cabbage would be quite various.

[Signed]

ALFRED M. PETER, Chemist.

In 1902 and again in 1903 sprayed cabbage was submitted to Dr. Peter for analysis, but after carefully testing it he reported that he was unable to find a trace of poison present. In the latter year he removed the outer leaves from the heads and made a separate analysis of them, so as to learn to what extent the poison might have remained here, but was not able to find a trace even on them.

While the injury suffered by cabbage in Kentucky is largely the work of a half dozen species of insects, we have in the State not less than two dozen species that have been accused here or elsewhere of attacking cabbage at times. Our troublesome species are, the Imported Cabbage Worm, the Cabbage Looper, the Southern Cabbage Moth (*Evergestes rimosalis*), the Cabbage Plutella, the Harlequin Cabbage Bug, the Cabbage Plant-louse and the Cabbage Flea-beetle (*Phyllotreta vittata*). The other species attacking cabbage here are occasional or local in their depredations. Still others, though in some cases common in Kentucky, have not actually been observed to injure cabbage here at all, though probably at times doing some slight damage.

THE IMPORTED CABBAGE WORM.*Pontia rapae.*

The adult of this worm is a common white butterfly with a wing expanse of from 1.62 to 1.87 inch, each front wing with a black tip, and one (male), or two (female) black spots, the hind wing of both sexes with a black spot at the front margin.

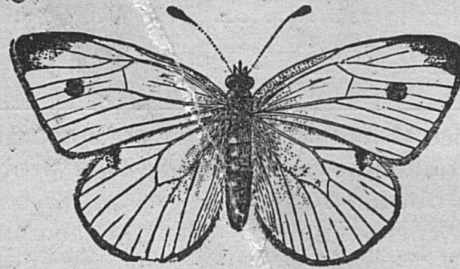


FIG. 1.—The Imported Cabbage Butterfly, male.

The yellow, ribbed, bluntly conical eggs of this butterfly are placed singly on the under sides of the leaves.

Worms or larvæ appear early in spring from eggs laid by recently emerged adults, the winter being spent in the pupa stage, and as a succession of broods is reared, may be found thereafter until cold weather comes the following fall. When grown they are green, sometimes with an obscure yellow, longitudinal line along the back and are rather thick-bodied, measuring about 1.25 inch in length and 0.18 inch in diameter. They are rather sluggish, moving about but little, and in doing so raising no portion of the body much from the surface of the leaf.

The worm becomes a pupa early in the summer, changing its skin for the purpose while about the plants, to which pupæ are secured by a silken band about the middle of the body and a slight mat of silk to which the tip of the abdomen is secured. The pupæ are angular bodies about three-fourths inch long.

Taking it one year with another, this worm causes more loss from its injuries to cabbage than any other, and most of the spraying and dusting of this crop is directed against it. However, the Cabbage Looper described farther along is at times quite as destructive, though not so evenly distributed nor so constantly present on the plants throughout the season.

THE NATIVE CABBAGE WORM.

Pontia protodice.

The adult male of this is a butterfly closely resembling the adult of the imported species, though lacking a faint yellow cast characteristic of the latter, but has about four angular spots on the disc of the front wing, and several angular black marks at and behind the tip. The female is strikingly different from the male, so much so that it might be mistaken for a different insect. Her wings are all checkered with black.

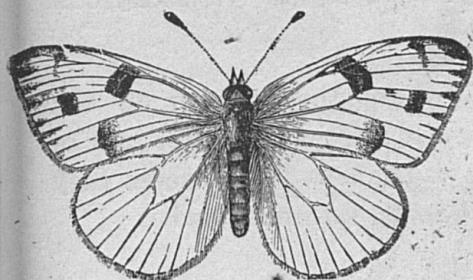


FIG. 2.—The Native Cabbage Butterfly, male. (From Riley, U. S. Dep. Agr. Rep. 1883.)

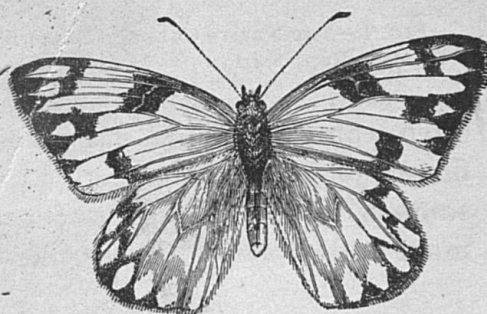


FIG. 3.—The Native Cabbage Butterfly, female. (From Riley, U. S. Dep. Agr. Rep. 1883.)

The egg is oval, is deposited singly, generally on the under sides of leaves.

The worm is of an obscure purple color, with four longitudinal pale yellow stripes, two on each side. The head and body is minutely dotted with black.

The pupa resembles that of the related species, but is dotted with black, and the spine at the front end of the body tapers more abruptly and is flanked with a couple of small teeth that are wanting in the pupa of the imported worm. The winter is spent as a pupa.

Several broods are reared each season. The worms are sometimes found on cabbage, but quite as often on turnips, and are not commonly troublesome on either. The adults are

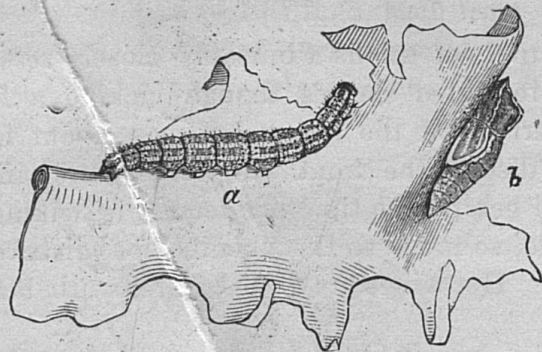


FIG. 4.—The Native Cabbage Butterfly, *a*, larva; *b*, pupa. (From Riley, U. S. Dep. Agr. Rep. 1883.)

often common along our pikes, where they cluster on the flowers of catnip and other wayside plants in the latter part of summer. From their abundance at times it would seem they must feed on some plants other than those mentioned.

THE CABBAGE LOOPER.

Autographa brassicae.

A rather plain, gray-brown moth measuring from tip to tip of its expanded wings about 1.37 inch, places its minute eggs on cabbage every summer, and its young are next to the imported worm, the most destructive cabbage insect occurring in Kentucky. The moth, because of its obscure colors and shy ways, is unknown to the practical gardener. It may be recognized among other insects likely to be found about cabbage by a small silvery dot and loop on the upper side, and near the center, of each front wing.

The eggs are placed singly or in clusters, generally on the upper surfaces of the leaves.

The worm is called a looper because while traveling it alternately draws the body up in a loop and then extends it again. It is of a pale green color, marked with four rather conspicuous pale longitudinal stripes and generally with a number of very narrow more or less evident lines between them. When fully grown it is rather larger than the common cabbage worm. This

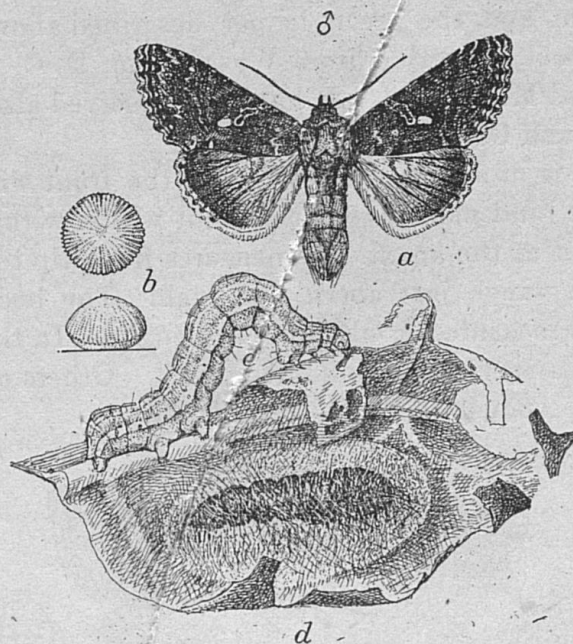


FIG. 5. The Cabbage Looper. a, adult; b, egg; c, larva; d, pupa. (From Chittenden, Bul. 33, U. S. Div. Ent.)

looping worm is more disposed to bore into the heads of cabbage than the other worms, and riddles the outer leaves with roundish holes, instead of eating away large areas of the leaf and leaving finally only the ribs, as is true of its associate in iniquity. It feeds on a variety of plants, including turnip, kale, dandelion and dock. At times it proves very destructive at Lexington to celery, a plant that is attacked farther north by a different species (*Autographa falcigera*) which is rather rare in Kentucky.

Several broods (4 or more) appear each year. The worm encloses itself in a thin web-like cocoon on the leaf, and becomes a brown pupa; this in turn disclosing the moth.

THE SOUTHERN CABBAGE MOTH.

Evergestes rimosalis.

A smaller moth with pale yellow obscurely marked wings, is now and then common among cabbage plants in Kentucky, and can generally be found in small numbers feeding with the imported worm and the green looper described above. It is a southern insect, occurring from Washington, D. C. to Georgia, Alabama and Mississippi. It has been observed also in Southern Illinois and California.

The moth is of a cream-yellow color, the front wings dusky-clouded, the hind pair largely iridescent white, with a blackish border widest at the apex. It measures from tip to tip of the outstretched wings just about one inch. The body is rather slender, and measures a half inch in length. In the Division collection is a specimen captured May 9. Others emerged in confinement August 13 and November 21.

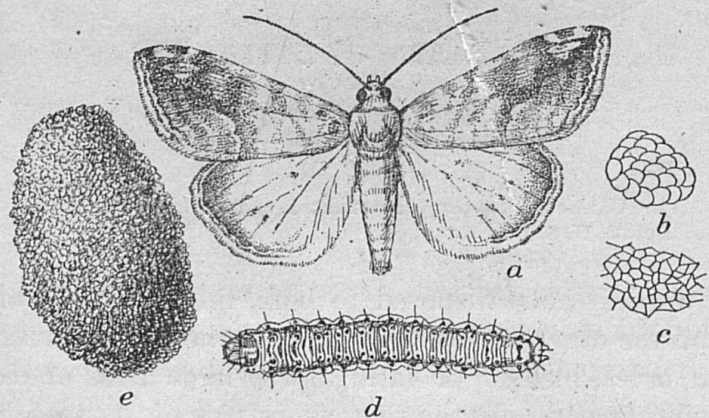


FIG. 6.—The Southern Cabbage Moth. a, adult; b, egg-mass; d, larva; e, cocoon. (From Chittenden. Bul. 33, U. S. Div. Ent.)

The female places her eggs in masses of about twenty. The egg is yellow, oval, flattened, and about 0.04 inch in diameter.

The larva is pale bluish on the back, this region finely cross-lined with black, and edged on each side with a well defined longitudinal black stripe, this in turn bordered below by a stripe of yellow including the spiracles. Greenish beneath. Head

translucent brown. Body divisions with slender, erect, black hairs, arising from small black tubercles, about six of which are present on each division, and in addition is a series of small tubercles, mostly pale, along the lower part of each side, some of these bearing two small hairs instead of one. Legs pale. An example before me measures 0.68 inch in length, and 0.12 inch in diameter. The worms creep rather rapidly when so disposed, but do not lift the body from the surface upon which they are. Ordinarily they are found between the inner leaves, lying inactive. When disturbed they may drop off the leaf, emitting at the same time a silken thread. The injury consists in eating round holes in the leaves. When fully grown the worm deserts the plant and descends to the ground, where it may either spin a loose cocoon on the surface or change to a pupa lying exposed. The pupa is about one-half inch long, brown in general color, the abdomen paler. It is said to hibernate in the soil as a larva, becoming a pupa the following Spring.

THE CABBAGE PLUTELLA.

Plutella maculipennis.

Quite often cabbage is badly injured in this region by a very small worm that is completely overlooked by the grower as a distinct species, being considered, if observed at all, as the young of some other insect. It might readily enough pass as the young of the imported worm. It is the larva of a slender-bodied, slender-winged moth of the same family as the clothes moth of dwellings.

The wings of this moth are kept folded against the sides of the body, are a little turned up at the tips, and are provided with a long fringe. The color above on head, thorax, and upper part of closed wings, is of a light clay-yellow. That part of the wings that is lowest when they are folded is bronzy brown, this color terminating abruptly where it meets the clay-yellow of the back by a well defined sinuous margin. The length from front of head to tips of folded wings is about one-fourth inch.

The eggs are whitish, very minute, and are attached to the leaves, though sometimes when very abundant they are, it is said, placed on the sides of crates holding cabbage.

The larva when about grown measures 0.3 inch in length, tapers a little to the extremities, and is of a pale green color. It is active and irritable, in this respect being very different from any of the larger larvæ described. Examined closely, the head may show numerous minute brown dots. On the body divisions are small erect black hairs, each arising from a pale

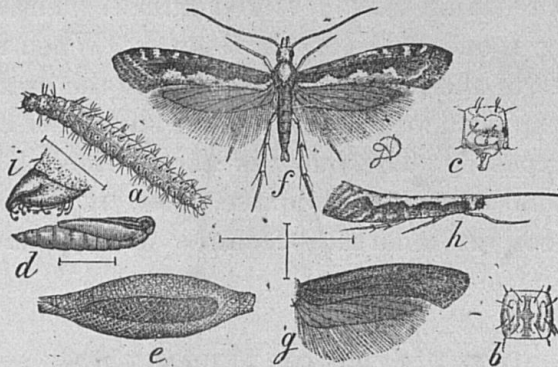


FIG. 7.—The Cabbage Plutella. *a*, larva; *b*, single division of same greatly enlarged; *c*, single division, side view; *d*, pupa; *e*, pupa in cocoon; *f*, adult; *g*, wings of dark variety; *h*, moth with folded wings. (From Riley, U. S. Dep. Agr. Rep. 1883.)

dot. Generally eight of these may be counted on a division. The false legs are slender and dusky tipped.

The pupa is enclosed in a delicate silken net, or open-work bag, attached to the leaves. The pupa is whitish, but sometimes shows brown stripes.

During very dry weather these little insects become exceedingly common, and riddle the cabbage leaves with small holes. Wet weather, on the other hand, has long been known to be unfavorable to them, and this led Dr. Fitch, many years ago, to recommend drenching the plants with water as a means of lessening the injuries. Tar water has been found a useful and cheap remedy in European countries. Coal oil emulsion has been suggested for the purpose also. It hibernates as a pupa. The species has a world-wide distribution.

THE ZEBRA CATERPILLAR.

Mamestra picta.

A rather stout, smooth-bodied worm of a pale yellow color, with markings of black arranged on the side as more or less evident up and down stripes, is often encountered in Kentucky on cabbage, peas, cauliflower, mangel wurzel, and related plants. The insect belongs to the same order as the imported cabbage butterfly, and may be treated in the same way.

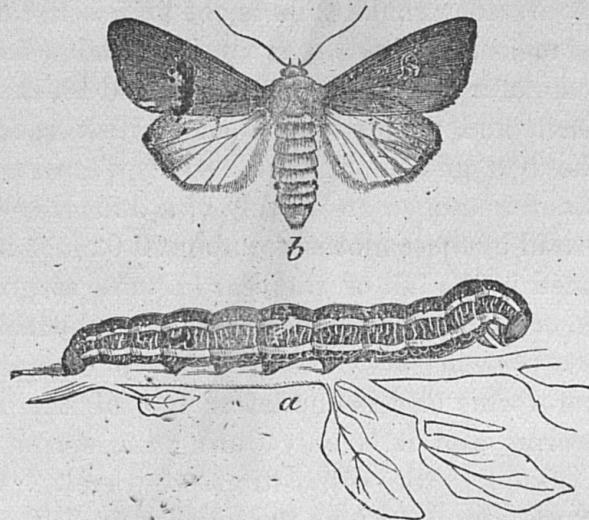


FIG. 8.—The Zebra Caterpillar. *a*, larva; *b*, moth. (From Riley, U. S. Dep. Agr., 1883.)

The worms are seen here on cabbage in June, and again in September. A brood of young was observed here 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 pupæ, in which condition they pass the winter. There are two or more annual broods.

The fore wings of the moth are of a rich purple 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, consequently, associated in

colonies, but later, disperse. If they are taken before this occurs they can be destroyed with little trouble. When young plants are attacked it is possible to destroy the worms with a spray of Paris green.

THE ARMY WORM.

Heliophila unipuncta.

This insect is not generally known as an enemy of garden truck, but has at times shown a fondness for such fare, and among other things is known to have a relish for cabbage.

The moth is one of our most common night-flying species, but owing to its nocturnal habits is not known to farmers. Its front wings measure a little over an inch and a half from tip to tip, and are of a fawn-color, with a curved blackish bar near the tip of each and a clearly defined whitish speck near the center. The head and thorax are also of a fawn color. The hind wings and abdomen are largely of a dull gray color.

The eggs laid by these moths are about 0.02 inch in diameter, and are placed in the fall of the year in tufts of grass and on dried stems, or may be thrust beneath the ensheathing parts of grass blades.

The young worms feed in the latter part of the season like young cutworms and it is only during the spring that they sometimes assume the disposition to travel. When fully grown, they measure 1.50 inch in length, and 0.19 inch in diameter. The general color is gray, with stripes of black, and narrow lines of white, the white lines along the middle of the back being interrupted. Under side of body greenish. Head smooth and shining, pale yellow, finely reticulated on sides with brown lines, and with a pair of curved stripes beginning near the mouth, approaching for a short distance then diverging to the back of the head.

The pupa is formed in the soil. It is of a bright chestnut-brown color, smooth and shining, and is provided with a pair of spines at the tip of the abdomen, and with several cross rows of small black denticles. Its length is about 0.75 inch.

The winter is spent in both larva and moth state. Several annual broods develop at this latitude.

THE CORN WORM.

Heliothis armiger.

This well known pest of corn fields sometimes deserts the corn ears when these grow tough and resorts to plants near at hand. Under such circumstances it may attack tomatoes, tobacco, cotton, or cabbage. The worm is in a general way not unlike the army worm, and is a member of the same insect family. At the South it is known as the Cotton Boll-worm.

The moth is of about the size of the army worm moth, its wings expanding about 1.50 inch. The front wings are brown, obscurely marked with black, a noticeable mark being a black spot on the center of each. The hind wings are pale at base, and are bordered with a dusky band. When ready to become pupæ the worms leave their burrows in the ends of corn ears and cutting through the husks descend to the ground, into which they enter for a few inches and pupate in a cell made of compacted earth. They hibernate as pupæ. There are three or more annual broods.

It is a Southern insect in its general distribution, but occurs throughout most of the United States and extends even into Southern Canada.

THE YELLOW WOOLLY BEAR OR TIGER MOTH.

Diacrisia virginica.

A large hairy caterpillar, of a yellow, reddish, or blackish brown color, is quite common at times on cabbage and cauliflower in Kentucky, and does a good deal of mischief by gnawing the leaves, especially at the edges of fields. It is an omnivorous feeder, and besides these plants also attacks cow-peas and soy beans, and I have known one instance of its injuring severely water lilies and other aquatic plants in ornamental pools in a park, working, of course, at the edges. The moth is pure snow-white, with a few small, black dots on the wings, one at the center of each front wing, and two on each

hind wing, one near the center, the other near the hind angle. The abdomen is marked with black dots in four lengthwise series, and with yellow stripes.

Two annual broods appear. The adult insect is often known to children as the White Miller, and is frequently encountered by them when playing about lawns of evenings.

THE VARIEGATED CUTWORM.

Peridroma margaritosa.

Cut-worms do their mischief to cabbage when the plants are newly set out, but some of them may be found on the leaves of the fully matured cabbage. When the plants are young they are especially troublesome, and it requires all the attention of the grower at times to get a stand. Several different species of

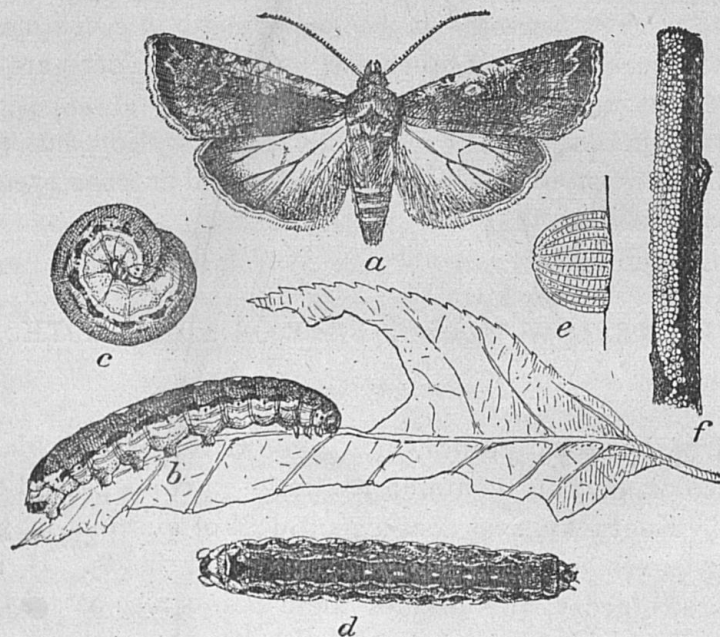


FIG. 9.—The Variegated Cutworm. a, moth; b, c, d, larva; e, f, eggs. (From Howard, U. S. Dep. Agr. Farmers' Bul. 120.)

insects are concerned in these injuries, but among them the species named above is generally conspicuous. The moth is

a night flyer, and measures about 1.75 inch from tip to tip of its outstretched wings. The front wings are of brownish black color, with obscure markings.

The worms are active during April and May, then go into the ground in 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 frequent until fall. Individuals may sometimes be captured as late as October 25. They are very indiscriminate feeders, attacking among other things, corn, clover, timothy, strawberries, tomatoes, and sweet potatoes. They hibernate in all three stages,—larva, pupa, and imago, and appear to be two-brooded.

THE GREASY CUTWORM.

Agrotis ypsilon.

This is the young of another moth of about the same size as the preceding, and of about the same general hue. It has been observed at Lexington from June 25 until September 23. Freshly emerged adults have been noted as common on June 29, and on July 12 as very common. From this date they generally become somewhat less abundant, but are frequent among moths attracted to light in dwellings until about September 1.

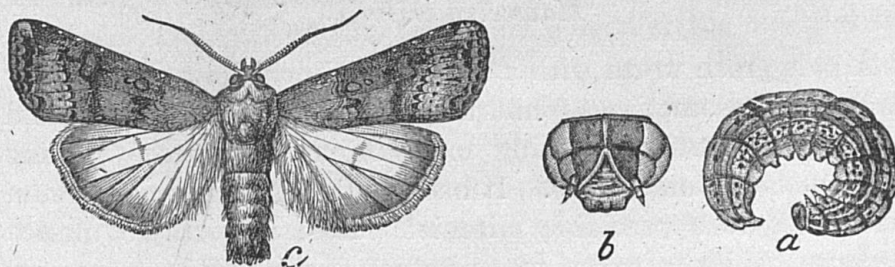


FIG. 10.—The Greasy Cutworm. *a*, larva; *b*, front view of head; *c*, moth. (From Howard, U. S. Dep. Agr., Farmers' Bul. 120.)

The worm measures from 1.5 to 1.60 inch in length when outstretched. Its general color is dull gray or brown, some-

times approaching black. The markings are obscure, but commonly a couple of pale lines are apparent on the sides just above the breathing pores. The head is brown, somewhat darker above. It is especially destructive to newly set tobacco plants and to corn, and has been observed at work on young tomato plants. It hibernates as a worm.

THE COTTON CUTWORM.

Prodenia ornithogalli.

The worm of this insect has proved very destructive to young cotton plants in the southern states, but has a wide range in food plants, and is occasionally found injuring cabbage. The moth is a rather pretty insect, expanding about one and a half inch, with the front wings blackish, marked with distinct whitish lines and spots in a complex fashion. The hind wings are largely whitish, with a faint iridescence.

The worms are conspicuously marked with a row of black triangular spots along each side of the back, and are most often seen in midsummer. Moths have been observed common in late June, and again in the latter part of August.

THE CABBAGE CUTWORM.

Mamestra trifolii.

A pale green worm with a rose-colored or yellow stripe along each side is sometimes found among cabbage in Kentucky, and has the reputation of doing much injury at times by boring into the heads and stems. It has not thus far proved common enough to do appreciable mischief, but it is worthy of notice because of its capacity for mischief and possible future increase in numbers.

The adult is a moth, measuring from 1.25 to 1.37 inch from tip to tip of the outstretched front wings, which are of a pale umber-brown color and marked with a kidney-shaped black

spot at the centers. The hind wings are whitish at base, with whitish fringe, preceded by a rather broad black border.

The worm goes into the earth a few inches to pupate, and remains a pupa over winter. Adults have been secured April 8 and again August 6 and 18, from which there appears to be several annual broods.

THE CABBAGE FLEA-BEETLE.

Phyllotreta vittata.

In cabbage and turnip plots that are not well cared for this small beetle is very abundant and injurious in Kentucky. The injury ordinarily attracting attention is that done by the adults, which sometimes become so abundant that as one brushes along the plants the dispersing insects leaping from plant to plant produce a pattering resembling in no slight degree a shower of rain upon the leaves. The beetle is from 0.08 to 0.09 inches in length, shining black, and is marked with two sinuous yellow stripes which extend from the bases to the tips of the wing covers.

The early history of the cabbage flea-beetle was made out in 1865 by Dr. Shimer, of Mt. Carroll, Illinois. He found that the larva feeds on the roots of cabbage, in which respect it is different from a very similar European beetle, and also from the next one treated in this paper, both of them being leaf miners. The eggs of this beetle are placed at the bases of the plants. The grubs hatching from them work their way into the earth, mining and feeding on the roots, in some cases completely destroying the plants. When fully grown they are about one-fifth inch long, yellowish white in general color, the head dark brown. They desert the roots when ready to change to pupae, and pushing into the earth a short distance, make a small cell, in which the change takes place.

Doubtless several broods appear each summer. The adults appear with the first days of spring, and may prove troublesome at that time by eating off the leaves of young cabbage

plants as soon as these come up. From this time forth until cold weather sets in the beetles are seen in larger or smaller numbers on the plants. In this State they are particularly injurious to cabbage, turnips, radishes, and mustard, but may occur on almost any member of the family to which these plants belong. They are common at times on the leaves of cultivated strawberry. The injury done by the beetle consists in gnawing small holes and pits in the leaves.

THE CABBAGE FLEA-BEETLE.

Phyllotreta sinuata.

This beetle is so closely like the preceding that it would not be recognised by most people as a different insect. The yellow stripes of the wing covers are here more slender and the basal portion is narrowed and not so much turned inward. The thorax is smoother and more shining. It is not as common as the related insect, and its young feed in mines in the leaves, as already stated.

THE PALE-STRIPED FLEA-BEETLE.

Systema blanda.

One of the commonest jumping beetles in Kentucky is a very small yellowish species with two rather wide and nearly straight white stripes on the wing covers. As an adult it lives upon a great variety of plants, cultivated, or not, many of them troublesome weeds. It has been observed even riddling the leaves of cockle bur, at times. It is sometimes common on cabbage. The beetle is about 0.12 inch long, and is more slender relatively than the two species just described.

The larva is a slender, yellowish white, rather rigid grub, measuring about 0.12 inch long. It has been found feeding on the roots of lamb's quarters and of jimpson weed. The species occurs throughout the Eastern United States. It has at times been found very destructive to the leaves of beets.

THE SPOTTED CUCUMBER BEETLE.

Diabrotica 12-punctata.

This beetle is well known as an enemy of corn in the southern states. Its larva destroys the roots so as to cause the stalks to fall. As an adult it feeds on almost any succulent vegetation it comes across. It is known to be specially fond of the leaves and other parts of cucumbers, melons, and other related plants. It sometimes gnaws the leaves of young cabbage also, and when abundant is capable of a good deal of mischief to them.

The adult beetle, the only stage that is known to injure cabbage, is of a pale green color, or greenish yellow, marked with black. The head, mouth parts, and greater part of the antennæ, are black. The thorax is green. The wing covers are green, or yellow, with twelve large black spots arranged in three cross series, the first series at the base, the second at about the middle, and the third about midway between the last and the tips of the wing covers. Beetles measure from about 0.25 to 0.28 inch in length, and are thus considerably larger than the flea-beetles described.

THE MARGINED BLISTER-BEETLE.

Epicauta marginata.

One other beetle remains to be noticed as an enemy of cabbage. It is better known from its attacks on tomato, potato, and beets, which plants it sometimes completely deprives of their foliage. It has not in my experience proved troublesome on cabbage, but is so very common at times that it may at any timeshow its quality as a cabbage pest. The beetle measures about five-eighths inch in length, is rather slender, and widens to the hind extremity. It is black in general, with a narrow gray edging on the margins of the wing covers. These blister beetles are rather difficult to deal with, because of the quantity of poison they can eat without being affected. They are generally found in the greatest numbers, however, on land that

has been somewhat neglected, and while sometimes appearing in large numbers, they are generally restricted to an acre or

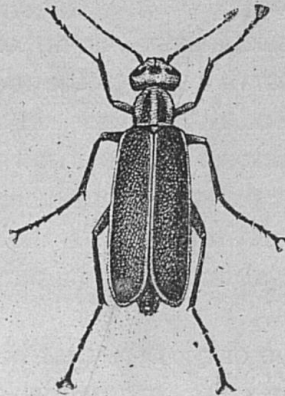


FIG. 11.—The Margined Blister-Beetle. (From Chittenden, U. S. Div. Ent. Bul. 43.)

two, and elsewhere are not sufficiently common to do serious mischief.

THE HARLEQUIN CABBAGE-BUG.

Murgantia histrionica.

The insects thus far mentioned as attacking cabbage do their injury by devouring the leaves. This one feeds in an entirely different manner, being provided with a beak with which it punctures and abstracts the sap. The effect of the puncture appears to be somewhat like that of the tarnished plant-bug. The leaves wither and turn brown as if scalded. It is very destructive at times, killing in this way the greater part of the plants in a field.

It is a glossy, flattish insect, about $\frac{3}{8}$ inch long and nearly $\frac{1}{4}$ inch in greatest width. The general color is black, and the markings are of an orange, or reddish yellow. The wings are ample, and ordinarily lie flat on the back, with the plain black tips overlapping. The young differ chiefly in lacking the wings. They feed at all times after hatching from the egg.

The calico-back, as it is sometimes called, places its relatively large eggs in two rows, side by side, on the leaves.

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 a great deal however, and may be wanting, while often extensive blotches appear. When the young hatch they push up a round lid-like piece at the free end of the egg.

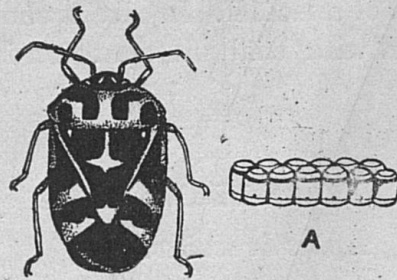


FIG. 12.—The Harlequin Cabbage Bug. Enlarged to twice its length. A, eggs.

The adult spends the winter among rubbish in gardens and fields, and comes out very early in the spring to feed on the first plants of the cabbage family to appear. Several broods develop during the season. Within the cabbage family, it seems to have no preferences. Among other plants, it is known to feed on peas, grapes, and even corn, at times.

Coal oil in emulsion is about the only thing that can be recommended for such insects, since it is necessary to kill them by means of a contact insecticide. Owing to the disposition of the insect to hide among the leaves where it cannot readily be reached with sprays, it is not easy to get rid of. One of the best remedies is the sowing of some trap crop before the regular sowing, then when the bugs have been drawn to it, plants and bugs can be destroyed with hot water, oil, or fire.

It is not constantly present in our fields. Some seasons it appears in scattered localities and occasions a good deal of complaint. Then it disappears and nothing is heard of it for a number of years. It seems not to endure very severe winter weather, being a southern insect, and this may account for its comings and goings.

THE FALSE CHINCH-BUG.*Nysius angustatus.*

A very small olive-gray bug, about $\frac{3}{8}$ inch long, and about one-fourth this in diameter, is sometimes found about cabbage plants, and has been charged with injuring them. It is sometimes very common among grasses, and might, if it were disposed, do a good deal of mischief. In case it should ever prove troublesome, spraying with coal oil emulsion is to be recommended to check it.

THE CABBAGE PLANT-LOUSE.*Aphis brassicae.*

This is one of the most abundant and mischievous of all the puncturing insects attacking cabbage in Kentucky. It is always present in some numbers, becoming especially common in the fall, and increasing steadily until cold weather cuts it off. Early in the fall, commonly, it can be found in small groups occupying depressed regions which the attack causes to develop in the leaves. Later, these colonies greatly increase, until the greater part of a leaf or head may be covered with the lice. They secrete a whitish powdery coat over their bodies which conceals their real color. Often this material becomes detached from their bodies and the leaves are dusted with it. Most of the individuals are wingless, but the species is disseminated by winged individuals that appear among the others.

The injury consists in sucking the sap and thus exhausting the plant. The result is checking the growth, and preventing the development of good heads. It is interesting to note that while this insect has a beak, like that of the harlequin cabbage bug, and uses it in the same way, yet the effect on the plant is entirely different. It serves to show that the harlequin bug injects some poison into the wound made by its beak, which causes the leaves to wilt and then turn brown. No such effect is produced by the punctures of the plant lice.

Like most other plant lice with which we are familiar, this

one multiplies during most of the summer by bringing forth living young. But an egg-laying generation is known, the eggs produced by it serving to preserve the species at times when food is not available.

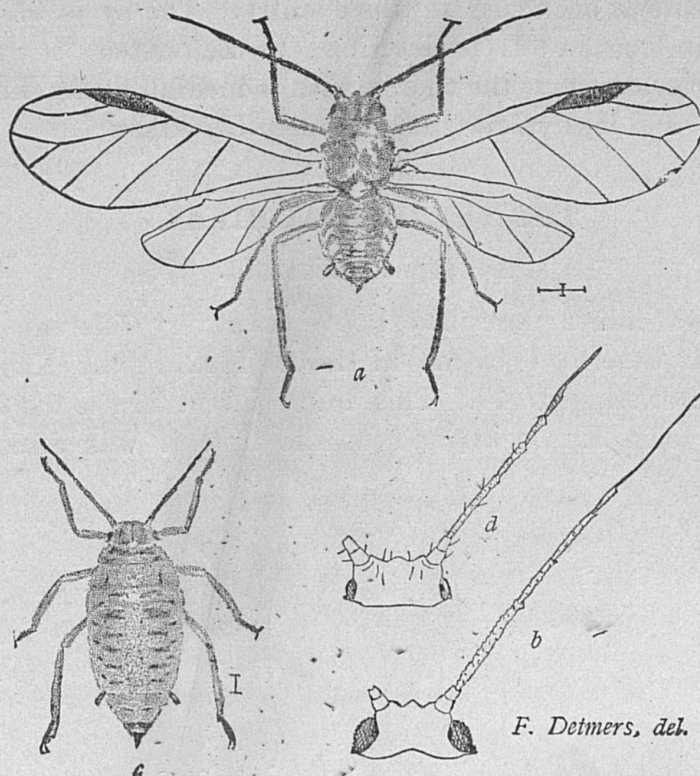


FIG. 13.—The Cabbage Plant-louse. *a*, winged male; *b*, head of same; *c*, ovoviviparous female; *d*, head of same. (From Weed, Insect Life, Vol. III.)

Spraying with coal oil emulsion is the best treatment for this insect. A spray made of whale oil soap has also been recommended. To prevent the development of egg-laying individuals, it may be well, where the insect is gathering head on a place, to make a point of destroying the remnants of cabbage left in the field after harvesting a crop.

THE CABBAGE LEAF-MINER.

Drosophila graminum.

In 1894 this insect was reported as having been reared from mines in the leaves of cabbage in West Virginia. It has not

been observed here, but probably occurs at least in the Kentucky counties adjoining West Virginia. The injury is done by a small whitish maggot working between the cuticles of the leaf. It is a common insect, and the adult fly has been known for many years as occurring in this country. The fly is 0.08 inch or less in length. It is described by Zetterstedt, a Swedish author, as ash-gray, the thorax with a median dusky line, the antennæ and legs yellow, the abdomen blackish.

