FOURTH ANNUAL REPORT

OF THE

KENTUCKY

AGRIGULTURAL EXPERIMENT STATION

OF THE

STATE COLLEGE OF KENTUCKY.

FOR THE YEAR 1891.

LEXINGTON, KENTUCKY.

FRANKFORT, KY.:
PRINTED BY THE CAPITAL PRINTING CO.
1894.

LETTER OF TRANSMITTAL.

To His Excellency, HON. JOHN YOUNG BROWN, *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 provision of an act, approved July 2, 1862, and of the acts supplementary thereto," and of an act of the Legislature of the State of Kentucky, approved February 20, 1888, and entitled "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with the Agricultural Colleges established by the several States and Territories under act of Congress, approved July 2, 1862," I hereby submit the Fourth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

M. A. SCOVELL, *Director*.

FEBRUARY 1, 1892.

LIST OF OFFICERS.

BOARD OF CONTROL.

DR. R. J. SPURR, Chairman.

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J. K. PATTERSON, President of the College.

M. A. SCOVELL, Director, Secretary.

STATION OFFICERS.

M. A. SCOVELL, Director.

A. M. PETER, Assistant Chemist.

H. E. CURTIS, Second Assistant Chemist.

H. GARMAN, Entomologist and Botanist.

A. T. PARKER, Microscopist.

C. L. Curtis, Assistant Agriculturist.

MISS ALICE M. SHELBY, Stenographer.

Address of the Station, LEXINGTON, KY.

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

1891.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30th, 1891, under act of Congress, approved March 2d, 1887		$15,000 00
By salaries	$7,729 96	
By labor	2,390 95	
By supplies	1,142 44	
By freight and express	166 55	
By postage and stationery	257 25	
By printing	988 98	
By library	340 84	
By tools, implements, etc.	370 43	
By chemical apparatus	578 56	
By live stock	482 75	
By miscellaneous	241 91	
By entomological supplies	93 10	
By traveling expenses	70 24	
By seeds	146 04	
		$15,000 00

We, the undersigned, duly authorized auditors for the institution, hereby certify that we have examined the books and the accounts of the Experiment Station of the Agricultural College of Kentucky for the year ending June 30th, 1891, that we have found them all well kept, and correctly classified as above, and that the receipts for the year named are shown to have been $15,000, and that the corresponding disbursements, $15,000, for all of which proper vouchers are on file, and have been examined and found correct.

[Signed] R. J. SPURR,
PHILEMON BIRD,
Auditing Committee Board of Trustees.

I hereby certify that the foregoing statement of accounts, to which this is attached, is a true copy from the books of account of the institution named.

[Signed] W. D. NICHOLAS, *Treasurer.*

HART GIBSON,
Secretary Board of Trustees, A. & M. College of Kentucky.

ANNUAL REPORT

—OF THE—

Kentucky Agricultural Experiment Station

FOR 1891.

REPORT OF THE DIRECTOR.

The year, though begun under the most auspicious conditions, was marked by a serious disaster to the Station by the partial destruction of the Station building on the night of February 22d. The loss was a severe one to the Station, not only in the destruction of the building, but also by the loss of valuable records, and especially the laboratory records, by which much of the work already done in many lines will be a total loss. Fortunately the records in the office were saved. A great part of the time of the Station force has necessarily been taken up in preparing temporary quarters and planning for future quarters. No time has been lost in rebuilding on the same model as before, and we are now situated once again as fortunately as we were before the fire, but unfortunately without any of our records. No changes have been made in the Station force this year. The work of the year may be summarized as follows:

1. Fertilizer control work.
2. Studying the variations of fat in the milk of cows by the use of different kinds of food.
3. Examination of honeys, candies, sugars and syrups as to adulterations. This work was done directly under charge of the Director, and the results may be found under the head of the chemical division.

4. Chemical analyses.

5. Field experiments with fertilizers on corn, hemp, potatoes, tobacco, wheat and pasture.

6. Field experiments, test of varieties.

7. Grass plot experiments.

8. Test of varieties of strawberries and vegetables.

Results of this work may be found in the Bulletins incorporated in this report. The following Bulletins were published during the year:

32. Strawberries and vegetables.

33. Corn experiments.

34. Commercial fertilizers.

35. Experiments with wheat; experiments with oats.

36. Commercial fertilizers.

37. Experiments with potatoes.

Very respectfully,

M. A. SCOVELL, *Director*.

DIVISION OF CHEMISTRY.

Notwithstanding the fact that the loss of the chemical laboratory by fire occurred at the beginning of the fertilizer season, the fertilizer control work has been kept up, thanks to the efficiency of Mr. H. E. Curtis, and the analyses have been published in Bulletins 34 and 36. In addition to these, quite a number of fertilizer samples have been analyzed for farmers. The determinations of specific gravity of potatoes for Bulletin 37 were also made in the chemical laboratory. Daily tests of the fat in the milk of each cow at the Station farm have been made, averaging about ten tests each day. Various rocks, minerals, &c., have been determined for farmers and others. The work of the Association of Official Agricultural Chemists on methods was joined in as usual, and a large number of syrups, sugars, honeys, &c., were analyzed for the United States Department of Agriculture (see Bulletin 13, part 6, Division of Chemistry). This last work was done by the Director, assisted by Mr. Curtis, with the aid of a polariscope and other apparatus kindly loaned by the Department. The results of this work are interesting, and are inserted here, as are also a few other analyses and investigations that have not been published elsewhere.

Butter.

A few samples of butter made at the Station farm from milk of the Jersey cow, Justa Pogis, were analyzed in connection with a test of this cow. Milk of each day was creamed in a Cooley creamer and churned separately, taking care to have the treatment in all respects as nearly uniform as possible. The analyses may serve to show how much variation there may be, even with the greatest care of manipulation :

Jersey Butter—Cow, Justa Pogis.

Station Number.	From milk of May.	Fat per cent.	Salt and Curd per cent.	Water per cent.
1568	11th.	80.16	5.30	14.54
1569	12th.	80.90	3.84	15.26
1570	13th.	78.70	6.14	15.16
1576	14th.	71.50	7.86	20.64
1577	15th.	75.26	8.22	16.52
1578	16th.	77.60	7.98	14.42
1579	17th.	82.02	4.91	13.07
1580	18th.	78.95	5.76	15.29
1581	19th.	81.50	6.26	12.24
1582	20th.	79.40	5.39	15.21
1592	21st.	78.81	7.52	13.67
1593	22d.	80.24	6.00	13.76

Sorghum Cane.

A few varieties of sorghum were grown on the Station farm this year from selected seed heads furnished by the Department of Agriculture. The most promising ones were gathered on October 9 and tested for their sugar contents, the results being given in the following table. The sample for analysis was obtained by selecting ten or twelve of the ripest stalks of each variety, which were weighed, topped and stripped and weighed again, and then run through a small cane-mill and the juice weighed and taken to the laboratory, where the sugar was immediately determined. The specific gravity of the juice was taken at 20° C. The table gives the per cent. of cane sugar and reducing sugars in the juice, the weight of juice extracted by the mill from 100 parts of stripped cane, and the weight of tops and leaves to 100 parts of stripped cane:

Table—Analyses of Sorghum Juice.

Station Number.	Variety of Cane and Description.	Specific Gravity.	Cane Sugar . . .	Reducing Sugar .	Juice From Stripped Cane . . .	Tops and Leaves to 100 Parts of Stripped Cane.
			Per cent.	Per cent.	Per cent.	Per cent.
1646	Amber—Seed head 3802 . .	1.077	13.02	2.16	36	25
1647	Amber—Seed head 5671 . .	1.075	12.12	2.33	46	31
1648	Lot 112—Seed head 6098 Seed hard	1.069	11.19	2.92	46	54
1649	Folger's Early—Seed head 7278	1.085	14.62	1.80	33	29
1650	Folger's Early—Seed head 7790	1.081	13.94	1.98	40	35
1651	Early Orange—Seed head 9272. Seed hard	1.081	13.02	2.94	50	35
1652	Link's Hybrid—Seed head 10470	1.079	14 39	1.39	41	28
1653	Link's Hybrid—Seed head 12043	1.075	13.04	2.31	46	37

Phosphatic Limestone.

Dr. Robert Peter first called attention, in the reports of the Kentucky Geological Survey (Vol. A, part 1, p. 245), to the occurrence in the upper part of the Trenton limestone, in Fayette county, of layers remarkably rich in phosphoric acid. He had already, as early as 1848, observed the occurrence of considerable quantities of phosphoric acid in the common "blue limestone" underlying the "Bluegrass Region" of Kentucky, and recognized the relations between the presence of this store of plant food and the remarkable fertility of this region. (Albany *Cultivator*, April, 1849.) The best and most characteristic "Bluegrass" soil rests upon the Trenton limestone, and seems to have been formed in place by the disintegration of this limestone, and it is interesting to record here an observation of

Dr. R. J. Spurr, who found abundant fragments of the phosphatic material in the subsoil of a part of his farm, in Fayette county, near Greendale. In taking a sample of subsoil, Dr. Spurr noticed this material resembling weathered chert in appearance, but very soft; and, upon bringing some to the laboratory, it was found to be highly phosphatic, as well as containing a very notable quantity of fluorine, as is the case with the phosphatic limestone generally. It was almost entirely free from carbonate.

Below is given the per cent. of phosphoric acid in this, and also in some unweathered samples of the limestone, selected with a view to obtaining the largest results:

1659. Soft, brownish material in thin fragments, from subsoil on farm of Dr. R. J. Spurr, near Greendale, Fayette county, Ky.

677. Gray and blue limestone from cut on Cincinnati Southern Railroad, Fayette county, near Greendale; soft, with reddish tint.

592. Soft, dark streak, about one-half inch thick in sixth layer, exposed by grading in front of A. & M. College building, Lexington, Ky.

593. Light streak; rather hard, in same layer as 592.

Analysis—Air-dried.

	1659	677	592	593
Phosphoric Acid	33.56	13.22	29.73	14.29
Equivalent to Tricalcic Phosphate	73.32	28.86	64.93	31.21

In this connection it may not be out of place to give the results obtained from some other samples of limestone from different localities:

551. Blue limestone, from in front of A. & M. College building, Lexington, Kentucky.

660. Slaty rock, from cut on K. U. R. R., near the Warfield place, Lexington, Kentucky.

661. Rock in place, city quarry, Lexington, Kentucky, layer two feet thick; third layer from top.

662. Ordinary limestone from cut on K. U. R. R.

663. Blue limestone, same locality, more slaty than 662.

664. Same locality ; like 662, but more fossiliferous.

665. Same locality ; more slaty than 663.

675. Gray limestone, from cut near Greendale, Fayette county; hard rock.

676. Blue limestone from same locality ; soft rock.

724. Soft limestone, on Georgetown road, five miles from Lexington.

Analysis—Air-dried.

	591	660	661	662	663	664	665	675	676	724
Phosphoric Acid . . .	3.84	1.20	3.30	2.01	2.51	0.70	0.67	0.38	1.05	1.01
Equiv. to Tricalcic Phosphate	8.38	2.63	7.21	4.39	5.48	1.54	1.45	0.84	2.29	2.21

Ash Analyses of Corn.

In connection with the experiments described in Bulletin No. 17, partial analyses were made of the corn raised upon some of the experimental plats with a view to determine the nitrogen, phosphoric acid and potash removed in the crop. These are now published for reference, though not a part of this year's work. In preparing the sample a fair average portion was taken after weighing the crop, and the stover and cobs cut up in a feed-cutter. These samples were weighed and allowed to air-dry in the laboratory, weighed, ground, and moisture determined by the old method of drying on watch-glasses to constant weight in a water-oven. Nitrogen was determined in duplicate by the Kjeldahl method. Portions of from 50 grams in the stover to 250 grams in the cobs were incinerated, the crude ash weighed, and the charcoal, carbon dioxid and sand determined and deducted, the remainder being calculated as "pure ash."

In the following tables the results are given, calculated in percentages of the water-free substance of the stover, shelled corn, cobs and whole crop, as well as per cent. of the pure ash. The amount of water-free substance produced upon each plat, calculated to pounds per acre, and the amounts of nitrogen, phosphoric acid and potash and pure ash, stated in the same way, are also given.

The fertilizers applied to each plat were as follows. It is to be noted that plats one to six are situated side by side, separated only by a three-foot walk, and are of uniform character, while sixteen and nineteen are in a different field, and are richer soil.

Plat 1 received no fertilizer.

Plat 2 received sulphate of potash, acid phosphate and sulphate of ammonia, equivalent to 58 pounds nitrogen, 44 pounds phosphoric acid, and 31 pounds potash per acre.

Plat 3 received sulphate of potash and acid phosphate in the same proportions as above.

Plat 4 received acid phosphate and sulphate of ammonia in the same proportions as above.

Plat 5 received sulphate of potash and sulphate of ammonia in the same proportions as above.

Plat 6 received about 1,000 pounds gypsum per acre.

Plat 16 received barnyard manure in liberal amount.

Plat 19 received tobacco stems at the rate of about 4,000 pounds per acre, and equivalent to about 240 pounds potash, 40 pounds phosphoric acid, and 90 pounds nitrogen per acre.