THE TURNIP LEAF-MINER.

Drosophila flaveola.

The leaf-miner described above is a very different insect from that described by me in March, 1892, in the Kentucky Station Bulletin No. 40. This latter insect mines the leaves of turnips in Kentucky, and at the time it was discovered

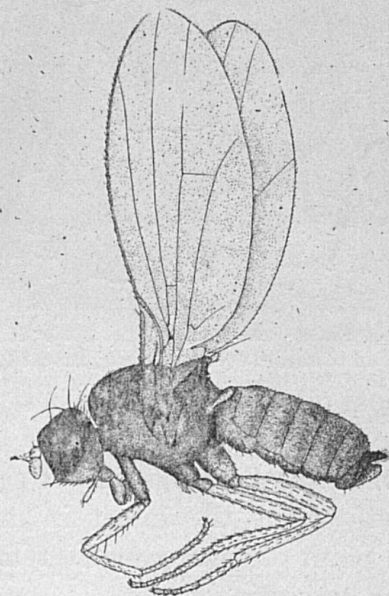


FIG. 14.--The Turnip Leaf-miner. Adult, greatly magnified.

here had not been recorded as an American insect. It is of European origin. Fresh specimens of the adult fly measure 0.12 inch in length, being thus larger than the preceding species. The living colors are as described by me in 1892,—

brown of varying shades, in some examples almost black on the sides of the thorax. The alcoholic examples preserved in 1891 have faded, and are now of a more yellow cast.* The insect was observed by Mr. Pergande, of the U. S. Department of Agriculture in June, 1892, according to Mr. Chittenden, and is said to attack cabbage, peas, and other less important plants.

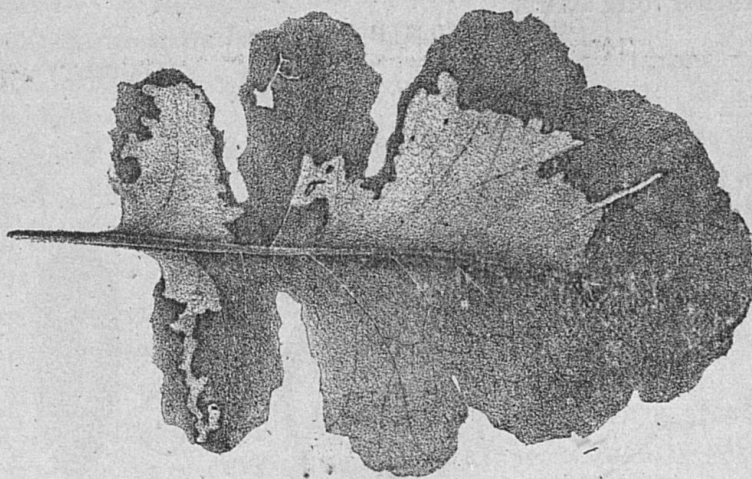


FIG. 15.—Turnip Leaf Mined by Leaf-miner.

THE FRINGED ANTHOMYIAN.

Pegomya fusciceps.

Another small fly is known to attack young cabbage plants and at times destroy them. The maggots work in the stems. It is especially likely to be mischievous in plant beds in early spring. In Kentucky it has proved very destructive to hemp at times, destroying the young plants, when one and a half to two inches high, over extensive areas, an injury for which the cutworms get the blame commonly, since this insect is so minute that it escapes the observation of farmers.

Adults reared from young hemp plants emerged May 20, and measured from 0.18 to 0.20 inch in length of body, the wing

*Meigen, Zweifluegeligen Insecten, Vol. 8, p. 66, first describes the fly as pale yellow, but afterward says that the whole animal is pale brownish yellow, from which it appears that he also observed that the color was not a pure yellow.

being of about the same length. General color gray, eyes brown, face at edges of eyes, whitish, top of head dull brown. Antennæ black. Basal half of proboscis yellow, the rest black. Thorax with three stripes, the outer ones very faint. Abdomen with a distinct median black stripe; incisures also black. Veins of wings brown, membrane slightly smoky, iridescent. Balancers pale yellowish white. Body everywhere with rather long hairs.

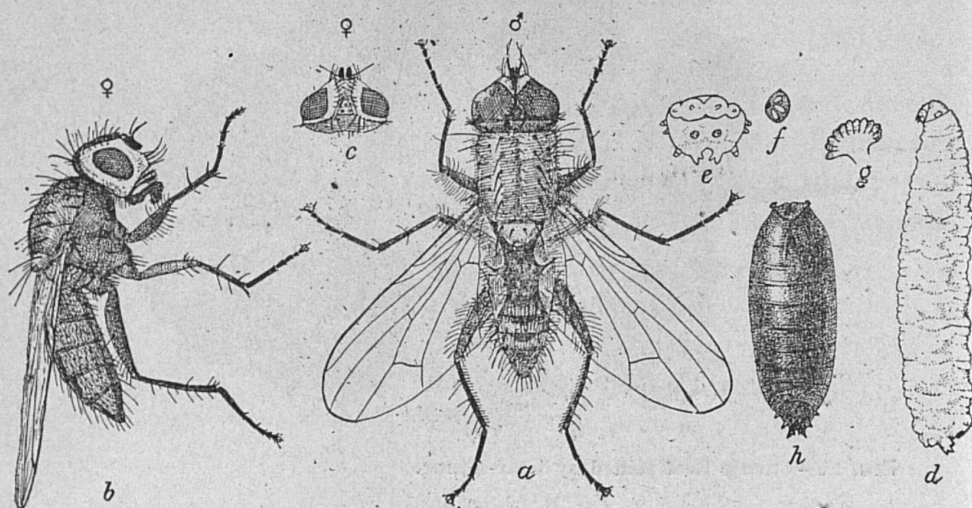


FIG. 16.--The Fringed Anthomyian. *a*, adult male; *b*, adult female; *c*, head of female; *d*, larva; *e*, last body division of larva; *h*, puparium. (From Chittenden, Bul. 33, U. S. Div. Ent.)

The young always leave the plants when ready to become pupæ, and penetrate the earth for a short distance, changing to yellow pupæ 0.18 inch long and about 0.06 inch in diameter.

Besides hemp and cabbage, the insect is known as an enemy of planted seed corn, of radishes, onions, and of the common weed, Hedge-mustard.

THE ONION THRIPS.

Thrips tabaci.

The conflict in meaning between the common and scientific names of this insect is not the result of mistakes in observa-

tion, for it is both an onion and tobacco insect, and also a cabbage insect from which fact it might just as appropriately have been named *Thrips brassicae*. Besides the plants named, it attacks cauliflower, turnip, squash, cucumber, and many others. It is the smallest insect of this list of cabbage-infesting species. The length of an example from cucumber is 0.044 inch, while its greatest diameter is 0.008 inch. The wings are very slender, and are fringed with long hairs; they measure 0.02 inch in length, and do not reach the tip of the abdomen. The eyes are black, as are also scattered hairs upon the body.

The insect undergoes no decided changes, and feeds at all periods of its life on the same kind of food. This it secures by rasping the tissues so as to reach the sap, and the part attacked becomes deprived of its green coloring matter, and dies, giving the plant a blasted appearance that has led gardeners to style the injury White Blast, the insect connected with the trouble being unknown to them.

This thrips can be destroyed by the use of sprays of strong tobacco water, or of coal oil emulsion. It is frequently troublesome to plants under glass.

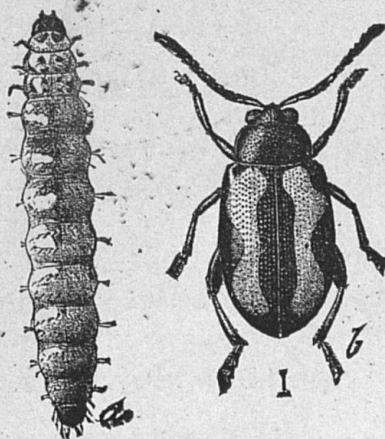
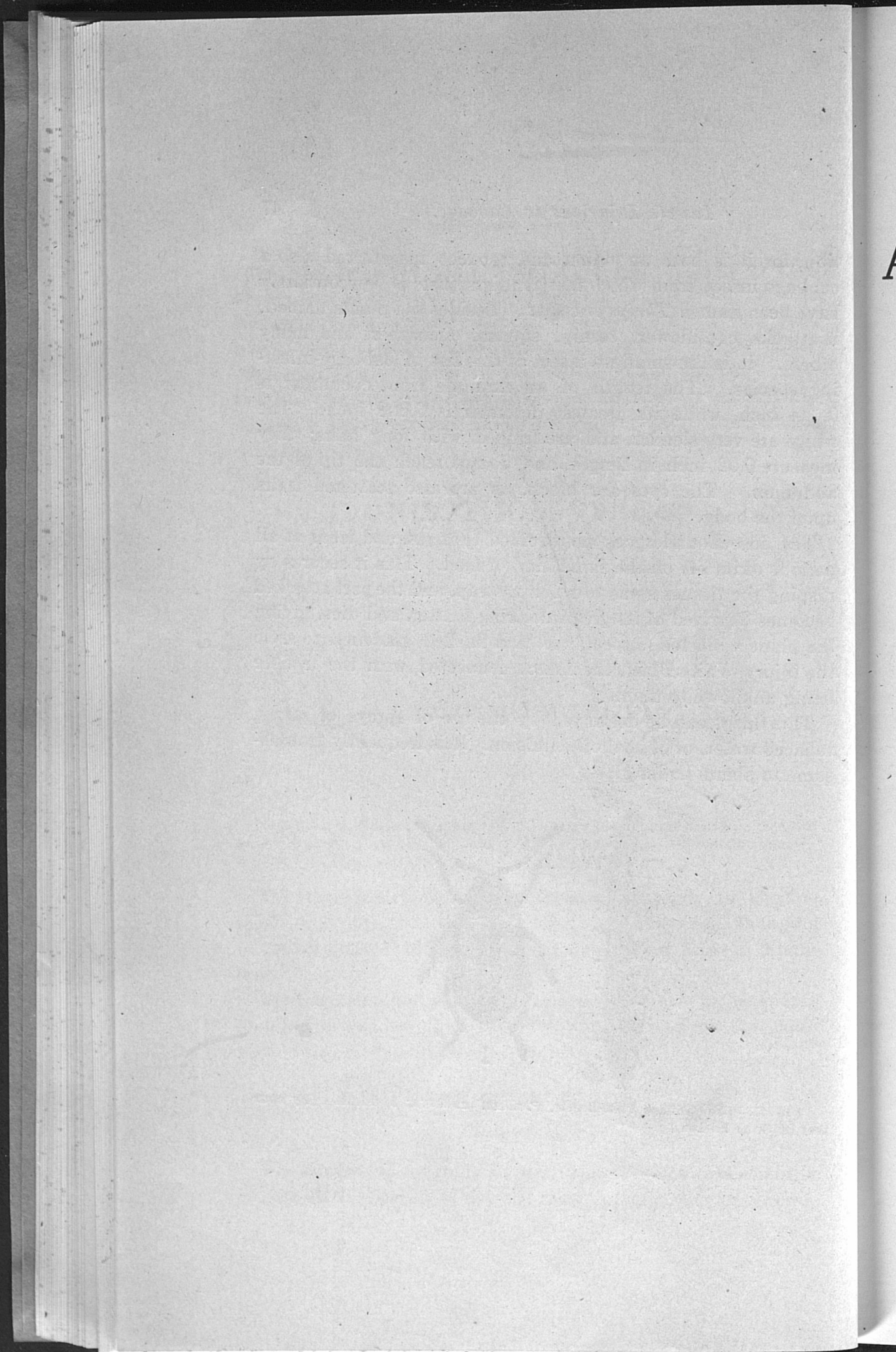


FIG. 17.—The Cabbage Flea-Beetle, *P. vittata*. a, larva; b, adult. (By courtesy of S. A. Forbes.)



KENTUCKY

Agricultural Experiment Station

OF THE

State College of Kentucky

BULLETIN No. 115.

WHEAT.

FIELD TEST OF VARIETIES.

LEXINGTON, KENTUCKY,

September 20, 1904.

KENTUCKY

Agricultural Experiment Station.

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Kentucky Agricultural Experiment Station,
Lexington, Ky.

BULLETIN NO. 115.

WHEAT.

BY J. N. HARPER, AGRICULTURIST.

FIELD TEST OF VARIETIES.

The variety test was made this season upon first rate bluegrass land which had been cultivated in tobacco for two years previously, before which it had been a bluegrass pasture for many years. The wheat was sown October 21st, 1903, with a disc drill at the rate of six pecks to the acre, in drills 7 inches apart. Each plot contained 9 rows or drills 363 feet long, and narrow spaces were left between the plots. Calculating the yields per acre the plots were reckoned as 1-20 acre each. All of the varieties stood the winter well. They were all harvested July 21st as soon as the latest varieties were fully ripe. The season was favorable, and the wheat crop in the State larger than was anticipated. The yields of the varieties and a number of other comparative data are summarized in the following tables. In determining the weight per bushel the method was employed which we adopted four years ago (See Bulletin 89, p. 177) and we are again indebted to Mr. W. W. Patterson of the Lexington Roller Mills Co., for passing upon the milling qualities of samples of grain from each variety. Following the tables are some additional notes and descriptions of the several wheats.

Table 1.

Station Number.	NAME.	Grain Bushels 60 lbs per bushel.	Lbs. Straw and Chaff.	Weight Per Bushel	Milling Qualities scale of 100 perfection	Date when heading out.	Date when ripe
3	Beech-wood Hybrid	36.	3880	61 $\frac{3}{4}$	94.5	May 27	June 26
5	Indiana Swamp	35.2	3800	63 $\frac{1}{2}$	97.	" 28	" 29
9	Kansas Mortgage Lifter	33.5	4000	63	94.	" 28	" 26
11	Rudy	33.8	2980	63	95.	" 30	July 1
13	Turkish Red	40.2	4000	63 $\frac{1}{4}$	91.5	" 30	June 29
14	Lancaster Red	35.	3600	62 $\frac{1}{4}$	91.5	" 28	" 26
15	Fulcaster	34.8	3400	64	96.	" 28	" 26
16	Harvest King	35.2	3300	61 $\frac{3}{4}$	91.5	" 27	" 29
17	Fultz	38.3	3500	63 $\frac{1}{2}$	93.	" 28	" 23
18	Jersey Fultz	38.5	4000	65	94.	" 27	" 23
19	Extra Early Oakley	37.8	3460	63 $\frac{1}{2}$	93.	" 25	" 23
22	Harvest Queen	36.7	3100	61 $\frac{1}{4}$	80	" 30	July 1
25	Gold Coin	35.4	3680	61 $\frac{1}{4}$	82.5	" 27	" 1
29	Canadian Hybrid	47.2	4480	60	89.5	" 30	" 1
33	Dawson's Golden Chaff	44.4	3940	59 $\frac{3}{4}$	90.	" 27	June 29
34	Pearl Prolific	42.2	3120	62 $\frac{1}{4}$	93.	" 26	" 21
35	Improved Rice Wheat	39.3	3240	62 $\frac{1}{4}$	93.5	" 27	" 21
36	Hungarian Wheat	36.6	4000	62	90.	" 28	July 1
37a	Pootung	29.5	3580	63 $\frac{3}{4}$	95.	" 26	June 26
37b	Pootung	29.5	3580	63 $\frac{1}{4}$	98.	" 28	" 26
38	Blue Stem	22.8	2440	60	90.	" 28	July 1

Station Number

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Table 2.

Station Number	NAME.	Character of Straw	Length of Straw		Kind of head B—Bearded S—Smooth	Kind of Chaff P—Pubescent S—Smooth	Color of Chaff	Average Length of Heads
			Feet	Inches				In's
3	Beech-wood Hybrid	Very good	4	5	S.	S.	Red	3½
5	Indiana Swamp	Medium	4	5	B.	S.	White	3¼
9	Kansas Mortgage				B.			
	Lifter	"	4	4		S.	"	3¾
11	Rudy	"	4		B.	S.	"	3¾
13	Turkish Red	Weak	3	8	B.	S.	"	2½
14	Lancaster Red	Medium	4	6	B.	S.	"	3
15	Fulcaster	"	4	3	B.	S.	"	3
16	Harvest King	Good	4	2	S.	S.	Red	4¼
17	Fultz	"	4	3	S.	S.	White	3½
18	Jersey Fultz	Very good	4	4	S.	S.	"	3¼
19	Extra Early Oakley	"	4	4	S.	S.	"	3
22	Harvest Queen	"	4	4	S.	S.	"	3¼
25	Gold Coin	"	4	1	S.	S.	Red	3
29	Canadian Hybrid	"	4	5	S.	P.	Silver	4
33	Dawson's Golden							
	Chaff	"	4	2	S.	S.	Red	3¼
34	Pearl Pr lific	Medium	4	2	S.	S.	"	3¼
35	Improved Rice							
	Wheat	"	4	2	S.	S.	"	3¼
36	Hungarian Wheat	Weak	4	5	P.	S.	White	3
37a	Pootung	"	4	9	S.	S.	"	3
37b	Pootung	"	4	9	B.	S.	Red	3½
38	Blue Stem	"	4	1	S.	S.	White	2¾

NOTES AND DESCRIPTIONS.

No. 3. Beech-wood Hybrid.

This is one of the very best wheats we have for planting on rich land. Its straw is exceptionally strong, it withstands the winter well and it is considered a good milling wheat. But, while it is a medium long-berry wheat, it is a little inclined to degenerate to the starchy type. It tested only $61\frac{3}{4}$ lbs. per bushel this year, while Jersey Fultz tested 65 lbs. per bushel. It is not an early maturing wheat nor can it be classed with the late wheats. It is not an extra heavy yielder and may be scored down some on that account. From year to year on soil of average fertility it will not yield as much as some of the other varieties, but on bottom land we believe it will stand up much better than any other wheat. Being a smooth-headed wheat it is to be preferred to some of the bearded varieties that excel it slightly in yield. It has a smooth red chaff, and it is an excellent stooler. It has a fairly large head, but has only two well-formed seeds and one small one to each spikelet. It does not shatter its grain and is one of the first wheats to head out in the spring.

No. 5. Indiana Swamp.

This variety is not recommended to the Kentucky farmer in general. It has some good points but they are offset by bad ones. This year it has an exceptionally large percentage of flinty grains and was scored as being one of the two best milling wheats. Of the 19 varieties tested, it ranked 13th in yield. Some farmers would object to it on account of it being a bearded wheat, but this is not as objectionable as its inclination to shatter its grain. It is a very loose-headed wheat and has only two seeds to each spikelet. It should be scored down two points on the character of its straw. It is easily blown down by a rain storm and seldom recovers. It is a very heavy wheat. This year it weighed $63\frac{1}{2}$ lbs. per bushel. It is one of the poorest wheats we have in the percentage of protein, is late in maturing and is thus liable to be injured by rust. Its straw and head are of medium length. It has a white smooth chaff and very long beard.

No. 9. Kansas Mortgage Lifter.

Some years this is a very heavy yielding wheat but it will not average high from year to year. It is easily winter killed. It is a good milling wheat and is rich in protein, containing a large percentage of flinty kernels. The straw is of medium strength. It has large, plump seed, and nearly every spikelet has three good kernels. It does not shatter its seed. The heads are long and heavily bearded, and have a smooth white chaff. This wheat ranks with the best in weight. It is a medium maturing wheat. The seed resemble Fultz.

No. 11. Rudy.

This is a very fine long-berry wheat but on Kentucky soils it produces kernels that are rather inclined to be starchy. This year, however, its kernels are long, angular, and flinty and it was scored as one of the best milling wheats. It will not compare with some of the other varieties in the point of yield. We do not recommend it to Kentucky farmers. It is a late maturing variety and while it has a long, well-filled head, and does not shatter its grain, it is a poor stooler and is easily attacked by rust. The percentage of protein in this wheat is the lowest of any of the varieties. It is a bearded wheat with a white smooth chaff.

No. 13. Turkish Red.

This is a very good yielding wheat. It is very hardy and withstands the winter well. Although the heads are very short and small, yet it is a good stooler, it stood the fourth, this year, in yield. It is not considered a very good milling wheat. The seed are small and those kernels that are flinty are very hard, probably too hard for the roller mills in Kentucky, while the starchy kernels are very soft. The flinty kernels do not show a high percentage of protein. This year it tested $63\frac{1}{4}$ lbs. per bushel. This is one of the late wheats and therefore is not recommended for low land where the wheat is liable to rust. It has a very short and weak straw. It does not shatter its grain. It is a bearded wheat with a smooth white chaff.

No. 14. Lancaster Red.

While this is a fairly good wheat, it does not compare with some of the other varieties in any respect. It has no remarkable characteristic. We would not recommend it to the farmers of this State. We cultivate it each year to make comparisons with other varieties. In studying the effect of climate on wheats it is necessary to grow quite a number of varieties for comparison. There are wheats being grown in the State that are inferior to this one.

No. 15. Fulcaster.

This is a much better variety than Lancaster Red. It stands third in milling qualities, and second in weight per bushel. It is of rather low yield, however, its straw is of common strength, and it is medium in the time of maturity. It has a short, strongly-bearded head, with a smooth white chaff. This is a fairly good yielder from year to year.

No. 16. Harvest King.

This is considered by some farmers one of our best wheats. It has some very good points. It has the longest head of any of the varieties tested by us, and, being a smooth-headed wheat with a smooth red chaff, a field of it is very pretty but also very deceiving. The yield is always below what one would expect from the outlook before harvesting. It is lacking in the essential characteristics of an ideal wheat, yield, quality, etc. The complaint made by farmers is, not that it is a bad yielder, but that it shatters its grain. It is very loose-headed and shatters its grain more than any of our other varieties. It is not considered an extra good milling wheat, but some years it grades well. It has a fairly good straw of medium length and very seldom lodges. It is much later in maturing than Fultz. Even with all of these faults it is not a bad wheat. It is one of the very best yielders on poor land and withstands almost all kinds of diseases.

No. 17. Fultz.

No wheat is better known than Fultz. Without doubt the improved type is among the best all round wheats we have. It yields well and is excellent for milling purposes—that is, yield-

ing a large percentage of the patent grade of flour. Its straw is strong and flexible and it therefore very seldom lodges. It is an excellent wheat for rich land, being a smooth-headed and smooth chaffed wheat, it is quite a favorite, and deservedly so, among the farmers of the central wheat belt. It is among the earliest maturing wheats and has medium sized heads which usually contain a good percentage of large, well-developed, flinty kernels rich in protein. It is one of the hardest of the soft wheats. With us the average yield for 1900, 1901, 1903 and 1904 is 36.6 bushels.

No. 18. Jersey Fultz.

This is another good wheat. In many respects it is better than Fultz. In the field it is hard to distinguish it from Fultz. It is always rated very high by the millers, and is among the best yielders we have. It has a good stiff straw, resists disease well, and is the heaviest wheat we have ever cultivated. This year it tested 65 lbs. per bushel. It is among the first wheats to ripen and is a close headed wheat. It does not shatter its grain. Analyses show that it is among the richest wheats in protein we have.

No. 19. Extra Early Oakley.

This is the first wheat to head out in the spring, but while it is an early wheat, it does not ripen its seed as early as does Pearl Prolific, and Improved Rice Wheat. Extra Early Oakley is in many respects like Fultz. It is a smooth headed, smooth chaffed wheat, and a good yielder. It is not quite as good a wheat for milling purposes as Jersey Fultz but the difference is slight. It has an excellent straw and can be grown on rich land. This is an excellent wheat for the Blue Grass region of Kentucky. It contains a high percentage of protein.

No. 22. Harvest Queen.

This is a soft white wheat producing only an average yield from year to year, and is considered the poorest milling wheat we have. It has one good feature and that is its good, stiff straw, but its poor qualities discount it from our list of good wheats.

No. 25. Gold Coin.

Like Harvest Queen this is a soft white wheat, inferior in many respects.

No. 29. Canadian Hybrid.

Of all varieties tested this year, Canadian Hybrid ranks first in point of yield. Under favorable conditions it is very prolific. It is a beardless wheat and has a very long head with velvety chaff. During the growing period it is readily distinguishable from the other varieties quite a distance from the field by the light-green color of its foliage. As a yielder we recommend it very highly, but like so many good yielding wheats it has only few good qualities. It is an amber wheat, very soft and starchy, and very low in protein. Its straw is good, but grows most too long and coarse. While it is a beardless wheat, the chaff is very hairy or downy; the heads, therefore, hold moisture and do not dry out readily after a rain. It is a light wheat and also matures very late.

No. 33. Dawson's Golden Chaff.

This is the best white wheat we have ever tested. It was second this year in point of yield, and first in the character of its straw. While it is a white wheat and is classed as a soft wheat, it, nevertheless, has this year, a large percentage of flinty, angular, kernels, and was scored much higher on milling qualities than some other white varieties. It is a beardless, smooth, red chaffed wheat, with a good long head.

No. 34. Pearl Prolific.

If this variety of wheat had a better quality of straw it would be the *acme* of all varieties for Kentucky. It is one of the best yielders we can grow, and the first to mature. It is rich in protein and a fine milling wheat. In almost every characteristic it is a leading wheat, but it has one draw-back; its straw is too weak for rich land.

No. 35. Improved Rice.

This wheat resembles Pearl Prolific in every characteristic but in the point of yield. The yield is slightly under that of Pearl Prolific.

No. 36. Hungarian.

This is one of those hard varieties that are so popular and grown so extensively in the West. It becomes somewhat starchy when grown on our soils, and, because of the starchy appearance it assumes after being grown on our soils for a few years, it is rated low as a milling wheat. Hungarian wheat is very hardy, withstanding the winters well, and is a fairly good yielder; its straw, however, is very weak and it matures late. The proportion of straw to grain is very large, and, being a bearded wheat, it is not as desirable as some of the other varieties under test.

No. 37a. Pootung.

This wheat resembles the Fultz wheats in many respects. In the shape, size and color of the head, it is hard to make any distinction; and the kernels resemble the Fultz wheats very closely. This is a fine milling wheat and it is also very heavy, weighing 63¾ lbs per bushel this season. The yield is low and its straw is very long and weak. However after it has become thoroughly acclimated, it may prove to be of value. It has improved wonderfully during the three years it has been grown in this country.

No. 37b. Pootung.

The first Pootung wheat grown at this station, in 1900-1, from seed obtained from the U. S. Department of Agriculture produced both smooth and bearded heads in about equal numbers (Bulletin 94, p. 128). Last year we separated the two kinds, planting them on different plots, and we have designated the smooth kind 37a and the bearded 37b. The latter resembles 37a in almost every characteristic except that it is bearded wheat. The kernels are hard and rich in protein, and it may prove to be a fine wheat.

Meteorological Summary.

To show something of the character of the season, the following table has been compiled from the records of observation on temperature, rainfall and sunshine taken at the United States Weather Bureau Station on the College Campus.

Table 3—Summary by Months.

Months, 1903-1904.	per Ct. Sunshine.	Cloudiness.	Amount of Rain-fall in Inches.	Temperature. Degrees.		
				Mean.	Highest.	Lowest.
July, 1903	65.	35.	2.62	77.	94.	58.
August	63.	37.	1.49	74.	93.	56.
September	78.	22.	0.81	70.	92.	40.
October	64.	36.	2.12	57.	86.	28.
November	48.	52.	2.84	40.	71.	12.
December	55.	45.	1.90	28.	51.	4.
January 1904	46.	54.	1.92	30.	61.	2.
February	46.	54.	2.38	31.	67.	5.
March	39.	61.	4.75	46.	77.	19.
April	46.	54.	3.08	48.	76.	27.
May	67.	33.	2.60	64.	89.	40.
June	68.	32.	2.51	72.	88.	54.

The average monthly rainfall for the past 16 years, as observed at this place, is: for July, 3.97 inches; August, 3.79; September, 2.48; October, 2.12; November, 3.60; December, 3.33; January, 3.99; February, 3.37; March, 4.77; April, 3.24; May, 3.60; June 4.21 inches.

KENTUCKY

Agricultural Experiment Station

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State College of Kentucky.

BULLETIN No. 116.

1. ON AN INJURY TO FRUITS BY INSECTS AND BIRDS.
2. THE APPLE TREE MEASURING WORM.
3. THE FALL BEAUTY, A NEW APPLE.

LEXINGTON, KENTUCKY.

December 1, 1904.

KENTUCKY Agricultural Experiment Station.

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BULLETIN NO. 116.

1. ON AN INJURY TO FRUITS BY INSECTS AND BIRDS.

By H. Garman, Entomologist and Botanist of the Station.

Grapes and other fruits are attacked in Kentucky by such well known insects as the codling moth, the grape-berry moth, the grape curculio, and the plum curculio, but suffer severely at times from an attack the nature of which has not been well understood, and which it is the purpose of the writer to discuss in this bulletin. I refer to the cutting of the skins of ripening grapes, peaches, and plums, most commonly observed in the autumn, and especially destructive because it is accompanied by an invasion of the brown rot. Quite generally fruit men are disposed to accuse bees of some of this mischief, and while bee men deny the charge, yet they have not been in a position to do more than this; and I imagine are well pleased that the burden of proof rests with those making the accusation. Until the past summer I have been inclined to think bees did some of this cutting,—I knew from observation that they abstracted the contents of the skins after the cutting was done—but with both bees and fruit under close observation in September, I was first driven to the conclusion that bees did not cut the fruit, and later learned that tree-crickets working at night were the evil doers. Green June bugs, as stated below, do a somewhat similar mischief earlier in the season. Birds have been accused of the work. They undoubtedly destroy a good deal of fruit in other ways, generally devouring it entire, but the holes cut in the skins, characteristic of the injury of which I write, are not made by them, and I think it doubtful if they do a similar injury. Mr. F. B. Threlkeld, of Visalia, who sent

me birds, shot in his vineyard, for examination, concluded that they were doing the mischief, but it will be noted below that the stomachs examined contained both skin and seeds, when grapes had been eaten at all. The following observations on tree-crickets were written in September, 1904, immediately after the facts were learned:

Tree-crickets (*Oecanthus angustipennis* and *Oe. niveus*)
Cut the Skins of Fruit at Night.

For some time I have been watching honey bees from my hives at work on plums, peaches, and grapes, with a view of learning if they actually cut the skins of these fruits. While loath to believe ill of so estimable a little busybody, I have at times felt that there was no other solution of the question. They seem to know the location of every cut skin, whether the cut is fresh or otherwise, and once started, never rest until every drop of juice of the injured fruit is abstracted. But it was observed that plums that were perfect in the morning remained so at night, and no matter how close a cut plum hung to a sound one they never touched the latter. To test them, I more than once removed cut plums from clusters, thinking that when they found their forage gone they would cut the next plum. They returned again and again, circling through the vacant space, but in no case did they show the slightest disposition to attack the other plums. Then I began to take paper sacks from plums that had been enclosed to protect them from rot. These plums generally came out of the sacks in perfect condition, and when exposed in the morning, remained perfect the following evening. But the next morning some of them were generally with small fresh-cut holes in their skins, and the bees soon came to them. These observations persuaded me finally that some nocturnal insect was the culprit. But to test the bees still further ripe plums and grapes were placed upon the alighting boards of hives, and although in this situation the bees crawled all over them, they were never injured. In short it seemed never to occur to the bees, under all the temptation put in their way, to use their jaws on

the fruit. This seems quite remarkable to one who has witnessed the effective manner in which they use these organs against robbers and in cutting the caps from cells.

The holes cut in the fruit were of such character that it did not seem possible that they could be cut by so clumsy an instrument as the beak of a bird, so I began to look about for an insect that might do the mischief. I soon found numerous tree-cricket hidden away among the leaves, and on the 11th of September, after watching a cluster of plums all day, I came out again with a lamp at 9:30 p. m., and as soon as the light fell on the fruit, saw a tree-cricket cutting a hole in one of the plums. The hole was then about as large as its head. Several other crickets were near by. The individual at work on the plum was captured, and proved to be the species known as the snowy tree-cricket, *Oe. niveus*. The injured plum was removed. At 10:30 p. m., I returned. Two other plums were found to be injured in the same way, and I captured several of the crickets about them. This settled the question as far as the plums were concerned. The peaches on trees standing near the plum tree were being cut in the same manner as the plums. I took a peach from a dish on the side-board, and suspended it in the plum tree where the crickets were numerous. The following morning it was examined before the bees were abroad, and found cut in two places.

I now turned my attention to the grapes near by. They were not at this time being as badly injured as the plums, and only an occasional grape with a broken skin could be found. Yet in the majority of cases, no matter how greatly shriveled the skin might have become, when straightened out a hole was found cut exactly like those in the peaches and plums. The marks of the jaws could in many cases be distinctly seen.

On September 13, 1904, at 9 o'clock p. m., I examined a bunch of Concord grapes from which a sack had been removed during the day, and found a cricket lurking among the grapes. Shortly afterward, on returning, this cricket was observed cutting a hole in the skin near the stem of a grape. When captured it proved to be *Oe. angustipennis*.

Here then was the solution of the puzzle. The crickets

were cutting the fruit. The honey bees were simply following them. Possibly the fact may carry with it a remedy for the trouble, at any rate should help to find one. It is possible that the crickets can be driven away from trees and vines when fruit is ripening by dusting the leaves from time to time with pyrethrum. It is probable that foliage would be cleared of them before fruit ripens by spraying with coal oil emulsion.

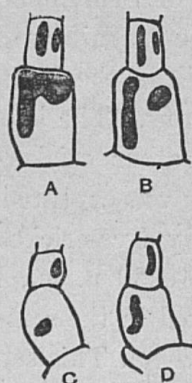


Fig. 1.—Antennal markings of three common Kentucky Tree-crickets. A and B, *Oecanthus fasciatus*; C, *O. niveus*; D, *O. angustipennis*. Enlarged. After Hart.

The tree-crickets are slender, rather fragile insects, with the hind legs enlarged for leaping, somewhat like those of the common black crickets. They live upon herbs, shrubs, and trees. They are generally of a very pale greenish color, without striking markings. One species, however, *Oe. fasciatus*, common in Kentucky on hemp and weeds, is more or less black on head, thorax and legs. The others are distinguished by characteristic black dots or lines on the under sides of the two basal divisions of the antennæ, but it is necessary to look for these with a hand magnifier. The eggs of these insects are inserted in the tender stems and twigs of raspberry and other woody plants in the autumn. The young come forth the following season, and are known to do some good by destroying plant lice, of which they seem very fond. *Oe. angustipennis* was by far the commoner of the two species observed cutting fruit. I should say ten of this species occurred to one of *Oe. niveus*. The call note of the former insect is softer and more prolonged than that of *Oe. niveus*, though of the same general musical quality. One does not notice it ordinarily at any distance from the trees. The note of *Oe. niveus* is the rhythmic trill heard every summer from trees and shrubbery on quiet evenings. It is produced by the expanded wings of the male, these organs being elevated above the back, and certain ribs with which they are provided, rubbed together. After night it is easy to observe them

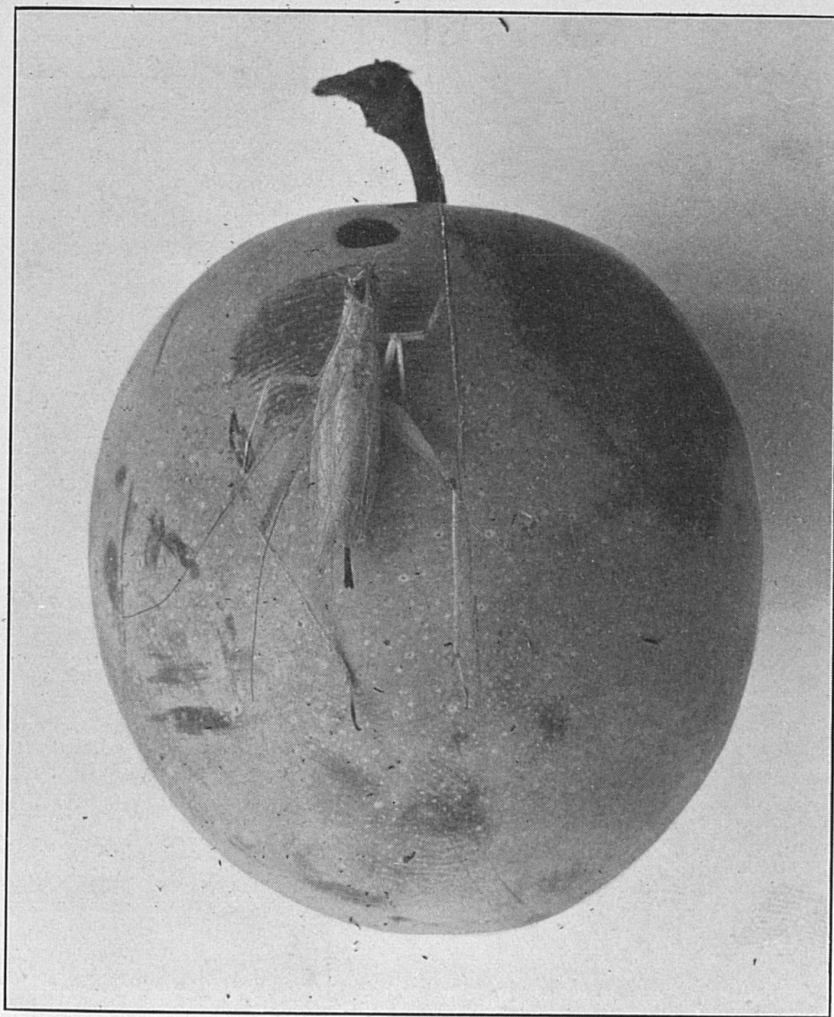


Fig. 2.—A Lombard plum cut by the snowy tree-cricket
(*O. nivens*). X 2.

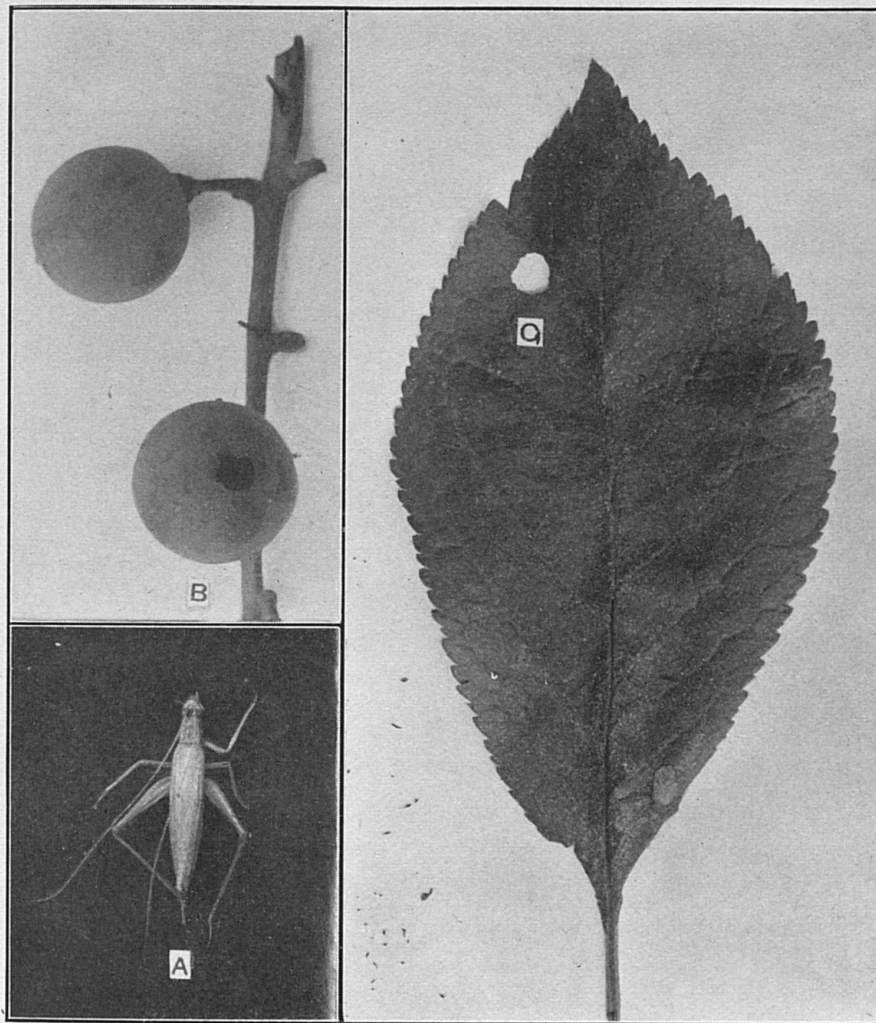


Fig. 3.—A, The snowy tree-cricket; B, A grape cut by *α. angustipennis* ; C, Plum leaf cut by same. Natural size.

while they are engaged in producing the note, by carrying a lantern or lamp under a plum tree, or grape vine. They remain stationary and appear to be completely absorbed in their music, but if one places his hand on the tree, the music stops at once, as does that of the Katydid under the same circumstances. The ears in the front legs of these creatures thus appear to be intended to apprise them of enemies shuffling about the tree trunks and branches, the vibrations set up being beyond doubt recognized by these oddly placed organs. A brown tree-cricket (*Orocharis saltator*), common on grape vines, but sometimes also found upon plum at Lexington, appears to be too busy to stop for its music, and while running about, which it seems to be doing perpetually after night, it raises its wings now and then and produces a high-pitched and rather shrill chirping noise, but never stops running, its attention being occupied with something more important than music.

The females of the tree-crickets of the genus *Oecanthus* are exceedingly common about trees and vines in September, and when a light is thrown upon the branches of a plum tree dozens may sometimes be observed boring the bark to deposit the eggs, gnawing the leaves, which they cut in exactly the same manner as the fruit, while others simply roam restlessly about. During the daytime one may scrutinize the same trees with the greatest care, and only an occasional example will be found, so cunningly do they conceal themselves.

The species observed by me placing eggs in the bark of plum is *Oe. angustipennis*, but *Oe. niveus* was common at the time in the same trees; but appeared to spend most of its time on the upper branches, where it could not be watched closely.

The Green June Bug.

Allorhina nitida.

The common green June bug, well known to every Kentucky school boy, becomes very troublesome locally and occasionally by cutting the skins of grapes and utterly destroying the fruit of whole bunches and even whole vines. On the Experiment farm

at Lexington this pest would, if allowed to work unhindered, destroy the whole crop of the early varieties in the experimental vineyard. It was formerly more troublesome than now, but is liable any season to appear in such numbers as to be the cause of anxiety on the part of those having the vineyard in charge. The very sweet, thin skinned, early sorts suffer most severely. On a visit to the vineyard, August 1, 1896, I found Moore's Early, Poughkeepsie and White Imperial being severely damaged, while Brilliant was only moderately injured. The clumsy beetles were clinging to the berries, in some cases a dozen on a bunch, greedily devouring the pulp and leaving them in an unsightly and utterly ruined condition. They were guilty during the same month of injury to early peaches and plums. On my home place the insect does very little mischief, sometimes cutting a ripe peach or plum, but never touching the grapes. On other places with which I am familiar it does not appear in such numbers as to excite comment. But now and then some one in the State reports to the Station that his grapes are being ruined by the beetles while his neighbor's grapes are not being troubled at all.

This unevenness of distribution and injury was difficult to account for as long as it was supposed that the grubs of the green June bug fed upon the roots of living plants, but it is now known that they feed only on dead vegetable matter, manure, compost and the like, and are consequently most numerous where food of this sort is most abundant, namely about heavily enriched land, and in the vicinity of old heaps of decaying manure. Experiments made in the Vivarium of this Division some years ago under conditions such that it was impossible for them to get food other than living plants provided them or, in other tests, dead matter in the soil, proved that they did not feed at all on living plants and could live and complete their transformations in soil without other food than the manure with which it had been enriched.

The same beetle injures corn by working its way under the husks when the grains are in the dough stage, and gnawing the latter away, often well down to the bases of the ears. An experi-

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mental plot on the farm that each year is enriched with stable manure, is always badly infested, and would be ruined if we did not have a man go through the corn frequently when the beetles are about and knock them into a pan or bucket of water on the surface of which is a little coal oil. Other plantings of corn on the farm are but little, and sometimes not at all, injured by the insect. This little plot, therefore, affords an excellent illustration of a danger that may lurk in a free use of stable manure on land to be planted in corn,—a danger not from the grubs living in the manure, but from the beetles which they produce.

The life-history of the insect as we have learned it from both indoor and outdoor observations is as follows:

In confinement the beetles placed eggs in the soil during the last week of July in 1896, one individual having deposited its complement on July 23. They were an inch or two below the surface, generally at the sides of the flower pots used to confine the beetles. Young grubs were found to have hatched from these eggs on August 20, and were then from one-fourth to one-half inch long. They continue to feed and grow from this time forward until cold weather sets in, being then about two-thirds grown, thick-bodied grubs, living a few inches beneath the surface in burrows which they keep open as long as the weather remains mild, and would undoubtedly keep open all winter if the cold did not become severe. In 1895 in building the Vivarium belonging to this Division, land was enclosed by the walls of the glass-covered portion that had had manure scattered on it recently, and in consequence the grubs were very abundant in the enclosed space. Their presence was recognized first by the rather broad trails they made in traveling about on the surface, for it is their habit to leave the burrows at night for this purpose, when they travel with considerable address by turning over on their backs and propelling the heavy body along by contractions of muscles within. They may be distinguished among grubs infesting the soil by this peculiar method of locomotion. The house was not heated, yet the grubs remained active all winter, quickly opening the entrances of their burrows when these were closed by our operations, and coming out and wandering

about during mild spells of weather. When the weather became very cold they could be found by digging down three or four inches where they lay coiled up at the bottoms of their burrows, seemingly without life, and feeling as cold to the hand as the soil itself, but soon reviving and becoming active when taken into a warm room. Ordinarily out of doors they must lie in this torpid condition most of the winter, though we have some winters during which I have no doubt they become active at times.

These partly grown grubs do not become pupæ until June of the spring following. On May 30, 1895, they were still in the larval condition. On June 11 of the same year they had mostly made earthen cells in the soil and were pupating. These cells are nothing but earth glued together, and rendered smooth within the cavity occupied by the pupa. Three examples measured as follows: (1) 0.92 by 1.24 inch; (2) 0.76 by 0.96 inch; (3) 0.60 by 0.96 inch. The walls varied in thickness, but averaged 0.026 inch. The adults began to emerge indoors on July 3, and one was observed out of doors on the 9th of the same month. By July 19 they become very common on very ripe wild blackberries, and during early August become troublesome on early grapes, as already noted. A single brood thus develops each year.

While the beetles are clumsy on their feet, they make use of their very ample wings with considerable address, once they get them unfurled, flying about in the hot sunlight with a loud humming noise somewhat like that of the bumble bees. Their fondness for sweets sometimes leads them to make persistent efforts to get into bee hives, and during the summer of 1903 some colonies of Cyprians belonging to the Division were kept constantly busy dragging them from the entrances and tumbling them from the alighting boards. The heavy shield of chitin with which the body is enclosed protected them from the stings of the bees, so that when ejected they simply pulled themselves together and went back to try again, thus finally working the colonies into a very irritable condition. A half-dozen could sometimes be seen about a hive at a time. Here again, as in the case of infested vineyards and plantings of corn, the explanation of their abun-

dance was in heaps of decaying vegetable matter kept for use in the Vivarium, near which the stands were placed. Carniolans on my home place have never been disturbed in this way. The habit is new to me, and I do not now recollect having seen mention made of it in bee or other entomological literature. The green June bug is certainly capable of becoming a very annoying enemy of the honey bee, and I doubt not, would, if the bees received no help, succeed at times in reaching the stores.

Description—The eggs are pure white, moderately glossy and smooth, spherical in general shape, the ends being rounded. Length, 0.09; shorter dimension, 0.08 inch.

The grubs when fully grown and outstretched, as in creeping about, measure two inches or a little more in length, and at the thickest place near the hind extremity are about one-half inch in diameter. They are whitish, with deep brown head, the antennæ and legs paler brown. There is a brown area on each side of the first segment behind the head. The body is everywhere clothed with short brown hairs and is deeply wrinkled crosswise in constant pattern.

When ready to pupate the larval skin is moulted and the pupa is disclosed with much the general shape of the adult, but is much shorter than the grub. Pupæ are less than an inch in length (an example measures 0.88 inch), and just about half an inch in greatest width. The body is somewhat flattened from above downward, the head with an upwardly projecting, squarish piece at the front margin, and a mallet-shaped elevation on the front. Body widest through the thoracic region. Wings and legs directed downward and backward, the hind pair of legs overlapped by the wings. Abdomen with a series of rounded tubercles along each side above. Whitish at first, becoming darker as the time for yielding the adult approaches.

Adults when fully mature are generally of a deep velvety green color above, with the margins of the thorax and wing covers yellowish brown. Immature examples are more brownish, and some individuals when mature retain a good deal of brown on the middle of the wing covers. This is especially true of

females, the other sex generally presenting a more continuous and richer green hue on the back. Beneath, the colors are generally paler with the brown predominating over the green. Length 0.76 to 0.84 inch. We have no other beetle in the State at all likely to be mistaken for this one except possibly *Euryomia fulgida*, a member of the same family, but smaller, though of the same general shape, and brown with bronzy and green reflections. The latter is rather rare, also, whereas the June bug is one of our commonest beetles.

Remedial Treatment.—Mention has already been made of the practice of removing the beetles from grapes and corn by hand. After a good deal of experimenting we find that this is about the only method that will save crops from severe injury. It is a simple matter for a boy to pass along the plants with a bucket containing water bearing a film of coal oil on the surface, and knock the beetles into it. But it requires some watchfulness during the height of the beetle season, because others soon take the places of those removed. Baits of poisoned sirups have not proved as alluring as the ripe grapes, and but few beetles were poisoned by them. Sprays for either grapes or corn are impracticable. Lantern traps are of no service, since, contrary to the statement in one of our best manuals of entomology, the beetles do not fly at night. They seem to be as strictly diurnal as bumble bees. The brown June bug, on the contrary, flies at night, and has lately proved very injurious to forest trees growing in our woodland pastures in early spring. When the grubs are very abundant on land it is generally because of the presence of manure in it, and often such land is visited by large numbers of moles, attracted by the grubs. I have known farmers to become alarmed because of the moles present in land under such circumstances. My advice to every one who may have this experience is to let the moles alone. As long as they remain it is the best of evidence that grubs and earth worms are abundant in the soil. Some years ago we established new forage plant plots on the site of an old garden. It was alive with the grubs, as was evident from the large numbers of trails made by the larvæ traveling over the surface. Moles came in after them, and while they did

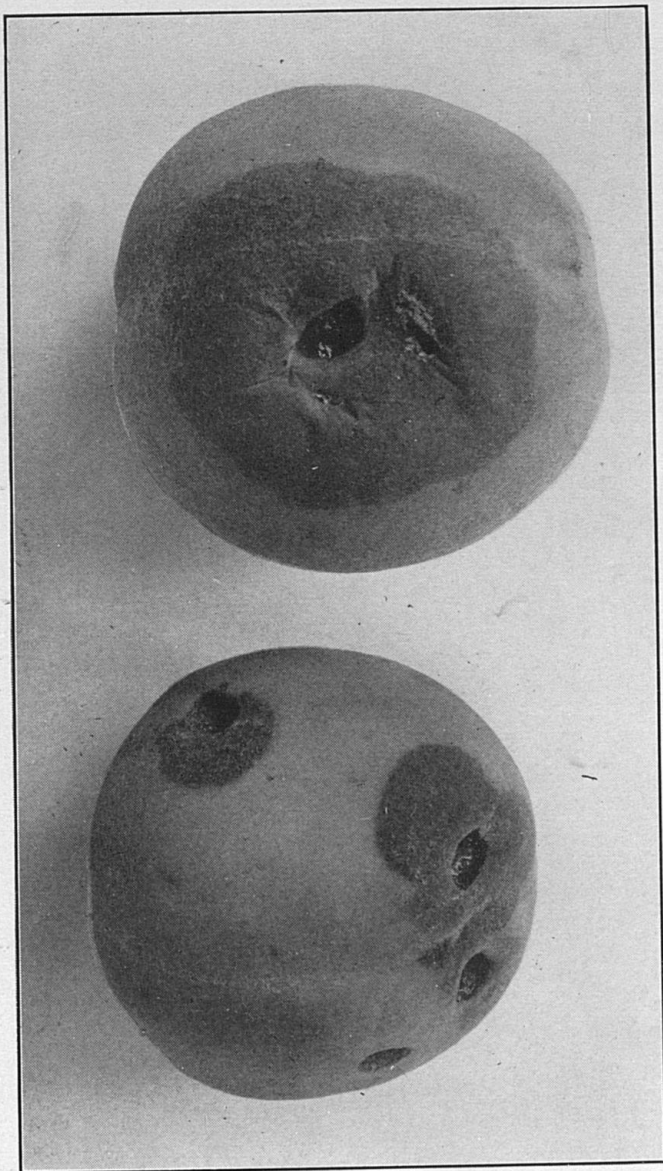


Fig. 4.—Peaches inoculated with brown rot through work of tree-crickets. Natural size.

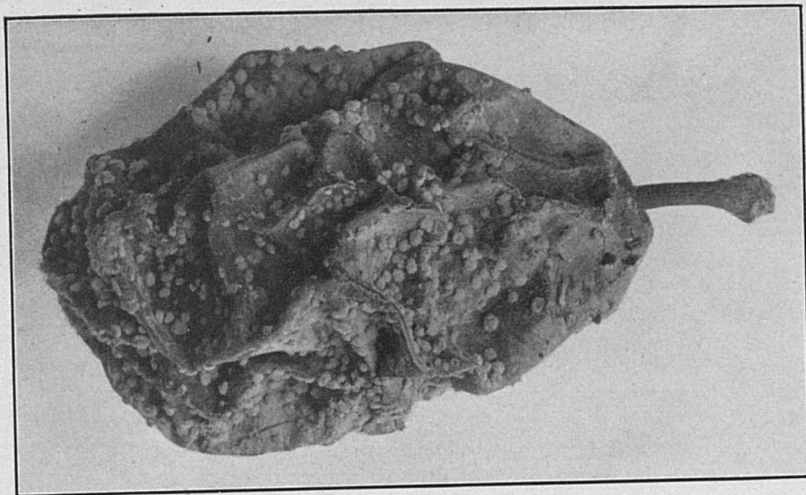


Fig. 5.—A Lombard plum destroyed by brown rot, showing masses of fungus fruit. X 2.



Fig. 6.—A peach inoculated with brown rot by means of a needle touched to one of masses of Fig. 5.
Natural size.

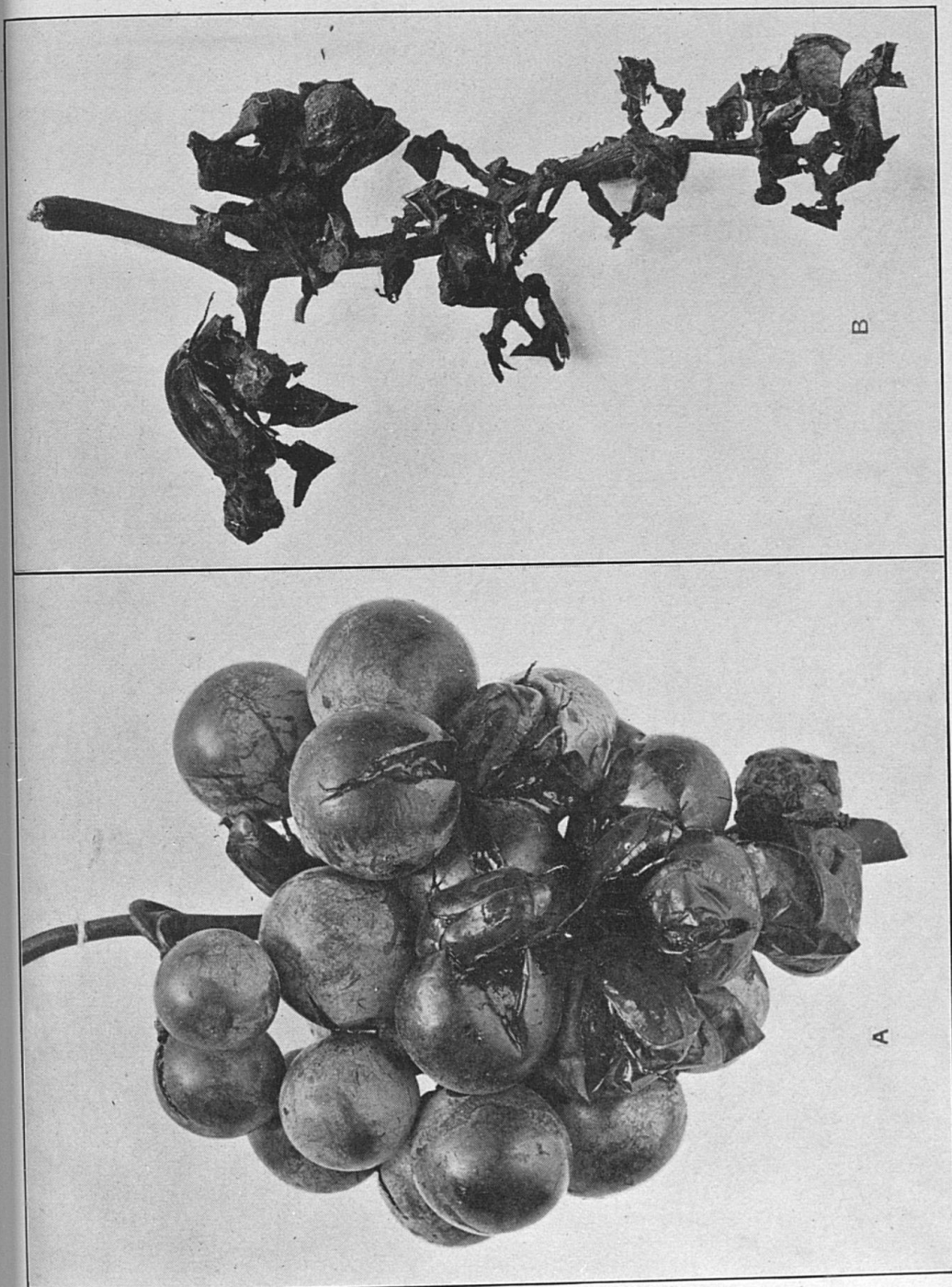


Fig. 7.—A, Grapes being injured by green June bug; B, An advanced stage of injury. Natural size.

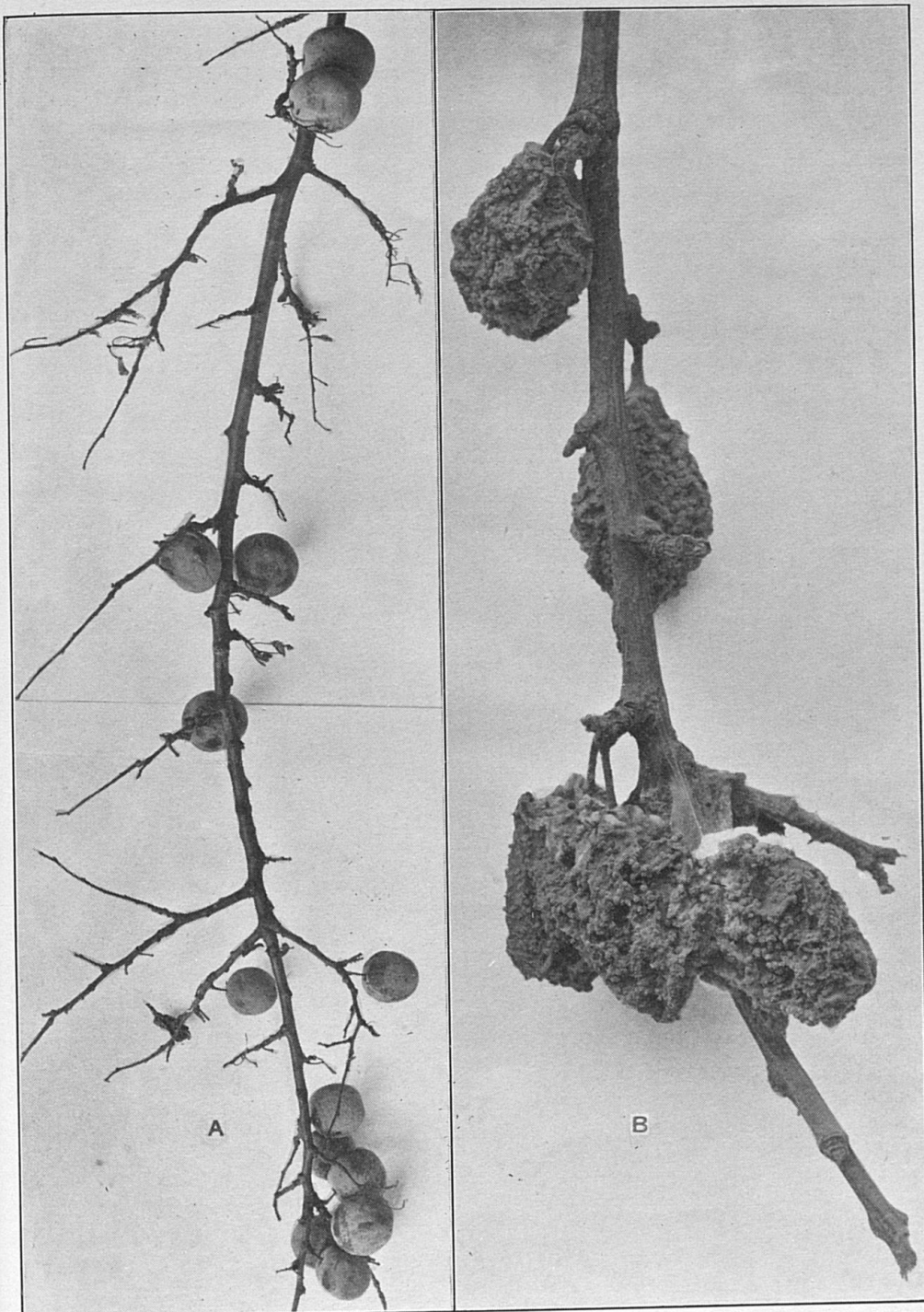


Fig. 8.—A, Branch of Lombard plum tree sprayed with lime-sulphur-salt wash. Reduced. B, Tip of branch not sprayed; plums destroyed by brown rot. Natural size.

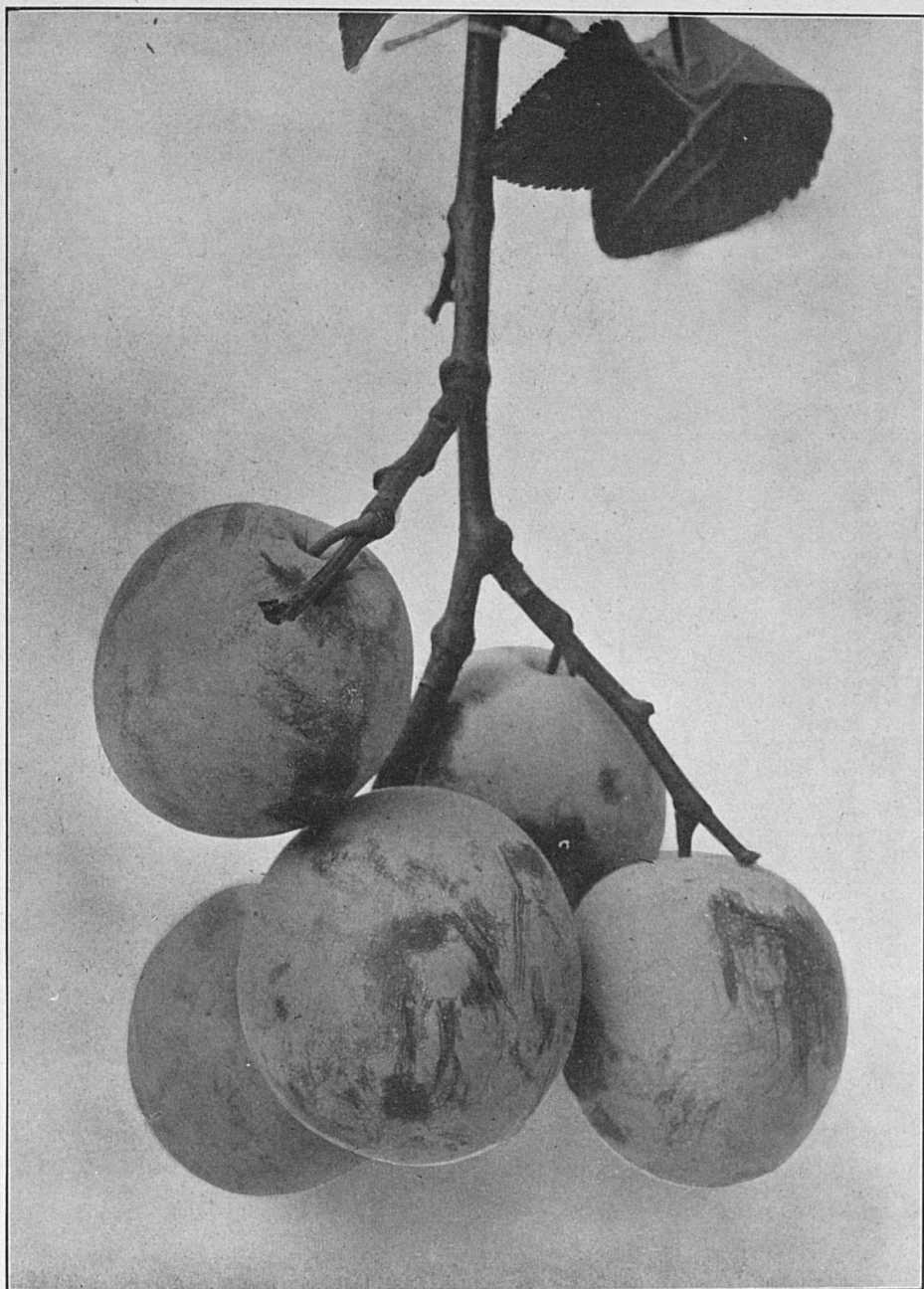


Fig. 9.—Lombard plums kept enclosed in sack until ripe.
Natural size.

some mischief by heaving young plants out of the soil, they cleared the land of grubs in a couple of seasons, and then left, and at present we see but little of their work in the plots. The same advice is to be given in case of an infested lawn. When moles become abundant in grass it means but one thing, and that is that their natural prey, the grubs, have become abundant there. If they are the young of the green June bug they will do no injury in the sod, but the adults produced from them will attack any sweet fruits that may be in the vicinity. If they are the young of the brown June bug they are doing mischief by devouring the root of the grasses, and when they emerge as adults will damage the foliage of trees growing about. So that in either case it is wise to let the moles have them. About hot-houses, where steam is available, it is possible to destroy them in manure by steaming the latter. Where it is desired to remove grubs from manure before applying it to land it may be done by injecting bisulphide of carbon into it, or by simply digging holes in the heap and pouring the bisulphide into them, then fill with the manure removed and allow it to do its work. On a limited scale the same treatment will serve for infested sod, or plant beds, but becomes impracticable when the grubs infest tracts of any large size.

Insect Injury to Fruit in Relation to Brown Rot.

Observations such as have just been recorded with reference to tree-crickets and June bugs have impressed me with the important part taken by these and other insects in the dissemination of the brown rot fungus of stone fruits. An examination of rotting peaches and plums has very commonly shown the presence of a perforation in the skin from which the disease spread. In many cases these breaks are traceable to insects, sometimes to curculios, sometimes to tree-crickets, sometimes to June bugs. But the rot may be introduced by bees following after some one of the preceding, and occasionally by wasps and even butterflies that visit the breaks to sip the exposed juices. And thus it happens that the injury actually destroying the fruit is the result of inoculation by insects that had no part in cutting the skin. Of

course any accidental break in the skins of such fruits is likely to result in rotting if the fungus is about the trees, but excepting in the case of certain varieties that are prone to split when growing rapidly, such breaks are not very common. While a plum that has been inoculated intentionally will in warm weather show the rot the following day, one that is simply punctured but not inoculated may lie for a week or ten days without an appearance of the disease. This has been the result at times when the skin of a plum was punctured in a half-dozen places; from which it appears that rotting on the trees would be less frequent if the taint were not carried on the mouth-parts of insects. I believe they sometimes introduce the rot on trees from which otherwise it would be completely absent.

Birds Injurious to Fruits.

There need be no great difficulty in recognizing the injury done by tree-crickets, and distinguishing it from any injury likely to be done by the beaks of birds. The fruit-eating birds with which I am familiar devour small fruits entire or nearly so, and are not at all likely to leave punctured skins. Last spring I watched a red-headed woodpecker make repeated visits to cherry trees at the rear of my yard from a tall sugar tree across the road, each time on leaving carrying a cherry in its beak. The robins and catbirds were less wary about it, and sat in the trees before one's eyes while feeding, evidently never suspecting that the owner of the trees had any interest in the fruit. None of these birds left fruit on the trees with punctured skins, as is the case with the tree-crickets, and as far as my observation goes they do not injure grapes in this manner.

Mr. F. B. Threlkeld, of Visalia, wrote me this fall complaining of an injury to his Delaware grapes, the skins of which were being punctured. He finally decided that it was the work of birds. At my request he sent some of the birds shot in the vineyard to the Station for identification. They proved to be the following:

Common Robin (*Merula migratoria*).

Catbird (*Galeoscoptes carolinensis*).

Mockingbird (*Mimus polyglottos*).

Summer Redbird (*Piranga rubra*).

Downy Woodpecker (*Dryobates pubescens*).

I have been familiar with all of these birds a large part of my life, and knew the three first named to be fruit eaters, but the last two have always been supposed by me to be strictly or very largely insectivorous. Unfortunately the woodpecker was thrown away before it occurred to me to look into its stomach. The rest were examined with reference to what they had eaten, with the following result:

Robin.—Two of these were examined. No. 1 had eaten a small wire-worm beetle (*Drasterius elegans*), a myriapod (Family Julidæ), and other unrecognized insects represented by small fragments. Grape seeds and skins constituted about fifty per cent. of the stomach contents. No. 2 also contained a wire-worm beetle (*D. elegans*), an ant, and fragments of other insects. About eighty per cent. of the contents of its stomach consisted of grape seeds and skins.

Catbird.—This bird had not eaten much of anything, but small fragments of insects were noted in the stomach. The pulp and skin of some fruit, apparently apple, constituted about ninety per cent. of the contents. No grape seeds or skins were noted.

Mockingbird.—The stomach contained the head of an ant, the skin of a large caterpillar, part of the wing cover of a corn root-worm (*Diabrotica 12-punctata*), portions of a myriapod (*Parajulus*), and small unrecognized seeds. Sixty per cent. consisted of grapes.

Summer Redbird.—The stomach contained nothing but the fragments of insects, so completely broken up that the species could not be determined.

The Kentucky Bird Law.

The examination of these birds reminded me of the laws enacted for the protection of birds, and of their effect in increasing the numbers of familiar species. Bird lovers have of late

been assuming that birds as a group are useful and should be protected. Looking at the matter from the side of pure sentiment they are all, or largely, worthy of protection. It would be a sad thing if our groves and fields were deprived of these sprightly and entertaining creatures, and this alone is I believe sufficient justification for all the laws that have been enacted in their behalf. To reduce the earth to a monotony of cornfields, stock paddocks, telephone poles, villages and cities, is to deprive a great many people of much of their pleasure in living. We need the wild flowers, the birds, the trees, the butterflies, and the squirrels. They conduce to the healthfulness and happiness of us all. And so the author of this bulletin has felt disposed to take sides with those who war against the milliner bird skin collector, and the vandal pure and simple, who together a few years ago were threatening many of our common birds with complete extermination.