Details of the experiment will be found in Bulletin 17. It is interesting to note that, although the soil of this field seems to be deficient in potash, and responds promptly to an application of potash fertilizers, yet the per cent. of potash in the water-free crop is nearly uniform, whether the fertilizer used contained potash or not. The phosphoric acid, however, varies considerably, and the crop seems to find abundance of nitrogen at its disposal, removing in each case more than was applied in the fertilizer.

Corn Stover—Calculated on Water-Free Substance.

No. of Plat.	1	2	3	4	5	6	16	19
Nitrogen	1.111	1.139	0.858	1.332	1.095	0.986	0.940	1.231
Phosphoric Acid .	0.597	0.903	0.573	0.773	0.636	0.694	0.744	0.656
Potash	0.575	0.553	0.550	0.547	0.576	0.479	0.650	0.803
Pure Ash	4.400	5.214	4.433	3.993	4.441	4.012	4.529	4.440

Corn Cobs—Calculated on Water-Free Substance.

No. of Plat.	1	2	3	4	5	6	16	19
Nitrogen	0.535	0.376	0.538	0.498	0.430	0.397	0.348	0.361
Phosphoric Acid .	0.217	0.134	0.127	0.196	0.155	0.171	0.176	0.170
Potash	0.777	0.590	0.619	0.753	0 657	0.677	0.645	0.599
Pure Ash	1.392	1.091	1.079	1.420	1.206	1.206	1.305	1.082

Shelled Corn—Calculated on Water-free Substance.

No. of Plat.	1	2	3	4	5	6	16	19
Nitrogen	1.947	1.719	1.798	1.850	1.780	1.710	1.730	1.860
Phosphoric Acid .	0.781	0.780	0 818	0.867	0.849	0.812	0.890	0 867
Potash	0.457	0 434	0.458	0.483	0.483	0.459	0.491	0.475
Pure Ash.	1.604	1.503	1.559	1.644	1.628	1.531	1.676	1.686

The Whole Crop—Calculated on Water-free Substance.

No. of Plat.	1	2	3	4	5	6	16	19
Nitrogen	1.313	1.297	1.218	1.429	1.310	1.171	1.212	1.419
Phosphoric Acid .	0.622	0.830	0.627	0.760	0.679	0.689	0.752	0.702
Potash	0.555	0.511	0 518	0.542	0.546	0.489	0.585	0.648
Pure Ash.	3.400	3.388	2.861	3.119	3.049	2.975	3.092	2.997

Ash of Corn Stover—Calculated on the Pure Ash.

No. of Plat.	1	2	3	4	5	6	16	19
Phosphoric Acid .	13.57	17.32	12.93	19.35	14.35	17.06	16.40	14.77
Potash	13.05	10.61	12.42	13.71	12.97	11.94	14.31	18.09

Ash of Corn-cobs—Calculated on the Pure Ash.

No. of Plat.	1	2	3	4	5	6	16	19
Phosphoric Acid .	15.27	12.29	11.73	13.79	12.87	14.17	13.47	15.73
Potash	55.97	54.07	57.32	53.01	54.47	56.18	49.43	55.33

Ash of Shelled Corn—Calculated on the Pure Ash.

No. of Plat.	1	2	3	4	5	6	16	19
Phosphoric Acid .	48.52	51.85	52.45	52.75	52.14	53.03	53.10	51.42
Potash	28.38	28.98	29.41	29.38	29.66	29.95	29.27	28.18

Ash of the Whole Crop—Calculated on the Pure Ash.

No. of Plat.	1	2	3	4	5	6	16	19
Phosphoric Acid .	18.34	24.50	21.92	24.43	22.40	23.18	24.44	21.63
Potash	16.32	15.07	18.13	17.42	18.02	16.43	18.90	21.23

Pounds of Water-Free Substance Calculated Per Acre.

No. of Plat.	1	2	3	4	5	6	16	19
Stover	2,531	3,972	3,434	2,697	3,471	2,512	3,854	4,140
Cobs	279	616	793	292	571	352	643	724
Shelled Corn . . .	1,120	2,831	3,062	1,263	2,658	1,371	3,100	3,496
Whole Crop . . .	3,930	7,419	7,289	4,252	6,700	4,235	7,597	8,360

Pounds Nitrogen, Phosphoric Acid, Potash and Ash in the Crop, Per Acre.

No. of Plat.	1	2	3	4	5	6	16	19
Nitrogen	51.6	92.6	88.7	60.7	87.8	49.6	92.1	118.6
Phosphoric Acid .	24.5	61.6	45.7	32.4	45.5	29.2	57.4	58.7
Potash	21.8	37.9	37.8	23.1	36.6	20.7	44.4	54.2
Pure Ash	133.6	251.4	208.5	132.6	203.1	126.0	234.9	250.6

Miscellaneous Analyses.

1604. Iron ore sent by Mr. J. C. Kennedy, Lebanon, Kentucky, from his brother's land.

The ore is a soft, cellular limonite. The air-dried ore contains:

Iron	42.4 per cent
Phosphorus	0.25 per cent.
Insoluble Matters	21.5 per cent.

1605. Mineral water, from "Sulphur Spring," South Union, Kentucky; sent by Mr. E. S. Price, Manager.

The water had a greenish-yellow color and strong smell of "sulphuretted hydrogen" gas, and the bottle contained some black sediment. The following is the analysis, as reported to Mr. Price:

1605—Analysis.

Free carbonic acid gas } Considerable quantities.
Free sulphuretted hydrogen gas }

	Grams per Liter.	Grams per Gallon.
Carbonate of iron	.016	0.93
Carbonate of lime	.082	4.78
Sulphate of magnesia	.135	7.87
Sulphate of soda	.418	24.37
Chloride of sodium	1.261	73.52
Sulphide of sodium	.271	15.80
Iodides and lithium	marked traces.	marked traces.
Organic matter, nitrates and undetermined	2.19	12.77
Total solid matters	2.402	140.04

Determination of Nitrogen in Nitrates.

In connection with the work done upon the samples sent out by the Reporter on Nitrogen of the Association of Official Agricultural Chemists, results of which are published in his report to the Association (United States Department of Agriculture, Division of Chemistry, Bulletin 31), a few experiments were

made with some other reducing agents than those commonly used in the various processes based upon the Kjeldahl method. As the results obtained may not be without interest, they are published here. The substance operated upon was the Reporter's Sample No. 1, being a mixture of sodium and potassium nitrates, containing, theoretically, 14.72 per cent. N., and by analysis of its constituents 14.60 per cent. In each case 0.7 gram of the substance was dissolved in the cold in 30 cc. Conc. H_2SO_4, 2 grams salicylic acid added, and then the reducing agent. The mixture was then heated a few minutes over a moderate flame, and finally 0.7 gram HgO was added, except where the potassio mercuric hyposulphite was used, in which case no more mercury was added, and process carried out as usual.

1. *Reduction by Potassium Iodide.*—One gram of potassium iodide was used, and the mixture heated until nearly all iodine vapor was expelled before adding the mercuric oxide. Time of digestion, about 1 to $1\frac{1}{4}$ hours. Two experiments gave 14.31 and 14.33 per cent. nitrogen.

2. *Reduction by Hydrogen Sulphide.*—After addition of the salicylic acid a slow stream of washed hydrogen sulphide was passed into the mixture for about ten minutes until a copious deposit of sulphur had been formed. The glass tube conducting the gas into the liquid was so arranged that it could be detached from the generator and allowed to remain in the flask during the digestion. The digestion occupied about the usual time (one hour), and went on quietly, as there was no deposition of salts to cause bumping. Results of two experiments were 14.64 and 14.57 per cent. nitrogen. The good results here obtained are interesting in connection with the fact that zinc sulphide and hyposulphite of soda have yielded generally higher results in our hands than zinc dust. The manipulation required, though more complicated than where a solid reducing agent is used, is not so much so as to render the method entirely out of the question for practical application.

3. *Potassio Mercuric Hyposulphite.*—Two grams of this salt were added immediately after the salicylic acid, and the process finished as usual, except that no more mercury was added, there being about the usual amount in the double salt. Two experi-

ments gave 14.51 and 14.47 per cent. nitrogen. The potassio-mercuric hyposulphite was prepared by boiling a saturated solution of potassium hyposulphite with excess of mercuric oxide. The hot solution was poured off, and, upon cooling, deposited a semi-crystalline mass, which was dried with filter paper and used immediately.

Especial attention is called to the results obtained with hydrogen sulphide, which approach nearest of all to the theoretical, and are a trifle higher than was obtained by the use either of zinc sulphide or hyposulphite of soda. The results obtained by the use of these last, under similar conditions, were, in mean of two experiments, 14.47 and 14.53 per cent. respectively.

Blank experiments were made in each case with the same quantities of reagents as were used in the above determinations, and the results given are corrected for the very small amount of nitrogen thus obtained.

SUGAR, MOLASSES, CONFECTIONS AND HONEY.

At the request of Dr. H. W. Wiley, Chief Chemist of the United States Department of Agriculture, fifty samples of molasses, fifty samples of sugars, fifty samples of honey and twenty-five samples of cheap candies and confections were purchased in Louisville, Lexington, Frankfort and Bowling Green and in Cincinnati, and analyzed for the purpose of detecting adulterations. The results of this work have already been published by Dr. Wiley, in Bulletin No. 13, part sixth, of the Division of Chemistry, United States Department of Agriculture, but as the results are both interesting and instructive to the consumers in this State, they are repeated here with a brief account of the investigation and some of the conclusions drawn by Dr. Wiley in regard to adulterations, acknowledgment for which is hereby made.

TEST OF APPARATUS AND CHEMICALS.

First. 100 cc flask.—The 100 cc flask was graduated in the usual manner with 100 grams distilled water at 17.5° C.

Second. Polariscope tubes used were tested by a normal solution of the test sugar sent for the purpose. Temperature of the solution at the time of testing being 24.8°. The readings were as follows:

First, 200 mm metal tube, 99.8.

Second, 100 mm glass tube, 49.9.

Third, 220 mm glass tube, 110.

Tests in each case were made in triplicate. From the above results it will be seen that the 220 mm tube is a trifle long. No correction was made for this, however, in the readings of the inverts. Most of invert readings were made in the 220 mm tube.

Third. The Fehling Solution.—Violette's formula was used. To test it, 0.95 grams of the test sugar was dissolved in 50 cc of water and inverted with 5 cc of hydrochloric acid at 68° C. This solution was diluted to 100 cc. After neutralizing, 10 cc of Fehling's solution was put in a small Erlenmeyer flask, and to this 30 cc of water was added and the solution boiled. The diluted sugar solution was gradually added to the copper solution until the copper was entirely reduced as indicated by ferrocyanide of potash in the acetic acid solution. The following are the results obtained:

4.9 cc sugar solution added to copper solution; copper not all reduced.

5 cc sugar solution added; copper all reduced.

4.9 cc sugar solution added; reaction for copper.

5 cc sugar solution added; no copper in solution.

METHODS.

The sucrose was calculated by the following formula:

$$\text{Per cent. sucrose} = \left\{ \frac{\text{Direct reading} - \text{indirect reading}}{142.4 - \frac{T}{2}} \right\} 100.$$

The direct readings were all made approximately at 25° C.

The instrument used was a Schmidt & Haensch half shade polariscope. The solutions were clarified for polarization when necessary by basic acetate of lead, aluminum hydrate or bone black in extreme cases. The inversion was effected by heating 50 cc of the normal solution for ten minutes at 68° C. with 5 cc strong hydrochloric acid in a stoppered flask in the water-bath, cooling quickly and polarising in the 110 or 220 mm tube.

Moisture was determined by drying one hour at 102 to 103° C., and ash by incineration of this portion. Tin and copper were tested for by dissolving the material in water, saturating with hydrogen sulphide and allowing to stand 24 to 48 hours. The precipitate, if any, was then filtered off and tested by means of the blow-pipe.

SUGARS.

Description of Samples.

Sample 51. Powdered sugar. Sold by "Griffith," Cincinnati. Made by the Franklin Sugar Refinery, Philadelphia, Pa.

Sample 52. Coffee Crushed. A light C sugar, soft grained. Made by F. O. Matthiessen & Weichers. Sold by Hamilton Grocery Company, Cincinnati, Ohio.

Sample 53. Havemeyer & Elder's Y. C., a straw-colored soft sugar. Sold by R. J. McCombs, Cincinnati, Ohio.

Sample 54. Havemeyer & Elder's Y. C., a soft-grained yellow sugar, brighter colored than 53. Sold by the Hamilton Grocery Company, Cincinnati, Ohio.

Sample 55. Prairie C. Made by F. O. Matthiessen & Weichers. Sold by Henry Vogt, Lexington. A light soft-grained sugar.

Sample 56. Powdered XXX. Havemeyer & Elder. Sold by Joseph R. Peeble's Son's Co., Cincinnati, Ohio.

Sample 57. Dark C. Havemeyer & Elder. Sold by R. J. McCombs, Cincinnati, Ohio. A dark soft-grained sugar. The sample taken from a sugar bin and brand given by the seller.