But from the point of view of the entomologist, and of the fruit grower, I suppose the last word has not yet been said with reference to the value of some of our birds. All insects are not injurious: this much is certain. The number of beneficial species in existence will probaby not fall very far short of the number of injurious ones. Few of the well known injurious insects but have their parasitic or predatory insect enemies, these in some cases numbering three or four to one host. Whenever the army worm, the canker-worm, or the Kansas grasshopper, become exceptionally numerous these enemies of theirs multiply too, and begin to reduce them to their normal numbers. They have the help, it is true, of the birds under such circumstances, but they are much the more effective of the two, being able to follow their prey into all its hiding places. And here the question arises as to the the ultimate usefulness of birds as insect destroyers. Feeding as they do on our friends and foes alike do they not do us as much or more harm than good? The problem is a difficult one, and in view of the present impossibility of saying that certain of our fruit-eating birds, such as the robin, catbird, and mockingbird, are on the whole injurious or beneficial, it seems

wise to give them the benefit of the doubt, and keep them with us at least until we have evidence sufficient to convict, giving farmers and fruit growers at the same time the privilege of protecting their fruit with the shotgun from such feathered marauders as may become too troublesome.

This is what we have been trying to do in Kentucky, anyway. In our game law (Chapter 57, Kentucky Statutes, Act of Feb. 27, 1894), it is made unlawful to destroy any insectivorous bird within the State, except when it is destroying fruit or crops. Section 1946, Ky. Statutes, reads:

"No person shall at any time, catch, kill, or pursue with such intent, or have in possession after the same has been caught or killed, any thrush, meadow lark, finch, martin, swallow, woodpecker, flicker, oriole, redbird, tanager, catbird, blue-bird, or other song or insectivorous bird, except where the same shall be destructive to the fruit or grain crops."

Section 1948 reads: "No person shall rob or destroy the nests or eggs of any wild bird whatsoever, save only those of a predatory nature, and destructive of other birds or fowls."

Section 1949 reads: "Any person guilty of violating any of the provisions of either of the preceding sections shall be fined for each offence not less than five nor more than twenty-five dollars."

One would suppose that this was a sufficiently stringent law to put a stop to the destruction of our birds, yet the shooting went on as if no such law were in force. The trouble seemed to be that the general feeling of our people was one of indifference, so that the violation of the law aroused no protest except from a few people who had given the subject thought and foresaw the complete extermination of many of our song birds unless robbing of nests and shooting could be stopped.

Another law was enacted by the General Assembly at its regular session in 1902. This covers practically the same ground as the sections of the game law, forbidding the destruction of all insectivorous or song birds, excepting when destroying crops, but permitting the killing at any time of the English sparrow, the great horned owl, the sharp-shinned and Cooper's hawks, the

crow and the crow blackbird. Game birds are defined as ducks, geese, brent, rails, plovers, snipe, woodcock, wild turkeys, quail, grouse, mourning doves, and their allies.

Intelligent people in the State are thinking more on the subject than formerly, and less indiscriminate shooting is now being done. Birds are becoming commoner as a result, and during the two years just past, robins, mockingbirds, catbirds and bluebirds have become more common than they had been for many years before. It is probable, however, that this result has come more from an increased public interest in birds, due to a number of different influences, than to the two laws mentioned. Some killing goes on still, and will go on until we have all been educated beyond the point of destroying birds out of pure savagery. For, the disposition bred in our boys that impels them to take the life of every living thing they encounter is surely a survival of the instinct of the hunting savage in civilized man, if indeed it be not an inheritance from some simian ancestor.

But I would not condemn too strongly, for I remember still the delight I felt as a child when first shown the four blue eggs in a bluebird's nest, and how I struggled later to make my short arm reach these treasures, that I might look at them more closely and handle them. I recall too the joy I felt at opportunities to go hunting with an older brother, and I would, if possible, preserve to all boys this experience and pleasure. In hunting, I say, not in puttering along fence rows, potting innocent field sparrows and chickadees. And what a blessing it would be to many a tired man to get a good day's hunting or fishing, who as things are, has little to attract him into the open air. Speed the day when our splendid streams will again be full of fishes, when woodland and field will furnish good shooting, and when our insect-eating birds will be as free to nest and sing in our dooryards as in days gone by. But this condition of things can only come when we have learned to curb ourselves and to submit to the control of laws that restrict shooting and fishing within reasonable limits.

2. THE APPLE TREE MEASURING WORM.

Ennomos subsignaria.

By H. Garman, Entomologist and Botanist of the Station

Canker-worms are often complained of in Western Kentucky as injuring orchards in early spring. Especially is this true of the fruit-producing counties along the Ohio River west of Louisville. But it appears that two entirely different species of insects have been confounded by the growers of fruit in that section of the State under the name of Canker-worm. Both, however, belong to the order containing the moths and butterflies, and to the same family (Geometridæ). Both are measuring worms when young and become moths when adult, but in the latter condition one is gray and the other white.

The species here noticed has been for several seasons past very injurious in an apple orchard on the farm of Peter Whitmer near Bremen, in Muhlenberg County. It appears early in spring, attacking the leaves as they unfold, and eating large holes in them between the larger veins, leaving at length but little except veins and midrib. The larva or worm is a rather slender looper, creeping by extending the body its full length, grasping the twig with the jointed front legs, then drawing up the hind end of the body, thus throwing the middle portion into a loop, when it takes hold with the fleshy hind legs and is ready for another forward movement. By the middle of May these worms begin to assume the pupa stage, when they draw a leaf or two loosely together, securing them with slight strands of silk, and spinning across the opening between edges an open-work net to prevent the pupa from falling out.

Pupæ sent me June 7, 1904, from Muhlenberg County, by Mr. Elvis J. Whitmer, yielded adults June 14 and 15 in my rooms at the Station. After the moths have emerged, the empty pupa cases can be seen for some time occupying the shelters provided by the larvæ among the leaves. By this feature of its life-history alone, trees injured by it may always be known from

those injured by the Canker-worm, which pupates in the soil, thus leaving on the trees nothing but gnawed leaves.

This measuring worm was especially injurious in 1903 and less so in 1904, probably because of the attacks of parasites. Several of the pupæ examined by me had a round hole cut in the skin through which some parasite had emerged. At the North and East it has long been known from its injuries to elm and other shade trees, and in the South Atlantic states it was at one time a veritable scourge because of its destruction of foliage of all sorts of trees and shrubs. It is said that the insects were so abundant that their droppings tinged green the water of the streams, and trees were completely enveloped in the silken material spun by the larvæ in traveling about.

The larva, like many other insects of the same order, has a way of dropping from the branches when pursued by birds, and remaining suspended until danger is past. In Georgia it is said that the moths also drop from the branches like a shower of snow when birds appear among them. Fortunately the insect has not become as destructive here as at the South, and only in regions still retaining a good deal of forest has it done mischief in orchards. But it is well to know its extraordinary capacity in this direction as a safe-guard against future outbreaks. It has been known to devour the foliage of trees so completely that the young apples dropped off.

The moths emerging in the middle of June soon place their eggs about the trees and then disappear. The eggs are secured to the bark of the upper branches in large numbers, sometimes hundreds in a place, generally on the under sides of branches and arranged in series. They remain here until spring when they hatch as the leaves unfold, producing, as already stated, measuring worms.

The pupæ measure 0.66 to 0.74 inch in length, and about 0.22 inch in greatest diameter. When fresh they are dull greenish, becoming darker later. The surface is oddly granulate, and dotted with brown. The antennal cases extend downward and backward almost to meet on the ventral side opposite the ends of the wing cases. They are conspicuously elevated, especially

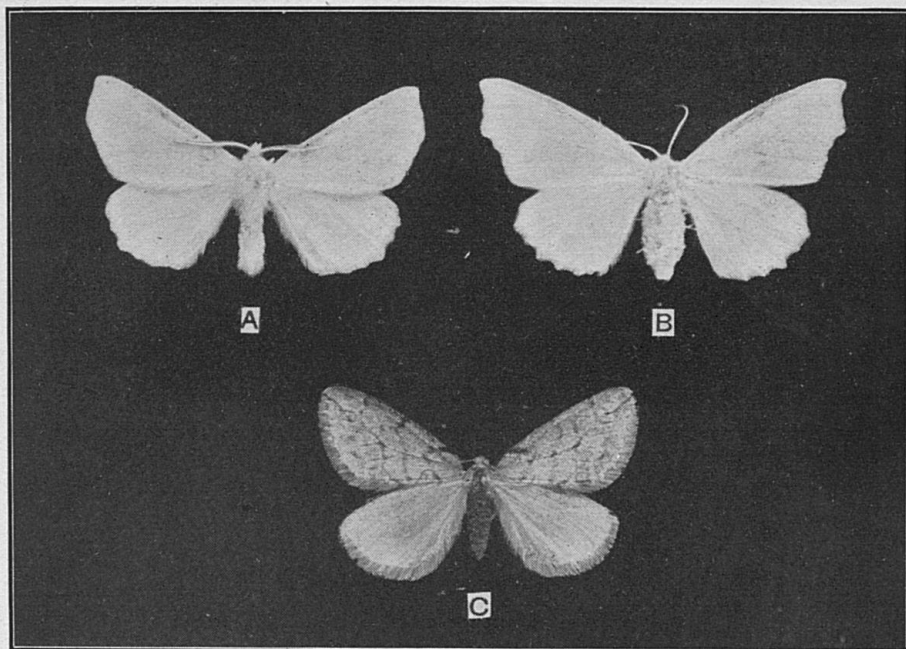


Fig. 10.—A, Adult male of apple tree measuring worm;
 B, Adult female of same; C, Adult male of
 true canker worm. Natural size.

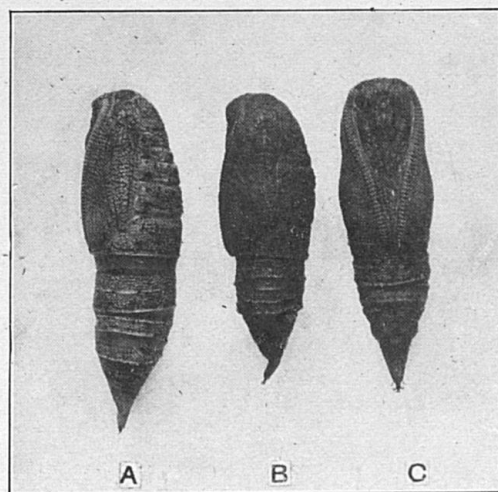


Fig. 11.—Pupæ of apple measuring worm. X 2.



Fig. 12.—Pupæ of apple measuring worm in partly rolled leaves.
Natural size.

in the male, and are rather roughly cross-striate. The tip of the abdomen is produced into a strong conical piece, excavated beneath, bearing at its tip six minute brown hooklets, by which it retains hold of the silken web within the rolled leaves.

The male moth measures 1.12 to 1.25 inch in wing expanse, while the female is somewhat larger, measuring from 1.12 to 1.50 inch in stretch of wing. As ordinarily examined the moths appear to be pure snow-white, but on close inspection of recently emerged examples, a faint greenish tinge is apparent along the front margins of the wings, above and below, the antennæ are greenish beneath, the eyes are black, an evident brown discal dot appears on each wing, the femora of the front legs of the male are faintly and the tibiæ are decidedly buff-yellow, and a long yellow tuft arises on the inner side of the base of each tibia. The front margin of the front wings is nearly straight, the outer margin of the same pair is decidedly angled at the middle in the female, and has small scallops in front and behind the angle, while in the male the angle is less decided and the scallops scarcely visible. The hind wings are evidently and coarsely toothed in the female, and only slightly so in the male. The abdomen of the male is slightly tufted, and the antennæ strongly pectinate.

The difference between this insect and the Canker-worm may be summarized as follows: The adult of this species is white, that of the Canker-worm, gray; the female of this has ample wings like its male, while the female of the Canker-worm has no functional wings. This insect places its eggs on the branches in midsummer and they remain without hatching over winter, while the Canker-worm creeps up the trunks of trees in the spring and places its eggs, which hatch shortly afterward; the pupa of this worm is secured among the leaves, while that of the Canker-worm is formed in the soil beneath the trees.

The remedy for both insects is the same, namely, spraying the young foliage with Paris green or arsenate of lead. Of the former one pound in 150 gallons, with a little lime added, may be used. Of the arsenate of lead three pounds in 100 gallons of water is a suitable proportion. Bands of tin smeared with tar have sometimes been used to prevent the wingless female Canker-worm from ascending the trees, but have no value for the species here described because of the capacity for flight possessed by the female.

3. THE FALL BEAUTY, A NEW APPLE ORIGINATING IN KENTUCKY.

By H. Garman, Entomologist and Botanist of the Station.

The writer has more than once had seedling fruits originating in Kentucky brought to his notice, some of which seem well worthy of propagation and of notice in horticultural literature. One of the handsomest of these is an apple in the possession of Mr. O. Piper, of Clinton, Hickman County. He has recently sent me the mature fruit of this variety, and upon this material the subjoined description and figures are based. The name "Fall Beauty" selected by Mr. Piper is a very appropriate one. The apple is a beauty, and has other good qualities. In thus entering the new variety in our bulletin and bringing it to public notice the writer wishes to be understood as not establishing a precedent, though possibly this is the proper place to record and describe all of these Kentucky novelties. At any rate our nurserymen and fruit growers ought to have some recognized place for registering their new fruits, and the present notice may be considered simply as pointing the way and making a beginning. A beautiful yellow apple, claimed to be a new one, was also shown me last summer by Mr. Edwin Stovall, of Vine Grove, Hardin County. It is worthy of a place beside the Fall Beauty, and should some time be carefully described and figured. Mr. Stovall gave me the name, "Nall's Golden Pippin" for it.

Description of the Fall Beauty.

Sphæoidal, inclined in some cases to be deeper on one side than on the other, generally quite symmetrical. Rather deeply impressed at calyx end, sometimes obscurely furrowed outwardly from the cavity. Rarely decidedly oblate-sphæroid. Stem short and abruptly thickened at the tip. Ripe examples sometimes showing abbreviated striæ concentric to the calyx end. The following are measurements of apples sent me by Mr. Piper, the first number in each case denoting the diameter from

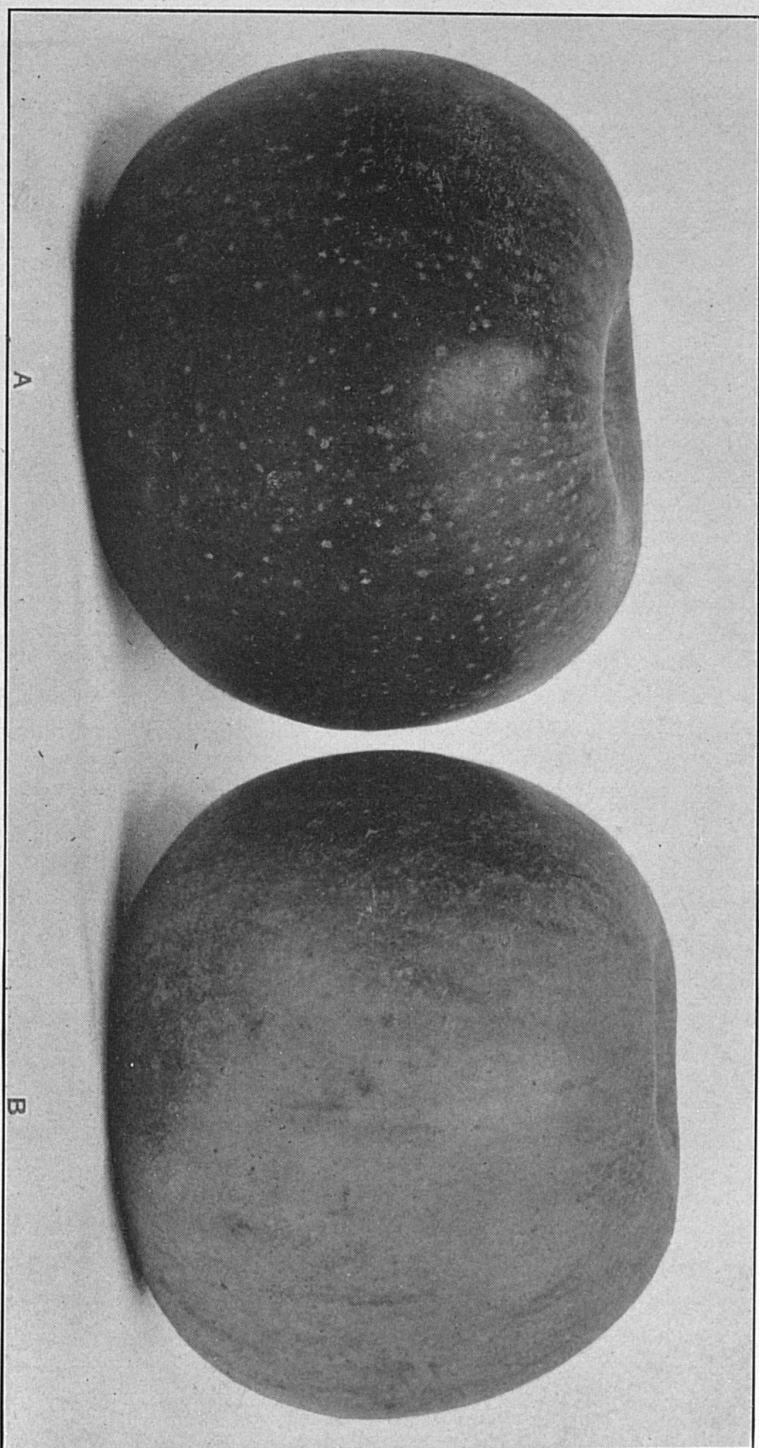


Fig. 13.—The Fall Beauty Apple. Natural size.

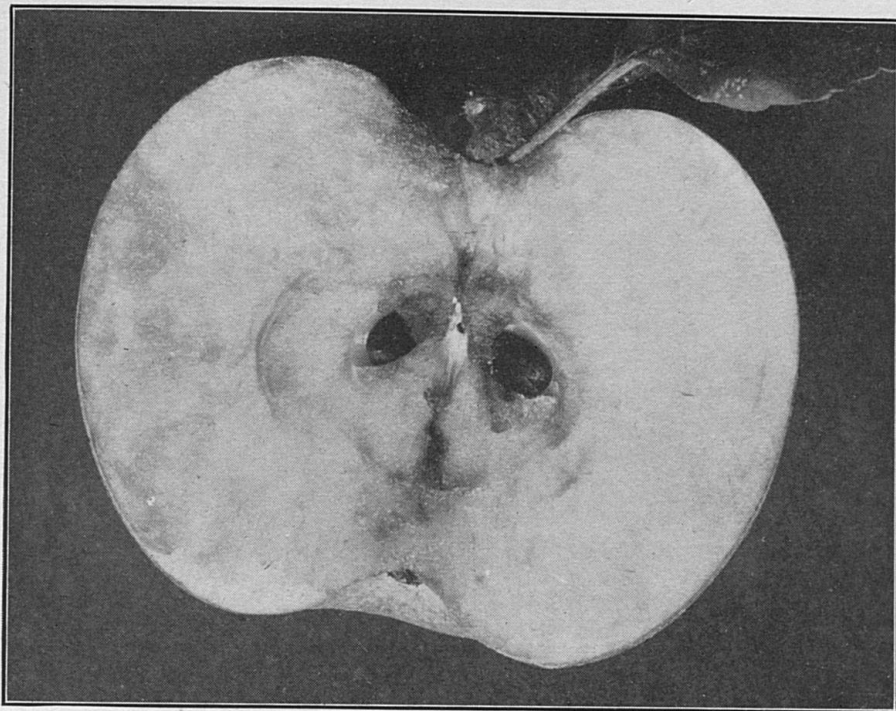


Fig. 14.—Section of Fall Beauty Apple. Natural size.

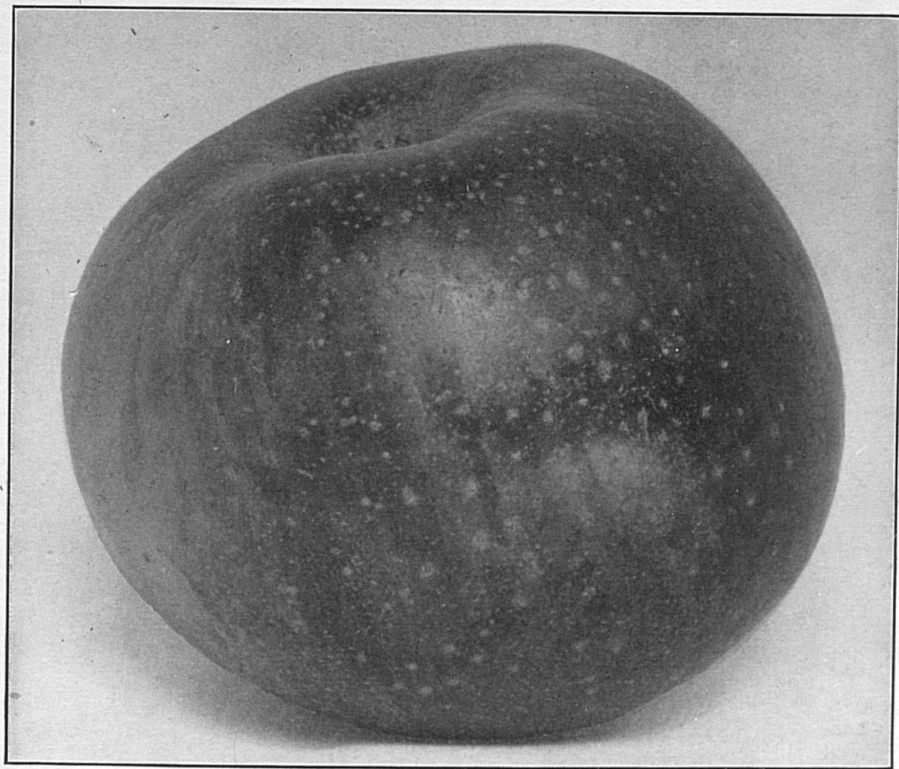


Fig. 15.—A large example of Fall Beauty Apple. Natural size.

side to side, the second, the greatest depth from calyx to stem end:

- (1) 3.08 by 2.60 inches.
- (2) 2.76 by 2.20 inches.
- (3) 3.08 by 2.20 inches.
- (4) 3.20 by 2.84 inches.
- (5) 2.72 by 2.60 inches.
- (6) 3.28 by 2.68 inches.
- (7) 3.44 by 2.76 inches.

In weight the apples submitted to me range a fraction above a half pound, the average of seven examples being seven ounces and a quarter. The following are the weights of these seven examples:

- (1) 7.31 ounces.
- (2) 8.25 ounces
- (3) 7.37 ounces.
- (4) 7.50 ounces.
- (5) 6.62 ounces.
- (6) 4.75 ounces.
- (7) 8.94 ounces.

Color, deep purplish red, sometimes completely so, again only or largely on the exposed side; striped with deeper purple and pale waxen yellow, when fully ripe, with ocher-yellow; the stripes contracting and extending into the cavity at the calyx end. Marked with evident ocher-yellow dots, these becoming especially conspicuous where the purplish red is deepest. Region about the calyx end sometimes extensively waxen yellow. Sometimes a half or more of an apple is yellow with little trace of stripes. When immature there is more purple and less red in the coloring.

Flesh white at first, becoming creamy when thoroughly ripe. Flavor, not striking, but pleasant; subacid. Skin rather tough, thus calculated to protect it from insect and fungus injury, and to render it a good shipper. Ripe, September 22. While it is adapted only for fall use, it ripens at a time when few apples as good are in a condition for the table, the early ones being long gone and the late ones not yet sufficiently ripe. It keeps very well, becoming finally in October mellow and agreeable as an eating apple. It cooks well before this final change, making good sauce, but proving especially acceptable when baked.

According to Mr. Piper the growth and foliage of his trees resemble those of the Rome Beauty. In bearing, he says, it is as regular as Rome Beauty or Ben Davis.

The history of this variety is somewhat uncertain and obscure. Mr. Piper writes me under date of October 10, that the original tree sprang up in a thicket on the place of Mr. R. H. Emerson, at Clinton, Ky., and stood about fifty yards from an orchard. Grafts were made from it about twenty years ago by J. M. Samuels, then engaged in the nursery business at Clinton. Mr. Piper's trees came from these grafts, and he has recently made numerous grafts of his own. The original tree has been destroyed unfortunately, so that it is impossible now to get information concerning it except at second hand.

The Illustrations of the Fall Beauty.

The apples, as explained under the figures, are represented of natural size. But I wish to call the attention of fruit growers to the fact that an apple when looked at with two good eyes appears larger than when represented of its exact mathematical dimensions on a plane surface. It is the result of seeing things with two lenses as against one. With our two eyes we see around the apple and thus get a little different measure of its size than we do when we see it through a single camera lens. I am calling attention to the fact because a lithographic firm recently explained to me that it was accustomed to make fruit "show up well", *i. e.*, exaggerate the size, because fruit men would be dissatisfied with the illustration otherwise. I have seen a colored lithograph of the Fall Beauty, made by this firm, representing an apple that would weigh a good pound, whereas I know from having weighed them that not a single apple sent me by Mr. Piper weighed much more than a half pound. And this latter is a better weight than the other.

Unfortunately, photography does not show all the richness of the coloring of the Fall Beauty. I used isochromatic plates, and this has helped some, but I must admit that the black-and-white illustrations do not present what a first-rate colored figure would.

KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE
STATE COLLEGE OF KENTUCKY.

BULLETIN NO. 117.

COMMERCIAL FERTILIZERS.

LEXINGTON, KENTUCKY
DECEMBER 31, 1904.

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 postoffice address, or of any failure to receive the bulletins.

Address:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,
Lexington, Ky.

BULLETIN NO. 117

ANALYSES OF COMMERCIAL FERTILIZERS.

The matter of plant food is all important in purchasing fertilizers. When a farmer buys a ton of an average commercial fertilizer he buys in reality only about 300 pounds of actual plant food. If he buys a cheaper fertilizer he gets less than this amount. If he buys a high grade fertilizer he may receive as much as 600 pounds. It costs as much to mix a ton of fertilizer containing 300 pounds of plant food as it does one containing 600 pounds. The cost of sacking, hauling, and freighting is the same. Therefore, it is evident that the manufacturer can sell the plant food in a high grade fertilizer cheaper per pound than he can the plant food in a low grade fertilizer. In other words, the higher the grade the cheaper can the plant food be bought. Farmers are advised therefore to purchase only high grade fertilizers.

Attention is called to those brands which have less than two per cent. of ammonia or potash. Less than two per cent. of either of these ingredients is too small a quantity where such ingredients are needed, and where not needed it is useless to purchase them. It is an utter waste of money to purchase potash or ammonia in fertilizers containing less than one per cent. of these ingredients.

Number of brands. There were 366 different brands of commercial fertilizers registered during 1904. Of these different brands 202 were complete fertilizers, or fertilizers containing all three of the essential ingredients, namely: phosphoric acid, nitrogen, and potash; 47 were acid phosphates, or superphosphates; 6 contained a mixture of acid phosphates and nitrogen compounds only; 53 acid phosphate and potash salts only; and 58 were classed as bones or tankage.

Samples Collected and Analyzed. Three hundred and eighty-two samples were collected by deputy inspectors, or were sent by

farmers from various parts of the state; 369 samples were those sent in by firms as official samples; of these samples 630 were analyzed by the Station.

Results of the Analyses. The results of the analyses show that of the 630 samples analyzed, 111, representing 89 brands and 33 firms, fell so far below the guaranteed analyses in phosphoric acid, nitrogen or potash, or any two, or all three of these ingredients, that the deficiencies could not be accounted for by variations in sampling or analysis. It is probable that in most cases variations can be accounted for by hurried or careless mixing at the factories, or gross mistakes in shipping one brand for another, but in one or two instances, the results show a desire on the part of the manufacturer to guarantee a higher percentage of the essential ingredients than the goods contain.

The following table gives the names of all manufacturers legally selling fertilizers in the State during 1904, and the number of samples analyzed of each firm's fertilizers taken from various places in the State or furnished by the manufacturers.

The table also shows in how many of these samples there was a serious deficiency of either phosphoric acid, nitrogen or potash, and in how many the percentages of these constituents are such as to be considered acceptable, from the point of view of the buyer, either because they equal or exceed the percentage guaranteed by the manufacturer, or because a slight deficiency in one constituent is, in the Director's judgment, fully made up by an excess in one or both of the others. Under the heading "Relative Value Per Ton," is shown in how many instances the "estimated value per ton" calculated from our analysis, equals or exceeds the value calculated from the manufacturer's minimum guaranteed analysis, and in how many it is too low, reasonable allowance having been made for unavoidable variations. This table should be carefully studied. It concisely reviews each firm, showing how the samples of fertilizers taken from various places in the State compare with what was guaranteed. In order, however, to see the amount of variations from the guaranteed analyses, this table should be studied in connection with the table of results of analyses, which follows this introduction. This table can be easily referred to, as the names of the firms are arranged in alphabetical order.

NAME OF MANUFACTURER.	No. of Samples Analyzed.	Phosphoric Acid.		Nitrogen.		Potash.		Relative Value Per Ton	
		No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.
The Abbott & Martin Rendering Co.	3	2	1	3	0	3	0	3	0
A. D. Adair & McCarty Bros.	2	2	0	2	0	2	0	2	0
The Amer. Ag. Chemical Co., Cleveland Dryer Works	11	10	1	6	0	5	0	11	0
The Amer. Ag. Chemical Co.	2	2	0	2	0	0	0	2	0
American Guano Co.	6	6	0	4	0	6	0	6	0
The Armour Fertilizer Works	32	30	2	24	0	22	0	31	1
Bowker Fertilizer Co.	21	18	3	13	0	12	2	20	1
C. S. Brent	4	4	0	3	1	3	1	4	0
The Buckeye Fertilizer Co.	6	6	0	4	0	4	0	6	0
Wm. Casler.	1	1	0	1	0	0	0	1	0
The Cincinnati Phosphate Co.	12	9	3	7	1	8	2	10	2

NAME OF MANUFACTURER.	No. of Samples Analyzed.	Phosphoric Acid.		Nitrogen.		Potash.		Relative Value Per Ton	
		No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.
Continental Fertilizer Co.	22	17	5	14	0	14	1	20	2
The Currie Fertilizer Co.	18	18	0	16	1	16	0	18	0
Duncan Bros. Co.	14	11	3	12	0	6	0	14	0
The Empire Guano Co.	10	8	2	7	1	9	1	10	0
Fox Chemical Co.	37	35	2	24	0	25	2	36	1
Globe Fertilizer Co.	53	48	5	36	2	38	2	52	1
The Hardy Packing Co.	3	2	1	3	0	3	0	3	0
Indiana Fertilizer Co.	7	7	0	5	0	6	0	7	0
The Jarecki Chemical Co.	26	22	4	16	2	17	3	23	3
J. B. Jones	7	3	4	7	0	4	0	4	3
The Jones Fertilizing Co.	13	12	1	8	0	6	0	13	0

Kaufman Fertilizer Co	11	11	0	7	2	6	1	11	0
Louisville Fertilizer Co.	30	28	2	22	0	19	1	29	1
Michigan Carbon Works	21	20	1	17	0	14	0	20	1
Nelson Morris & Co.....	12	3	9	12	0	7	0	12	0
National Fertilizer Co.	28	22	6	11	2	20	0	28	0
North-Western Fertilizing Co	28	28	0	23	0	20	0	28	0
The Ohio Farmer's Fertilizer Co.....	6	4	2	5	0	6	0	6	0
Packer's Fertilizer Association	10	10	0	6	0	7	0	10	0
The Packer's Fertilizer Co.	2	1	1	1	0	2	0	1	1
Pero & Stoecker.	4	4	0	4	0	0	1	4	0
The Queen City Fertilizer Co	6	5	1	5	0	6	0	6	0
Read Phosphate Co	25	25	0	17	0	21	1	25	0
Singer & Johnson Fertilizer Co	5	3	2	3	0	2	2	5	0
Smith Brothers.	15	15	0	10	2	8	1	15	0
Swift & Company.....	29	25	4	24	1	18	2	26	3

NAME OF MANUFACTURER.	No. of Samples Analyzed	Phosphoric Acid.		Nitrogen.		Potash.		Relative Value Per Ton	
		No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.	No. Too Low.	No. Acceptable.
Tennessee Chemical Co.	20	1	19	0	9	2	12	0	20
Tennessee Valley Fertilizer Co.	6	1	5	0	4	1	4	0	6
Tuscarora Fertilizer Co.	16	1	15	0	12	2	9	0	16
Virginia-Carolina Chemical Co.	23	0	23	0	16	0	19	0	23
Wake Fertilizer Co.	1	0	1	0	1	0	1	0	1
White River Packing Co.	4	0	4	0	3	0	4	0	4
Wood, Stubbs & Co.	9	2	7	0	8	0	7	0	9

It is evident from the preceding table that while most of the fertilizers examined ran above the minimum guarantee, yet a thorough and careful inspection seems essential. It is hoped that farmers will generally take advantage of Section 8 of the fertilizer law, and when they purchase fertilizers, at least in quantity, that they will take a sample in accordance with Section 8, and send it to the Station for free analysis.

Essentials in Taking a Sample. 1. Take it at the time of purchase, and if possible in the presence of agent or seller. 2. Take a sample from not less than two bags, and from one additional bag for every ten purchased; mix these samples carefully and take at least a pint of this mixed sample, put it into a fruit jar, seal, box and express to M. A. Scovell, Director, Lexington, Ky. 3. Take the sample in the presence of at least one witness, and have the witness sign the required certificate. 4. The certificate for free analysis to be sent *by mail* and should be in accordance with the law as given in Section 8.

If the sample is taken in accordance with the above directions it may be sent by express and the charges will be paid by the Station.

Form of Certificate. A good form of certificate is the following and blank certificates will be sent free to any farmer requesting the same.

CERTIFICATE FOR FREE ANALYSIS.

.....190

M. A. SCOVELL, Director, Lexington, Ky:

This is to certify that I am not a dealer in, or agent for the sale of any fertilizer, and that the fertilizer, a sample of which I have sent by express to you for free analysis was purchased by me190.. for my own use and not for sale.

I further certify that the sample was taken at the time of purchase from at least 10 per cent. of the sacks or other packages comprising the whole lot purchased, and that it was taken as provided in Section 8 of the fertilizer law, in the following described man-

ner, towit:

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

(Signature).....

(P. O. Address).....

Signature of Witnesses:

.....

Should, however, any farmer desire to take a sample and not have a blank certificate at hand, he may write one in full like the form above given, or take the sample in presence of seller and witness and so mark it that he can identify it subsequently in a certificate, and send it at once to the Experiment Station with the request that the station furnish form of certificate, such certificate to be filled out upon receipt covering the sample and properly signed by sender and witnesses and sent by return mail to the Station.

Section Providing for Free Analysis. The section of the Fertilizer Law, providing for the taking of samples for free analysis is as follows:

Sec. 8. Any person not a dealer in, or agent for the sale of any fertilizer who may purchase any commercial fertilizer in this State for his own use and not for sale, may take a sample of the same for analysis, which analysis shall be made by the said Experiment Station free of charge. Such sample for free analysis shall be taken by the purchaser in presence of the person, company or agent selling the fertilizer from at least ten (10) per cent. of the sacks or other packages comprising the whole lot purchased, and shall be thoroughly mixed and at least one pound of the material after

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

Values Used.—In calculating the relative value per ton, the following values have been used:

Soluble and reverted phosphoric acid in mixed fertilizers	6c per lb.
Soluble and reverted phosphoric acid in plain acid and unacidulated phosphates	5c per lb.
Insoluble phosphoric acid in mixed fertilizers.....	2c per lb.
Insoluble phosphoric acid in plain acid phosphates...	Nothing.
Phosphoric acid in fine bone	4c per lb.
Phosphoric acid in medium bone	3c per lb.