Sample 58. Y. C. Red Star Brand sugar. Spreckel's Sugar Refinery, Philadelphia, Pa. Sold by Joseph R. Peeble's Son's Co., Cincinnati, Ohio. Taken from bin; brand given by seller.

Sample 59. New Orleans. Open kettle. Sold by Hamilton Grocery Company, Cincinnati, Ohio. A dark, fairly well-grained sugar having a greenish tint.

Sample 60. Y. C. Havemeyer & Elder. Sold by the Great Atlantic and Pacific Tea Company, 663 Pearl street, Cincinnati, Ohio. Sample taken from bin.

Sample 61. Crescent C. F. O. Matthiessen & Weichers. Sold by D. H. B. Coffin, Cincinnati, Ohio. A soft-grained, light straw-colored sugar. From barrel.

Sample 62. Y. C. New Orleans Sugar Refinery Company, New Orleans. A dark-yellow soft-grained sugar. Sold by Thomas Foster, Cincinnati, Ohio. From bin. Description given by seller.

Sample 63. Green Star Brand C. Spreckel's Sugar Refinery, Philadelphia, Pa. Sold by D. H. B. Coffin, Cincinnati, Ohio. From bin. A dark, wet sugar.

Sample 64. Extra C. Havemeyer & Elder. Sold by the Joseph Peeble's Son's Company, Cincinnati, Ohio. From the bin.

Sample 65. Y. C. Havemeyer & Elder. Sold by A. "Barnes," Cincinnati, Ohio. Soft grained, straw colored. From the bin.

Sample 66. New Orleans. Open kettle sugar. Sold by Henry Hüneke Company, Cincinnati, Ohio, through Heitmeyer & Company, Cincinnati, Ohio. In barrel.

Sample 67. Orange Yellow. Louisiana Refinery, American Sugar Refining Company, New Orleans. Sold by John Hutchison, Lexington, Ky. In sacks

Sample 68. Ridgewood B. Havemeyer & Elder. Sold by C. W. Jefferson, Louisville, Ky. A very light, soft sugar. In barrel.

Sample 69. New Orleans. Open kettle. Sold by Sterritt, Cincinnati, Ohio. In barrel. A fine-grained greenish straw color.

Sample 70. Dark C. From Thurber, Whyland & Co., New York. Sold by C. Sack, Cincinnati, Ohio. A hard, lumpy, dark sugar.

Sample 71. Traders' Brand. F. O. Matthiessen & Weichers. Sold as "Blackberry" sugar, by G. H. Kinnear, Lexington, Ky. A very dark, soft sugar. In barrel.

Sample 72. Extra C. Franklin Sugar Refinery Company, Philadelphia, Pa. Sold by Colter & Co., Cincinnati, Ohio. A light, straw colored, soft sugar.

Sample 73. New Orleans. Open kettle. Saidia Plantation. Sold by John Hutchison, Lexington, Ky.

Sample 74. Prairie C. F. O. Matthiessen & Weichers. Sold by G. H. Kinnear, Lexington, Ky. In barrel.

Sample 75. Crescent C. F. O. Matthiessen & Weichers. Sold by Sculley & Yates, Lexington, Ky. In barrel. Light and soft.

Sample 76. Crescent C. F. O. Matthiessen & Weichers. Sold by John Hutchison, Lexington, Ky. In bin. Light, soft.

Sample 77. Extra C. Havemeyer & Elder. Sold by Colter & Co., Cincinnati, Ohio. Light and soft. In barrel.

Sample 78. Extra C. Havemeyer & Elder. Sold by W. H. May, Lexington, Ky. In barrel.

Sample 79. New Orleans. Open kettle. A wet dark brown crystallized sugar. Sold by C. W. Jefferson, Louisville, Ky. Wholesaler, Torbitt & Castleman, Louisville, Ky.

Sample 80. Off A. Havemeyer & Elder. Sold by G. T. Sterritt, Cincinnati, Ohio. A white soft sugar.

Sample 81. New Orleans. Open kettle. A light straw-colored crystallized sugar, wet. Sold by M. J. Doyle, Louisville, Ky.

Sample 82. Metropolitan Extra C. F. O. Matthiessen & Weichers. Sold by Eiseman & Co., Cincinnati, Ohio. A soft light sugar, in barrel.

Sample 83. Extra C Coffee sugar. Havemeyer & Elder. Sold by T. J. Cassell, Lexington, Ky. A light soft sugar, in barrel.

Sample 84. Maple sugar. Manufactured for Joseph R. Peebles' Sons' Co., Cincinnati, and sold by Joseph R. Peebles' Sons' Co, Cincinnati, Ohio. A light col ored cake.

Sample 85. Maple sugar. Made by G. G. Ehrmann & Son, Louisville, Ky. Sold by T. N. McClelland, Lexington, Ky. A dark colored cake.

Sample 86. Caramel sugar. From Thurber, Whyland & Co., New York. Sold by T. N. McClelland, Lexington, Ky. A very dark lumpy sugar, in barrel.

Sample 87. New Orleans. Open kettle. Through Torbitt & Castleman, Louisville, Ky. Sold by Lindsay & Nugent, Lexington, Ky. In barrel,

Sample 88. New Orleans. Open kettle. Sold by Isaac Hutchinson, Lexington, Ky. A well-grained open-kettle sugar, in barrel.

Sample 89. Green Star C. Spreckels. Sold by C. W. Jefferson, Louisville, Ky. From bin.

Sample 90 Extra C. Knight Sugar Refinery. Sold by M. J. Doyle, Louisville, Ky.

Sample 91. Y. C. New Orleans Sugar Refinery Co. Sold by T. Menamara, Cincinnati, Ohio. In bin.

Sample 92. Red Star A. Spreckels. Sold by Montgomery & Bailey, Louisville, Ky. In barrel.

Sample 93. Demerara sugar. Sold by T. H. Watkins, Louisville, Ky. Wholesaler, Creele & Co., Louisville, Ky. A very large-grained yellow sugar. Looks like first centrifugal Louisiana sugars. In bin.

Sample 94. Y. C. New Orleans "Homestead Plantation, J. N. Hill." Sold by C. W. Jefferson, Louisville, Ky. In barrel.

Sample 95. New Orleans sugar. "Glencoe Plantation W. R. K." First centrifugal. Sold by Montgomery & Bailey, Louisville, Ky.

Sample 96. Extra C. Havemeyer & Elder. Sold by "Frank," Cincinnati, Ohio. In bin.

Sample 97. New Orleans. Open kettle. Sold by "Barnes," Cincinnati, Ohio. In barrel.

Sample 98. Y. C. Spreckles. Sold by Berry & Shelby, Lexington, Ky. In barrel. No head. Brand given by sellers.

Sample 99. New Orleans. Open kettle. Sold by J. P. Banahan, Lexington, Ky., through Torbitt & Castleman, Louisville, Ky. In barrel.

Sample 100. Traders' Brand. F. O. Matthiessen & Weichers. Sold by J. C. Berryman, Lexington, Ky. A very dark sugar. In barrel.

ANALYTICAL DATA.

Number.	Sugar by Direct Polarization.	Water.	Ash.
51	99.75	0.02	0.02
52	89.5	4.87	0.64
53	89.2	3.42	0.88
54	86.7	4.72	1.87
55	87.3	5.04	1.11
56	99.7	0.03	Trace.
57	88.1	2.01	1.21
58	88.3	3.24	0.75
59	92.6	4.18	1.19
60	88.5	2.96	0.61
61	89.6	3.38	0.96
62	88.7	2.73	0.86
63	88.4	3.77	3.32
64	85.9	4.95	0.64
65	91.2	3.03	1.85
66	93.0	1.89	0.53
67	86.4	3.47	1.00
68	84.8	6.00	0.66
69	92.9	1.73	0.65
70	88.0	3.81	1.11
71	85.5	4.61	1.84
72	85.6	5.25	0.66
73	90.0	5.01	0.65
74	85.8	4.64	0.50
75	86.3	5.54	0.98
76	85.7	4.64	0.58
77	84.8	4.45	0.70
78	87.0	5.14	0.93
79	86.4	5.85	0.96
80	87.7	5.70	0.44
81	93.1	4.26	0.61
82	90.7	4.59	0.79
83	85.8	3.83	0.63
84	74.4	4.88	0.67
85	79.0	4.46	1.03
86	85.2	4.98	1.58
87	92.1	4.58	0.97
88	92.3	3.99	0.70
89	84.1	6.10	1.34
90	88.2	3.88	0.75
91	88.7	2.58	0.62
92	98.0	0.91	0.24
93	99.2	0.20	0.11
94	98.9	0.15	0.09
95	99.6	0.05	0.04
96	90.1	3.36	0.93
97	91.9	1.90	0.89
98	85.5	4.86	0.64
99	92.0	4.69	0.63
100	90.2	2.27	2.50

REMARKS ON THE ANALYSES OF SUGARS.

The total absence of any added matters to the sugars of commerce is plainly shown by the analyses of these samples purchased in open market. The following remarks in regard to the adulteration of sugars, taken from Bulletin 13, Division of Chemistry of the United States Department of Agriculture, page 673, are from the pen of Dr. H. W. Wiley:

"A few years ago an attempt was made to adulterate cane sugar, then worth nearly ten cents a pound, with sugar made from corn starch, worth from three to five cents a pound. This sugar was sold in considerable quantities under the name of new process sugar. It is needless to say that it passed into consumption under the impression that it was genuine cane sugar. The corn starch sugar, on account of the difficulty of drying it, made the whole mass sticky and difficult to handle. This variety of sugar, therefore, did not find a ready sale, and its manufacture never assumed very large proportions.

"Attempts were then made to manufacture pure anhydrous corn starch sugar, and these attempts were successful from a chemical, but not from a commercial, point of view. In point of fact, however, considerable quantities of this dry dextrose were put on the market, and I believe it is still made under the patents of Dr. Arno Behr.

"The low price of cane sugar, however, has heretofore prevented the profitable adulteration of cane sugar with any article made from starch. It is also gratifying to know that the powdered sugars of commerce were not found adulterated with starch or terra alba; at least, in so far as the limited examination of them extended.

"The chief adulterant of low-grade sugars, if it can properly be so called, is water. By modern methods of sugar boiling a great deal of low-grade sugar and water can be incorporated in low-priced sugars, which still show an almost white color. This is due to the combined influence of bone black, and low temperature in the vacuum pan. By means of bone black the sirups are nearly or quite decolorized; and by boiling at a low

temperature (115 degrees to 120 degrees F.) a soft crystal of sugar is formed which is capable of holding a large percentage of water and reducing sugar. The resulting sugar is, nevertheless, almost white, and finds a ready sale for many culinary operations. These sugars are easily detected by noticing the polarizations below 90 degrees in the tables of analyses.

"The question of the use of these sugars is one of economy only, for they are certainly not injurious to health. In general it may be said that for a given sum a greater quantity of saccharine matter can be purchased by taking the high-grade sugars."

MOLASSES AND SYRUPS.

Description of Samples.

Sample 1. New Orleans. Light color, some sugar. Seller, R. J. McCombs, Cincinnati, Ohio. Manufacturer, Raceland Plantation, Louisiana.

Sample 2. Sugarhouse Syrup. Bright, light color, thick, clean. Seller, Hamilton Grocery Company, Cincinnati, Ohio. Manufacturer, American Preserve Company, Cincinnati, Ohio.

Sample 3. Rock-candy Drips. White, thin. Seller, Joseph R. Peebles' Sons' Company, Cincinnati, Ohio. Manufacturer, R. A. Hulden, Cincinnati, Ohio.

Sample 4. New Orleans. Light color, medium consistency. Seller, Joseph R. Peebles' Sons' Company, Cincinnati, Ohio. Manufacturer, "S. & A." Plantation, Louisiana.

Sample 5. Golden Syrup. Very light color, thick. Seller, Joseph R. Peebles' Sons Company, Cincinnati, Ohio. Manufactured through "Hobard," New York.

Sample 6. Maple Syrup. Light color, thin. Seller, R. J. McCombs, Cincinnati. Manufacturer, Henry E. Crane, Garrettsville, Ohio.

Sample 7. McMechen's Old Virginia Tree Maple Syrup. Dark color, medium thickness. Seller, Schwabacher, Louisville, Ky. Made by Geo. R. McMechen, Wheeling, W. Va.

Sample 8. King Drips. Light color, thick. Seller, R. J. McCombs, Cincinnati. Wholesaler or manufacturer, Thurber, Whyland & Co., New York.

Sample 9. Clymer's Select Maple. Put up by the Buckeye Syrup Refinery, Cincinnati, Ohio, in quart tin cans. Seller, Hamilton Grocery Company, Cincinnati, Ohio. Color light, medium thickness.

Sample 10. Old Time Maple Syrup. Put up by L. G. Yoe & Co., Chicago, Ill., in quart tin cans. Sold by P. Tracy, Cincinnati, Ohio. Light color, medium thickness.

Sample 11. Vermont Maple Syrup. Put up by the Crescent Sugar Refinery Company, Sold by H. D. Gosa, Cincinnati, Ohio. Fair color, medium consistency.

Sample 12. Maple Syrup. Put up at the camp for Jos. R. Peebles' Sons' Company, Cincinnati, Ohio. Very light, thin.