Fine bone is all that passes through a sieve with meshes one-twenty-fifth inch square. Medium bone passes through a sieve with meshes one-sixth inch square, but does not include fine bone.

Nitrogen in all fertilizers	15c per lb.
Potash in all fertilizers, from sulphate.....	6c per lb.
Potash in all fertilizers, from muriate	5c per lb.

The term "Potash from muriate" does not indicate necessarily that the manufacturers used muriate of potash in furnishing the potash; they may have used sulphate of potash, or other salts of potash, but in all fertilizers where the term "Potash from muriate" is used there is enough chlorine present to combine with the potash, either from salt in the tankage used, or the potash salts used, as muriate, kainit, carnallite, etc. As the objection to the use of muriate of potash arises from the chlorine present in this salt, it likewise follows that chlorine in a fertilizer is objectionable, whether put in with the potash or otherwise. The using of sulphate of potash where there is chlorine present in other ingredients of the fertilizer will not obviate the injurious effect of the chlorine, and therefore we take this method of showing chlorine present by designating the potash as "from muriate."

Explanation of the Table. In the table of analyses, following the name of each brand will be found the analysis of the sample furnished by the manufacturer at the time the fertilizer was entered for sale and which was accompanied by an affidavit giving the guaranteed analysis. This is the analysis that is marked "manufacturer" in the column headed "From Whom Obtained." If any other analyses of the same brand have been made, they will be found following this analysis. These samples have been collected by deputy inspectors or sent in by farmers. The manufacturer's guarantee is printed last in *italic* figures.

The figures in the table which are set in bold face type are those results which, in the judgment of the Director, were too low to be acceptable. Where the total phosphoric acid in samples of bone is marked with (*), it indicates that the bone contains soluble phosphoric acid. This soluble phosphoric acid is an indication of either the addition of acid phosphate to the bone, in which case it would not be a pure raw bone, or else that the bone containing this soluble phosphoric acid was not strictly a pure or high grade

bone, but contained trashy materials, which carried with them the soluble phosphoric acid.

The names of the manufacturers are arranged in alphabetical order, and all the analyses of the same brand have been grouped together.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	FROM WHOM OBTAINED.
	The Abbott & Martin Rendering Co., Columbus, O.	
13250	Ideal Grain Grower	Manufacturer
13251	Peerless Bone and Potash..	Manufacturer
13252	Abbott's Tobacco and Potato Special	Manufacturer
	A. D. Adair & McCarty Bros., Atlanta, Ga.	
13336	Furman High Grade Fertilizer	Manufacturer
13337	Furman Soluble Bone	Manufacturer
	The Amer. Ag. Chem. Co., New York, N. Y.	
	Cleveland Dryer Works.	
13256	Horsehead Phosphate	Manufacturer
13418		Hiner & Gardner, Vanceburg
13617		O. A. Lutes & Co., Sheph'dsv'le
13257	XXX Super Phosphate.....	Manufacturer
13419		Hiner & Gardner.....
13258	Ohio Seed Maker	Manufacturer
13259	Ohio Seed Maker with Potash	Manufacturer
13260	Phospho Bone	Manufacturer
13420		R. W. Newman, Lewisburg...

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				8.14 7.00	2.71	10.85 9.00	0.83 0.82	1.01 1.00		2.07	\$15.82 12.66	13250
				7.06 8.00	3.75	10.81 10.00	0.83 0.41	1.01 0.50	2.44 2.50	1.51	16.71 14.13	13251
				9.22 8.00	2.33	11.55 10.00	1.80 1.65	2.19 2.00	3.80 4.00	0.70	22.03 19.35	13252
		8.00	2.00	10.80 10.00	0.91	11.71 1.65	1.56 2.00	1.89 2.00	2.60		20.60 19.35	13336
		8.00	2.00	10.98 10.00	1.25	12.23 0.82	1.11 1.00	1.35 1.00	1.11		18.12 15.66	13337
				11.08 10.14 9.57 10.00	0.78 4.38 4.03	11.86 14.52 13.60 12.00					11.08 10.14 9.57 10.00	13256 13418 13617
		8.00	2.00									
				14.99 13.40 14.00	1.54 3.19	16.53 16.59 16.00					14.99 13.40 14.00	13257 13419
	12.00	2.00										
				10.34 10.00	1.34	11.68 12.00	1.86 1.65	2.26 2.00			18.53 17.75	13258
				8.20 8.00	3.36	11.56 10.00	1.80 1.65	2.19 2.00	3.14 2.00		19.72 17.35	13259
	5.00	3.00										
				10.12 12.42 10.00	3.15 1.65	13.27 14.07 12.00	1.02 0.87 0.82	1.24 1.06 1.00	1.04 1.04 1.00		17.50 19.21 16.26	13260 13420
	7.00	3.00										

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	The Amer. Ag. Chem. Co., New York, N. Y. Cleveland Dryer Works.	
13261	Tobacco, Potato and General	Manufacturer
13421	Crop Fertilizer	R. W. Newman
	The Amer. Ag. Chem. Co., New York, N. Y.	
13262	Ground Bone	Manufacturer
13263	Special Bone Meal	Manufacturer
	American Guano Co., Nash- ville, Tenn.	
13350	Mule Brand Potash For- mula	Manufacturer
13351	M. B. Blood and Bone.....	Manufacturer
13352	M. B. Cotton, Corn and	Manufacturer
13618	Wheat Guano	Dunagan & Kirtley, Horse Cave
13353	M. B. Vegetable and Tobac- co Grower	Manufacturer
13603	M. B. Acid Phosphate and Potash	Manufacturer
	The Armour Fertilizer Works, Chicago, Ill.	
13117	Grain Grower	Manufacturer
13424		Christmas & Goad, Glasgow..
13619		Barren Co. Gro. & Hdw. Co., Glasgow

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				7.32	2.17	9.49	0.90	1.09	4.50		\$16.85	13261
				8.06	2.01	10.07	1.05	1.27	3.56		17.18	13421
		5.00	3.00	8.00		10.00	0.82	1.00	4.00		16.86	
16.23	5.70					21.93	2.70	3.28			24.50	13262
						20.00	2.47	3.00			19.41	
17.78	10.44					28.22	1.55	1.88			25.13	13263
						25.00	1.23	1.50			18.69	
				12.14	2.48	14.62			3.65		19.21	13350
		6.00	6.00	12.00		13.00			2.00		16.80	
				13.30	3.70	17.00	1.06	1.29	1.65		22.27	13351
		5.00	5.00	10.00		11.00	0.82	1.00	2.00		16.86	
				9.15	4.87	14.02	1.93	2.34	3.09		21.81	13352
				9.53	6.46	15.99	2.21	2.68	2.05		22.70	13618
		4.00	4.00	8.00		9.00	1.65	2.00	2.00		16.95	
				11.51	4.21	15.72	1.97	2.39	4.25		25.65	13353
		5.00	5.00	10.00		11.00	1.65	2.00	2.00		19.35	
				10.46	2.60	13.06			7.12		20.71	13603
		6.00	4.00	10.00		11.00			4.00		16.40	
				8.28	0.55	8.83	1.92	2.33	2.34		18.26	13117
				9.51	2.32	11.83	1.77	2.15	1.10	1.13	20.11	13424
				9.44	1.18	10.62	1.65	2.00	2.58		19.33	13619
		6.00	2.00	8.00		10.00	1.65	2.00	2.00		17.35	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13118 13425	The Armour Fertilizer Works, Chicago, Ill. Bone, Blood and Potash...	Manufacturer Durham & Cecil, Danville....
13119	White Burley and Black Tobacco	Manufacturer
13120 13426 13620	Wheat, Corn and Oat Special	Manufacturer D. E. Patterson, Hodgenville.. A. Cash & Co., Princeton....
13121	Ammoniated Bone with Potash	Manufacturer
13122 13427 13621	Star Phosphate	Manufacturer D. E. Patterson..... Forbes Mfg. Co., Hopkinsville
13123 13428 13622	Phosphate and Potash.....	Manufacturer Forbes Mfg. Co..... J. W. Riley, Newstead.....
13124 13415 13416 13429	Tobacco Grower	Manufacturer B. F. Wood, Cerulean..... B. F. Wood, Cerulean..... Hatter & March, Franklin....
13125	Cereal Phosphate	Manufacturer
13126	Armour's Champion	Manufacturer
13127	Dark Tobacco Special	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				8.26	2.05	10.31	4.52	5.49		6.92	\$32.59	13118
				7.47	3.44	10.91	4.62	5.61		9.30	35.36	13425
	6.00	2.00		8.00		10.00	4.12	5.00		7.00	31.16	
				7.36	3.02	10.38	3.12	3.79		4.31	24.57	13119
	6.00	2.00		8.00		10.00	2.88	3.50		4.00	23.84	
				7.11	0.43	7.54	1.15	1.40	1.21		13.36	13120
				8.33	1.25	9.58	1.05	1.27	1.15		14.80	13426
				6.44	1.20	7.64	0.85	1.03	1.30		12.06	13620
	5.00	2.00		7.00		9.00	0.82	1.00	1.00		12.66	
				6.19	0.69	6.88	2.86	3.47	2.29		18.58	13121
	4.00	2.00		6.00		8.00	2.47	3.00		2.00	17.81	
				14.02	0.50	14.52					14.02	13122
				16.64	0.29	16.93					16.64	13427
				14.38	1.23	15.61					14.38	13621
	10.00	4.00		14.00		16.00					14.00	
				10.35	0.47	10.82			2.18		14.79	13123
				12.47	0.86	13.33			2.03		17.33	13428
				8.96	0.88	9.84			2.65		13.75	13622
	6.00	4.00		10.00		12.00			2.00		14.80	
				8.46	0.50	8.96	1.84	2.23		5.23	22.15	13124
				8.98	1.33	10.31	1.40	1.70	0.94	4.15	21.43	13415
				8.13	2.28	10.41	1.64	1.99		5.05	21.65	13416
				8.79	2.56	11.35	2.07	2.51	0.72	4.03	23.34	13429
	6.00	2.00		8.00		10.00	1.65	2.00		5.00	21.35	
				10.45	0.31	10.76					10.45	13125
	6.00	4.00		10.00		12.00					10.00	
				10.73	0.59	11.32	1.92	2.33	2.29		21.17	13126
	6.00	4.00		10.00		12.00	1.65	2.00	2.00		19.75	
				8.16	0.27	8.43	1.97	2.39		4.23	20.89	13127
	5.00	2.00		7.00		9.00	1.65	2.00		4.00	18.95	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	FROM WHOM OBTAINED.
	The Armour Fertilizer Works, Chicago, Ill.	
13128	Bone Meal	Manufacturer
13430		Forbes Mfg. Co., Hopkinsville
13623		W. Lewis & Bro., Greensburg.
13129	Raw Bone Meal	Manufacturer
13431		Cox & Clore, Beard.....
13608		C. A. Sloss, Woodburn.....
13312	High Grade Potato	Manufacturer
13560	Record Brand	Manufacturer
13561	Soluble Phosphate and Potash	Manufacturer
	Bowker Fertilizer Co., Boston-New York-Cincinnati.	
13215	Bowker's Fish Guano.....	Manufacturer
13432		Richardson & Turner, Campbellsville
13624		J. H. Thurman, Somerset....
13216	Bowker's Harvest Bone....	Manufacturer
13217	Bowker's Tobacco Grower..	Manufacturer
13411		O. Schadler, Richwood.....
13218	Bowker's Kentucky Special	Manufacturer
13410		O. Schadler
13625		Gardner & Judd, Elizab'tht'wn

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
20.66	4.85					25.51	3.19	3.87				
16.51	8.51					25.02	3.16	3.84			\$29.01	13128
21.14	5.96					27.10	2.70	3.28			27.80	13430
						24.00	2.47	3.00			28.59	13623
											21.81	
16.93	7.25					24.18	3.66	4.44			28.87	13129
13.96	11.42					25.38	3.74	4.54			29.24	13431
20.96	5.91					26.87	3.40	4.13			30.52	13608
						22.00	3.71	4.50			24.33	
		6.00	2.00	9.11	0.43	9.54	2.11	2.56	3.60	6.69	29.06	13312
				8.00		10.00	1.65	2.00	10.00		25.35	
		6.00	4.00	11.19	0.41	11.60	1.20	1.46	1.16		18.35	13560
				10.00		12.00	0.82	1.00	1.00		16.26	
		6.00	4.00	10.84	0.43	11.27			4.23		17.41	13561
				10.00		12.00			4.00		16.80	
				8.92	2.41	11.33	0.86	1.04	2.73		16.97	13215
				9.18	2.88	12.06	0.81	0.98	2.93		17.53	13432
				9.56	2.47	12.03	1.03	1.25	2.72		18.27	13624
				8.00		10.00	0.82	1.00	3.00		15.86	
				7.80	3.02	10.82	0.91	1.10	0.98		14.28	13216
				8.00		10.00	0.82	1.00	1.00		13.86	
				8.52	3.21	11.73	1.94	2.36		6.03	24.56	13217
				8.38	3.35	11.73	1.66	2.02	0.84	4.75	22.92	13411
				8.00		10.00	1.65	2.00		5.00	21.35	
				8.84	2.21	11.05	1.15	1.40	4.80		19.74	13218
				8.51	2.48	10.99	1.21	1.47	4.01		18.84	13410
				7.85	3.38	11.23	1.51	1.83	4.09		19.39	13625
				8.00		10.00	1.23	1.50	4.00		18.09	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Bowker Fertilizer Co., Boston, New York, Cincinnati.	
13219	Bowker's Potash Fertilizer	Manufacturer
13433		Goldsboro & Co., Lagrange...
13626		M. E. Bogue, Sonora.....
13220	Bowker's Dissolved Bone with Potash	Manufacturer
13434		Eads Bros., Science Hill.....
13221	Bowker's Soluble Bone.....	Manufacturer
13435		Eads Bros.
13627		Eads Bros.
13222	Bowker's Bone Meal.....	Manufacturer
13436		Richardson & Turner
13452	Bowker's Raw Bone.....	Manufacturer
13628		M. E. Bogue
	C. S. Brent, Lexington, Ky.	
13367	Brent's Grain Grower.....	Manufacturer
13422		Mfrs. Warehouse
13381	Brent's Hemp and Tobacco Special	Manufacturer
13423		Mfrs. Warehouse
	The Buckeye Fertilizer Co., Columbus, O.	
13408	Special Blood and Potash Mixture	Manufacturer
13437		Berea College, Berea
13496	Complete Fertilizer	Manufacturer
13498		J. W. Bell, Bedford.....

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				9.50	3.84	13.34			4.37		\$17.31	13219
				9.25	3.36	12.61			4.98		17.42	13433
				10.40	3.28	13.68			4.27		18.06	13626
				10.00		12.00			5.00		17.80	
				9.18	2.92	12.10			3.04		15.23	13220
				9.45	3.39	12.84			1.78		14.48	13434
				10.00		12.00			2.00		14.80	
				13.31	3.07	16.38					13.31	13221
				12.75	3.80	16.55					12.75	13435
				14.22	3.13	17.35					14.22	13627
				14.00		16.00					14.00	
12.93	9.76					22.69	1.88	2.28			21.84	13222
16.21	6.00					22.21	1.71	2.08			21.70	13436
						20.00	1.65	2.00			16.95	
16.97	6.93					23.90	3.26	3.96			27.52	13452
15.66	6.40					22.06	2.33	2.83			23.36	13628
						20.00	2.47	3.00			19.41	
				9.19	0.64	9.83	1.84	2.23	1.66		18.47	13367
				9.66	2.37	12.03	1.89	2.29	1.78		19.99	13422
				8.00		10.00	1.65	2.00	2.00		17.35	
				6.70	1.78	8.48	3.46	4.20	3.12	7.50	31.25	13381
				6.84	2.32	9.16	3.71	4.50	1.64	7.28	30.65	13423
				5.00			4.00	4.86		10.00	30.00	
				8.52	2.62	11.14	1.40	1.70	3.00	0.60	19.19	13408
				9.60	2.16	11.76	1.08	1.31	4.66		20.28	13437
				8.00		10.00	0.82	1.00		4.00	17.66	
				9.00	0.79	9.79	0.34	0.41	3.74		15.88	13496
				8.29	2.93	11.22	0.41	0.50	2.60		14.95	13498
				8.00		10.00	0.41	0.50		2.50	14.63	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13497 13499	The Buckeye Fertilizer Co., Columbus, Ohio. Extra Superphosphate	Manufacturer J. W. Bell
13602	Wm. Casler, Louisville, Ky. Champion Raw Bone Meal..	Manufacturer
13208 13438	The Cincinnati Phosphate Co., Cincinnati, O. Capitol High Grade Guano	Manufacturer The Reynolds Co., Waynesb'rg
13209	Capitol Wheat Grower.....	Manufacturer
13210 13439 13629	Capitol Grain and Grass Grower	Manufacturer The Reynolds Co..... Sievers & Sievers, Somerset..
13211	Capitol Dissolved Bone and Potash	Manufacturer
13212 13440	Capitol Tobacco Food	Manufacturer Hiner & Gardner, Vanceburg..
13213	Capitol Ground Bone	Manufacturer
13214 13441	Capitol Alkaline Bone	Manufacturer Hiner & Gardner
13150 13359	Continental Fertilizer Co., Nashville, Tenn. Bear Potash Compound ...	Manufacturer T. L. Button, Bedford.....

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				14.64	2.78	17.42					\$14.64	13497
				13.64	5.37	19.01					13.64	13499
				14.00		16.00					14.00	
22.41						22.41	3.21	3.90			27.56	13602
						22.00	3.29	4.00			23.07	
				10.17	1.27	11.44	0.85	1.03		1.81	17.43	13208
				10.03	1.96	11.99	0.61	0.74		1.94	16.98	13438
				10.00		11.00	0.82	1.00	2.00		16.86	
				13.39	2.00	15.39					13.39	13209
				14.00		15.00					14.00	
				10.09	1.71	11.80	0.81	0.98		1.20	16.66	13210
				8.56	3.07	11.63	0.69	0.84		1.54	15.42	13439
				12.20	1.68	13.88	0.69	0.84		0.82	18.36	13629
				10.00		11.00	0.82	1.00	1.00		15.86	
				11.52	1.62	13.14			2.26		16.73	13211
				12.00		13.00			3.00		17.80	
				8.36	1.20	9.56	0.79	0.96	3.71		16.59	13212
				7.12	2.21	9.33	0.59	0.72	4.21		15.40	13440
				8.00		9.00	0.82	1.00	2.00	2.00	16.86	
19.24	5.12					*24.36	1.93	2.34			21.25	13213
						20.00	2.47	3.00			19.41	
				8.20	3.24	11.44			2.31		13.45	13214
				10.63	2.65	13.28			1.39		15.21	13441
				10.00		11.00			2.00		14.40	
				6.32	2.17	8.49	1.79	2.17		7.10	22.34	13150
				5.56	2.05	7.61	1.34	1.63		5.97	18.67	13359
		4.00	2.00	6.00		7.00	1.65	2.00		6.00	19.75	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANU- FACTURER AND NAME OF BRAND.	From Whom Obtained.
13321 13630	Continental Fertilizer Co., Nashville, Tenn. Bear Corn & Wheat Special	Manufacturer Barren Co. Gro. and Hdw. Co., Glasgow
13322 13442	Bear Beef, Blood & Bone..	Manufacturer Frank X. Merkley, Campbells- ville
13326 13443	Bear Special Tobacco Grow- er	Manufacturer Lovell & Huffine, Franklin...
13327 13609	Bear Potash Mixture.....	Manufacturer R. L. Roberts, Waverly.....
13331	Bear Special Corn Grower..	Manufacturer
13332 13444	Bear High Grade Tobacco & Potato Grower	Manufacturer McClure & Wells, Springfield..
13357	Bear High Grade Dissolved Bone	Manufacturer
13358 13445	Bear Phosphate	Manufacturer Barren Co. Gro. and Hdw. Co.
13409	Bear Tobacco Grower.....	Manufacturer
13467 13470	Bear Bone Meal	Manufacturer Frank X. Merkley

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				10.08	0.50	10.58				0.66	\$13.09	13321
				10.89	0.61	11.50				0.37	13.75	13630
	6.00	4.00		10.00		11.00				0.50	13.00	
				9.09	2.78	11.87	1.93	2.34		2.22	20.47	13322
				11.25	2.25	13.50	1.47	1.78		1.75	20.91	13442
	6.00	4.00		10.00		11.00	1.65	2.00		2.00	19.75	
				9.18	0.68	9.86	0.90	1.09		1.85	16.21	13326
				8.23	3.04	11.27	0.70	0.85		0.98	14.38	13443
	5.00	3.00		8.00		9.00	0.82	1.00		1.50	14.26	
				10.33	0.58	10.91				2.50	15.63	13327
				9.22	0.95	10.17				1.88	13.70	13609
	6.00	4.00		10.00		11.00			2.00		14.40	
				7.23	0.73	7.96	0.82	1.00		1.32	13.01	13331
	4.00	3.00		7.00		8.00	0.82	1.00	1.00		12.26	
				7.40	0.74	8.14	1.83	2.22		4.57	20.15	13332
				6.39	1.45	7.84	1.67	2.03		4.03	18.10	13444
	4.00	3.00		7.00		8.00	1.65	2.00		4.00	18.55	
				13.69	1.55	15.24					13.69	13357
	8.00	6.00		14.00		15.00					14.00	
				11.65	1.62	13.27					11.65	13358
				11.69	1.47	13.16					11.69	13445
	7.00	5.00		12.00		13.00					12.00	
				7.02	3.19	10.21	2.74	3.33		6.39	25.59	13409
	5.00	3.00		8.00		9.00	2.47	3.00		6.00	24.61	
29.96	2.26					32.22	0.82	1.00			27.79	13467
21.66	6.84					*28.50	0.69	0.84			23.50	13470
						20.00	0.82	1.00			14.46	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Continental Fertilizer Co., Nashville, Tenn.	
13468	Bear Special Wheat Grower	Manufacturer
13469	Bear XX Ground Bone.....	Manufacturer
13517	Bear Acid Phosphate	Manufacturer
	The Currie Fertilizer Co., Lou- isville, Ky.	
13342	Currie's Acid Phosphate....	Manufacturer
13343	Currie's Corn and Wheat Special	Manufacturer
13446		C. W. Quiggins, Elizabethtown
13632		C. W. Quiggins, Elizabethtown
13344	Currie's Soluble Bone.....	Manufacturer
13447		Wm. Leming, Hodgenville ...
13633		Wm. Leming, Hodgenville ...
13345	Currie's Dissolved Bone....	Manufacturer
13346	Currie's Climax Tobacco and Potato Grower	Manufacturer
13347	Currie's Golden Leaf Tobac- co and Potato Grower....	Manufacturer
13448		Wm. Leming
13348	Currie's Tobacco and Potato Grower	Manufacturer
13449		C. W. Quiggins

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
		4.00	3.00	8.17 7.00	0.54	8.71 8.00	0.80 0.82	0.97 1.00	1.00	1.05	\$13.68 12.26	13468
		3.00	1.00	8.75 4.00	7.52	16.27 15.00	1.60 1.23	1.94 1.50			18.31 12.89	13469
		6.00	4.00	8.88 10.00	1.83	10.71 11.00					8.88 10.00	13517
				13.18 13.50	0.97	14.15					13.18 13.50	13342
				10.04 11.56 10.11 10.00	1.51 0.84 2.48	11.55 12.40 12.59 12.50	0.85 0.93 1.00 0.82	1.03 1.13 1.21 1.00	1.39	1.03 0.98 1.51 1.00	16.44 18.18 17.51 16.66	13343 13446 13632
				9.97 10.34 15.30 10.00	1.84 1.54 0.26	11.81 11.88 15.56 12.00	1.25 1.17 1.30 1.03	1.52 1.42 1.58 1.25	1.54	1.51 1.43 23.90 1.50	18.26 18.26 23.90 17.69	13344 13447 13633
				8.43 8.00	0.81	9.24 10.00	1.73 1.65	2.10 2.00		2.11 2.00	18.16 17.75	13345
				9.83 9.50	2.05	11.88 12.00	1.26 1.03	1.53 1.25		1.53 1.50	18.24 17.29	13346
				8.64 8.56 8.00	1.85 1.85	10.49 10.41 9.50	1.65 1.87 1.65	2.00 2.27 2.00	2.32 2.52	1.48 1.30 3.50	20.16 20.70 19.35	13347 13448
				8.06 7.64 7.00	1.36 1.75	9.42 9.39 9.00	1.67 1.84 1.65	2.03 2.23 2.00	7.82 8.52		23.04 23.91 23.75	13348 13449

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	The Currie Fertilizer Co.	
13572	Currie's Wheat Grower....	Manufacturer
13634		W. S. McClanahan, Franklin..
13592	Currie's Butchertown Raw Bone Meal	Manufacturer
13635		C. W. Quiggins
13611	Currie's Fine Ground Raw Bone Meal	Manufacturer
	Duncan Bros. Co., Lagrange, Ky.	
13318	Tiger Tobacco and Potato Grower	Manufacturer
13404		L. H. Bradshaw, Lagrange...
13319	Tiger Brand Bone Tankage and Potash	Manufacturer
13405		J. J. Sanford, Smithfield.....
13636		Mfrs. Warehouse
13320	Tiger Brand Pure Raw Bone	Manufacturer
13637		Mfrs. Warehouse
13371	Tiger Brand Soluble Bone and Potash	Manufacturer
13564	Tiger Brand High Grade Phosphate	Manufacturer
13638		Mfrs. Warehouse
13565	Tiger Brand Bone Tankage and Phosphate	Manufacturer
13639		Mfrs. Warehouse

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				11.62	0.81	12.43	1.10	1.34		1.56	\$19.43	13572
				10.48	2.11	12.59	1.40	1.70	1.71		19.33	13634
				10.00		11.00	1.03	1.25		1.50	17.29	
11.90	2.80					*14.70	1.01	1.23		2.11	16.76	13592
11.94	2.98					*14.92	1.32	1.60	0.85		16.15	13635
						15.00	1.65	2.00		0.75	14.85	
10.52	4.73					*15.25	1.87	2.27			16.87	13611
						15.00	1.65	2.00			13.95	
				5.05	3.42	8.47	2.51	3.05		5.79	21.91	13318
				4.84	3.01	7.85	3.52	4.27		4.14	22.54	13404
		4.00	2.00	6.00		12.00	2.47	3.00		4.00	21.81	
				6.58	5.78	12.36	3.02	3.67		2.04	21.72	13319
				4.88	3.83	8.71	2.86	3.47		2.05	18.43	13405
				6.12	7.79	13.91	2.49	3.02	0.70	0.96	19.78	13636
		4.00	2.00	6.00		12.00	2.47	3.00		2.00	19.41	
12.31	9.67					21.98	3.72	4.52			26.81	13320
11.60	12.07					23.67	4.06	4.93			28.70	13637
						22.00	3.71	4.50			24.33	
				12.82	1.92	14.74	0.50	0.61		1.68	19.67	13371
				10.00		12.00	0.82	1.00		1.50	17.06	
				17.09	0.72	17.81					17.09	13564
				17.98	0.19	18.17					17.98	13638
		10.00	6.00	16.00		18.00					16.00	
				11.06	2.53	13.59	1.39	1.69			18.45	13565
				9.90	3.47	13.37	1.32	1.60			17.23	13639
		6.00	4.00	10.00		12.00	1.65	2.00			17.75	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13578 13640	Duncan Bros. Co. Tiger Brand Pure Bone Meal	Manufacturer Mfrs. Warehouse
13412 13450 13641	The Empire Guano Co., Nashville, Tenn. Empire Wheat and Corn Grower	Manufacturer Peak & Wentworth, Bedford.. Durham, Blakeman & Cantrell, Greensburg
13413 13451 13642	Empire Favorite Manure...	Manufacturer Peak & Wentworth Durham, Blakeman & Cantrell
13414 13643	Empire Bone and Potash...	Manufacturer Durham, Blakeman & Cantrell
13486 13487	Empire Tobacco Grower...	Manufacturer Peak & Wentworth
13180 13615	Fox Chemical Co., Branch, Federal Chemical Co., Louisville, Ky. Fox Formula	Manufacturer J. P. Ragland, Woodburn.....
13181 13453	Fox, Bone, Blood & Potash	Manufacturer T. W. Buchanan & Co., Campbellsville
13182	Fox Wheat & Grain Special	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
20.50	3.06					23.56	2.72	3.30			\$26.40	13578
19.53	4.29					23.82	2.78	3.37			26.53	13640
						24.00	2.47	3.00			21.81	
				9.76	2.25	12.01	1.07	1.30	1.53		17.35	13412
				9.16	2.64	11.80	0.91	1.10	1.56		16.34	13450
				12.40	1.28	13.68	0.49	0.59	1.20		18.06	13641
				10.00			0.82	1.00	1.00		15.46	
				9.63	2.10	11.73	0.94	1.14	3.50		18.72	13413
				9.59	2.21	11.80	0.66	0.80	3.07		17.44	13451
				11.00	1.87	12.87	0.58	0.70	2.92		18.61	13642
				10.00			0.82	1.00	3.00		17.46	
				10.08	1.70	11.78			2.48		15.26	13414
				11.39	1.34	12.73			1.09		15.30	13643
				10.00					2.00		14.00	
				10.07	1.00	11.07	2.17	2.63	0.88	4.33	25.07	13486
				7.37	1.70	9.07	1.61	1.95		3.82	18.93	13487
				8.00			1.65	2.00		4.00	19.35	
				11.87	0.91	12.78	1.11	1.35	1.70	1.66	21.62	13180
				11.95	0.63	12.58	0.69	0.84	0.88	1.77	19.66	13615
				11.00		12.00	0.82	1.00		3.00	19.66	
				12.01	0.82	12.83	0.59	0.72		1.10	17.83	13181
				11.01	1.18	12.19	0.58	0.70		0.98	16.60	13453
				11.00		12.00	0.41	0.50		1.00	16.03	
				13.97	0.77	14.74	1.11	1.35		0.81	21.37	13182
				12.00		13.00	0.82	1.00		1.00	18.46	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANU- FACTURER AND NAME OF BRAND.	From Whom Obtained.
13183 13454 13644	Fox Chemical Co., Branch, Federal Chemical Co. Fox Grain Special	Manufacturer H. A. Engelman, Bedford.... V. B. Lockett, Horse Cave....
13184 13455	Fox Special Tobacco Grower	Manufacturer Forbes Mfg. Co., Hopkinsville
13185 13456	Fox Tobacco Grower	Manufacturer Forbes Mfg. Co.....
13186 13457	Fox Bone Phosphate and Potash	Manufacturer H. A. Engelman
13187	Fox Bone Phosphate.....	Manufacturer
13188 13458 13645	Fox Alkaline Bone	Manufacturer H. A. Engelman Adams Bros., Marion
13189	Fox High Grade Acid Phos- phate	Manufacturer
13190 13646	Fox Standard Acid Phos- phate	Manufacturer T. W. Buchanan & Co.....
13191 13459	Fox Wheat & Corn Grower	Manufacturer Dickey & Co., Glasgow.....
13192	Fox Acid Phosphate	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen:	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				10.37	0.86	11.23	0.91	1.10				
				8.61	0.81	9.42	0.54	0.66		1.83	\$17.71	13183
				10.68	0.35	11.03	0.39	0.47	1.58	1.51	14.08	13454
				9.00		10.00	0.41	0.50		1.50	15.71	13644
											14.23	
				10.64	1.01	11.65	1.73	2.10		5.03	24.40	13184
				9.17	1.24	10.41	2.13	2.59		6.44	25.62	13455
				8.00		9.00	1.65	2.00		5.00	20.95	
				10.83	1.02	11.85	1.72	2.09	1.99		20.56	13185
				8.80	2.88	11.68	1.80	2.19		2.08	19.61	13456
				8.00		9.00	1.65	2.00		2.00	17.35	
				11.18	0.55	11.73			3.75		17.39	13186
				10.42	0.47	10.89			2.72		15.41	13457
				10.00		11.00			4.00		16.40	
				11.57	1.85	13.42			1.77		16.39	13187
				12.00		13.00			2.00		16.80	
				9.75	1.66	11.41			1.95		14.31	13188
				10.24	0.72	10.96			2.05		14.63	13458
				10.18	0.54	10.72			1.36		13.80	13645
				10.00		11.00			2.00		14.40	
				14.69	2.41	17.10					14.69	13189
				16.00		17.00					16.00	
				12.69	0.69	13.38					12.69	13190
				11.44	0.69	12.13					11.44	13646
				12.00		13.00					12.00	
				12.24	1.28	13.52	1.69	2.05		1.85	22.49	13191
				10.24	1.22	11.46	1.87	2.27	1.18	0.74	20.46	13459
				10.00		11.00	1.65	2.00		2.00	19.75	
				14.29	1.34	15.63					14.29	13192
				14.00		15.00					14.00	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13193 13647	Fox Chemical Co., Branch, Federal Chemical Co. Fox A. A. Acid Phosphate..	Manufacturer Adams Bros.
13194 13648	Fox Ground Bone	Manufacturer J. H. Lenon, Hardinsburg....
13195 13649	Fox Raw Bone	Manufacturer T. W. Buchanan & Co.....
13349 13460	Fox Vegetable Grower.....	Manufacturer C. R. Hall & Co., Paducah....
13361	Fox Grain Grower.	Manufacturer
13379	Fox Bone and Potash.....	Manufacturer
13601	Fox Wheat Special	Manufacturer
13604 13650	Fox Wheat Grower	Manufacturer T. W. Buchanan & Co.....
13158 13471 13651	Globe Fertilizer Co., Branch, Federal Chemical Co., Lou- isville, Ky. Braden Formula	Manufacturer Dickey & Co., Glasgow..... Hill & McElroy, Bowling Green
13159 13472 13652	Progress Corn and Wheat Grower	Manufacturer C. M. Langdon, Science Hill.. A. Cash & Co., Princeton.....

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				11.31	0.87	12.18					\$11.31	13193
				11.13	0.51	11.64					11.13	13647
				10.00		11.00					10.00	
13.39	8.20					21.59	3.05	3.70			24.78	13194
15.11	10.50					25.61	3.28	3.98			28.23	13648
						20.00	2.47	3.00			19.41	
12.85	13.91					26.76	3.92	4.76			30.39	13195
17.09	0.90					17.99	3.76	4.56			25.49	13649
						22.00	3.29	4.00			23.07	
				10.77	0.86	11.63	1.72	2.09		5.17	24.62	13349
				8.53	1.68	10.21	1.56	1.89		5.45	22.13	13460
				8.00			1.65	2.00		5.00	20.55	
				11.99	0.92	12.91	1.18	1.43		1.19	19.73	13361
				9.00			0.82	1.00		1.00	14.46	
				9.30	1.22	10.52			0.94		12.59	13379
				9.00					1.00		11.80	
				11.75	1.30	13.05	0.98	1.19	3.40	1.60	22.88	13601
				10.00			0.82	1.00		4.00	19.26	
				10.95	0.99	11.94	1.66	2.02		1.83	20.72	13604
				9.87	1.91	11.78	2.12	2.57	2.05		21.01	13650
				8.00			1.65	2.00		2.00	16.95	
				11.73	1.01	12.74	1.09	1.32		3.36	21.78	13158
				12.14	1.00	13.14	0.91	1.10	2.69		20.39	13471
				12.91	0.23	13.14	0.66	0.80	2.48		20.04	13651
				11.00		12.00	0.82	1.00		3.00	19.66	
				11.68	1.36	13.04	1.92	2.33		1.14	21.69	13159
				10.76	1.83	12.59	1.84	2.23		1.12	20.50	13472
				11.57	1.29	12.86	1.40	1.70		1.22	20.06	13652
				9.00		10.00	1.65	2.00		1.00	17.35	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13160	Globe Fertilizer Co., Branch, Federal Chemical Co. Eagle Corn and Wheat Grower	Manufacturer
13473		C. M. Langdon
13653		C. M. Langdon
13161	Globe Bone Dust	Manufacturer
13474		C. L. Dudley, Flemingsburg..
13654		Durham, Blakeman & Cantrell, Greensburg
13162	Globe Special Tobacco Grow- er	Manufacturer
13475		N. H. Stringer, Franklin.....
13163	Kentucky Standard Tobacco Grower	Manufacturer
13476		Wilson Hdw. Co., Pembroke..
13164	Big Four Tobacco Grower..	Manufacturer
13477		Edwards Bros., Walton
13165	Globe Potato Grower	Manufacturer
13478		Ellis Bros., Beard
13166	Bone Phosphate and Potash	Manufacturer
13479		Edwards Bros.
13167	Potash Compound	Manufacturer
13480		F. P. Blair, Morehead.....
13168	Potash Special	Manufacturer
13481		Hill & McElroy
13563		T. J. Turley, Leitchfield.....
13610		S. L. Clements, Morganfield...