Sample 13. New Orleans, Avon Plantation. By E. W. B. Sold by Henry Huneke & Co., Cincinnati, Ohio. Light-colored, some sugar.

Sample 14. Maple Molasses. Made by Crane Brothers, Garrettsville, Ohio. The label states: "We guarantee this to be perfectly pure maple molasses, purchased by us of responsible farmers, and hermetically sealed in cans, under our own supervision. It is justly denominated the best of all, and is unequaled by any other brands. Colter & Co., northwest corner Sixth and Main streets, Cincinnati, Ohio."

Sample 15. Sugarhouse Molasses. Dark-colored, saltish taste, clear. Made by Havemeyer & Elder. Bought of Sterritt, Cincinnati, Ohio.

Sample 16. Sugarhouse Molasses. Very dark, thick, turbid, greenish; has the smell of New Orleans. Sold by W. H. May, Lexington, Ky. Wholesaler, Mosley, Raum & Gogreve, Cincinnati, Ohio.

Sample 17. New Orleans Molasses. Dark, with much sugar. Seller, Lindsay & Nugent, Lexington, Ky. Maker, J. N. R. Plantation, Louisiana.

Sample 18. New Orleans Molasses. Light colored, some sugar, fine flavor. Voiron Plantation. Sold by G. H. Kinnear, Lexington, Ky.

Sample 19. Bartino Syrup. "Made for winter use." Smell and flavor of New Orleans. Made by Hopple, Flasche & Co., Cincinnati, and sold by G. H. Kinnear, Lexington, Ky.

Sample 20. Clover Drips. "Pure sugar syrup." Dark, turbid, saltish. From Hobart, New York City. Sold by Colter & Co., Cincinnati, Ohio.

Sample 21. Sorghum. Dark colored, very acid taste. Made by Mr. Hurst, Fayette County, Ky. Sold by J. T. Honaker, Lexington, Ky.

Sample 22. Bartino Syrup. Dark colored, New Orleans flavor. Made by Hopple, Flasche & Co., Cincinnati, Ohio, and sold by T. J. Cassell, Lexington, Ky.

Sample 23. Phœnix Drips. A bright, thick, light syrup. Made by Bradshaw & Waite, Chicago, Ill. Sold by Mrs. Clark, Lexington, Ky.

Sample 24. New Orleans Molasses. Open kettle. Sold by Cozine, Lexington, Ky., through Mosley, Raum & Co , Cincinnati, Ohio.

Sample 25. Sorghum. From the Big Sandy River, Kentucky. Fair color, fermenting slightly. Sold by W. H. May, Lexington, Ky.

Sample 26. New Orleans. Fair color, no sugar. In cypress barrels marked "D. A. Brand." Bought through Curry, Howard & Co., Lexington, Ky., by T. J. Cassell, and sample obtained of T. J. Cassell.

Sample 27. New Orleans. Dark-colored, turbid molasses, thick. Seller, McClelland, Lexington, Ky. Made by the Cedar Grove Plantation, Louisiana.

Sample 28. New Orleans. Open kettle. In cypress barrels, marked "Ser. pt." Seller, W. H. May, Lexington, Ky. Wholesaler, Torbitt & Castleman, Louisville, Ky. Very light colored syrup. Very little sugar.

Sample 29. Caramel Drips. A light transparent sirup, made by Bradshaw & Waite. Sold by W. H. May, Lexington, Ky.

Sample 30. Bartino. A very reddish black thick syrup. Made by Hopple, Flasche & Co., Cincinnati. Sold by Vogt, Lexington, Kentucky.

Sample 31. Sorghum. A fair-colored bright molasses, with sorghum taste. Seller, Henry Vogt, Lexington, Ky. Wholesaler, J. T. Heitmeyer & Son, Cincinnati, Ohio.

Sample 32. Open Kettle. A fair New Orleans molasses, with much sugar. Sold by H. Vogt, Lexington, Ky. Wholesaler, Torbitt & Castlemen, Louisville, Kentucky.

Sample 33. New Orleans. A light-colored molasses, with fine flavor. Sold by McClelland, Lexington, Ky. Wholesaler, Torbitt & Castleman, Louisville, Ky. Said to be branded "Magnolia Plantation."

Sample 34. Maple Syrup. A bright, thin syrup. Put up in quart jugs by Thurber, New York. Sold by John Hutchison, Lexington, Ky.

Sample 35. Old Time Maple Syrup. Bright, medium thickness. Put up in quart cans by L. G. Yoe & Co. Sold by John Hutchison, Lexington, Ky.

Sample 36. Milton Maple Syrup. Light colored, thin. Said to be put up by L. G. Yoe & Co., Chicago, Ill., although there is no manufacturer's name on the can. In quart cans. Sold by John Hutchison, Lexington Ky.

Sample 37. Bartino. A medium-colored thick syrup. New Orleans flavor. Made by Hopple, Flasche & Co., Cincinnati, Ohio. Sold by John Hutchison, Lexington, Ky.

Sample 38. Sweet Clover Syrup. A very light straw-colored, thick syrup, made by L. G. Yoe & Co., Chicago, Ill. Sold by A. J. Ross, Louisville Ky.

Sample 39. Sorghum. Horseshoe brand. A fair colored sorghum flavored molasses. Sold by John Hutchison, Lexington Ky. Wholesaler, Hopple, Flasche & Co., Cincinnati, Ohio.

Sample 40. Melrose Syrup. A light-colored, clear, thick syrup. Manufacturer, T. Willard & Co., New York City. Sold by J. B. Wurach, Louisville Ky.

Sample 41. New Orleans reboiled. Barrel marked "Union." Blackstrap. Sold by John Hutchison, Lexington, Ky. Wholesaler, Torbitt & Castleman, Louisville Ky.

Sample 42. New Orleans Molasses. Magnolia Plantation. Light colored, some sugar. Sold by John Hutchison, Lexington, Ky.

Sample 43. New Orleans Sugarhouse Molasses. Dark colored. In barrels branded "Mrs. A. A. B." Sold by Scully & Yates, Lexington, Ky.

Sample 44. New Orleans Centrifugal. A blackstrap. Alice B. Plantation. Sold by Cozine, Lexington, Ky.

Sample 45. Golden Syrup. A bright, transparent, thick syrup made by the Buckeye Syrup Refinery, Cincinnati, Ohio. Sold by Hamilton Grocery Company, Cincinnati, Ohio.

Sample 46. Sorghum. Light-colored, sorghum taste. Sold by McClelland, Lexington, Ky. Wholesaler, Hopple, Flasche & Co., Cincinnati, Ohio.

Sample 47. Maple Syrup. In quart tin cans, thin, bright. Labeled as follows: "Guaranteed pure Maple Syrup, canned for C. W. Jefferson, Louisville, Ky." Manufacturer's name not on the can. C. W. Jefferson states that it was made by L. G. Yoe, Chicago, Ill.

Sample 48. Rock-candy Drips. A white syrup of medium consistency, made by L. G. Yoe & Co., Chicago, Ill. Sold by A. J. Ross, Louisville, Ky.

Sample 49. New Orleans. A light-colored sugar syrup, made by Church (A. W. S.) Plantation. Sold by Scully & Yates, Lexington, Ky.

Sample 50. California Golden Syrup. Made from pure cane sugar of Spreckels. Sunset brand. None genuine without the brand. Sold by J. C. Berryman, Lexington, Ky.

ANALYTICAL DATA.

No.	Polarization.		Temperature, °C.	Sucrose.	Reducing Sugars.	Water.	Ash.	Tin or Other Metals.
	Direct.	Indirect.		Per Ct.	Per Ct.	Per Ct.	Per. Ct.	
1	42.4	— 20.6	24.0	48.31	18.52	25.41	2.51	Tin.
2	130.4	117.0	24.8	10.31	40.81	16.89	0.72	Do.
3	46.6	— 21 9	24.0	52.53	16.13	28.82	0.03	
4	44.2	— 18.5	24.0	48.08	18.18	26.32	2.33	Tin.
5	41.5	— 5.1	24.6	35.82	30.30	18.13	2.45	
6	62.8	— 20.8	25.2	64.41	2.53	25.28	0.58	
7	83.4	16.9	24.2	51.04	12.54	23.29	0.33	Trace.
8	36.0	— 12.3	24.8	37.15	34.48	15.05	3.25	
9	92.0	46.4	24.8	35.08	20.20	25.24	0.39	Tin.
10	104.8	76.1	24.6	22 06	25.15	26.70	0.29	Do.
11	128.2	112.0	24 8	12.46	32.25	23.23	0.46	Do.
12	61.4	— 21.4	24.8	63.70	1.56	29.72	0.63	
13	42.4	— 20.4	24.8	48.30	18.35	25.47	2.05	
14	59.8	— 20.0	25.2	61.48	1.31	30.67	0.74	Tin.
15	64.2	23.3	24.0	31.36	31.25	18.70	3.14	
16	25.0	— 20.5	24.6	34.97	32.26	20.37	4.82	
17	62.4	— 23.6	24 4	66.05	10.52	16.68	1.87	
18	38.0	— 21.2	24.8	45.54	25.00	20.28	3.68	
19	130.8	120.1	24.4	8.22	35.39	18.80	1.13	Tin.
20	38.0	— 15.8	24.8	41.39	30.30	15.03	2.83	Copper.
21	30.4	— 12.5	25.0	33.02	31.74	27.83	3.46	
22	123.6	116.2	24.4	5.68	37.73	21.73	1.19	Tin.
23	153.8	144.1	25.6	7.48	34.78	16.40	0.65	
24	47.2	— 20.9	25.6	52.54	16.81	22.69	3.15	
25	42.8	— 14.2	24.6	43.81	21.05	27.50	2.58	
26	39.6	— 20.2	24.8	46.00	20.41	25.63	2.70	
27	30.6	— 16.4	24.8	36.16	31.25	17.68	4.80	
28	35.4	— 15.6	24.8	39.23	28.98	21.84	2.63	
29	121.0	108.5	25.0	9.62	40.82	17.33	1.17	
30	125.6	116.6	24.8	6.92	41.24	13.69	1.42	Tin.
31	122.2	112.6	24.8	7.38	40.00	17.79	1 52	
32	52.8	— 24.0	24.8	59.07	17.86	17.17	1.86	
33	44.0	— 18.9	26.0	48.60	20.20	24.13	2.09	Do.
34	60.4	— 20.0	24.8	61.53	4.90	30.24	0.28	
35	109.8	78.1	24.8	24.38	25.31	26.08	0.31	Tin.
36	115.6	98.6	24.6	13.06	27.31	31.83	0.22	Do.
37	125.2	113.9	25.4	8.82	39 22	18.98	1.02	Do
38	153.0	145.6	25.2	5 67	40.81	14.89	0.32	
39	106.4	86.0	24.8	15.69	34 48	21 84	1.17	
40	39.2	— 11.6	24.8	39.08	33.33	13.78	2.63	
41	— 8.0	— 18.3	24.8	7.92	54.05	20.11	4.84	Trace of Tin.
42	41.0	— 18.9	24.6	46.04	18.35	25.70	3.05	
43	34.4	— 21.6	24.2	42.97	25.32	18.81	2.56	Tin.
44	28.2	— 19.8	25.2	36.97	28.57	19.30	4.36	Do.
45	142.2	138.6	24.2	2.76	40.82	18.47	0.64	
46	102.0	76.1	24.6	19.91	29.70	27.30	1.93	
47	61.6	— 20.0	24.8	62.77	5.81	28.32	0.33	Do.
48	67.6	— 21.1	24.8	68.23	0.53	23.81	0.15	
49	38.4	— 20.7	24.8	45.46	23.25	24.50	3.16	Trace of Tin.
50	36.6	— 13.0	25.6	38.27	31.25	20.44	2.20	

REMARKS ON THE ANALYSES OF MOLASSES AND SYRUPS.

The following remarks by Dr. Wiley are quoted from the Bulletin already referred to under sugars:

"It has long been known that a large part of the maple syrup sold in the market is made from glucose, understanding by this term the liquid product of the conversion of starch into sugar. It is also well known that large quantities of maple syrups are sold on the market which are fabrications made up of other sweets, to which a little maple molasses is added for the purpose of giving it flavor, or, as is often the case, being entirely free from any addition of maple product whatever. The maple flavor is imparted to syrups by mixing with them an extract of hickory bark, and this product has been made and sold under the term of 'mapleine.' It is safe to say that perhaps the greater quantity of maple molasses or syrup sold on the market is an adulteration in the true sense of the word. These definitions, however, are only of a popular nature, and a syrup could not be said to be adulterated, legally, unless some statute is enacted establishing a standard by which these products could be judged.

"For the purposes of this report a molasses or syrup is adulterated whenever it contains glucose or any other substance which would not be a natural product of sorghum, sugar cane, or the maple tree.

"It has already been noticed under the head of sugars that a certain brand of sugar placed upon the market, viz, 'yellow clarified,' is washed in the centrifugal machine with a solution of chloride of tin. This tin would naturally find its way into the molasses, and, being of a poisonous nature, its presence in the molasses in any large quantity would be highly objectionable. Molasses, therefore, which is the natural product of the sugar cane, but which contains tin as a result of washing the crystals in the centrifugal with that substance, should be considered adulterated. In looking for tin in a number of instances copper also was found in the molasses. This copper doubtless comes from the copper pans and copper coils used in evaporat-

ing the juices and syrups. Its presence being merely accidental, it could not be considered as an adulteration. Copper salts are, however, not palatable, and their presence in a molasses or syrup is highly objectionable.