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED												
Phosphoric Acid.							Potash.			Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.			From Sulphate.
				10 85	1.09	11.94	1.72	2.09	1.99		\$20.61	13160
				9.81	1.77	11.58	1.79	2.17	2.07		19.92	13473
				9 10	1 52	10.62	1.68	2.04		1 95	18 91	13653
				8.00		9.00	1.65	2.00		2.00	17.35	
				12.73	0.24	12.97	1.24	1.51		1.15	20.48	13161
				10.61	1.02	11.63	0.95	1.15		0.86	17.02	13474
				10.10	0.77	10.87	0.88	1.07	0.94		16.01	13654
				9.00		10.00	0.82	1 00		1.00	14.86	
				9.25	0.64	9.89	2.64	3 27		10 23	31.71	13162
				9.79	0.84	10.63	2.04	2.48		9.43	29.53	13475
				8.00		9.00	2.47	3.00		10.00	29.41	
				10.72	0.97	11.69	1.75	2.12		5.32	24.88	13163
				9.52	1.07	10.59	1.63	1.98	0.98	3.79	22.27	13476
				8.00		9.00	1.65	2.00		5.00	20.95	
				10.88	0.99	11.87	1.75	2.12	2.17		20.88	13164
				9.60	4.34	13.94	1.92	2.33		2.16	21.61	13477
				8.00		9.00	1.65	2 00		2.00	17.35	
				9.67	1.27	10.94	2.92	3.54		4.46	26.22	13165
				9.43	0 74	10.17	2.77	3.36	0.78	4.48	26.09	13478
				8.00		9.00	3.29	4.00		4.00	24.67	
				10.96	0.36	11.32			3 89		17.18	13166
				10.90	0.70	11.60			3.96		17.32	13479
				10.00		11.00			4.00		16 40	
				11.68	1.88	13.56			1.73		16.50	13167
				13.80	1 91	15.71			1.56		18.88	13480
				12.00		13.00			2.00		16.80	
				9.98	1.55	11.53			1.89		14.49	13168
				8.93	1.04	9.97			2.93		14 07	13481
				7.93	0.95	8.88			1.93		11.83	13563
				10.29	2.87	13 16			2.47		15.97	13610
				10.00		11.00			2.00		14.40	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13169	Globe Fertilizer Co., Branch Federal Chemical Co. High Grade Acid Phosphate	Manufacturer
13170 13655	Standard Acid Phosphate...	Manufacturer Head, Nichols & Co., Clarkson
13171	Wheat and Grain Special...	Manufacturer
13172 13482 13656	Globe Grain Grower	Manufacturer Hill & McElroy Head, Nichols & Co.....
13173 13657	Globe Wheat Grower.....	Manufacturer C. R. Barnes, Bardstown.....
13174 13483 13658	Globe Bone and Potash....	Manufacturer Ellis Bros. C. R. Barnes
13175 13484	Globe Soluble Vegetable Manure	Manufacturer E. L. Faris, London.....
13176	Big Four Phosphate	Manufacturer
13177	Globe Acid Phosphate	Manufacturer
13178 13485 13614 13665	Globe Raw Bone	Manufacturer N. H. Stringer W. D. Hicks, New Haven..... W. M. Elliott, Silva.....
13179 13659	Acorn Bone Meal	Manufacturer Hill & McElroy

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TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
In Fine Bone.	In Medium Bone.	Phosphoric Acid.					Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
		Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				15.08 16.00	1.96	17.04 17.00					\$15.08 16.00	13169
				11.91 12.73 12.00	0.97 1.80	12.88 14.53 13.00					11.91 12.73 12.00	13170 13655
				13.88 12.00	0.97	14.85 13.00	1.14 0.82	1.38 1.00		0.96 1.00	21.62 18.46	13171
				10.62 9.19 10.54 9.00	0.87 0.90 1.69	11.49 10.09 12.23 10.00	0.88 0.41 0.42 0.41	1.07 0.50 0.51 0.50		1.63 1.31 1.58 1.50	17.69 14.19 16.49 14.23	13172 13482 13656
				12.74 10.27 10.00	1.24 2.01	13.98 12.28 11.00	1.63 2.13 1.65	1.98 2.59 2.00	2.16	1.98 2.00	23.06 21.67 19.75	13173 13657
				12.14 11.81 12.28 11.00	0.96 1.64 1.24	13.10 13.45 13.52 12.00	0.66 0.55 0.44 0.41	0.80 0.67 0.53 0.50		1.02 1.12 0.90 1.00	18.15 17.82 17.64 16.03	13174 13483 13658
				10.50 10.85 8.00	1.30 1.42	11.80 12.27 9.00	1.71 1.63 1.65	2.08 1.98 2.00	0.76	5.13 3.40 5.00	24.41 23.32 20.95	13175 13484
				9.46 8.00	1.50	10.96 9.00			0.63 1.00		12.58 11.00	13176
				13.69 14.00	1.88	15.57 15.00					13.69 14.00	13177
13.36 9.05 17.98 19.06	12.84 13.03 0.75					26.20 22.08 18.73 19.06 22.00	3.93 3.94 3.55 3.36 3.29	4.77 4.78 4.31 4.08 4.00			30.18 26.88 25.48 25.33 23.07	13178 13485 13614 13665
15.08 18.67	6.16 4.38					21.24 *23.05 20.00	2.99 3.02 2.47	3.63 3.67 3.00			24.73 26.63 19.41	13179 13659

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13377	Globe Fertilizer Co., Branch Federal Chemical Co. Golden Harvest Bone Meal..	Manufacturer
13378 13660	Acorn Acid Phosphate.....	Manufacturer Head, Nichols & Co.....
13253	The Hardy Packing Co., Chi- cago, Ill. Hardy's Crop Producer.....	Manufacturer
13254	Hardy's Corn and Wheat Grower	Manufacturer
13255	Hardy's Tobacco and Potato Special	Manufacturer
13301	Indiana Fertilizer Co., Indian- apolis, Ind. Tobacco and Vegetable Spe- cial	Manufacturer
13302	Burley Tobacco Grower....	Manufacturer
13303	Grain Grower	Manufacturer
13304	Complete Fertilizer	Manufacturer
13305	Bone and Potash Mixture..	Manufacturer
13306	Soluble Bone and Potash..	Manufacturer
13372	Acid Phosphate	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				11.52 10.00	2.57	14.09	2.64 2.47	3.20 3.00			\$22.77 19.41	13377
				11.48 11.14 10.00	0.72 1.82	12.20 12.96					11.48 11.14 10.00	13378 13660
				8.22 7.00	2.74	10.96 9.00	0.82 0.82	1.00 1.00	1.00	2.16	16.01 12.66	13253
				6.96 8.00	3.72	10.68 10.00	0.81 0.41	0.98 0.50	2.36 2.50	1.50	16.43 14.13	13254
				9.02 8.00	2.47	11.49 10.00	1.89 1.65	2.29 2.00	3.68 4.00	0.59	21.87 19.35	13255
				8.78 8.00	1.30	10.08	1.58 1.65	1.92 2.00	1.02	3.11 4.00	20.55 19.35	13301
				8.40 8.00	1.36	9.76	1.11 1.03	1.35 1.25	2.03	2.00	15.98 15.09	13302
				8.66 8.00	1.27	9.93	1.06 1.03	1.29 1.25	1.89	2.00	15.97 15.09	13303
				7.42 7.00	1.38	8.80	0.83 0.82	1.01 1.00	1.24	1.00	13.18 12.06	13304
				6.87 7.00	1.45	8.32	0.83 0.41	1.01 0.50	0.87	0.50	12.18 10.23	13305
				8.02 8.00	0.92	8.94			1.24	1.00	11.23 10.80	13306
				10.91 10.00	1.13	12.04					10.91 10.00	13372

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13196 13406 13407	The Jarecki Chemical Co., Sandusky and Cincinnati, O. Lake Erie Fish Guano.....	Manufacturer G. W. Phelps, White Hall.... H. Chenault, Conway
13197 13488 13661	Number One Fish Guano...	Manufacturer Hines & Swope, Science Hill.. Durham, Blakeman & Cantrell, Greensburg
13198 13489	Fish and Potash Grain Special.	Manufacturer Overstreet & Snyder, Lagrange
13199 13490 13662	C. O. D. Phosphate	Manufacturer Hines & Swope Hines & Swope
13200 13491	Ground Bone	Manufacturer I. K. Miller & Sons, Campbellsville
13201 13492	Square Brand Phosphate & Potash	Manufacturer Hines & Swope
13202 13493	Fish and Potash Tobacco and Potato Food	Manufacturer I. K. Miller & Sons
13203 13494	O. K. Fertilizer	Manufacturer Jno. Botts, Shelbyville
13204	St. Bernard Phosphate.....	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				10.08	1.27	11.35	0.92	1.12		1.69	17.40	13196
				7.87	3.11	10.98	0.98	1.19		1.73	15.70	13406
				10.29	2.09	12.38	0.53	0.64		1.75	16.88	13407
				10.00		11.00	0.82	1.00	2.00		16.86	
				9.81	2.05	11.86	0.72	0.87	1.26		16.01	13197
				9.62	2.52	12.14	0.75	0.91		1.34	16.41	13488
				10.46	2.15	12.61	0.86	1.04		0.85	17.01	13661
				10.00		11.00	0.82	1.00	1.00		15.86	
				9.92	1.27	11.19	1.31	1.59		2.31	19.11	13198
				8.16	2.48	10.64	0.94	1.14		2.56	16.67	13489
				9.00		10.00	1.23	1.50	2.00		16.89	
				12.53	2.81	15.34					12.53	13199
				13.61	2.25	15.86					13.61	13490
				15.10	1.20	16.30					15.10	13662
				14.00		15.00					14.00	
17.87	6.28					*24.15	2.00	2.43			24.07	13200
19.56	5.51					*25.07	1.87	2.27			24.57	13491
						20.00	2.47	3.00			19.41	
				9.12	2.39	11.51			2.27		14.17	13201
				9.82	2.06	11.88			2.22		14.82	13492
				10.00		11.00			2.00		14.40	
				8.32	1.20	9.52	0.81	0.98	3.81		16.70	13202
				6.53	2.34	8.87	0.76	0.92	2.06	1.65	15.10	13493
				8.00		9.00	0.82	1.00	2.00	2.00	16.86	
				5.83	1.14	6.97	0.52	0.63		0.81	9.99	13203
				6.58	2.53	9.11	0.67	0.81	0.88	0.76	12.71	13494
				6.00		7.00	0.41	0.50	0.50		9.33	
				11.71	2.58	14.29					11.71	13204
				12.00		13.00					12.00	

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13205	The Jarecki Chemical Co. Indian Brand Ohio Valley Phosphate	Manufacturer
13206	Indian Brand Gilead Phosphate	Manufacturer
13207	Indian Br. Tobacco and Potato Fertilizer	Manufacturer
13495		I. K. Miller & Sons
13341	Dissolved Bone with Potash	Manufacturer
13663		Hines & Swope
	J. B. Jones, Louisville, Ky.	
13338	Raw Bone	Manufacturer
13500		Alexander & Pile, Custer
13613		T. B. Henderson, Lewisport...
13339	Tobacco and Potato Grower	Manufacturer
13340	Corn Grower	Manufacturer
13501		Duncan Bros. Co., Lagrange..
13584	Wheat Grower	Manufacturer
	The Jones Fertilizing Co., Cincinnati, O.	
13151	Jones Corn and Wheat Grower	Manufacturer
13152	Jones Tobacco and Potato Grower	Manufacturer
13153	Jones Reliable	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				9.62 8.00	1.33	10.95 9.00	1.61 1.65	1.95 2.00		2.37 2.00	19.74 16.95	13205
				9.34 9.00	1.85	11.19 10.00	2.61 2.47	3.17 3.00		2.03 2.00	22.22 20.61	13206
				9.56 10.38 9.00	1.70 3.30	11.26 13.68 10.00	2.49 2.21 2.47	3.02 2.68 3.00		4.73 3.09 4.00	25.30 25.38 24.41	13207 13495
				11.45 12.06 12.00	1.93 2.51	13.38 14.57 13.00			2.54 2.41 3.00		17.05 17.88 17.80	13341 13663
8.48	15.08					23.56	4.01	4.87			27.86	13338
11.59	9.11					20.70	3.85	4.67			26.29	13500
14.08	7.26					21.34	3.94	4.78			27.44	13613
						21.50	3.50	4.25			23.40	
				8.29 10.00	3.79	12.08 12.00	2.85 2.88	3.46 3.50		4.81 5.00	25.79 27.44	13339
				6.35 6.52 9.00	3.21 3.68	9.56 10.20 11.00	2.11 2.19 2.47	2.56 2.66 3.00		1.99 1.82 2.00	17.62 18.04 21.41	13340 13501
				6.88 9.00	2.39	9.27 11.00	2.17 2.47	2.63 3.00		1.87 2.00	17.97 21.41	13584
				7.22 7.00	0.72	7.94 8.00	0.79 0.82	0.96 1.00		1.40 1.00	13.00 12.26	13151
		4.00	3.00									
				7.57 7.00	0.86	8.43 8.00	1.82 1.65	2.21 2.00	0.96	3.63 4.00	20.20 18.55	13152
		4.00	3.00									
				9.31 8.00	0.72	10.03 9.00	0.91 0.82	1.10 1.00	0.94 1.50	0.85	16.15 13.96	13153
		5.00	3.00									

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13154	The Jones Fertilizing Co. Jones Phosphate	Manufacturer
13155	Jones Bone Meal	Manufacturer
13156	Jones Raw Bone	Manufacturer
13502		Goldsborough & Co., Lagrange
13157	Jones Jewell Phosphate....	Manufacturer
13503		J. W. Webb & Son, Vanceburg
13364	Jones Special Tobacco Grower	Manufacturer
13365	Jones Miami Valley Phosphate	Manufacturer
13366	Jones Potash Mixture	Manufacturer
13568	Jones High Grade Dissolved Bone	Manufacturer
13295	Kaufman Fertilizer Co., Indianapolis, Ind. Special Potato and Tobacco Fertilizer	Manufacturer
13296	Kentucky Tobacco Grower..	Manufacturer
13297	Harvest King	Manufacturer
13298	Banner Crop Grower	Manufacturer
13664		H. B. Patterson, Sonora

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
		7.00	5.00	11.91 12.00	1.47	13.38 13.00					\$11.91 12.00	13154
15.81	4.20					20.01 20.00	2.04 0.82	2.48 1.00			21.29 14.46	13155
21.97	3.00					24.97	2.32	2.82			26.34	13156
16.55	5.22					21.77 20.00	2.75 2.47	3.34 3.00			24.62 19.41	13502
				12.05 11.84 12.00	1.10 1.34	13.15 13.18 13.00					12.05 11.84 12.00	13157 13503
		5.00	3.00	9.20 8.00	0.45	9.65 9.00	0.92 0.82	1.12 1.00		1.83 1.50	16.18 14.26	13364
		6.00	4.00	9.27 10.00	2.56	11.83 11.00	1.97 1.65	2.39 2.00		2.25 2.00	20.75 19.75	13365
		6.00	4.00	10.27 10.00	0.63	10.90 11.00			2.00	2.26	15.28 14.40	13366
		8.00	6.00	14.10 14.00	1.71	15.81 15.00					14.10 14.00	13568
				7.87 8.00	1.37	9.24 1.65	1.39 2.00	1.69 2.00	1.12	6.05 6.00	22.54 21.75	13295
				7.69 8.00	1.33	9.02 1.03	1.08 1.25	1.31 1.25	0.84	3.41 2.00	17.93 15.09	13296
				8.20 8.00	1.20	9.40 1.03	1.02 1.25	1.24 1.25	0.84	3.30 2.00	18.18 15.09	13297
				8.98 9.62 7.00	1.13 0.95	10.11 10.57	0.73 0.37 0.82	0.89 0.45 1.00		1.51 0.40 1.00	15.23 13.51 12.06	13298 13664

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13299	Kaufman Fertilizer Co. Bone Tankage and Potash..	Manufacturer
13300	Alkaline Bone and Potash..	Manufacturer
13360	Acid Phosphate	Manufacturer
13569	Half and Half	Manufacturer
13570 13612	Pure Bone	Manufacturer
		H. C. Wells, Madisonville....
	Louisville Fertilizer Co., Louisville, Ky.	
13148 13504 13666	Eagle Soluble Bone	Manufacturer
		Smith & Flora, Campbellsville
		Smith & Flora, Campbellsville
13149 13667	Eagle Phosphate	Manufacturer
		Sexton, Farley & Co., Murray
13307	Eagle Potato Grower	Manufacturer
13323 13505	Eagle Special Tobacco Grower	Manufacturer
		W. T. Soper, Carlisle.....
13324 13668	Eagle High Grade Dissolved Bone	Manufacturer
		Sexton, Farley & Co.....
13328 13506	Eagle Tobacco Grower.....	Manufacturer
		L. S. Brough, Bowling Green

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				10.99 7.00	1.06	12.05	0.00 0.41	0.50		1.22 0.50	\$15.07 10.23	13299
				10.43 10.00	0.83	11.26				1.58 2.00	14.75 14.40	13300
				12.02 10.00	1.25	13.27					12.02 10.00	13360
				10.40 10.00	1.66	12.06	1.43 1.65	1.74 2.00			17.43 16.95	13569
21.79	4.46					26.25	2.76	3.35			28.39	13570
21.42	4.70					26.12	2.94	3.57			28.78	13612
						22.00	2.47	3.00			20.61	
				9.10 8.82	0.67 5.28	9.77 14.10	0.89 0.86	1.08 1.04		1.82 1.31	16.04 16.84	13148 13504
		5.00	3.00	8.41 8.00	0.74	9.15 9.00	0.78 0.82	0.95 1.00	1.10 1.50		13.83 13.96	13666
				12.22 11.78	1.06 0.90	13.28 12.68					12.22 11.78	13149 13667
		7.00	5.00	12.00		13.00					12.00	
		5.00	3.00	7.56 8.00	2.90	10.46 9.00	2.95 2.47	3.58 3.00	2.92	3.42 6.00	26.10 24.61	13307
		5.00	3.00	9.27 8.32	0.59 3.36	9.86 11.68	0.87 1.09	1.06 1.32	0.66	1.80 0.68	16.13 16.07	13323 13505
		5.00	3.00	8.00		9.00	0.82	1.00		1.50	14.26	
				14.15 12.67	1.36 0.92	15.51 13.59					14.15 12.67	13324 13668
		8.00	6.00	14.00		15.00					14.00	
				7.47 8.25	2.93 1.27	10.40 9.52	2.78 2.17	3.37 2.63		6.70 6.15	26.51 24.30	13328 13506
		5.00	3.00	8.00		9.00	2.47	3.00		6.00	24.61	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANU- FACTURER AND NAME OF BRAND.	FROM WHOM OBTAINED.
13329 13507	Louisville Fertilizer Co. Eagle High Grade Tobacco and Potato Grower.....	Manufacturer L. S. Brough
13330 13508	Eagle Special Corn Grower..	Manufacturer L. S. Brough
13354 13509 13669	Eagle Potash Mixture.....	Manufacturer McElrath, Sexton & Co., Mur- ray J. W. Crume & Bro., Lebanon
13355	Eagle Corn and Wheat Grower	Manufacturer
13356 13670	Eagle Guano	Manufacturer L. S. Brough
13461	Eagle XX Ground Bone....	Manufacturer
13462 13671	Eagle Bone Meal	Manufacturer J. W. Crume & Bro.....
13463 13510	Eagle Raw Bone	Manufacturer Smith & Flora
13464 13672	Eagle Special Wheat Grower	Manufacturer L. H. Hulett, Hanson
13586	Eagle Standard Raw Bone..	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				7.12	0.95	8.07	1.85	2.25		4.55	\$19.93	13329
				6.34	1.68	8.02	1.64	1.99		4.59	18.71	13507
		4.00	3.00	7.00		8.00	1.65	2.00		4.00	18.55	
				7.51	0.86	8.37	0.79	0.96		1.27	13.24	13330
				6.93	2.87	9.80	0.87	1.06		1.23	13.56	13508
		4.00	3.00	7.00		8.00	0.82	1.00	1.00		12.26	
				9.80	0.78	10.58				2.59	15.18	13354
				10.01	0.93	10.94				1.80	14.54	13509
				10.76	0.96	11.72				1.72	15.35	13669
		6.00	4.00	10.00		11.00			2.00		14.40	
				10.58	0.32	10.90				0.62	13.57	13355
		6.00	4.00	10.00		11.00			0.50		12.90	
				9.32	2.35	11.67	1.94	2.36		2.31	20.71	13356
				9.72	1.61	11.33	1.70	2.06		2.25	20.10	13670
		6.00	4.00	10.00		11.00	1.65	2.00	2.00		19.35	
				9.49	7.29	16.78	1.60	1.94			19.11	13461
		3.00	1.00	4.00		15.00	1.23	1.50			12.89	
27.16	4.06					31.22	0.98	1.19			27.11	13462
17.05	2.32					19.37	1.23	1.50			18.72	13671
						20.00	0.82	1.00			14.46	
21.68	3.24					24.92	2.28	2.77			26.12	13463
20.33	4.77					25.10	2.70	3.28			27.22	13510
						20.00	2.47	3.00			19.41	
				7.85	0.79	8.64	0.77	0.93		1.08	13.35	13464
				6.46	3.24	9.70	0.95	1.15	1.77		13.67	13672
		4.00	3.00	7.00		8.00	0.82	1.00	1.00		12.26	
14.77	7.95					22.72	3.68	4.47			27.63	13586
						22.00	3.71	4.50			24.33	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Michigan Carbon Works, Detroit, Mich.	
13241	Homestead A Bone Black Fertilizer	Manufacturer
13511		Barren Co. Gro. and Hdw. Co., Glasgow
13673		Hatter & March, Franklin...
13242	Homestead Potato and Tobacco Special	Manufacturer
13512		J. D. Jackson, Scottsburg....
13243	Homestead Tobacco Grower	Manufacturer
13513		Hatter & March
13244	Red Line Crop Grower.....	Manufacturer
13674		Barren Co. Gro. and Hdw. Co.
13245	Red Line Complete Manure	Manufacturer
13514		W. Lewis & Bro., Greensburg
13675		C. E. Owen, Madisonville....
13246	Red Line Phosphate with Potash	Manufacturer
13515		Bland & Danks, Lewisburg...
13247	Red Line Phosphate	Manufacturer
13676		J. R. Davis & Bro., Campbells-ville
13248	Wolverine Pure Ground Bone	Manufacturer
13677		Forbes Mfg. Co., Hopkinsville
13249	Desiccated Bone	Manufacturer
13516		Hatter & March
13678		Hatter & March

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				8.45	0.75	9.20	2.52	3.06	1.51		\$19.51	13241
				8.26	0.67	8.93	2.24	2.72	1.34		18.24	13511
				8.95	1.19	10.14	1.86	2.26	1.81		18.61	13673
				8.00		9.00	2.06	2.50	1.50		17.68	
				8.74	0.68	9.42	2.27	2.76	5.36		22.93	13242
				8.26	0.75	9.01	2.30	2.79	4.74		21.85	13512
				8.00		9.00	2.06	2.50	5.00		21.18	
				10.43	0.29	10.72	3.16	3.84	3.41		25.53	13243
				10.48	0.19	10.67	3.11	3.78	3.38		25.37	13513
				10.00		11.00	2.88	3.50	3.50		24.54	
				8.28	3.22	11.50	1.86	2.26	2.41		19.22	13244
				9.07	1.46	10.53	1.80	2.19	1.84		18.70	13674
				8.00		9.00	1.65	2.00	2.00		16.95	
				6.78	2.69	9.47	0.89	1.08	1.05		12.94	13245
				7.37	2.34	9.71	0.85	1.03	1.03		13.36	13514
				7.56	1.18	8.74	0.85	1.03	1.71		13.80	13675
				7.00		8.00	0.82	1.00	1.00		12.26	
				10.41	1.37	11.78			2.28		15.32	13246
				10.10	2.67	12.77			1.81		15.00	13515
				10.00		11.00			2.00		14.40	
				15.06	1.62	16.68					15.06	13247
				12.86	1.83	14.69					12.86	13676
				14.00		15.00					14.00	
15.53	7.65					23.18	2.91	3.53			25.74	13248
22.10	5.87					27.97	3.41	4.14			31.43	13677
						20.00	2.47	3.00			19.41	
26.56	5.44					32.00	1.39	1.69			28.68	13249
27.03	4.77					31.80	1.49	1.81			28.95	13516
25.30	7.56					32.86	1.39	1.69			28.95	13678
						25.00	1.23	1.50			18.69	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Nelson Morris & Co., Chicago, Ill.	
13391	Big One, Pure Ground Raw Bone	Manufacturer
13679		Ovesen Burba Co., Hodgenville
13392	Big Two, Pure Bone Meal..	Manufacturer
13616		T. A. Lee, Elizabethtown.....
13393	Big Three, Pure Bone Phosphate	Manufacturer
13518		Ovesen Burba Co.....
13394	Big Four, Pure Bone Phosphate	Manufacturer
13519		Ovesen Burba Co.....
13680		Ovesen Burba Co.....
13395	Big Five, Pure Bone Phosphate	Manufacturer
13520		Ovesen Burba Co.....
13396	Big Six, Special Bone Meal..	Manufacturer
	National Fertilizer Co., Nashville, Tenn.	
13398	Corn Grower	Manufacturer
13399	Tobacco Grower	Manufacturer
13521		Wilson & Co., Russellville...
13400	Acid Phosphate and Potash	Manufacturer
13522		Wilson & Co.....
13681		Dunagan & Kirtley, H'se Cave

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.			
11.42	10.12					21.54	3.96	4.81				\$27.09	13391
12.41	13.99					26.40	3.58	4.35				29.06	13679
						27.00	3.29	4.00				26.07	
21.47	4.40					25.87	2.15	2.61				26.27	13392
21.75	4.78					26.53	2.85	3.46				28.82	13616
						28.00	2.06	2.50				22.98	
				6.95	4.90	11.85	2.75	3.34		2.57	21.63	13393	
				6.56	2.56	9.12	2.83	3.44		2.04	19.83	13518	
				7.00		10.00	2.47	3.00		2.00	19.41		
				6.38	4.87	11.25	4.37	5.31		4.95	28.66	13394	
				7.53	6.04	13.57	4.27	5.18	0.74	3.69	29.44	13519	
				7.64	6.00	13.64	4.29	5.21		4.20	29.48	13680	
				9.00		12.00	4.12	5.00		4.00	29.16		
				6.10	4.03	10.13	3.01	3.65		1.34	19.57	13395	
				6.07	3.97	10.04	3.55	4.31	0.54	0.95	21.20	13520	
				7.00		10.00	2.47	3.00		1.00	18.21		
21.46	2.92					*24.38	1.08	1.31			22.16	13396	
						27.00	0.82	1.00			18.66		
				10.57	6.24	16.81	1.16	1.41	1.93		20.64	13398	
		6.00	4.00	10.00		11.00	0.82	1.00	1.00		15.86		
				10.50	5.39	15.89	1.89	2.29	2.86		23.29	13399	
				11.56	4.32	15.88	1.20	1.46	1.61		20.81	13521	
		7.00	3.00	10.00		11.00	1.65	2.00	2.00		19.35		
				10.67	2.61	13.28			2.78		16.62	13400	
				11.77	2.12	13.89			1.87		16.84	13522	
				13.49	1.85	15.34			2.72		19.65	13681	
				10.00					2.00		14.00		

*Contains Soluble Phosphoric Acid.

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	National Fertilizer Co.	
13401	Sadler's Formula	Manufacturer
13523		I. K. Miller & Sons, Campbellsville
13682		Hatter & March, Franklin...
13402	Tobacco Fertilizer	Manufacturer
13403	Acid Phosphate	Manufacturer
13566	Rock City Guano	Manufacturer
13571		J. E. Poynter & Son, Adairville
13567	Omaha Bone and Meat Meal	Manufacturer
13683		Dunagan & Kirtley
13580	National Blood and Bone Guano	Manufacturer
13581	National Wheat Grower....	Manufacturer
13582	National Pure Raw Bone Meal	Manufacturer
13684		Jno. P. Sullivan, Sonora.....
13583	National Pure Bone Meal..	Manufacturer
13594	Anti-Trust Acid Phosphate and Potash	Manufacturer
13685		Dunagan & Kirtley
13595	High Grade Dissolved Bone	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
11.57 16.56	1.58 1.44	9.00	3.00	12.03	2.64	14.67			2.57		\$18.07	13401
				12.60	1.79	14.39			2.57	18.41	13523	
				11.33	4.81	16.14			2.34	17.86	13682	
				9.65	5.01	14.66	2.27	2.76	3.58	23.97	13402	
				10.00			2.06	2.50	3.00	21.18		
		8.00	4.00	12.39	2.97	15.36				12.39	13403	
				12.00						12.00		
				7.68	5.83	13.51	1.97	2.39	2.86	20.32	13566	
				10.15	4.68	14.83	1.82	2.21	3.33	22.84	13571	
		4.00	4.00	8.00		9.00	1.65	2.00	2.00	16.95		
				13.15	5.03	6.11			25.30	13567		
				18.00	4.17	5.06			26.62	13683		
				14.00	5.35	6.50			24.45			
		5.00	5.00	10.27	6.31	16.58	1.17	1.42	1.85	20.20	13580	
				10.00		11.00	0.82	1.00	1.00	15.86		
10.71	4.91			15.62	1.57	1.91	2.41	21.93	13581			
5.00	5.00	10.00		11.00	1.65	2.00	2.00	19.35				
10.80 19.14	9.57			20.37	3.71	4.50			25.51	13582		
				19.14	3.61	4.38			26.14	13684		
				22.00	3.29	4.00			23.07			
23.32	4.44			27.76	2.29	2.78			28.19	13583		
				20.00	2.47	3.00			19.41			
		6.00	4.00	10.53	2.52	13.05			5.19	18.84	13594	
				12.18	2.19	14.37			4.12	19.62	13685	
				10.00		11.00			4.00	16.40		
		8.00	6.00	14.21	2.48	16.69				14.21	13595	
				14.00		15.00			14.00			

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	National Fertilizer Co.	
13596	High Grade Acid Phosphate	Manufacturer
13597	High Grade Acid Phosphate	Manufacturer
13686	and Potash	Hatter & March
13722	20th Century Acid Phosphate	Manufacturer
13723	and Potash	I. K. Miller & Sons.....
	North-Western Fertilizing Co., Chicago, Ill.	
13223	Horse Shoe Brand Quick	Manufacturer
13687	Acting Phosphate	E. P. Barnes & Bro., Beaver Dam
13224	H. S. B. Bone and Potash..	Manufacturer
13524		Dickey & Co., Glasgow
13688		Dickey & Co., Glasgow
13225	H. S. B. Success Corn Gro.	Manufacturer
13525		Dickey & Co.....
13226	H. S. B. Cap Sheaf Wheat	Manufacturer
13689	Grower	T. W. Buchanan & Co., Camp- bellsville
13227	H. S. B. Dark Tobacco Gro.	Manufacturer
13228	H. S. B. Acidulated Bone	Manufacturer
13690	and Potash	T. W. Buchanan & Co.....

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.			
		8.00	8.00	17.54 16.00	1.92	19.46 17.00						\$17.54 16.00	13596
				12.14 12.71	1.60 3.22	13.74 15.93			7.04 4.02			22.25 20.56	13597 13686
		8.00	6.00	14.00		15.00			4.00			21.20	
				10.23 13.06	2.70 2.00	12.93 15.06			7.12 4.62			20.48 21.09	13722 13723
		8.00	4.00	12.00		13.00			4.00			18.80	
				10.99	0.83	11.82						10.99	13223
		8.00	2.00	11.32 10.00	1.51	12.83 12.00						11.32 10.00	13687
				10.25 10.39 10.74	1.70 0.88 1.57	11.95 11.27 12.31			2.24 1.73 1.59			15.23 14.55 15.11	13224 13524 13688
		7.00	3.00	10.00		12.00			2.00			14.80	
				7.26 7.91	2.25 2.23	9.51 10.14	0.79 0.89	0.96 1.08	1.06 1.04			13.04 14.09	13225 13525
		4.00	3.00	7.00		8.00	0.82	1.00	1.00			12.26	
				7.22	2.35	9.57	0.81	0.98	1.01			13.04	13226
				7.78 7.00	2.07	9.85 8.00	0.95 0.82	1.15 1.00	1.11 1.00			14.13 12.26	13689
		4.00	3.00	7.00		8.00	0.82	1.00	1.00			12.26	
				7.21	2.46	9.67	0.82	1.00	1.02			13.11	13227
		4.00	3.00	7.00		8.00	0.82	1.00	1.00			12.26	
				10.03 10.83	3.35 2.14	13.38 12.97	1.02 1.00	1.24 1.21	1.15 1.19			17.59 18.05	13228 13690
		7.00	3.00	10.00		12.00	0.82	1.00	1.00			16.26	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	FROM WHOM OBTAINED.
	North-Western Fertilizing Co.	
13229	H. S. B. Corn and Wheat	Manufacturer
13526	Grower	Dickey & Co.....
13691		Dickey & Co.....
13230	H. S. B. Kentucky Tobacco	Manufacturer
13527	Grower	Dickey & Co.....
13231	H. S. B. Challenge Corn	Manufacturer
	Grower	
13232	H. S. B. Tobacco Grower...	Manufacturer
13528		Hatter & March, Franklin....
13233	H. S. B. Special Potato	Manufacturer
	Grower	
13234	H. S. B. Raw Bone and Superphosphate Mixture ...	Manufacturer
13235	H. S. B. Pure Ground Bone	Manufacturer
13529		Forbes Mfg. Co., Hopkinsville
13692		Reynolds & Co., Slaughters...
13236	H. S. B. Special Bone Meal	Manufacturer
13237	H. S. B. Fine Raw Bone...	Manufacturer
13693		J. T. Chenault, Sonora
	The Ohio Farmers' Fertilizer Co., Columbus, O.	
13313	Tobacco Grower	Manufacturer
13530		Thompson & McAtee, Maysville

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				8.29	3.10	11.39	1.78	2.16	2.84		\$19.37	13229
				7.99	3.93	11.92	1.77	2.15	1.96		18.43	13526
				7.77	4.98	12.75	1.85	2.25	2.08		18.94	13691
		5.00	3.00	8.00		10.00	1.65	2.00	2.00		17.35	
				8.46	3.08	11.54	1.85	2.25	2.46		19.39	13230
				7.95	4.38	12.33	1.73	2.10	2.17		18.65	13527
		5.00	3.00	8.00		10.00	1.65	2.00	2.00		17.35	
				8.58	4.52	13.10	2.02	2.45	1.58		19.75	13231
				8.00		10.00	2.06	2.50	1.50		18.08	
				9.34	2.29	11.63	2.40	2.91	4.91		24.24	13232
				8.56	4.30	12.86	2.14	2.60	4.99		23.40	13528
		5.00	3.00	8.00		10.00	2.06	2.50	5.00		21.58	
				9.18	2.60	11.78	2.36	2.87	4.97		24.11	13233
				8.00		10.00	2.06	2.50	5.00		21.58	
				8.54	8.17	16.71	2.79	3.39	1.11		23.00	13234
		4.00	3.00	7.00		13.00	2.47	3.00	0.50		18.71	
16.83	5.61					22.44	3.05	3.70			25.98	13235
19.54	6.17					25.71	2.62	3.18			27.19	13529
15.60	5.48					21.08	2.40	2.91			22.97	13692
						20.00	2.47	3.00			19.41	
16.24	9.53					25.77	1.43	1.74			23.00	13236
						25.00	1.23	1.50			18.69	
15.10	8.13					23.23	3.93	4.77			28.75	13237
10.32	11.17					21.49	3.84	4.66			26.48	13693
						22.00	3.29	4.00			23.07	
				6.65	3.65	10.30	0.90	1.09	2.56	1.72	16.76	13313
				7.54	2.72	10.26	0.83	1.01	6.82		19.45	13530
				8.00		10.00	0.82	1.00	4.00		16.86	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	The Ohio Farmers Fertilizer Co.	
13314	Soluble Bone and Potash...	Manufacturer
13315	General Crop Fish Guano..	Manufacturer
13316	Wheat Maker and Seeding Down	Manufacturer
13317	Corn, Oats and Wheat Fish Guano	Manufacturer
	Packers' Fertilizer Association Chicago, Ill.	
13264	Boars Head Brand Special Tobacco Grower	Manufacturer
13265	B. H. B. Corn and Wheat Grower	Manufacturer
13266	B. H. B. World-of-Good Pot. and Tob. Grower	Manufacturer
13267	B. H. B. W-of-G Superphosphate	Manufacturer
13268	B. H. B. Kentucky Potash Mixture	Manufacturer
13606		L. D. Stringer, Pulaski
13269	B. H. B. Soluble Phosphate	Manufacturer
13270	B. H. B. Potash Phosphate	Manufacturer

Commercial Fertilizers.