"In regard to glucose it may be said that its presence in molasses or syrup is an adulteration unless the article containing it is distinctly so marked. A few years ago, when sugars and molasses were higher priced than they are now, the manufacture of syrups from glucose was very profitable. The price of genuine molasses, however, has at the present day fallen so low as to make the manufacture of glucose for the above purpose much less profitable than before. The advantage of using glucose, nevertheless, is very great aside from its cheapness. It gives to a syrup a fine body and a light color. A molasses or syrup, therefore, made chiefly of glucose and flavored with the refuse molasses of a refinery, makes a very attractive article for table use, in so far as appearance goes. In regard to wholesomeness also it is not possible to condemn glucose. When properly made it is apparently as wholesome an article of diet as cane sugar. In fact the starches which are consumed in our foods are all converted into glucose during the process of digestion. A glucose food, therefore, is a starch food already partially digested. The use of acids in converting the starch into glucose would prove detrimental to health unless they were carefully removed. Glucoses are, therefore, often made with ferments for the purpose of converting the starch into sugar rather than by the use of acids. Diastase is sometimes used for this purpose, and other ferments are also employed. At the present time the use of glucose in the manufacture of molasses and syrups can not be said to be a fraud, from a financial point of view, inasmuch as the glucose costs quite as much as the other materials of which the molasses and syrups are made. * * * * *

"Of the whole number of samples examined, 19, or 38 per cent., were adulterated with glucose. Fifteen of the samples were labeled 'New Orleans.' None of these were adulterated with glucose, but seven of them contained tin.

"No 41, labeled 'New Orleans reboiled,' shows an almost perfect inversion of the sucrose either by reboiling or by sub-

sequent fermentation. It gives a left-handed solution in direct polarization.

"There are 10 samples of maple syrup. Of these, 7 are adulterated with glucose.

"Five of the samples are marked sorghum. Of these, 3 are adulterated with glucose.

"Eighteen of the samples contained tin and one copper.

"In all samples containing glucose, its presence is revealed by the high right-handed polarization and by the large quantity of undetermined matter. Glucose has a low factor for the sugars which reduce copper—and nevertheless all reducing sugars are entered as dextrose in the tables. There arises, therefore, a large deficit in total solids when this method of calculation is pursued."

CONFECTIONS.

Description of Candies.

Sample 151. Mint Lozenges, white; made by John Perkins, Cincinnati, Ohio. Sold by Henry Huneke & Co., Cincinnati, Ohio.

Sample 152. Mixed Creams, pink, red, white and yellow; made by John Perkins, Cincinnati, Ohio. Sold by Henry Huneke & Co., Cincinnati, Ohio.

Sample 153. Stick Candy, striped with red, not colored on inside of stick; made by J. W. Lell, Lexington, Ky. Sold by Norris & Son, Lexington, Ky.

Sample 154. Cinnamon Stick, solid red on outside of stick, not colored inside; made by J. W. Lell, Lexington, Ky. Sold by Henry Vogt, Lexington, Ky.

Sample 155. Peppermint, red; made by J. W. Lell. Sold by Henry Vogt, Lexington, Ky.

Sample 156. Decorated Creams, yellow, blue, pink, red, purple, brown and white Bought by Norris & Son of Thurbur, Whyland & Co., New York. Bought of Norris & Son, Lexington, Ky.

Sample 157. Pink lozenges; made by G. G. Ehrman & Sons, Louisville, Ky. Sold by T. N. McClelland, Lexington, Ky.

Sample 158. Cinnamon Drops, red; made by Rheinhart, Newton & Co., Cincinnati. Sold by Norris & Son, Lexington, Ky.

Sample 159. Peppermint Rings, red; made by G. G. Ehrman & Sons, Louisville, Ky. Sold by T. N. McClelland, Lexington, Ky.

Sample 160. Lemon Drops, straw color; made and sold by Beehive Candy Kitchen, Lexington, Ky.

Sample 161. Lemon Drops; made by G. G. Ehrman & Sons, Louisville, Ky. Sold by T. N. McClelland, Lexington, Ky.

Sample 162. Fine Candy, bright and dull greens; made by G. G. Ehrman & Sons, Louisville, Ky. Sold by T. N. McClelland, Lexington, Ky.

Sample 163. French Kisses, light red; made and sold by Montgomery & Bailey, Louisville, Ky.

Sample 164. Verdant Squares, light green and white; made by Hall, Hayward & Co., Louisville, Ky. Sold by Hall, Hayward & Co., Louisville, Ky.

Sample 165. Clove Drops, white with red center; made and sold by Montgomery & Bailey, Louisville, Ky.

Sample 166. White Creams; made by Hawley & Hoopes, New York. Sold by Montgomery & Bailey, Louisville, Ky.

Sample 167. Plain, mixed, red, yellow, pink, white, straw color; made and sold by Hall, Hayward & Co., Louisville, Ky.

Sample 168. Light-pink Creams; made by Hawley & Hoopes, New York. Sold by Montgomery & Bailey, Louisville, Ky.

Sample 169. Dull-yellow Creams; made by Hawley & Hoopes, New York. Sold by Montgomery & Bailey, Louisville, Ky.

Sample 170. Gem Mixed, white, red-printed; made and sold by Hall, Hayward & Co., Louisville, Ky.

Sample 171. Mixed Creams, purple, red and straw color, and pink; made and sold by Hall, Hayward & Co, Louisville, Ky.

Sample 172. Gem Creams, white; made and sold by Hall, Hayward & Co., Louisville, Ky.

Sample 173. Maple Caramels; made and sold by Beehive Candy Kitchen, Lexington, Ky.

Sample 174. Strawberry Creams; made by Hawley & Hoopes, New York, and sold by Montgomery & Bailey, Louisville, Ky.

Sample 175. Yellow Creams; made by Hawley & Hoopes, New York, and sold by Montgomery & Bailey, Louisville, Ky.

ANALYTICAL DATA.

Number	Polarization. Direct . .	Polarization. Indirect . .	Temperature °C. .	Sucrose	Reducing Sugars .	Water	Ash	Insoluble in Cold Water	Coloring Matter . .
				Per Ct.	Per Ct.	PerCt.	PerCt.	PerCt.	
151	109.1	2.0	25.5	82.60	6.99	2.66	0.11	. .	None.
152	103.6	— 1.6	25.2	80.98	6.02	3.50	0.08	0.91	Organic.
153	106.1	1.5	25.0	80.52	10.53	0.40	0.22	0.06	Do.
154	107.4	4.0	25.0	80.21	10.76	3.30	0.30	. . .	Do.
155	112.6	3.8	24.5	83.59	11.91	3 64	0.25	. . .	Do.
156	106.4	— 4.6	25.0	85.51	9.09	1.88	0.05	. . .	Organic.
157	84.8	—29.5	24.0	87.65	10.42	4.42	0.15	. . .	Cochineal.
	85.0	—29.3	25.0	87.99	10.53	4.72	0.15	. . .	
158	110.4	0.7	25.4	84.28	8.20	1.46	0.15	. . .	Eosin.
159	96.4	—11.9	25.1	83.37	11.75	3.93	0.09	. . .	Cochineal.
160	73.2	—29.0	25.0	78.67	22.22	0.39	0.15	. . .	None.
161	91.0	—15.8	25.8	82.47	13.16	3.15	0.07	. . .	Do.
162	86.8	—15.2	24.8	78.47	11.36	2.64	0.11	. . .	Organic.
163	110.4	8.6	25.2	78.42	11.49	2.71	0.13	. . .	Cochineal.
164	100.8	— 0.2	25.0	77.74	9.43	2.88	0.06	. . .	Organic.
165	103.8	— 4.5	24.8	83.31	8.93	4.00	0.12	. . .	Cochineal.
166	107.4	7.0	25.6	77.46	8.69	2.50	0.11	0.10	None.
167	111.4	8.2	25.2	79.51	10.00	2.89	0.18	. . .	Organic.
168	106.4	5.9	25.2	77.43	9.80	2.41	0.12	. . .	Cochineal.
169	106.0	4.0	25.2	78.58	8.85	2.70	0.15	. . .	Organic.
170	100.0	1.7	26.0	75.96	6.25	3.49	0.14	12.40	Do.
171	98.4	— 1.5	24.4	76.73	10.10	3.05	0.07	. . .	Organic; some eosin.
172	101.0	0.8	25.0	77.13	9.80	2.56	0.05	. . .	None.
173	91.2	12 1	24.0	60.66	11.60	3.85	0.88	13 57	Do.
174	104.6	— 2.7	24.2	82.35	7.14	0.94	0.12	. . .	Organic.
175	107.6	6.6	25.2	77.81	9.60	2.56	0.12	. . .	Do.

REMARKS ON ANALYSES OF CONFECTIONS.

In the Bulletin, already referred to, Dr. Wiley comments as follows on the analyses of confections:

"The question of the adulteration of candies and confections is hardly debatable. The general conception of a pure confection is one that contains saccharine flavoring and coloring matters, so mixed and adjusted as to be attractive, both to taste

and sight. As long as these ingredients are not harmful to the health, they can scarcely be regarded as adulterations.

"Harmful ingredients, and the admixture in confections of terra alba, kaolin, or other mineral substance calculated to give weight and volume to the mass, must be regarded as adulterations.

"Starches and gums, although insoluble in cold water, are not of themselves hurtful to the health, and their presence in certain kinds of confections may be regarded as necessary. Coloring matters are divided, first of all, into organic and inorganic classes. The metallic oxides comprising the latter class should never be used as pigments for confections. It has been claimed that lead compounds have been used for coloring candy, especially lead chromate; but our investigations have shown that inorganic colors are not used to any very great extent in this country. Were it otherwise, more samples of it would have been found in the 250 samples, mostly colored, bought in open market in different parts of the country. The organic colors may be divided into innocuous and hurtful, but it is difficult to say where the line should be drawn. Harmless vegetable pigments, it may be said, can be used without endangering the health of the consumer. The same is true of the like compounds of insect origin like cochineal. Some of the coal tar colors are also said to be without injurious effect, but this statement can not be made to apply to the whole family of aniline dyes, perhaps the most frequent colors in candies. Among the colors found in the samples examined may be mentioned cochineal, eosin, and other aniline dyes, and ultramarine.

"All of the samples except one, viz: No. 157, contained glucose.

"Only two contained notable quantities of starch and gum, viz: Nos. 170 and 173.

"Nineteen of the samples had organic coloring matter added.

"In no case did the percentage of ash reach .90, showing the entire absence of added earthy or mineral matter.

"Sucrose was the chief constituent of all the samples examined."

SUMMARY.

	Samples.
Glucose	24
Organic coloring	19
Of which—	
Cochineal	5
Eosin	2
Starch and gum	2

HONEYS.

Description of Samples.

Sample 101. McMechen's Old Virginia Pure Honey, prepared by Geo. K. McMechen & Son, Wheeling, W. Va. In bottle. Label around neck reads, "These goods are absolutely pure." Signed, Geo. K. McMechen & Son. Sold by Joseph R. Peeble's Son's Co., Cincinnati, Ohio.

Sample 102. Pure California Honey, from Los Angeles, Cal. Sold in bulk by Hamilton, Cincinnati, Ohio.

Sample 103. Choice Comb Honey; made by Githens & Rexamer, Philadelphia, Pa. In glass jar. Sold by R. J. McCombs, Cincinnati, Ohio. There is some comb in the bottle, but the greater portion is liquid. The liquid only was taken for analysis.

Sample 104. Pure Machine-Extracted Honey, from the Italian apiary of Chas. F. Muth, 976 and 978 Central avenue, Cincinnati, Ohio. Sold in bottle by Joseph Peeble's Son's Co., Cincinnati, Ohio.

Sample 105. Pure California Honey, from Los Angeles, Cal. Sold in bulk by R. Schudeldecker, 230 Elm street, Cincinnati, Ohio.

Sample 106. Bought of Stephens W. Holm, commission merchant, Cincinnati, Ohio. Country honey in tin buckets.

Sample 107. Pure honey, prepared by Dickerson & Tyler, Bowling Green, Ky. Sold in bulk by John Edwell, Bowling Green, Ky.

Sample 108. California honey. Sold in bulk by E. T. Poynter, Bowling Green, Ky.

Sample 109. Honey prepared by Hanna, Lexington, Ky. Sold in bulk by W. H May, Lexington, Ky.

Sample 110. California Strained Honey, product of the San Diego apiary. Sold in tin cans by L. G. Yoe, Chicago, Ill.

Sample 111. Honey sold by Arthur Peter & Co., Louisville, Ky.

Sample 112. Honey, prepared by James Downing, Lexington, Ky. Sold at market-house, Lexington, Ky.

Sample 113. Pure Machine-Extracted Honey, from the Italian apiary of Chas F. Muth & Son, corner of Freeman and Central avenues, Cincinnati, Ohio. Sold in bottle by H. Wedekind & Co., Louisville, Ky.