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TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.			
				11 31 11.00	3.48	14.79 12.00			1.21 1.00		\$16.17 14.60	13314	
				8.02 7.00	2.78	10.80 9.00	1.01 0.82	1.23 1.00		2.03 1.00	16.20 12.66	13315	
				6.78 8.00	3.84	10.62 10.00	0.83 0.41	1.01 0.50	2.28 2.50	1.64	16.42 14.13	13316	
				8.76 8.00	2.46	11.22 10.00	1.47 1.23	1.78 1.50	2.52 2.00	1.15	19.80 16.09	13317	
		5.00	3.00	8.09 8.00	3.39	11.48 10.00	1.85 1.65	2.25 2.00	2.30 2.00		18.92 17.35	13264	
		5.00	3.00	8.08 8.00	3.56	11.64 10.00	1.84 1.65	2.23 2.00	2.29 2.00		18.93 17.35	13265	
		5.00	3.00	8.93 8.00	2.71	11.64 10.00	2.43 2.06	2.95 2.50	5.49 5.00		24.58 21.58	13266	
		5.00	3.00	7.92 8.00	4.99	12.91 10.00	2.06 2.06	2.50 2.50	1.52 1.50		19.20 18.08	13267	
				10.30 10.42 10.00	1.11 3.11	11.41 13.53 12.00			5.13 1.85 2.00		17.93 15.59 14.80	13268 13606	
		8.00	2.00	10.76 10.00	1.04	11.80 12.00					10.76 10.00	13269	
		8.00	2.00	10.13 10.00	1.29	11.42 12.00			4.79 4.00		17.47 16.80	13270	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13271	Packers' Fertilizer Association B. H. B. Chicago Bone Meal	Manufacturer
13272	B. H. B. Special Bone Meal	Manufacturer
13362	The Packers Fertilizer Co., Cincinnati, O. Animal Guano and Potash..	Manufacturer
13363	Acidulated Bone and Potash	Manufacturer
13238 13694	Pero & Stoecker, Louisville, Ky Pure Bone Meal	Manufacturer T. J. Turley & Co., Leitchfield
13239	Pure Animal Matter Corn and Wheat Grower	Manufacturer
13240	Pure Potato Grower	Manufacturer
13308	The Queen City Fertilizer Co., Cincinnati, O. Tobacco and Potato Grower	Manufacturer
13309 13531	Miami Valley Grain Grower	Manufacturer C. L. Dudley, Flemingsburg..
13310 13532	Valley Gem Phosphate.....	Manufacturer C. L. Dudley
13311	High Grade Corn & Wheat Grower	Manufacturer

Commercial Fertilizers.

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TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
17.26	5.15					22.41 20.00	2.69 2.47	3.27 3.00			\$24.97 19.41	13271
17.99	9.26					27.25 25.00	1.51 1.23	1.83 1.50			24.48 18.69	13272
				8.14 8.00	1.42	9.56 9.00	0.69 0.82	0.84 1.00	3.67 1.00	3.00	16.08 17.06	13362
				8.61 10.00	2.88	11.49 11.00			2.12 1.00	1.00	13.60 14.60	13363
8.12	15.09					23.21 22.90	4.20 3.74	5.10 4.54			28.15 26.84	13238 13694
9.39	13.51					22.00 22.00	3.29 3.29	4.00 4.00			23.07	
8.36	3.58					11.94 10.00	5.50 3.50	6.68 4.25			25.34 16.50	13239
7.83	2.89					10.72 10.00	4.89 3.50	5.84 4.25		5.22 6.00	28.92 23.70	13240
				8.35 8.00	1.13	9.48	0.80 0.82	0.97 1.00	3.61	4.00	16.48 16.86	13308
				9.85 10.40 10.00	1.42 1.60	11.27 12.00	0.93 0.58 0.82	1.13 0.70 1.00		1.75 1.82 2.00	17.28 17.04 16.86	13309 13531
				10.03 9.97 10.00	1.78 2.03	11.81 12.00	0.78 0.75 0.82	0.95 0.91 1.00		1.21 1.26 1.00	16.54 16.53 15.66	13310 13532
				8.97 10.00	2.38	11.35			2.09	2.00	13.80 14.40	13311

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Read Phosphate Co., Nashville, Tenn.	
13368	Read's High Grade Tobacco	Manufacturer
13533	Grower	Smith & Wells, Glasgow.....
13369	Read's Farmers Special Ma-	Manufacturer
13534	nure	Smith & Wells
13695		Wells & Powell, Glasgow.....
13370	Read's Soluble Bone	Manufacturer
13535		W. Lewis & Bro., Greensburg.
13696		I. K. Miller & Sons, Camp-
		bellsville
13384	Read's High Grade Tobacco	Manufacturer
13536	Special	Smith & Wells
13385	Read's Blood and Bone No. 1	Manufacturer
13697		J. M. Stanley, Henderson.....
13386	Read's Corn Grower Special	Manufacturer
13387	Read's Alkaline Bone	Manufacturer
13537		Smith & Wells
13698		Wells & Powell
13388	Read's Special Potash Mix-	Manufacturer
13699	ture	B. G. Waller, Morganfield....
13389	Read's XXX Dissolved Bone	Manufacturer
13700		Wells & Powell

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
In Fine Bone.	In Medium Bone.	Phosphoric Acid.					Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
		Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				9.29	1.30	10.59	1.49	1.81	0.66	3.16	\$20.59	13368
				9.55	3.20	12.75	1.58	1.92	1.12	2.14	21.17	13533
				8.00			1.65	2.00		4.00	19.35	
				9.71	2.09	11.80	0.98	1.19	3.41		18.84	13369
				10.34	1.74	12.08	1.01	1.23	2.92		19.06	13534
				12.51	0.60	13.11	0.78	0.95	2.77		20.36	13695
				10.00			0.82	1.00	3.00		17.46	
				8.47	1.73	10.20	0.95	1.15	2.67		16.37	13370
				8.27	6.42	14.69	1.01	1.23	1.82		17.34	13535
				8.73	0.81	9.54	0.97	1.18	2.40		16.11	13696
				8.00			0.82	1.00	2.00		14.06	
				9.27	1.00	10.27	1.37	1.66	0.88	7.03	24.95	13384
				7.58	1.57	9.15	1.63	1.98	1.30	6.44	23.65	13536
				8.00			1.65	2.00		8.00	24.15	
				8.33	1.69	10.02	1.76	2.14	2.29		18.25	13385
				9.18	0.84	10.02	1.82	2.21	2.12		18.94	13697
				8.00			1.65	2.00	2.00		16.55	
				9.63	2.41	12.04	1.00	1.21	1.87		17.39	13386
				10.00			0.82	1.00	1.00		15.46	
				10.01	1.75	11.76			2.40		15.11	13387
				9.95	5.86	15.81			2.28		16.56	13537
				12.48	1.18	13.66			1.62		17.07	13698
				10.00					2.00		14.00	
				9.88	2.11	11.99			3.65		16.35	13388
				10.28	0.93	11.21			3.84		16.55	13699
				10.00					4.00		16.00	
				12.45	2.02	14.47					12.45	13389
				13.06	2.16	15.22					13.06	13700
				13.00							13.00	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Read Phosphate Co.	
13585	Read's XX Dissolved Bone..	Manufacturer
15008	Read's Red Diamond Special	Manufacturer
15010		J. M. Stanley, Henderson.....
15009	Read's Wheat and Clover	
15011	Grower	Manufacturer
		A. Cash & Co., Princeton.....
	Singer & Johnson Fertilizer Co., Nashville, Tenn.	
13573	Singer's Wheat Grower	Manufacturer
13701		Simpson & Logan Co. Club, Franklin
13574	Singer's Wheat Grower	Manufacturer
13702		Simpson & Logan Co. Club...
13575	Singer's Bone Meal	*Manufacturer
13576	Singer's Pure Raw Hard	
13703	Bone Meal	*Manufacturer
		Simpson & Logan Co. Club...
13577	Singer's No. 2 Wheat	
	Grower	*Manufacturer
	Smith Brothers, Louisville, Ky.	
13139	Pure Raw Bone	Manufacturer
13538		W. F. Grainger, Franklin.....
13704		W. F. Grainger
13140	Pure Bone Meal	Manufacturer
13705		W. F. Grainger

*The manufacturer failed to furnish proper sample as required by law.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.													
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.			
				10.43 10.00	2.12	12.55						\$10.43 10.00	13585
				10.68 10.26 10.00	1.29 3.22	11.97 13.48	2.29 2.46 2.47	2.78 2.99 3.00	3.62 3.30 3.00			23.83 24.28 22.41	15008 15010
				10.68 9.88 10.00	1.77 1.66	12.45 11.54	1.08 1.05 0.82	1.31 1.27 1.00	2.31 2.85 2.00			19.08 18.52 16.46	15009 15011
				10.87	3.20	14.07	1.48	1.80		1.99		21.15	13573
				8.89 10.00	5.40	14.29	2.08 1.65	2.53 2.00	0.66	0.85 2.00		20.75 19.35	13701
				11.17 10.39 10.00	4.85 2.90	16.02 13.29				1.11 2.60 3.00		16.67 16.75 15.60	13574 13702
						18.00	2.47	3.00				18.21	13575
12.04	5.41					17.45 20.00	2.91 3.29	3.53 4.00				21.61 21.87	13576 13703
				9.00			0.82	1.00		2.00		15.66	13577
15.46 21.90 20.22	8.69 5.14 7.11					24.15 27.04 27.33 22.00	3.76 2.89 3.20 3.71	4.56 3.51 3.88 4.50				28.86 29.27 30.05 24.33	13139 13538 13704
20.80 21.34	4.56 4.37					25.36 25.71 24.00	3.20 3.11 2.47	3.88 3.78 3.00				28.98 29.02 21.81	13140 13705

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Smith Brothers.	
13141 13539	Special Tobacco Grower....	Manufacturer W. M. Lovell, Greenville.....
13142 13540	Standard Tobacco Grower..	Manufacturer W. F. Grainger
13143	Corn and Wheat Grower...	Manufacturer
13144	Soluble Phosphate	Manufacturer
13145	High Grade Potato Grower.	Manufacturer
13146 13541	Bone and Potash	Manufacturer Orr & Minor, Allensville.....
13147	Grain Special	Manufacturer
	Swift & Company, Chicago, Ill.	
13101 13542	Swift's Kentucky Tobacco Grower	Manufacturer Overstreet & Snyder, Lagrange
13102 13543	Swift's Special Tobacco Fertilizer	Manufacturer Smith & Wells, Glasgow.....
13103	Swift's Garden City Phos- phate	Manufacturer
13104 13544 13631	Swift's Superphosphate	Manufacturer Durham & Coakley, Greensb'g A. G. Lewis & Co., Glendale..

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				8.42	0.51	8.93	3.05	3.70		4.25	\$24.55	13141
				8.73	2.72	11.45	2.47	3.00		3.43	23.10	13539
		6.00	2.00	8.00		10.00	2.47	3.00		4.00	22.61	
				8.70	0.42	9.12	2.04	2.48		2.14	19.30	13142
				7.85	2.41	10.26	1.67	2.03		1.98	17.77	13540
		6.00	2.00	8.00		10.00	1.65	2.00		2.00	17.75	
				8.39	0.42	8.81	1.99	2.42	2.09		18.30	13143
		6.00	2.00	8.00		10.00	1.65	2.00	2.00		17.35	
				14.23	0.56	14.79					14.23	13144
		10.00	4.00	14.00		16.00					14.00	
				8.14	0.65	8.79	3.31	4.02		5.15	26.14	13145
		6.00	2.00	8.00		10.00	2.88	3.50		5.00	25.04	
				10.18	0.35	10.53			2.15		14.51	13146
				10.64	2.47	13.11			2.34		16.10	13541
		6.00	4.00	10.00		12.00			2.00		14.80	
				10.06	0.47	10.53	1.21	1.47	2.31		18.20	13147
		6.00	4.00	10.00		12.00	0.82	1.00	2.00		17.26	
				9.84	3.58	13.42	1.83	2.22		2.30	21.49	13101
				10.63	1.59	12.22	2.39	2.90	0.84	0.99	22.60	13542
				10.00		13.00	1.65	2.00		2.00	20.55	
				10.63	5.35	15.98	2.85	3.46		3.37	27.49	13102
				10.84	1.80	12.64	2.86	3.47	1.72	1.09	25.34	13543
				10.00		13.00	2.47	3.00		3.00	24.21	
				13.91	1.02	14.93					13.91	13103
				14.00		15.00					14.00	
				9.00	2.80	11.80	1.58	1.92	1.98		18.64	13 04
				7.16	3.04	10.20	1.65	2.00	1.98		16.74	13544
				7.27	2.39	9.66	1.68	2.04	1.80		16.52	13631
				8.00		12.00	1.65	2.00	2.00		18.15	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Swift & Co.	
13105	Swift's Complete Fertilizer..	Manufacturer
13545		Smith, & Wells, Glasgow.....
13706		Smith Bros., Princeton
13106	Swift's Pure Raw Bone Meal	Manufacturer
13546		Overstreet & Snyder
13707		Wells & Powell
13107	Swift's Bone Meal	Manufacturer
13108	Swift's Ammoniated Bone..	Manufacturer
13708		Wells & Powell
13109	Swift's Ammoniated Bone and Potash	Manufacturer
13110	Swift's Bone and Potash...	Manufacturer
13111	Swift's Diamond S Phosphate	Manufacturer
13112	Swift's Vegetable and Tobacco Grower	Manufacturer
13547		R. B. Hutchcraft, Paris.....
13113	Swift's Special Phosphate and Potash	Manufacturer
13548		Durham & Coakley
13114	Swift's Champion Wheat & Corn Grower	Manufacturer
13549		Ky. Supply Co., Danville.....

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				8.90	2.15	11.05	0.99	1.20	1.06		\$15.57	13105
				7.98	1.77	9.75	1.46	1.77	1.07		15.74	13545
				9.58	2.25	11.83	1.10	1.34	1.11		16.81	13706
				8.00		11.00	1.03	1.25	1.00		14.89	
15.71	8.83					24.54	4.21	5.11			30.50	13106
17.13	7.69					24.82	3.98	4.83			30.25	13546
14.97	9.57					24.54	4.08	4.95			29.76	13707
						23.00	3.71	4.50			24.93	
22.03	3.89					25.92	2.84	3.45			28.47	13107
						25.00	2.47	3.00			22.41	
16.76	2.07					18.83	4.96	6.02			29.53	13108
13.46	5.24					18.70	4.63	5.62			27.80	13708
						17.00	4.94	6.00			25.02	
18.16	3.20					21.36	3.93	4.77	2.46		30.70	13109
						16.00	4.74	5.75	3.00		26.82	
21.30	4.36					25.66	2.82	3.42	2.69		30.81	13110
						23.50	2.47	3.00	3.00		24.51	
				12.02	0.67	12.69					12.02	13111
				10.00		11.00					10.00	
				8.19	5.28	13.47	2.85	3.46		10.51	33.10	13112
				9.38	1.56	10.94	2.97	3.61	1.60	8.05	32.05	13547
				8.00		10.00	2.47	3.00		10.00	29.81	
				11.23	0.42	11.65			2.52		16.17	13113
				12.57	0.86	13.43			2.03		17.45	13548
				10.00		11.00			2.00		14.40	
				9.94	4.18	14.12	1.59	1.93	1.89		20.26	13114
				10.88	3.44	14.32	1.78	2.16	2.14		21.92	13549
				12.00		13.00	1.65	2.00	2.00		21.75	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Swift & Co.	
13115	Swift's Onion, Potato and Tobacco	Manufacturer
13550		Durham & Coakley
13116	Swift's Bone Meal and Blood	Manufacturer
	Tennessee Chemical Co., Nashville, Tenn.	
13273	Ox Potash Mixture	Manufacturer
13551		Barren Co. Gro. and Hdw. Co., Glasgow
13709		W. T. Kirkman, Elkton.....
13274	Ox Special Wheat and Corn Guano	Manufacturer
13325	Ox Alkaline Bone	Manufacturer
13710		Sexton, Farley & Co., Murray
13333	Ox Special Tobacco Guano..	Manufacturer
13552		McElrath, Sexton & Co., Murray
13334	Ox Special Corn Grower...	Manufacturer
13553		Barren Co. Gro. and Hdw. Co.
13335	Ox Corn and Wheat Grower	Manufacturer
13382	Ox Phosphate	Manufacturer
13554		T. J. Turley & Co., Hartford..
13711		Barren Co. Gro. and Hdw. Co.
13383	Ox High Grade Tobacco and Potato Grower	Manufacturer

Commercial Fertilizers.

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TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												Estimated Value per Ton.	Station Number.
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.				
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.			
22.24	3.32			8.13	2.94	11.07	1.75	2.12		6.46	23.94	13115	
				7.84	3.35	11.19	1.68	2.04		6.61	23.72	13550	
				8.00		11.00	1.65	2.00		7.00	24.15		
						25.56	3.49	4.24			30.25	13116	
						23.00	3.71	4.50			24.93		
				9.97	0.81	10.78				2.28	15.02	13273	
				9.73	1.71	11.44			0.56	1.29	14.47	13551	
				9.50	0.90	10.40				1.54	13.61	13709	
		6.00	4.00	10.00		11.00			2.00		14.40		
				12.96	0.86	13.82	0.90	1.09		1.33	20.19	13274	
		7.00	5.00	12.00		13.00	0.82	1.00	1.00		18.26		
				12.58	0.61	13.19				2.17	17.94	13325	
				13.73	0.79	14.52				0.78	17.74	13710	
		7.00	5.00	12.00		13.00			2.00		16.80		
				9.46	2.46	11.92	1.95	2.37		2.12	20.72	13333	
				9.99	1.33	11.32	1.67	2.03	0.72	1.41	19.94	13552	
		6.00	4.00	10.00		11.00	1.65	2.00		2.00	19.75		
				7.19	0.82	8.01	0.81	0.98		1.24	12.88	13334	
				6.73	1.69	8.42	1.19	1.44	0.80	0.33	13.53	13553	
		4.00	3.00	7.00		8.00	0.82	1.00	1.00		12.26		
				9.93	0.70	10.63				0.65	12.98	13335	
		6.00	4.00	10.00		11.00			0.50		12.90		
				12.26	1.57	13.83					12.26	13382	
				12.79	1.79	14.58					12.79	13554	
				12.05	1.02	13.07					12.05	13711	
		7.00	5.00	12.00		13.00					12.00		
				7.26	0.81	8.07	1.80	2.19	0.80	3.82	19.81	13383	
		4.00	3.00	7.00		8.00	1.65	2.00		4.00	18.55		

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13397	Tennessee Chemical Co. Ox Slaughter House Bone..	Manufacturer
13465	Ox Bone Meal	Manufacturer
13466	Ox Special Wheat Grower..	Manufacturer
13587	Ox High Grade Dissolved Bone	Manufacturer
13712		Sexton, Farley & Co.....
	Tennessee Valley Fertilizer Co., Florence, Ala	
13579	Pride of Kentucky	Manufacturer
13607		M. E. Webb, Guthrie.....
13588	Monarch	Manufacturer
13589	Bone and Potash	Manufacturer
13590	Tiger High Grade Dissolved Bone	Manufacturer
13591	Tiger Guano	Manufacturer
	Tuscarora Fertilizer Co., Chi- cago, Ill.	
13130	Ammoniated Phosphate	Manufacturer
13131	Tuscarora Standard	Manufacturer
13713		Bricken & Merkley, Lebanon..

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
In Fine Bone.	In Medium Bone.	Phosphoric Acid.					Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
		Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
30.29	1.93	5.00	3.00	7.33 8.00	1.55	8.88 9.00	1.78 1.65	2.16 2.00		2.20 2.00	\$17.40 17.35	13397
						32.22 20.00	0.80 0.82	0.97 1.00			27.79 14.46	13465
		4.00	3.00	7.61 7.00	0.82	8.43 8.00	0.79 0.82	0.96 1.00	1.00	1.07	13.11 12.26	13466
				14.35 14.23 14.00	1.39 0.92	15.74 15.15 15.00					14.35 14.23 14.00	13587 13712
				11.30 11.61 10.00	1.83 1.41	13.13 13.02 12.00	1.15 1.00 0.82	1.40 1.21 1.00	2.56 1.10	0.85 2.87 4.00	21.32 22.03 20.06	13579 13607
				12.75 8.00	3.65	16.40 10.00	1.70 1.65	2.06 2.00	2.62		24.48 17.75	13588
				8.54 8.00	10.29	18.83 15.00	1.90 1.65	2.31 2.00	10.15 3.00		30.22 20.35	13589
				16.53 14.00	1.64	18.17 16.00					16.53 14.00	13590
				9.05 10.00	2.17	11.22 12.00			11.45		23.18 15.20	13591
		5.00	2.00	7.11 7.00	0.40	7.51 9.00	1.09 0.82	1.32 1.00	1.10 1.00		13.06 12.66	13130
				8.57 8.55 8.00	0.54 2.25	9.11 10.80 10.00	1.93 1.74 1.65	2.34 2.11 2.00	2.13 2.74 2.00		18.42 19.12 17.35	13131 13713

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
	Tuscarora Fertilizer Co.	
13132	Big (4) Four	Manufacturer
13555		Cox & Clore, Beard
13714		Bricken & Merkley
13133	Bone and Potash	Manufacturer
13715		Bricken & Merkley
13134	Tuscarora Bone Phosphate..	Manufacturer
13135	Acid Phosphate	Manufacturer
13136	Tuscarora Trucker	Manufacturer
13556		Cox & Clore
13137	Animal Bone	Manufacturer
13716		Bricken & Merkley
13138	Tuscarora Raw Bone	Manufacturer
13562	Corn and Wheat Grower...	Manufacturer
	Virginia-Carolina Chemical Co.	
	Memphis Division, Memphis, Tenn.	
13275	Beef, Blood and Bone Fertilizer	Manufacturer
13557		Eldred & Co., Princeton.....
13717		S. B. Froman, Sonora
13276	Scott's State Standard Guano	Manufacturer
13558		Eldred & Co.
13277	Royal High Grade Guano...	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
In Fine Bone.	In Medium Bone.	Phosphoric Acid.					Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
		Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				8.04	0.45	8.49	1.94	2.36	4.31		\$19.96	13132
				8.78	2.09	10.87	2.12	2.57	3.46		21.20	13555
				8.31	1.28	9.59	1.82	2.21	3.81		19.75	13714
		5.00	2.00	7.00		9.00	1.65	2.00	4.00		18.15	
				10.94	0.41	11.35			1.98		15.27	13133
				10.49	1.48	11.97			2.27		15.45	13715
		6.00	4.00	10.00		12.00			2.00		14.80	
				11.01	0.40	11.41					11.01	13134
		6.00	4.00	10.00		12.00					10.00	
				15.09	0.50	15.59					15.09	13135
		10.00	4.00	14.00		16.00					14.00	
				7.11	1.85	8.96	4.69	5.69		8.17	33.14	13136
				8.42	3.13	11.55	4.47	5.43	1.02	5.19	32.01	13556
		6.00	2.00	8.00		10.00	4.12	5.00		7.00	31.16	
21.66	3.24					24.90	2.53	3.07			26.86	13137
20.60	5.47					26.07	2.82	3.42			28.22	13716
						24.00	2.47	3.00			21.81	
15.93	8.20					24.13	3.72	4.52			28.82	13138
						22.00	3.71	4.50			24.33	
				11.29	0.42	11.71	1.20	1.46	1.36		18.68	13562
		6.00	4.00	10.00		12.00	0.82	1.00	1.00		16.26	
				10.13	2.93	13.06	2.28	2.77	2.82		22.97	13275
				10.10	0.63	10.73	1.53	1.86	2.41		19.37	13557
				8.77	1.46	10.23	1.75	2.12	1.92		18.27	13717
		6.00	2.00	8.00		10.00	1.65	2.00	2.00		17.35	
				10.30	0.13	10.43	1.94	2.36	2.43		20.66	13276
				8.48	0.14	8.62	1.65	2.00	2.14		17.33	13558
		6.00	2.00	8.00		10.00	1.65	2.00	2.00		17.35	
				10.79	2.60	13.39	2.15	2.61	2.07		22.51	13277
		8.00	2.00	10.00		12.00	1.65	2.00	2.00		19.75	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANUFACTURER AND NAME OF BRAND.	From Whom Obtained.
13278 13417	Virginia-Carolina Chemical Co. National Tobacco Fertilizer	Manufacturer J. T. Fuqua, Fordsville.....
13279	Royal Tobacco Grower	Manufacturer
13280 13559 13718	Champion Corn and Wheat Grower..... ..	Manufacturer Noah Hicks, Guston T. J. Turley & Co., Leitchfield
13281 13719	Royal Grain Grower	Manufacturer T. W. Buchanan & Co., Camp- bellsville
13282	V. C. C. Co.'s Ammoniated Fertilizer	Manufacturer
13283 13720	Capital Bone and Potash Compound	Manufacturer Patton & Anderson, Greensb'rg
13284	Royal Compound	Manufacturer
13285	Royal Dissolved Bone	Manufacturer
13286	Capital Dissolved S. C. Bone	Manufacturer
13287 13721	Pure Raw Animal Bone....	Manufacturer Patton & Anderson
13288	Gold Leaf Tobacco Fertilizer	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Available.	Insoluble.	Total.			From Muriate.	From Sulphate.		
				7.79	0.18	7.97	1.68	2.04	1.14	3.21	\$19.45	13278
				8.99	0.91	9.90	1.73	2.10	2.12	1.59	20.37	13417
		5.00	2.00	7.00		9.00	1.65	2.00		4.00	18.95	
				8.61	0.35	8.96	1.71	2.08		5.70	22.44	13279
		6.00	2.00	8.00		10.00	1.65	2.00		5.00	21.85	
				9.51	0.58	10.09	1.08	1.31	2.05		16.93	13280
				8.77	0.70	9.47	1.39	1.69	1.96		16.93	13559
				7.89	5.30	13.13	1.00	1.21	1.94		16.53	13718
		6.00	2.00	8.00		10.00	0.82	1.00	2.00		14.86	
				11.71	0.23	11.94			3.98		18.12	13281
				10.17	2.33	12.50			4.47		17.60	13719
		8.00	2.00	10.00		12.00			4.00		16.80	
				10.89	0.46	11.35	0.99	1.20	3.11		19.33	13282
		7.00	3.00	10.00		12.00	0.82	1.00	3.00		18.26	
				11.36	0.64	12.00			2.61		16.50	13283
				10.38	1.93	12.31			2.06		15.29	13720
		8.00	2.00	10.00		12.00			2.00		14.80	
				11.71	0.24	11.95			2.32		16.47	13284
		8.00	2.00	10.00		12.00			2.00		14.80	
				15.90	0.05	15.95					15.90	13285
		12.00	2.00	14.00		16.00					14.00	
				13.55	0.33	13.88					13.55	13286
		10.00	2.00	12.00		14.00					12.00	
8.46	15.03					23.49	4.05	4.92			27.94	13287
19.12	1.66					20.78	3.31	4.02			26.23	13721
						20.00	3.29	4.00			21.87	
				8.84	0.28	9.12	1.73	2.10		3.79	20.46	13288
		5.00	2.00	7.00		9.00	1.65	2.00		4.00	18.95	

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANU- FACTURER AND NAME OF BRAND.	FROM WHOM OBTAINED.
13390	Wake Fertilizer Co., Adair- ville, Ky. Old Kentucky Tobacco Grower	Manufacturer
13373	White River Packing Co., In- dianapolis, Ind. Kentucky Tobacco Fertilizer	Manufacturer
13374	Corn Fertilizer	Manufacturer
13375	Wheat Fertilizer	Manufacturer
13376	Soluble Bone and Potash...	Manufacturer
13289	Wood, Stubbs & Co., Louis- ville, Ky. Acme Brand Wheat and Corn	Manufacturer
13290	Acme Br. Blood, Bone and Potash	Manufacturer
13291	Acme Br. Special Truckers..	Manufacturer
13292	Acme Br. High Grade Vege- table	Manufacturer
13293	Acme Br. Potato and To- bacco	Manufacturer
13294	Acme Br. Soluble Bone and Potash	Manufacturer

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.									Potash.		Estimated Value per Ton.	Station Number.
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Avallable.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.		
				6.33 6.00	2.00	8.33 8.00	3.71 3.00	4.50 3.64		9.68 7.00	\$31.15 25.40	13390
				8.37 8.00	1.38	9.75 1.03	1.11 1.03	1.35 1.25	1.84 2.00		15.76 15.09	13373
				8.60 8.00	1.37	9.97 1.03	1.13 1.03	1.37 1.25	1.82 2.00		16.08 15.09	13374
				8.42 8.00	1.39	9.81 1.03	1.13 1.03	1.37 1.25	1.87 2.00		15.92 15.09	13375
				7.90 8.00	0.86	8.76			1.21 1.00		11.03 10.80	13376
				10.96 10.00	1.18	12.14 0.82	1.15 0.82	1.40 1.00	2.31 2.00		19.38 16.46	13289
				10.12 10.00	2.52	12.64 1.65	1.86 1.65	2.26 2.00	2.90 2.00		21.63 18.95	13290
				7.28 8.00	0.88	8.16 2.47	2.10 2.47	2.55 3.00	2.81 2.00		18.76 19.01	13291
				10.80 10.00	2.12	12.92 3.29	3.38 3.29	4.10 4.00	0.80 4.00	3.57	29.03 25.87	13292
				10.13 8.00	2.25	12.38 2.47	2.10 2.47	2.55 3.00	1.06 6.00	5.76 6.00	27.33 24.21	13293
				11.14 10.00	0.97	12.11			2.39 2.00		16.15 14.00	13294

TABLE OF ANALYSES.

Station Number.	NAME AND ADDRESS OF MANU- FACTURER AND NAME OF BRAND.	From Whom Obtained.
13598	Wood Stubbs & Co. Acme Br. Raw Bone Meal..	Manufacturer
13599	Acme Br. Steamed Bone Meal	Manufacturer
13600	Acme Br. Half and Half Wheat Grower	Manufacturer

December 31, 1904.

TABLE OF ANALYSES.

POUNDS IN THE HUNDRED.												
Phosphoric Acid.							Potash.			Estimated Value per Ton.	Station Number.	
In Fine Bone.	In Medium Bone.	Soluble.	Reverted.	Avalliable.	Insoluble.	Total.	Nitrogen.	Equivalent to Ammonia.	From Muriate.			From Sulphate.
13.05	8.34					21.39 23.00	3.91 3.29	4.75 4.00			\$27.17 23.67	13598
22.47	2.78					25.25 25.00	3.02 2.47	3.67 3.00			28.71 22.41	13599
16.34	2.88					*19.22 17.00	1.91 1.65	2.32 2.00	0.95 1.00		21.48 16.15	13600

*Contains Soluble Phosphoric Acid.

M. A. SCOVELL, Director and Chemist.

H. E. CURTIS, Chemist, Fertilizers.

W. H. SCHERFFIUS, Chemist.

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DEPARTMENT OF CHEMISTRY

MISCELLANEOUS CHEMICAL ANALYSES MADE IN 1904.

BY A. M. PETER AND S. D. AVERITT.

Distillery Slop.

14315—Strained slop from the "Old Crow" distillery of Messrs. W. A. Gaines & Co., Frankfort, Ky. Sample from a barrel received by Prof. May, Jan. 15, 1904. This material is the thin part that passes through the strainers in the process of preparing the dried feed. It is of the consistency of cream and still contains a good many rather coarse particles. On being allowed to stand until the solid particles had settled, leaving the liquid clear, the deposit was found to occupy about six-tenths of the total volume.

1. Determinations made on the Material as Received.

Specific gravity at 15.5° C, 1.013 by hydrometer.	
Total solids by evaporation, at 100° C.....	4.264 per cent.
Ash	.287
Nitrogen	.209
Protein (Nx6.25)	1.306
Phosphoric acid	.065
Potash	.075

2. Analysis of the material obtained by evaporating the slop on the water-bath and drying at 100° C.

Ash	6.95 per cent.
Protein	31.59
Fiber	3.95
Nitrogen-free extract	42.61
Fat	14.90
Total.....	100.00
Phosphoric acid	1.57
Nitrogen	5.05
Potash	1.84

3. Determinations made upon the clear liquid obtained by filtering the slop through paper.

Total solids by evaporation, at 100° C.....	2.497 per cent.
Ash	.353
Nitrogen	.102
Protein	.638
Phosphoric acid	.080
Potash	.079

The following experiments were made with the clear liquid with a view to precipitate the protein:

1.—A portion boiled with alum solution and filtered hot gave no protein in the precipitate.

2.—A portion was mixed cold with 1 per cent. of tannic acid and filtered after standing and the precipitate washed with cold water. It contained an amount of protein equivalent to .375 per cent. of the original solution.

3.—A portion treated in the same way with 2 per cent. of tannic acid gave .412 per cent. of protein.

These tests show that more than half the protein in the clear filtrate from the slop may be precipitated in the cold by means of tannic acid. The strained slop contains so much nitrogenous material, a large part of which is in suspension, that it is evident a more perfect method of filtration is desirable than that now in use. Possibly a precipitant might be used also to recover part of the nitrogenous substances that are in solution. See also the analyses in the 16th Annual Report.

Corn.

14536—Seed corn sent by G. N. McGrew, Bayon, Ky., who says it was represented to be sepecially rich in protein. The variety is supposed to be "Leaming," from Funk Bros. Seed Co., Bloomington, Ill., who say this variety has the highest protein of any other with which they are familiar. Sample a good looking yellow corn.

ANALYSIS.	As received.	Water-free.
Moisture	per cent. 11.45	
Nitrogen	1.42	1.61
Protein (N.x6.25)	8.94	10.06

The percentage of protein is below the average.

Sugar Beets

175

Sugar Beets.

A sample was taken by Mr. Harper, July 26, 1904, from the plot of beets planted for the Co-operative Experiment with Dr. Wiley and tested as below.

14555—Three of the smaller beets.

14556—Three of the larger beets.