Sample 114. Pure California White Sage Honey. Thurber & Whyland, New York City. In bottle; label around neck reads, "This honey is absolutely pure and, unlike liquid honey that has been mixed with glucose to

keep it from granulating, it will naturally candy or granulate and become a solid mass in course of time. If preferred in its liquid state, remove the cork and place the bottle in hot water until the honey is melted." Sold by Schuabacher, Cincinnati, Ohio.

Sample 115. Buckwheat Honey, from New York. Sold by J. B. Wurach, Louisville, Ky.

Sample 116. Pure Sage California Honey. Sold by Gooch & Edwards, Franklin, Ky. Bought of H. C. Armstrong, Louisville, Ky.

Sample 117. Linn California Honey. Through Castner & Gage, Louisville, Ky. Retailed by L. Goose, Louisville, Ky.

Sample 118. California White Clover. Through Castner & Gage. Retailed by S. Scholtz, Louisville, Ky.

Sample 119. Honey, prepared by Graham. Sold by J. I. Younglove & Bro., druggist, Bowling Green, Ky.

Sample 120. California Honey. Sold by T. H. Watkins, Louisville, Ky.

Sample 121. Honey, prepared by Campbell. Sold by J. I. Younglove & Bro, Bowling Green, Ky.

Sample 122. Pure honey, from Dr. R. J. Spurr, Greendale, Ky.

Sample 123. Almond Blossom Honey, from Los Angeles, Cal., in bulk, by J. B. Wurach, Louisville, Ky.

Sample 124. Honey, from Mrs. Read, Montgomery, Ohio. Sold in bulk by L. T. Griffiths, northwest corner Sixth and Central avenues, Cincinnati, Ohio.

Sample 125. McMechen's Old Virginia Pure Honey. Prepared by George K. McMechen & Son, Wheeling, W. Va. Sold by H. Huneke, Cincinnati, Ohio, in bottle with label around neck that reads, "These goods are absolutely pure." Signed, Geo. K. McMechen

Sample 126. Muth's California Honey. Sold in bulk by S. Scholtz, Cincinnati, Ohio.

Sample 127. Honey, put up by Charles F. Muth & Son, Cincinnati, Ohio, in bottles. Label on neck of bottle reads "Warranted pure;" red label on stopper says, "Warranted pure honey." Sold by Sterritt, Cincinnati, Ohio. Light straw color.

Sample 128. Pure Orange Blossom Eagle Brand Honey, put up by Strohmeyers, New York. Sold by E. W. James, Louisville, Ky., in pear-shaped bottles. Label around neck reads, "Pure extracted honey; all pure honey will congeal, especially when exposed to light and cold; in such cases remove cork, place bottle in cold water and let it boil ten minutes and the honey will regain its liquid state."

Sample 129. Pure Extracted White Clover Honey, from the apiary of Charles Hill, Mount Healthy, Ohio. Sold by the Peebles' Son's Company, Cincinnati, Ohio. Put up in glass jelly jars; light colored.

Sample 130. Honey, put up by James Hanna, Lexington, Ky. Sold by S. K. Cozine, Lexington, Ky., in bottles. Light color.

Sample 131. Honey, put up by J. R. Vanmeter, near Lexington, Ky. Sold by John Hutchison, Ky. Light colored, beginning to candy.

Sample 132. Honey, put up by Dr. B. L. Price, near Lexington, Ky. Sold by Scully & Yates, Lexington, Ky. Light colored; sold in bulk; candied.

Sample 133. Honey, put up by Brown Vanmeter, Fayette county, Ky. Sold by G. H. Kinnear, Lexington, Ky. Light colored, somewhat candied.

Sample 134. Honey, put up by Brown Vanmeter, Fayette county, Ky. Sold by Henry Vogt, Lexington, Ky.

Sample 135. Comb Honey, put up in glass jars by Githens & Rexsamer, Philadelphia, Pa. Sold by Henry Huneke, Cincinnati, Ohio. Light colored, some comb in it and filled with strained honey. Liquid only taken for analysis.

Sample 136. McMechen's Comb Honey, Old Virginia. Sold by C. W. Jefferson, Louisville, Ky. Sold in glass jars; light colored.

Sample 137. California Water White Honey. Sold by J. B. Wurach, Louisville, Ky. Brought in bulk from Los Angeles, Cal.

Sample 138. Honey, put up by Joe Downing, near Lexington, Ky. Sold by Henry Vogt, Lexington, Ky. Light colored. For analysis liquid only was taken.

Sample 139. California Clover Honey. Bought in 50-pound cans; said to come from Los Angeles, Cal. Sold by George Collet & Bro., Bowling Green, Ky.

Sample 140. Choice Comb Honey. Githens & Rexsamer, in quart jars with glass covers. Some comb. and jar filled up with strained honey.

Sample 141. Pure machine-extracted Honey, from the Italian apiary of Charles F. Muth, corner Freeman and Central avenues, Cincinnati, Ohio. Sold in 1-pound bottle by Hamberger & Newburgh, Cincinnati, Ohio.

Sample 142. Alfalfa Honey, from Arizona. Sold by J. J. Hunt, Lexington, Ky.

Sample 143. Pure California Honey, from Los Angeles, California. Put up in 50-pound packages, and sold by Colter & Co., Cincinnati, Ohio.

Sample 144. McMechen's Comb Honey, Old Virginia. Put up in glass jars. Sold by Henry Huneke, Cincinnati.

Sample 145. Honey, put up in bottles, with label around the neck, which reads "Warranted pure," signed by Charles F. Muth & Son. Sold by B. H Kroger, Cincinnati, Ohio.

Sample 146. Honey, put up by J. Hanna, near Lexington, Ky. Sold in bulk; retailed by McClelland, Lexington, Ky.

Sample 147. Honey, put up by A. C. Kumman. Sold by Louis Roessler, Cincinnati Ohio. Light colored.

Sample 148. White Clover Honey, put up by Thomas Austin, Nichols & Co., Albany, N. Y. Sold by George Gelfins, Louisville, Ky.

Sample 149. Honey, put up by Charles F. Muth & Son, in bottle. The label on neck reads, "Warranted pure." Sold by A. Barnes, northwest corner Sixth and Elm streets, Cincinnati, Ohio. Light colored. Beginning to candy.

Sample 150. California Honey. Sold in bulk by M. J. Doyle, Louisville. Dark colored.

ANALYTICAL DATA.

No.	Polarization.		Temperature °C.	Sucrose.	Reducing sugars.	Water.	Ash.
	Direct.	Indirect.					
				Per Ct.	Per Ct.	Per Ct.	Per Ct.
101	54.0	46 5	24.0	5.75	62.50	9.86	0.08
102	—17.4	—22.7	24.8	4.07	75.47	14.36	0.06
103	92.8	89.0	24.8	3.08	52.63	16.09	0.21
104	51.0	45.3	24.8	4.38	61.54	13.99	0.11
105	—15.6	—18.3	25.0	2.08	73.39	14.88	0.12
106	—13.1	—16.8	25.2	2.85	75.47	13.83	0.07
107	—12.2	—14.8	24.8	2.00	74.07	13.15	0,05
108	—15.2	—20.8	24.8	4.31	72.73	13.77	0.08
109	—16.8	—18.4	24.2	1.23	75.47	14.31	0.06
110	72.6	67.9	24.8	3.62	56.34	18.54	0.16
111	—18.0	—21.6	24.5	2.77	73.39	13.97	0.04
112	—13.2	—16.4	25.2	2.46	74.76	15.77	0.03
113	—11.2	—18.5	24.8	5·61	74.07	16.21	0.19
114	—7.2	—15.1	24.8	6.08	75.47	11.76	0.20
115	—3.4	—18.1	24.4	11.29	65.57	13.95	0.12
116	75 2	71.1	25.2	3.16	57.97	13.81	0.19
117	—19.6	—22.5	24.6	2.23	72.73	17.78	0.07
118	—15.6	—21.7	24.8	4.69	74.07	15.08	0.08
119	— 1.2	—7.0	24.4	4.45	72.07	15.64	0.08
120	—17.0	—21.6	24.8	3.54	71.43	19.28	0.07
121	—13.6	—15.3	24.6	1.31	72.73	17.37	0.08
122	—11.0	—14.4	24.8	2.62	65.57	22.57	0.04
123	—14.8	—16.7	24.8	1.46	71.43	16.00	0.13
124	—15.8	—19.3	24.0	2.68	81.63	13.51	0.07
125	— 9.2	—12.4	24.0	2.45	65.04	26.90	0.19
126	93.4	89.5	24.8	3.00	56.34	13.01	0.25
127	41.0	37.7	24.2	2.53	64.51	13.87	0.12
128	— 14.8	—18.8	24.2	3.07	74.07	13.35	0.08
129	— 14.0	—16.7	24.8	2.08	75.47	13.31	0.06
130	— 13.2	—16.4	24.2	2.45	72.73	14.28	0.02
131	— 10.4	—15.0	24.8	3.54	74.08	14.65	0.02
132	— 14.2	—16.9	24.4	2.07	73.39	16.86	0.02
133	— 10.4	—14.6	24.0	3.22	72.73	14.30	0.03
134	— 11.2	—16.4	24.0	3.99	73.39	14.15	0.01
135	92.4	88.0	24.6	3.38	56.34	13.94	0.27
136	103.8	97.6	24.8	4.77	50.63	16.42	0.36
137	1.8	—19.7	24.8	16.54	60.61	15.88	0.05
138	— 12.2	—15.2	24.0	2.30	75.47	12 15	0.03
139	— 18.2	—21.5	24.6	2.53	72.73	13.96	0.08
140	84.4	80.1	24.6	3.31	54.78	15.48	0.18
141	46.4	40.2	24.8	4.77	64.51	13.11	0.07
142	— 12.4	—19.8	24.2	5.67	76.91	15.68	0.10
143	— 17.2	—23.2	24.8	4.61	75.47	12.83	0.01
144	117.4	113.5	24.6	3.00	50.00	11.96	0.18
145	— 12.0	—17.2	24.0	3.98	74.07	14.68	0.05
146	— 14.8	—17.4	24.2	2.00	74.07	16.80	0.04
147	— 10.6	—15.4	24.8	3.69	74.76	15.52	0.19
148	— 14.8	—19.0	24.8	3.23	72.73	13.20	0.06
149	40.0	35.2	24.6	3.69	66.67	14.30	0.14
150	— 15.8	—17.5	24.8	1.31	73.39	16.53	0.16

NOTES UPON THE ANALYSES OF HONEYS.

Samples Nos. 103, 104, 110, 116, 126, 127, 135, 136, 140, 141, 144 and 149 are all adulterated. No. 137 is a doubtful sample, and is possibly adulterated with cane sugar, though the extent of the adulteration is not great enough to permit its classification with the fraudulent samples without this explanation. The results of these analyses are well summarised by Dr. Wiley in the passages quoted below from the Bulletin already referred to:

"Of the whole number, thirteen are certainly adulterated, 26 per cent., and one other probably, 28 per cent. in all. In the present state of our knowledge it is necessary to pass all moderately left-handed honeys as pure, although there may be a great percentage of adulteration in such samples. Methods are now perfecting which will enable us to detect an adulteration in a left-handed sugar with as great a degree of certainty as we are now able to do with a right-handed one. * * * * *

"Perhaps there is no other article of food which has been so generally adulterated in the United States during the last twenty years as honey. The ease with which sophistication could be practiced, the cheapness of the material used, and the high price of the genuine product, have presented temptations which the manufacturer, producer and dealer have not been able to withstand.

"As long as honey was sold wholly in the comb, the difficulties in the way of successful sophistication were so great as to practically preclude its practice. The popular impression to the effect that comb honeys are adulterated was probably produced rather by ingenious attempts to manufacture the spurious article than by the commercial success of the enterprise. Artificial comb honey has not been regarded as a possible article of commerce by many scientific men."

BULLETIN No. 32.

By C. L. Curtis, Assistant Agriculturist.

1. **STRAWBERRIES—TEST OF VARIETIES.**
2. **VEGETABLES.**

1. STRAWBERRIES.

Summary.—After a trial of two years the following varieties recommend themselves:

For first early ..... **Jessie, Cloud.**
For second early ..... **Annie Forrest, Eureka, Daisy.**
For medium or late ..... **Crawford, Bubach No. 5. Haverland, Warfield.**
For very late ..... **Gandy's Pride.**

THE EXPERIMENT IN DETAIL.

The following experiments with strawberries were made in the season of 1890, our object being to place before the farmer and gardener such facts as will enable them to select the varieties that are most suitable to our soil; also the ones that are best for home and market uses. It is hardly necessary here to give our mode of setting and cultivating, as it is so simple and so well known to most of those who raise their own strawberries. However, a few remarks upon that subject to those who have had little or no experience, may do some good. Most of the varities included in these tests were set in the spring and fall of 1888. The plants were set in rows three feet apart, one foot apart in row. Care was also taken to have them so set that there would be a perfect blooming plant in every third row. The runners were all kept cut the first year, nothing but the single

plant being left. The following year they were allowed to spread to the width of about six inches, the spaces between being hoed out perfectly clean at intervals up to the time of bearing.

The first cultivation in the spring was to spade or plow with a narrow-pointed plow between the rows to the depth of six inches, after that very shallow.

The plants were protected during the winter season by spreading hemp herds over the entire bed to the depth of about two inches, this being removed for cultivation and replaced at blooming time, it serving the purpose of keeping the weeds back as well as keeping the berries clean. The following is a summary of the notes taken from time to time during the growing and bearing season. The table following the notes will also show the sex, B.–Bisexual, P.–Pistillate, when in bloom, when ripe, etc:

Jessie.—Perfect flower, a fine, strong plant, rusts but little, ripens very early. A fine size berry of excellent flavor, somewhat irregular in shape, very productive, fairly solid.

Crawford.—Perfect flower, plant of medium vigor, rusts some, ripens next to first early, fine size berry, good flavor, shape conical, fair bearer, not very solid.

Itaska.—Pistillate. A fine, vigorous plant, rusts some, ripens second early, berry of medium size, good flavor, cone shape, very perfect, good bearer, fairly solid.

Annie Forrest.—Perfect flower, plant very vigorous, but little rust, ripens next to first early, berry good size and shape, flavor fine, produces well, solid.

Ontario.—Perfect flower, plant very vigorous, some rust, ripens second early, berry fine size, shape very irregular, flavor very good, produces well, fairly solid.

Bubach No. 5.—Pistillate. Plant very fine, some rust, ripens medium early, berry fine size, cone shape, very irregular, flavor very good, very productive, fairly solid.

Cumberland Triumph.—Perfect flower, plant vigorous, rusts considerably, ripens a little late, berry good size, cone shape, perfectly smooth and even, flavor very good, good bearer, very soft.

Kentucky.—Perfect flower, plant of medium vigor, rusts

badly, ripens a little late, berry fair size, cone shape, flavor very fair, fair bearer, solid.

Loudon's 15.—Perfect flower, plant vigorous, some rust, ripens after first early, berry fair size, fair flavor, very fair bearer, solid.

Haverland.—Pistillate. Plant very fine, a little rust, ripens second early, berry cone shape, very long, good size, very good flavor, fine berry, very showy, very productive.

Pineapple.—Pistillate. Plant vigorous, some rust, ripens after first early, berry good size, flavor fair, only fair bearer, solid, cone shape with long neck.

Dutter.—Perfect flower, plant small, rusts some, ripens medium early, berry good size, fair flavor, poor bearer, soft.

Pearl.—Perfect flower, plant fine, little rust, ripens second early, fair size, flavor good, scant bearer, fairly solid.

Burt.—Perfect flower, plant fairly vigorous, some rust, ripens rather late, crop very poor.

Warfield.—Pistillate. Plant vigorous, rusts considerably, ripens medium to late, fair size, flavor good, fine bearer, very showy, solid.

Gypsy.—Pistillate. Plant very strong, no rust, ripens after first early, fair size, fair flavor, very prolific, solid.

Phelps.—Pistillate. Plant vigorous, little rust, ripens medium to late, fair size, fair flavor, scant bearer, fairly solid.

Primo.—Pistillate. Plant small, rusts some, ripens second early, size small, fair flavor, poor bearer, solid.

Parry.—Perfect flower, plant very poor, ripens second early, size small, quality poor, scant bearer, fairly solid.

Scarlet Queen.—Pistillate. Ripens second early, size small, fair flavor, scant bearer, fairly solid.

Piper.—Perfect flower, very poor plant, ripens second early, fair size, flavor good, scant bearer, fairly solid.

Belmont.—Perfect flower, fine plant, little rust, ripe next to first early, good size, flavor good, very good bearer, fairly solid.

May King.—Perfect flower, good plant, little rust, ripens after first early, flavor good, fair bearer, good size, fairly solid.

Gandy's Pride.—Perfect flower, good plant, but rusts some, ripens very late, flavor excellent, fair bearer, good size, solid, one of the most perfect-shaped berries grown.

Gold.—Pistillate. Plant small, little rust, ripens medium to late, flavor fine, scant bearer, very good size, fairly solid.

Logan.—Perfect flower, good plant, rusts some, ripens second early, very fair flavor, fair bearer, fair size, solid.

Lida.—Pistillate. Fine vigorous plant, almost free from rust, ripens medium to late, poor flavor, fine bearer, fair size, solid.

Photo.—Pistillate. Small plant, rusts some, ripens second early, flavor fair, very fair bearer, very good size, solid.

Henderson.—Perfect flower, good plant, little rust, ripens medium to late, flavor choice, fair bearer, very good size, fairly solid.

Bomba.—Perfect flower, small plant, some rust, ripens medium to late, very good flavor, fair bearer, very good size, solid.

Monmouth.—Perfect flower, plant small, rusts some, ripens second early, fair flavor, fair bearer, very good size, fairly solid.

Mammoth.—Perfect flower, plant medium, some rust, ripens late, flavor only fair, size very good, fair bearer, fairly solid.

Jewell.—Pistillate. Plant fairly vigorous, some rust, ripens second early, flavor good, size small, solid.

Summit.—Pistillate. Very fair plant, little rust, ripens second early, flavor good, scant bearer, fairly solid, good size.

Barton's Eclipse.—Pistillate. Plant fairly vigorous, some rust, ripens next to first early, flavor fair, large size, very fair bearer, solid, shape conical, somewhat flattened.

Lady Rusk.—Pistillate. Plant only fairly vigorous, some rust, ripens medium to late, flavor fair, good size, only fair bearer, soft, cone shape.

Cloud.—Pistillate. Plant very vigorous, but little rust, ripens early, flavor fair, small size but regular, fair bearer, soft.

Capt. Jack.—Bloom mixed, plant very good, some rust, ripens medium to late, flavor fair, size small, fine bearer, solid.

Eureka.—Pistillate. Plant fine, almost free from rust, ripens second early, flavor good, good size, good bearer, solid, cone shape, somewhat irregular, very desirable.

Great American.—Perfect flower, plant poor, some rust, ripens

medium to late, flavor good, very good size, scant bearer, fairly solid.

Miami.—Pistillate. Plant fair, some rust, ripens medium to late, flavor good, fair bearer, fairly solid, good size.

Triumph De Grande.—Pistillate. Poor plant, rusts, ripens medium to late, flavor only fair, poor bearer, soft, fair size.

Daisy.—Pistillate. Good plant, almost free from rust, ripens second early, good flavor, good size, good bearer, fairly solid, shape cone, long, desirable.

TABLE SHOWING CHARACTERISTICS AND COMPARATIVE DATA—FORTY-THREE VARIETIES.

NAME.	SEX. B—Bisexual. P—Pistillate.	Date in Bloom	Ripe	Productiveness (scale 0 to 10)	Size (scale 0 to 10)	Quality (scale 0 to 10)	Firmness (scale 0 to 10)	Diameter	Color	SHAPE.
Jessie	B	April 6. .	May 18. .	7	8	9	8	1½ in.	Crimson . . .	Cone.
Crawford	P	May 1. .	May 28. .	7	9	8	9	1 15-16 in.	Crimson . . .	Cone.
Itaska	P	April 18. .	May 25. .	7	6	8	8	1¾ in.	Red	Cone, very regular.
Annie Forrest	P	April 8. .	May 22. .	6	8	9	8	1⅛ in.	Pale Red . .	Cone, very regular.
Ontario	B	April 14. .	May 26 .	8	9	8	8	1¾ in.	Crimson . . .	Very irregular.
Bubach No. 5	P	April 25. .	May 27. .	10	10	8	8	1¼ in.	Pale Red . .	Cone, irregular.
Cumberland Triumph	B	April 25. .	June 2. .	8	8	7	6	1 1-16 in.	Pale Red . .	Cone, very irregular.
Kentucky	B	April 20. .	May 28. .	7	7	7	8	1 in	Red	Cone, regular.
Loudon's 15	B	Apr l 18. .	May 24. .	7	7	8	8	1 in	Dark Red . .	Cone.
Haverland	P	May 14 .	May 25. .	9	8	8	9	1 1-16 in.	Pale Red .	Long cone.
Pineapple	P	April 18. .	May 23. .	6	6	7	9	⅞ in.	Crimson . . .	Cone, with neck.
Dutter	B	April 12. .	May 24. .	6	8	7	6	1 1-16 in.	Light Red . .	Cone, short.
Pearl	B	April 20. .	May 25. .	6	7	8	8	1 in.	Crimson . . .	Cone.
Burt	B	April 26. .	May 28 .	2	7	. . .	9	1 in.	Crimson . . .	Cone.
Henderson	B	April 20. .	May 27. .	6	7	10	8	1 in.	Crimson . . .	Cone.
Bomba	B	April 20. .	May 28. .	7	7	8	8	1 in.	Crimson . . .	Cone.
Monmouth	B	April 23. .	May 25 .	8	8	8	7	1 in.	Medium Red.	Cone.
Mammoth	B	April 25. .	May 30. .	7	7	7	7	1 in	Medium Red.	Cone.
Jewell	P	April 25. .	May 25. .	6	6	7	8	¾ in.	Crimson . . .	Cone.
Summit	P	April 20. .	May 24. .	6	7	8	8	1 in.	Crimson . . .	Cone.
Barton's Eclipse	P	April 14. .	May 20. .	8	8	7	8	1¼ in.	Crimson . . .	Conical, flattened.
Lady Rusk	P	April 15. .	May 27. .	7	7	8	7	1 in	Pale Red . .	Cone.
Cloud	P	April 11. .	May 18. .	8	7	8	8	⅞ in.	Red	Cone, regular.
Capt. Jack		April 26. .	May 25. .	8	7	8	9	⅞ in.	Red	Cone.
Eureka	P	April 18. .	May 22. .	9	9	9	8	1⅛ in.	Red	Cone.
Great American	B	April 20. .	May 28. .	6	7	9	7	1 in.	Crimson . . .	Cone.
Miami	P	April 14. .	May 27. .	7	9	8	8	1⅛ in.	Pale Red . . .	Cone.
Triumph DeGrande	P	April 14. .	May 27. .	6	7	7	6	1 in.	Red	Oval.

Capt. Jack		April 26.	May 25.	8	7	8	9	$\frac{3}{4}$ in.	Red	Cone.
Eureka	P	April 18.	May 22.	9	9	9	8	$1\frac{1}{8}$ in.	Red	Cone.
Great American	B	April 20.	May 28.	6	7	9	7	1 in.	Crimson	Cone.
Miami	P	April 14.	May 27.	7	9	8	8	$1\frac{1}{8}$ in.	Pale Red	Cone.
Triumph De Grande	P	April 14.	May 27.	6	7	7	6	1 in.	Red	Oval.
Daisy	P	April 20.	May 23.	9	8	8	8	$1\frac{1}{8}$ in.	Red	Long cone.
Warfield	P	May 1.	June 1.	9	8	9	9	$\frac{7}{8}$ in.	Deep Crimson	Cone, very regular.
Gypsy	P	April 19.	May 23.	8	8	8	9	1 in	Dark Red	Cone.
Phelps	P	April 18.	May 29.	7	7	7	8	1 in	Red	Roundish.
Primo	P	April 20.	May 25.	6	6	6	9	$\frac{3}{4}$ in.	Medium Red.	Cone.
Parry	B	April 20.	May 25.	6	9	6	8	$\frac{3}{4}$ in.	Red	Cone.
Scarlet Queen	P	April 20.	May 25.	6	7	7	8	$\frac{3}{4}$ in.	Scarlet	Long slender, with neck.
Piper	B	April 20	May 25.	6	7	8	8	1 in.	Crimson	Cone.
Belmont	B	April 16	May 23.	8	8	8	8	$1\frac{1}{8}$ in.	Medium Red.	Roundish cone.
May King	B	April 15.	May 24.	7	8	8	8	1 1-16 in.	Pale Red	Cone, very even.
Gandy's Pride	B	May 1.	June 5.	7	9	10	9	1 1-16 in.	Medium Red.	Cone, very even.
Gold	P	April 23	May 26.	6	7	10	8	1 in.	Medium Red.	Cone, even.
Logan	B	April 15.	May 25.	7	7	7	9	1 in.	Medium Red.	Cone.
Lida	P	April 14.	May 30.	10	7	5	10	1 in.	Crimson	Cone.
Photo	B	April 15.	May 24.	8	8	8	8	$1\frac{1}{8}$ in.	Medium Red.	Cone, very regular.

2. VEGETABLES.

SUMMARY.—Special mention can well be made of a few varieties of the different kinds of vegetables, such as would do well for a family or market garden.

For Beans: A good selection would be for early use, the Saddle Back Wax and Early Mohawk, followed by New Union, White Valentine and Earliest Red Valentine.

For Peas: For early use, Extra Early, First of All, and Very Early Dwarf Frame, followed by Beck's Gem, Laxton's Alpha, Blue Peter and American Wonder. For later use, Abundance and Pride of the Market.

For Lettuce: Prize Head, New York and Stubborn Seeder, in the order named.

For Radishes: Rapid Forcing, Extra Early Turnip Rooted and French Breakfast, followed by White Olive Shaped and Lady Finger, in the order named.