ANALYSES.	14555	14556
Average weight, topped, ozs.....	10.9	17.5
Average weight, trimmed, ozs.....	8.6	14.0
Specific gravity of the juice at 20 degrees C.....	1.067	1.066
Brix	16.3	16.1
Cane sugar in the juice, per cent.....	13.2	12.5
Purity, per cent.	81.	77.6

Butter.

The samples analyzed were from that made at the Station Dairy in a churn test of the cow Prussian Queen, No. 152682, owned by E. A. Farra.

14572—From milkings of August 18, 19, 20, and 21.

14573—From milkings of August 22, 23, and 24.

ANALYSES.	14572	14573
Fat	82.68	81.53
Water	13.53	13.43
Salt	3.11	4.31
Curd	.68	.73
Total.....	100.00	100.00

Old Wood Ashes.

14564—Wood ashes from an old pile, the accumulation of about 20 years, sent by A. C. Hogan, Allensville, Todd County, Ky., August 9, 1904.

ANALYSIS—Per cent.

Moisture	16.5
Phosphoric Acid	.73
Potash	.96
Lime	23.6
Estimated value per ton, \$2.08.	

Tobacco Powder.

14568—Tobacco powder bolted out of smoking tobacco, sent by T. A. Courtenay, Louisville, Ky., August 20, 1904.

ANALYSIS—Per cent.	As received.	Water-free.
Moisture	9.15	
Phosphoric Acid	.99	1.09
Potash	2.42	2.66
Nitrogen	2.08	2.29
Estimated value per ton, \$10.13.		

This material was offered at \$30 per ton as a fertilizer, coarse ground stems being \$20 per ton. This material contains about the same amount of Nitrogen and Phosphoric acid as good tobacco stems but only about one-third as much potash.

Sal Bordeaux.

This is a fungicide made and sold by the Dust Sprayer Manufacturing Co., Kansas City, Mo., whose advertisements claim that it is better than Bordeaux Mixture. Their "Circular Letter No. 2" states that by means of this compound, used dry, bluestone is applied directly to the plants and has a stronger fungicidal action than Bordeaux Mixture. The directions for use call for 1 lb. of "Sal Bordeaux" to 40 lbs. of ground lime, for general orchard work, and state that "diluted in this way it contains more copper per gallon than the 4-4-50 formula." They quote this mixture "ready for the machine," at 11½ cents per pound in not less than 200 pound lots.

14355—Sal Bordeaux, sent to Prof. Garman by one of his correspondents. The material is a very fine, soft, white powder. When moistened with water it turns green.

ANALYSIS—Per cent.	
Water, with a little carbon dioxide	25.81
Lime	56.05
Magnesia	.12
Ferric oxide, alumina, etc.	.32
Silica	.21
Copper oxide	9.82
Sulphuric anhydride	8.32
Total	100.65

The probable constituents used in making the mixture, calculated from this analysis, are as follows:

	Per Cent.
Crystallized copper sulphate (blue vitriol).....	21.59
Crystallized calcium sulphate (gypsum or land plaster).....	5.98
Calcium hydrate (slaked lime)	71.45
Impurities (iron oxide, magnesia, silica).....	.65
Total.....	99.67

Or, to make 100 pounds of "Sal Bordeaux," we would mix together, in round numbers, 6 lbs. of gypsum or land plaster, 22 lbs. of blue vitriol, and 72 lbs. of fine, dry slaked lime. It would be best to grind the blue vitriol and gypsum together to a very fine powder before mixing with the slaked lime, which should previously have been sifted through a very fine sieve to remove all lumps.

The change of color produced when the "Sal Bordeaux" is put into water shows that the constituents have been mixed dry. The analysis shows, also, that the materials used in its manufacture were of excellent quality. The price, however, is exorbitant. Nor does there appear to be any foundation for the claim that this mixture is superior to Bordeaux Mixture. The moment the "Sal Bordeaux" becomes moist, as by contact with moist foliage, dew or rain, the same compounds will be produced that are contained in the ordinary Bordeaux Mixture.

Petroleum for Oiling Roads.

The crude petroleum extensively used upon the turnpike roads in Lexington and Fayette County in 1904 is a heavy, brown oil from the Bath County field. The first experiment was made on the Newtown road in 1903, using oil from which Sample No. 11964 was taken. The result of this experiment was very satisfactory and the next year all the principal pikes centering in Lexington were oiled for several miles, using the same kind of petroleum, represented by Sample No. 14565. The petroleum No. 14522 was not considered as suitable for this purpose as the oils containing a larger proportion of asphalt-like substances. Fractional distillations of the samples were made in the usual manner

and also comparative tests for the amount of asphaltic residue left when the oils were heated to a high temperature in open dishes. In making this test the heat was gradually increased until about 300 degrees C was reached by a thermometer placed in the oil, the whole operation requiring about 5 hours.

The samples tested may be described as follows:

11964—Petroleum from Bath Co., Ky., brought by Capt. John Bullock, of the Home Construction Co., September 3, 1903. The sample represents the oil used upon the experimental mile of the Newtown road. It is a dark brown, rather fluid oil.

14522—Petroleum from the Yale Oil Co., Bath Co., Ky., sent by Capt. Bullock, May 22, 1904. The sample is a dark brown oil, much thinner than No. 11964.

14565—Petroleum from the Ragland wells, supposed to be of the same character as No. 11964, brought by Capt. John Bullock, August, 1904. The sample represents the oil that is being used upon the county roads by the Home Construction Co. It is a thick, brown oil, having little smell.

Analyses of the Petroleums—Per cent.

Number	11964	14522	14565
Specific gravity at 15.50 deg. C.	.9174	.818	.921
Equivalent in Beaume degrees	22.6	41.	22.
Water	3.0	a trace	2.5
Distillate below 150 deg. C (302 deg. F)	2.5	a trace	4.0
Distillate from 150 deg. C to 300 deg. C (302 deg. to 572 deg. F)	80.0	69.	28.0
Distillate from 300 deg. C to 350 deg. C (572 deg. to 662 deg. F)	3.0	27.	45.0
Coke, by weight	11.6	4.	19.0
Total	100.1	100.00	98.5
Asphaltic residue at 300 deg. C (572 deg. F)	40.	13.	42.

The figures for coke give the number of grams obtained from 100 c. c. of petroleum, while the distillates are given in per cent. by volume. The amount of asphaltic residue obtained is stated as per cent. by weight. These residues differed somewhat in char-

acter, that from No. 14522 being a brittle solid, when cold, whereas the others were tough, sticky soft-solids. The percentage of distillate between 150 degrees C and 300 degrees C in 11964 is probably too high on account of "cracking" during a distillation conducted too slowly.

Mineral Waters.

ALLEN COUNTY.

14479—Chalybeate water sent by W. W. Thompson, Scottsville, Allen County, Ky., April 11, 1904.

ANALYSIS.

The water contains 76.8 grains of solid matter to the gallon (1.317 gram per liter) composed of calcium carbonate, calcium sulphate, magnesium sulphate, sodium chloride, iron carbonate and traces of potassium, lithium, strontium and zinc.

This is a chalybeate water of moderate strength.

14598—Sulphur water sent by Dr. W. E. Meredith, Scottsville, Allen County, Ky., August 26, 1904.

ANALYSIS.

The water contains 80.6 grains of solid matter to the gallon (1.383 gram per liter) composed of sodium chloride, calcium and magnesium carbonate and calcium sulphate, with traces of iron, potassium and zinc compounds.

The water contains also some hydrogen sulphide.

This is a weak sulphur water and should possess the usual properties.

BREATHITT COUNTY.

14552—Water sent by D. B. Crawford, Copebranch, Ky., July 2, 1904, from a spring in Breathitt County on the south side of Middle Fork of Kentucky River, 3 miles above Athol. The flow is about 60 gallons per hour. This spring has been known ever since the county was settled and the water is said to cure sore eyes and to be good for any kind of sores.

ANALYSIS.

One gallon contains 2.6 grains of solid matter (.045 gram per liter) composed of silica with a little calcium carbonate, sodium chloride, sodium sulphate and traces of iron, magnesium and potassium compounds.

This is a remarkably pure water, containing very little mineral matter.

CHRISTIAN COUNTY.

14620—Mineral water from a well on the farm of R. J. Crutchfield in Christian County, Ky., near Pembroke. Sample received October 13, 1904.

ANALYSIS.

The water contains 53.8 grains of solid matter to the gallon (.922 gram per liter) composed of calcium carbonate, calcium sulphate, magnesium sulphate and sodium chloride, with traces of iron, strontium and potassium.

This is a weak calcic saline water. It should be wholesome for drinking and may have some medicinal value.

CLARK COUNTY.

14603—Mineral water sent by N. A. Golden, Dodge, Clark County, Ky., September 27, 1904, from his well, just drilled, at that place.

ANALYSIS.

The water contains 107.6 grains of solid matter to the gallon (1.845 gram per liter) consisting of sodium chloride, with some sodium carbonate, calcium carbonate and sodium sulphate and traces of iodides, bromides, iron, potassium and strontium.

This is an alkaline saline water and should have some medicinal value. If bottled and charged with carbon dioxide it would be a very good table water.

FAYETTE COUNTY.

14504—Water from the well of Dr. J. W. Wilson, on the Newtown pike, about a mile from the city limits of Lexington. (See No. 11722, 16th Report.)

ANALYSIS.	Parts in 1,000,000	Grains per gal.
Total solid matter	320.	18.66
Total fixed matter	263.	15.34
Organic and volatile matter	57.	3.32

The residue is composed of calcium carbonate, magnesium carbonate, sodium carbonate, a little sodium chloride and marked traces of iron, potassium, lithium and strontium and zinc.

14505—Water from a well on the farm of P. T. Atkins, in Fayette County, on the Versailles pike, 2 miles from Lexington. The well is 86 feet deep and has just been bored.

ANALYSIS.

The water contains 38.1 grains of solid matter to the gallon (0.654 gram per liter) consisting of sodium chloride and calcium carbonate, a little magnesium carbonate and sodium carbonate, and traces of bromides, sulphates, potasisum, lithium, strontium and iron. The water gives a strong test for ammonia but only traces of nitrites and nitrates. The sediment in the bottle contained some free sulphur which probably was derived from a little hydrogen sulphide in the water.

Except for the presence of some free ammonia, the analysis would indicate a wholesome mineral water. The presence of this ammonia does not necessarily show that the water is impure, as this substance is often present in the water of deep wells that receive no surface contamination.

14608—Water from a bored well on the farm of F. R. ToeWater, in Fayette County, Ky., about 1½ mile from Lexington, on the Nicholasville pike. The well is 60 feet deep. Sample brought to Prof. Garman about October 2, 1904.

ANALYSIS.	Parts per million.	Grains per gal.
Total solid matter	615.	35.9
Total fixed matter	519.	30.3
Organic and volatile matter	96.	5.6

Chlorine	144.	8.4
Equivalent to sodium chloride.....	237.	13.8
Nitrogen of nitrites	.05	
Nitrogen of nitrates	.4	
Free ammonia	small	

The solid matter is mostly sodium chloride and calcium carbonate, with a little magnesium carbonate, calcium sulphate and traces of iron, potassium, lithium and strontium.

14629—Another sample from Mr. Toe Water's well (see above) brought to Prof. Garman November 4, 1904.

ANALYSIS.	Parts per million.	Grains per gal.
Total solid matter	651.	37.0
Total fixed matter	591.	33.5
Organic and volatile matter	60.	3.5
Chlorine	214.	12.5
Equivalent to sodium chloride	353.	20.6
Nitrogen of nitrites	.06	
Nitrogen of nitrates	.1	
Free ammonia	small	

Although the tests show the presence of an appreciable amount of nitrites, there is good reason to believe that the water is wholesome for drinking.

14609—Sulphur water brought by Rev. W. H. Felix from his well in Fayette County, Ky., 8 miles from Lexington, on the Winchester pike. This well was bored about a year ago and is 75 feet deep. The water was slightly milky and smelled of hydrogen sulphide.

ANALYSIS.

The water contains 125.4 grains of solid matter to the gallon (2.151 grams per liter) consisting of sodium chloride and calcium carbonate, with a little magnesium sulphate, sodium sulphide, potassium chloride and marked traces of borates, nitrates, free ammonia, iron, zinc, lithium and strontium.

The water also contained some free hydrogen sulphide. The

total amount of hydrogen sulphide, both free and combined, was found to be 0.7 grain per gallon (.012 gram per liter).

The sediment consisted of sulphur with a little zinc sulphide and iron sulphide.

This is a weak saline sulphur water. It is wholesome and should have some medicinal value.

14631—Sulphur water from a well on the farm of Mr. J. B. Haggin, about 7 miles from Lexington on the Maysville pike. The well was bored last summer at what is known as the Kerr place. It is 118 feet deep. The sample was sent by Mr. T. B. Watkins, November 7, 1904. The water was clear and had a decided smell of hydrogen sulphide.

ANALYSIS.

The water contains 37.3 grains of solid matter to the gallon (0.639 gram per liter) composed of sodium chloride, calcium carbonate, magnesium carbonate, a little calcium sulphate, sodium sulphide, and marked traces of potassium and lithium compounds.

The water also contains a little free hydrogen sulphide.

Tests for nitrites and nitrates gave negative results, but the test for ammonia showed a notable amount present.

This is a weak sulphur quite similar to the Renfro water, being slightly alkaline from the presence of calcium and magnesium carbonates and containing a little lithium. It is wholesome for drinking and should have some medicinal value.

GRAVES COUNTY.

14468—Chalybeate water from the well of P. B. Mahon, Dublin, Graves County, Ky., sent by W. T. Lowe & Co. to W. H. Scherffius, March 29, 1904. The bottle contained a brown, ferruginous sediment when received.

ANALYSIS.

The water contains 56.9 grains of solid matter to the gallon (0.976 gram per liter) consisting of the carbonates of calcium, iron, and magnesium, sodium chloride and calcium and magnesium sulphates, with a little manganese carbonate and potassium sulphate and a trace of lithium.

This is a weak chalybeate water and should possess the tonic properties characteristic of waters containing iron and manganese.

GREEN COUNTY.

14588—Sulphur water sent by Lucien Durham, Miami, Ky., from his well in Green County, 9 miles southeast of Greensburg, on the Greensburg and Milltown pike. The well is 50 feet deep and has been open since August 25, and there is a very good flow. The water is found to be beneficial in indigestion and is diuretic in its action. Sample received September 5, 1904.

ANALYSIS.

The water contains 310.3 grains of solid matter to the gallon (5.323 grams per liter) composed of sodium chloride, calcium sulphate, magnesium sulphate and calcium carbonate, with some sodium sulphide and potassium sulphate and marked traces of iron sulphide, zinc sulphide, lithium chloride, strontium carbonate and sodium biborate.

The water also contains some free hydrogen sulphide and the sediment contains iron and zinc sulphides and sulphur.

This is an alkaline-saline sulphur water and would be called a "black sulphur" on account of the iron it contains. It should have the usual medicinal properties of such waters.

HART COUNTY.

14550—Sulphur water sent by J. S. Lay & Bro., proprietors of the Allen House, Horse Cave, Hart County, Ky., June 17, 1904, from his well 165 feet deep, bored in 1900. The water is said to have "splendid curative properties."

ANALYSIS.

The water contains 15.2 grains of solid matter to the gallon (0.261 gram per liter) consisting of calcium carbonate, a little sodium chloride and magnesium sulphate and traces of iron, potassium and lithium compounds.

The water also contains a little hydrogen sulphide.

This is a weak sulphur water, containing very little mineral matter.

14551—Mineral water sent by J. L. Martin, Horse Cave, Ky., June 30, 1904, from a well drilled by him in August, 1903, on the farm of W. R. Wheeler in Hart County, $4\frac{1}{2}$ miles north of Canmer, near Green River. The well is $172\frac{1}{2}$ feet deep and this sulphur water was struck at the bottom. A stream of fresh water comes in at 110 feet. The water at the well is said to smell strongly of sulphur. It contained a slight gray flocculent sediment.

ANALYSIS.

The water contains 365.1 grains of solid matter to the gallon (6.262 grams per liter) composed of sodium chloride and sulphate and calcium carbonate, a little magnesium carbonate and potassium sulphate, traces of iron, lithium and strontium compounds and marked traces of iodides and bromides.

This is a saline water and should possess some medicinal value. It contained no hydrogen sulphide when examined, but this may have escaped, as the sample stood several days in the laboratory.

JESSAMINE COUNTY.

14421—Mineral water from the bored well of J. L. Johnson, Nicholasville, Jessamine County, Ky., brought by H. M. West, March 30, 1903. When received the water contained a slight gray sediment.

ANALYSIS.

The water contains 772.5 grains of solid matter to the gallon (13.25 grams per liter) composed of sodium chloride, calcium chloride and magnesium chloride, with some calcium sulphate, calcium carbonate and potassium chloride, and marked traces of iodides, bromides, borates, lithium, strontium, manganese, iron and zinc.

This is a saline water of a kind often obtained by boring into the limestone strata of this region. It is wholesome and should have medicinal value.

14638—Sulphur water brought by James K. P. Sallee, Keene, Ky., November 12, 1904, from a shallow well on his farm in Jessamine County, one mile from Keene, on the Nicholasville and Versailles pike. The well was dug about a year

ago; the flow is weak. The water smelled distinctly of hydrogen sulphide and contained a gray sediment.

ANALYSIS.

The water contains 76.8 grains of solid matter to the gallon (1.317 gram per liter) consisting of sodium chloride, calcium carbonate, magnesium carbonate, a little sodium carbonate, iron carbonate, potassium sulphate, and traces of bromides, iodides, lithium and strontium.

The water contains also a little hydrogen sulphide.

The sediment contained iron, sulphur and a trace of manganese.

This is a weak alkaline sulphur water of the kind commonly called "black sulphur."

JOHNSON COUNTY.

14558—Water sent by Clark Lemaster from a spring on his place at Manila, Johnson County, Ky., July 23, 1904. This spring is on the east side of Big Paint Creek, about 7 miles west of Paintsville. The water is very clear and cold and there is a large stream of it which flows down 300 yards to the creek. The spring is situated on high ground.

ANALYSIS.

The water contains 29.1 grains of solid matter to the gallon (0.496 gram per liter) consisting of calcium carbonate, with a little magnesium carbonate, sodium chloride and traces of calcium sulphate and potassium sulphate. The chlorine amounted to 10 parts per million; nitrites, nitrates and ammonia were absent.

This is a good, hard water, the principal constituent being calcium carbonate. It does not differ materially from the spring waters of limestone regions, but may have some local medicinal value in a region where the springs are mostly freestone water.

LAWRENCE COUNTY.

14311—Salt water from a flowing well in the town of Louisa, Lawrence County, Ky., brought by J. R. Johnson, January, 1904. This well was bored for oil about 10 years ago. The water is said to flow from it at the rate of 100 gallons a minute. Another well bored in the vicinity at

the same time yields natural gas which could be used for evaporating, if the water is strong enough to make salt.

ANALYSIS.

One gallon contains 1761 grains of solid matter (30.2 grams per liter) composed of sodium chloride, calcium chloride, magnesium chloride, a little calcium carbonate, iron carbonate, calcium sulphate, strontium sulphate, potassium chloride, potassium bromide, lithium chloride and sodium biborate.

This brine contains about as much salt as sea water, and is, therefore, too weak for profitable salt making, under ordinary conditions. Probably the natural gas could be utilized more profitably for other purposes.

LINCOLN COUNTY.

14643—Mineral water sent by Geo. F. Hicks, Mt. Salem, Lincoln County, Ky., November 17, 1904.

ANALYSIS.

This water contains 178.4 grains of solid matter per gallon (3.06 grams per liter) consisting of chlorides and sulphates of sodium, calcium and magnesium, some calcium carbonate and traces of iron, potassium and lithium compounds.

This is a saline water of moderate strength and should have a laxative effect.

LOGAN COUNTY.

14506—Sulphur water from a well recently dug on the place of Mr. Geo. W. Wilson, South Union, Logan County, Ky., sent by him May 19, 1904.

ANALYSIS.

The water contains 193.9 grains of solid matter to the gallon (3.326 grams per liter) composed of sodium chloride with some calcium carbonate, magnesium carbonate, sodium carbonate, sodium sulphide, potassium sulphate, and marked traces of iodides and lithium, traces of strontium, iron and zinc compounds and a very considerable amount of organic matter and ammonia compounds.

The hydrogen sulphide present, both free and combined, amounted to 4.9 grains to the gallon (.084 gram per liter.)

This is a strong alkaline saline sulphur water. There was so much organic matter present as to give the water a very offensive smell. In view of the presence of much organic matter and ammonia in this water, the purity of its source may very properly be questioned. It is possible, however, that these substances may be derived from the rock strata and not from surface drainage.

McLEAN COUNTY.

14546—Water from one of the public wells of Calhoun, McLean County, Ky., sent by Dr. H. W. Yates, Secretary of the County Board of Health, July 18, 1904. The sample was received July 21st in a quart bottle, well corked. There was a slight flocculent gray sediment in the bottle.

ANALYSIS.	Parts per million.	Grains per gal.
Total solid matters	4689.	273.4
Fixed mineral matters	3965.	231.2
Organic and volatile matters	724.	42.2
Chlorine of chlorides	242.	14.1
Equivalent to sodium chloride	399.	23.2
Nitrogen of nitrites	.01	
Nitrogen of nitrates	1.28	
Free ammonia	.360	
Albuminoid ammonia	.228	
Sulphates	much	
Lime	much	
Magnesia	much	

On account of the large amount of saline matter in this water it would be classed as a mineral water, but the presence of so much free and albuminoid ammonia and of notable quantities of nitrites and nitrates indicate that it is contaminated by surface drainage, and is not safe for drinking. A microscopical examination shows the presence of numerous amoebae in the sediment, a very unfavorable indication.

MONTGOMERY COUNTY.

14644—Water from a spring in a pool recently dug by J. G. Trimble, Mt. Sterling, Ky., on his farm near that place. The spring is an old one, but was rediscovered in making the pool.

ANALYSIS.

One gallon contains 30.8 grains of solid matter composed of calcium carbonate, calcium sulphate, magnesium sulphate, sodium chloride, a little iron carbonate and traces of potassium, lithium and strontium.

MORGAN COUNTY.

14559—Water from Amyx Springs, Morgan County, Ky., sent by Dr. R. Q. Drake, Mt. Sterling, Ky., July 26, 1904. The bottle contained a slight brownish sediment.

ANALYSIS.	Grains per gal.	Parts per million.
Total solid matter	10.03	172.
Total fixed matter	8.57	147.
Organic and volatile matter	1.46	25.
Chlorine	.52	9.
Equivalent to sodium chloride	.85	14.8
Nitrogen of nitrites		0.1
Nitrates		none
Free ammonia		slight
Sulphates		a trace

The solids are mainly calcium carbonate, silica, a little magnesium carbonate, iron carbonate, sodium chloride and traces of potassium and lithium compounds and sulphates.

This water contains too little mineral matter to be properly classed as a mineral water. It is a very weak chalybeate. The presence of a notable amount of nitrites and ammonia is a suspicious circumstance.

OLDHAM COUNTY.

14553—Water sent by T. W. Floyd, Louisville, Ky., from a spring on his place at Beard, in Oldham County, Ky. Sample received July 20, 1904.

ANALYSIS.

The water contains 22.8 grains of solid matter to the gallon (0.391 gram per liter) composed of calcium carbonate with a little magnesium carbonate, sodium chloride and calcium sulphate, with traces of iron carbonate and potassium and lithium compounds.

This is a hard limestone water, containing a little more than the average amount of solid matter, but not materially different from such waters generally, as found in this limestone region.

14587—Water sent by P. W. Johnson, LaGrange, Ky., August 30, 1904, from a well 25 feet deep, sunk about 8 years ago on his place. The well is on high ground and there is an abundant supply of water.

ANALYSIS.

The water contains 22.4 grains of solid matter to the gallon (0.384 gram per liter) composed of calcium carbonate, with a little magnesium carbonate, sodium chloride, calcium sulphate, and traces of iron, silica and potassium.

This is a hard limestone water containing only a trifle more solid matter than the average for this region and possibly a little more iron. It can hardly be considered a mineral water, but is good and wholesome for drinking.

14599—Water from a spring near LaGrange, Oldham County, Ky., sent by Miss Pearl Fuqua, September 16, 1904.

ANALYSIS.

The water contains 14.0 grains of solid matter to the gallon (.241 gram per liter) composed of calcium carbonate, with a little magnesium carbonate and traces of calcium sulphate, sodium chloride, iron carbonate, silica, etc.

This water has the usual amount and kind of solid matter found in our limestone spring waters. It is good and wholesome for drinking.

OWEN COUNTY.

14415—Mineral water sent by E. C. Watson, Georgetown, Ky., March 12, 1904, from a well on his place in Owen County, on the Owenton and Stamping Ground pike, 14 miles from Owenton and 18 miles from Georgetown. The well has been dug six or seven years. It is $17\frac{1}{2}$ feet deep and is situated on a ridge. The water has been used recently by many persons with benefit and is thought to be good for bowel and kidney troubles and for rheumatism. This has recently been named "Beechwood Springs Water."

ANALYSIS.

The water contains 170.7 grains of solid matter to the gallon (2.928 grams per liter) composed of magnesium sulphate with some calcium sulphate, calcium carbonate and sodium chloride, and traces of iron carbonate, potassium sulphate and lithium sulphate.

Tests for nitrites, nitrates and ammonia salts gave negative results.

This water is pure and wholesome and should have some medicinal value. It would be classed as a saline water, the magnesium sulphate being its most important constituent.

SIMPSON COUNTY.

14502—Sulphur water sent by R. S. Jackson, Hickory Flat, Ky., May 13, 1904, from a well on his place in Simpson County, $6\frac{1}{4}$ miles east of Franklin. The well is 37 feet deep and was bored in 1901. There was considerable sediment in the bottle when received.

ANALYSIS.

The water contains 91.5 grains of solid matter to the gallon (1.569 gram per liter) consisting of sodium chloride and magnesium sulphate, with some calcium carbonate, sodium sulphide, potassium sulphate and traces of iron, lithium and strontium compounds.

The water also contains hydrogen sulphide gas, the total amount of which, both free and combined, was found to be 6.06 grains to the gallon (.104 gram per liter).

The sediment in the bottle contained traces of iron, zinc and manganese in the form of sulphides.

This is a saline sulphur water and should possess the medicinal properties belonging generally to waters of this class. It is not very strong in saline matter, but quite strong in sulphur compounds.

TAYLOR COUNTY.

14554—Sulphur water sent by J. C. Morrison, Campbellsville, Taylor County, Ky., July 18, 1904, from a well just bored on his place. The water was struck at 88 feet July 5th, and rose 20 feet in the tube. Its level could not be reduced by a hand pump. The water smelled strongly of hydrogen sulphide and there was a deposit of sulphur in the bottle.

ANALYSIS.

The water contains 320.9 grains of solid matter to the gallon (5.504 grams per liter) composed of chlorides and sulphates of sodium, calcium and magnesium, some calcium carbonate and traces of iron, potassium and lithium compounds and a trace of borates.

The water contained also a very considerable quantity of hydrogen sulphide.

This is a very good saline sulphur water.

Another sample of this water received August 9, 1904, was found to contain 323.6 grains of solid matter to the gallon (5.551 grams per liter).

14590—Mineral water sent by W. A. Chandler, Campbellsville, Taylor County, Ky., September 9, 1904.

ANALYSIS.

The water contains 129.9 grains of solid matter to the gallon (2.228 grams per liter) composed of calcium sulphate, magnesium sulphate, sodium sulphate, sodium chloride and calcium carbonate, with traces of iron carbonate and potassium sulphate.

This is a weak saline water containing a little iron and may have some medicinal value.

WARREN COUNTY.

14596—Water from an old dug well about 32 feet deep on the farm of R. L. Hurd, in Warren County, Ky., about 9 miles from Bowling Green, 1 mile from Stahl and 3 miles from Gasper River. Sample brought by G. S. Milligan, August 31, 1904.

ANALYSIS.

The water contains 106.8 grains of solid matter to the gallon (1.832 gram per liter) consisting of calcium sulphate, magnesium sulphate and sodium chloride, with a little calcium carbonate and a trace of iron carbonate. The water contained no nitrites and only traces of nitrates and ammonia.

This is a weak saline water and should have some medicinal value on account of the magnesia and iron it contains.

14628—Sulphur water from a well recently bored by Mr. W. T. Miller, Bowling Green, Ky. The well is 61 feet deep, 5 feet through soil and the rest through solid limestone. The water stands in the well 21 feet from the surface of the ground. Sample received November 3, 1904.

ANALYSIS.

The water contains 34.4 grains of solid matter to the gallon (0.59 gram per liter) consisting of sodium chloride, calcium carbonate and magnesium carbonate, with a little sodium carbonate, potassium sulphate, sodium sulphide and traces of iron, zinc, lithium, strontium and silica.

The water contains also some hydrogen sulphide, the total amount, both free and combined, being 0.7 grain per gallon (.012 gram per liter).

This is a slightly alkaline, weak sulphur water.

WHITLEY COUNTY.

14589—Chalybeate water from the Bee Creek Mineral Spring, in Whitley County, Ky., on the Cumberland River, 8 miles above the falls. This spring has been in use for some 20 years and has the reputation of being a very good medicinal water. It is now rented by Robt. Price. Sample collected September 5th, by J. S. McHargue.

ANALYSIS.

The water contains 4.4 grains of solid matter to the gallon (.076 gram per liter) composed of calcium carbonate, magnesium carbonate, iron carbonate and silica, with traces of calcium sulphate, potassium sulphate and sodium chloride.

The brown sediment sent with the water contained iron and silica, being almost entirely composed of ferric hydrate deposited from the water on exposure to the air.

This is a weak chalybeate water and should have some medicinal value as such.

METEOROLOGICAL SUMMARIES

FOR THE YEAR 1904.

Compiled from the records of the U. S. Weather Bureau Station in
the main college building.

PRESSURE.

ELEVATION OF THE BAROMETER CISTERN ABOVE MEAN SEA LEVEL,
December 31, 989 feet.

MONTHS.	Monthly	Highest Observed	Date	Lowest Observed	Date	Absolute range.
	<i>In</i>	<i>In.</i>		<i>In.</i>		<i>In.</i>
January.....	28.99	29.41	18	28.37	22	1.04
February.	29.09	29.44	4	28.63	7	0.81
March	28.97	29.42	4	28.63	11	0.79
April.	28.94	29.42	4	28.51	8	0.91
May	28.91	29.21	11	28.69	17	0.52
June.	28.96	29.17	24	28.82	30	0.35
July	28.99	29.24	3	28.72	12	0.52
August.	29.02	29.20	23	28.85	16	0.35
September	29.05	29.33	22	28.88	26	0.45
October.	29.05	29.31	14	28.69	21	0.62
November	29.02	29.33	17	28.57	13	0.76
December.....	28.98	29.26	22	28.47	27	0.79
	Mean	Highest		Lowest		Mean
	29.00	29.44	Feb. 4	28.37	Jan. 22.	0.66

PRECIPITATION.

(Amount in inches and hundredths.)

Elevation of top of gauge above ground December 31, 68 feet

MONTH	Total Amount.	Greatest Am't in any 24 consecutive hours.		No. of days on which 1 in. fell.	No. of days on which no rain except "Trace" fell	Greatest No. of consecutive days without rainfall (Dates inclusive)	Normal rainfall.
		Am't	Date-				
January.	1.92	0.71	21 & 22	0	18	3 to 9	3.82
February	2.38	1.20	7	0	20	11 to 17	3.84
March	4.75	1.27	26	1	12	27 to 29	4.90
April.	3.08	1.78	25 & 26	0	15	17 to 22	3.72
May	2.60	1.08	29 & 30	0	17	4 to 7	3.49
June.	2.51	0.73	26	0	13	8 to 14	4.25
July..	3.13	1.16	27 & 28	1	18	13 to 16	5.10
August	2.44	1.22	10 & 11	0	20	26 to 30	3.52
September....	1.70	0.55	18 & 19	0	22	4 to 11	2.54
October.....	0.57	0.39	11	0	28	1 to 10	2.22
November....	0.53	0.50	9 & 10	0	27	14 to 30	3.72
December.. ..	3.10	1.10	26 & 27	0	18	20 to 23	3.40
Total	28.71				228		44.52

NUMBER OF DAYS

MONTHS.	Thunder Storms	Snows.	Hail	Fog
January.....	0	5	0	2
February	1	2	1	0
March.	6	3	0	0
April.	3	1	0	0
May.	5	0	0	0
June.	11	0	0	0
July	12	0	1	0
August.....	6	0	0	0
September....	7	0	0	2
October	0	0	0	0
November.. ..	0	1	0	1
December.	0	5	0	1
Summary.	51	17	2	6

TEMPERATURE.

ELEVATION OF THE DRY THERMOMETER BULB ABOVE GROUND DEC. 31st, 75 FEET.													No. OF DAYS.	
MONTHS.	FROM SELF-REGISTERING INSTRUMENTS.													
	MEAN			Highest	Date.	Lowest	Date.	RANGE.		Mean daily change	Max. below 32 de- grees.	Max. above 90 de- grees.		
	Max.	Min.	Monthly.					Abso- lute.	Mean Daily.					
January.....	37.5	21.6	29.6	61	22	2	27	59	15.9	7.4	10	0	28	
February.....	40.0	22.3	31.2	67	29	5	16	62	17.7	9.4	9	0	22	
March.....	55.3	36.0	45.6	77	22	19	4	58	19.3	9.4	2	0	10	
April.....	56.5	39.0	47.8	76	23	27	4	49	17.5	7.5	0	0	7	
May.....	73.4	54.2	63.8	89	25	40	15	49	19.2	4.5	0	0	0	
June.....	80.6	62.9	71.8	88	25	54	9	34	17.7	2.6	0	0	0	
July.....	83.5	64.3	73.9	92	18	55	2	37	19.2	2.4	0	2	0	
August.....	83.3	65.2	74.2	90	25	54	27	36	18.1	2.8	0	0	0	
September..	79.2	59.7	69.4	90	11	43	15	47	19.5	4.5	0	0	0	
October..	67.4	46.6	57.0	84	10	35	27	49	20.8	5.6	0	0	5	
November..	56.6	35.9	44.2	67	19	20	27	47	16.7	4.8	0	0	12	
December.....	41.5	26.4	34.0	65	27	9	29	56	1.1	5.7	7	0	23	
Mean.....	62.6	44.5	53.5	92 Max.	Jul.18	Min. 2	Jan. 27	49	18.1	5.6				

CLOUDINESS.

MONTHS	Mean Cloudn's (0 to 10)		Character of Day.		
	8 A. M.	Monthly	Clear	Partly Cloudy	Cloudy
January	5.1	5.5	10	10	11
February	6.9	6.0	6	14	9
March	7.7	6.6	6	11	14
April	6.8	5.8	11	7	12
May	5.1	4.3	15	7	9
June	4.1	4.0	13	14	3
July	4.0	3.7	17	11	3
August	4.9	3.9	15	12	4
September	4.1	4.2	12	13	5
October	2.8	2.2	22	9	0
November	4.0	4.8	11	11	8
December	6.7	6.0	5	14	12
Summary			143	133	90
Mean	5.2	4.8			

WIND

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

MONTHS.	Prevailing Direction.	Maximum hourly velocity during month.			No. of days with gales *	No. of Calms
		Miles	From	Date		
January	S.	48	W.	22	3	0
February	S.	50	W.	7	2	0
March	S. E.	60	N. W.	3	6	0
April	S. W.	44	S.	1	3	0
May	S. E.	52	S. W.	25	2	0
June	S. W.	45	N. W.	15	2	0
July	S. W.	42	W.	4	2	0
August	S. W.	33	N. W.	25	0	0
September	S.	36	N.	18	0	0
October	N. E.	50	N. W.	21	1	0
November	N. W.	36	S.	29	0	0
December	S. W.	48	W.	27	2	0
Mean	S. W.					

*Days with 40 miles per hour and over.

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