Several varieties of Tomatoes can be mentioned as choice for general use: The Favorite, an old standard sort, the Ignotum, a new variety, and the T ophy, being a good selection.

The Jersey Wakefield, Prize Wakefield and Lightning Cabbages are good in the order named.

A good selection of Corn would be No. 48 and Early Landreth Market for first early, followed by Gold Coin and Burlington Hybred.

The four varieties of Celery tested by us all proved to be good. Giant Paschal is strictly choice.

For a good Watermelon, take any variety in our list, and you will not miss it. Kentucky Wonder is our choice.

For Cantaloupes, Salmon and Green Emerald Gem, Osage, Princess and Perfection, in the order named.

EXPERIMENTS IN DETAIL.

The following tests of some of the different varieties of Vegetables, Melons, &c., were made on the Station farm in the year 1890. The varieties selected for these tests include some of the best-known old, as well as many new ones :

BEANS.

Eight varieties of Beans were planted with results as follows:

Saddle Back Wax Bean.—Seed from Burpee, Philadelphia. Planted April 29, up May 8, ready for use June 22. A fine bean, almost stringless, very prolific.

Earliest of All.—Maule, Philadelphia. Planted April 23, up May 7, ready for use June 21. A flat podded green bean, fair quality, fair bearer.

First in Market.—Landreth, Philadelphia. Planted April 23, up May 5, ready for use June 24. A coarse, flat podded green bean, quality good, fair bearer.

Extra Early Refugee.—Livingston, Columbus, Ohio. Planted April 23, up May 3, ready for use June 24. A round podded green bean, quality good, good bearer.

Earliest Red Valentine.—Henderson, New York. Planted April 23, up May 3, ready for use June 26. A round podded bean, very tender, fine bearer, keeping well on the vines.

New Union White Valentine.—Everett, Indianapolis. Planted April 23, up May 7, ready for use June 26. A round podded bean, quality good, very good bearer.

Best of All.—Everett, Indianapolis. Planted April 23, up May 5, ready for use June 24. A flat podded bean, quality very good, very good bearer.

Early Mohawk.—Seed from Dr. R. J. Spurr, Fayette county. Planted April 23, up May 4, ready for use June 22. Old standard variety of excellent quality. Good bearer.

PEAS.

Twenty varieties of peas were planted, including Early, Medium and Late, viz :

First of All.—From Peter Henderson, New York. Planted April 3, up April 14, ready for use June 3. A choice early pea, good bearer, quality good.

Extra Early.—From Landreth, Philadelphia. Planted April 3, up April 12, ready for use June 2. A choice, first early, good bearer, quality good.

Very Early Dwarf Frame.—Landreth. Planted April 3, up April 14, ready for use June 5. A choice, early pea, vine about twelve inches high and stands upright, good bearer, needs no sticking.

First in Market.—Livingston. Planted April 3d, up April 14, ready for use June 5. A very good early variety but not prolific.

Kentish Invicta.—Landreth. Planted April 3, up April 14, ready for use June 4. Quality good, fair bearer.

Early Reliance.—Everett. Planted April 3, up April 15, ready for use June 8. Quality good, only fair bearer.

Earliest of All.—Maule. Planted April 3, up April 16, ready for use June 6. Quality fair but a scant bearer.

Laxton's Alpha.—Maule. Planted April 3, up April 16, ready for use June 6. An early wrinkled sort of excellent quality but not a good bearer.

Profusion.—Burpee, Philadelphia. Planted April 29, up May 10, ready for use June 25. Good as to quality but poor bearer.

French White.—Maule. Planted April 3, up April 16, ready for use June 10. Quality choice, finely flavored, very poor bearer.

Abundance.—Landreth. Planted April 16, up April 29, ready for use June 25. Good for late use, having a fair sized, well filled pod, good bearer.

American Wonder.—Landreth. Planted April 16, up April 29, ready for use June 10. A good late sort, good bearer, well filled pods, vine very dwarf.

Beck's Gem.—Landreth. Planted April 16, up April 28, ready for use June 11. A good sort, being a good bearer and having good size, well filled pods.

Chelsea.—Henderson. Planted April 16, up April 29, ready

for use June 12. A very good sort, fair size pods, very well filled, good bearer.

Horsford's Market Garden.—Henderson. Planted April 16, up April 29, ready for use June 20. A very good sort, good size pod, very well filled, and a very good bearer.

Laxton's Alpha.—Henderson. Planted April 16, up April 28, ready for use June 10. One of the best for second early, good bearer, having good size, well filled pods.

Pride of the Market.—Landreth. Planted April 16, up April 29, ready for use June 25. One of the best, large pods, very well filled, good bearer, vine of medium height and almost self-supporting.

Blue Peter.—Landreth. Planted April 16, up April 29, ready for use June 10. An excellent sort, large pods very well filled. Good, strong vine standing up well, good bearer.

Eugenie.—Landreth. Planted April 16, up April 29, ready for use June 23. A choice kind, large pods well filled, good bearer.

Yorkshire Gem.—Henderson. Planted April 16, up April 28, ready for use June 25. A very good variety, pods large and very well filled, good bearer.

LETTUCE.

Seven different varieties of lettuce were tested.

Stubborn Seeder.—Maule. Planted April 8, up April 23, in use May 22, not a rank grower, but a most excellent sort, color light green, very crisp and tender.

Big Boston.—Henderson. Planted April 8, up April 23, in use May 24, a very good grower, quality very fair, color light green.

Improved Hanson.—Maule. Planted April 8, up April 20, in use May 22, a good variety, not a rank grower but of good quality, crisp and tender.

Prize Head.—Salzer. Planted April 8, up April 23, in use May 20. A choice variety, fine grower, very crisp and tender, color green tinged with red.

Oak Leaf.—Henderson. Planted April 8, up April 23, in use May 22. A good variety, very showy, having a leaf resembling the oak in shape, crisp and tender, color pale green.

New York.—Henderson. Planted April 8, up April 23, in use May 20. A fine sort, grows large and compact, very crisp, color dark green.

Denver Hard Heading.—Planted April 8, up April 23, in use May 23. A fine variety, very crisp and tender, good grower, color green and red.

RADISHES.

Eleven different varieties of radishes were planted.

Extra Early Turnip Rooted.—Landreth. Planted April 8, up April 16, in use May 15. Fine for early use, very crisp, color dark red or garnet. This was also tested in cold frame and found to be good.

Rapid Forcing.—Henderson. Planted April 8, up April 14, in use May 12. Extra early and very good, very fine size, color medium red, tested in cold frame and found to be choice.

Twenty Day Forcing.—Salzer. Planted April 8, up April 16, in use May 12. Only a fair variety, color red, globe shaped, tested in cold frame, and found to be only fair.

White Olive Shaped.—Salzer. Planted April 8, up April 17, in use May 22, one of the best for general crop, very crisp and tender, pure white, cone shaped.

Earliest Scarlet Globe.—Salzer. Planted April 8, up April 15, in use May 12. A good sort, globe shaped, color scarlet.

Eldorado.—Henderson. Planted April 8, up April 15, in use May 20. A fine sort, having a yellow or rusty appearance.

Lady Finger.—Livingston. Planted April 8, up April 15, in use May 22. A long-pointed radish of fine quality, color white, and a good keeper.

French Breakfast.—Henderson. Planted April 8, up April 15, in use May 10. A choice kind, very juicy and crisp, color pink, with white tip, shape oval.

White Box.—Livingston. Planted April 8, up April 15, in use May 18. A globe-shaped, white variety, very good, good keeper.

Long White Vienna.—Henderson. Planted April 8, up April 16, in use May 24. A long-pointed white radish, very good.

TOMATOES.

A few varieties of Tomatoes were tested; also a test of the different modes of trimming and framing. One dozen plants of each variety were used under the following heads: Trimmed and untrimmed, with and without frames. The process of trimming was simply to cut off five or six of the lower branches at blooming time. It was found that the vines that were trimmed and framed produced the largest and soundest fruit. Vines that were trimmed and left lying on the ground produced fine fruit in size, but unsound. Vines that were not trimmed and left lying on the ground produced an abundance of fruit, of small size; and unsound vines, that were framed and not trimmed, produced an abundance of sound fruit, but small.

Perfection.—Livingston. Set May 10, ripe July 12. Excellent for family use, early but not very prolific, size, shape and flavor good, color red.

Favorite.—Henderson. Set May 10, ripe July 15 A well known variety, fine bearer, quality excellent, fruit lasts well on vine, color medium red.

Dwarf Champion.—Maule. Set May 5, ripe July 12. A good sort, of medium size, quality good, very strong vine, standing up well, color deep red.

Table Queen.—Henderson. Set May 5, ripe July 15. A very good sort, only fair bearer, fruit does not last well on vines, color medium red.

Mikado.—Livingston. Set May 5, ripe July 25. A good flavored Tomato, considerably marked or creased. Skin very thin and hard to handle, color light red or pink.

Ignotum.—Set May 5, ripe July 20, a good late sort, flavor fine, bears late, very solid, color light red.

Trophy.—Henderson. Set May 5, ripe July 15. An early variety, flavor excellent, lasts well on vine, a little tender to handle, color medium red.

Matchless.—Maule. Set May 5, ripe July 18. Medium early, very good flavor, solid, good to handle, color red.

Earliest of All.—Salzer. Set May 5, ripe July 15. A very good early sort, size medium to small, flavor very good, shape a little flat, somewhat creased.

CABBAGE.

A few varieties of early cabbage were planted, but the season being a very unfavorable one, very poor results were obtained.

Landreth's Earliest.—Landreth. Set May 2, in use June 29, very good early sort, a small cone shaped head, of good quality.

New Express.—Maule. Set May 2. This variety did not do well with us this season; one among the best in '89, cone shaped.

Lightning.—Salzer. Set May 2, in use July 3, a very good variety, makes a good, solid, flat head, did extra well in '89.

Jersey Wakefield.—Henderson. Set May 2, in use July 1, a splendid early variety, almost a sure header, cone shaped.

Prize Wakefield.—Maule. Set May 2, in use July 1, a good sort, makes solid head, and a very sure header, cone shaped.

CORN.

The season for corn was unfavorable at the start, it being a difficult matter to get a good stand, but grew and matured very nicely.

Early Landreth Market.—Landreth. Planted May 1, up May 10, in use July 10, extra early, a fine sort, ear good size, filled well, vigorous grower, medium height, stays green a long time. On account of the seed being overlooked this variety was not planted at the same time as the others.

Gold Coin.—Livingston. Planted April 22, up May 5, in use August 1, a fine early sort, a good long ear, small cob, fine flavor, fine grower, stalk above medium, almost invariably two ears to the stalk.

Lacrosse Sweet.—Salzer. Planted April 22, up May 5, in use July 3, very good early sort, but small, growth very dwarf, extra early, very good yielder.

Stabler's Early.—Henderson. Planted April 22, up May 5, in use July 15, very good, second early, stalk medium height, very good yielder.

Northern Pedigree.—Salzer. Planted April 22, up May 5, in use July 4, very fair, early variety, but small, grows very dwarf.

No. 48.—Salzer. Planted April 22, up May 5, in use July 1.

A choice early variety, grows medium height, good size ear, productive, very desirable.

Henderson's Sugar.—Henderson. Planted April 22, up May 5, in use July 23. Choice second early, stalk small to medium, vigorous, productive.

Burlington Hybrid.—Everett. Planted April 22, up May 5, in use July 15. A choice second early, stalk small to medium, growth vigorous, very good size ear, quality good, desirable.

CELERY.

A few varieties of celery were planted, and with very favorable results.

Giant Paschal.—Henderson. Grows very rapid, height about two feet, very broad and thick ribbed, perfectly stringless, very crisp, flavor choice, splendid keeper, one of the very best.

Golden Self Blanching.—Henderson. A splendid early variety, very showy, fine flavor, growth medium, blanches a beautiful white, with leaves of a rich golden yellow color, very crisp.

New Rose.—Henderson. An excellent variety, medium growth, flavor choice, very crisp, a good keeper, blanches well, color beautiful pink, foliage light green, very showy, desirable.

Kalamazoo Broad Ribbed.—Everett. A choice variety, grows to a good size, flavor excellent, very broad thick ribbed, crisp, easily grown, a good keeper.

WATER MELONS.

Our space for melons being very limited, only a very few hills of each variety were planted. The land, an apple orchard, having but few trees in it, is what would be considered very fair old land. In February there were spread tobacco stems at the rate of one ton per acre. The ground was well and deeply plowed in April, and pulverized thoroughly. The melons were planted in hills twelve feet apart; cultivated first deep, later on shallow.

Boss.—Landreth. Planted May 8, ripe August 15. A choice melon of medium size, prolific, color very dark green, color of flesh blood red, very thin rind, very sweet, flavor fine.

Gragg.—Livingston. Planted May 8, ripe August 12. An

excellent melon, of good size, very prolific, color dark and light green stripes, flesh a rich yellow color, thin rind, splended flavor, a beauty on the table.

Hoosier King.—Everett. Planted May 8, ripe August 8. A fine large melon, very prolific, color dark and light green stripes, color of flesh medium red, shape a very regular oblong, quality excellent.

Wisconsin Hybrid.—Salzer. Planted May 8, ripe August 18. A splendid melon of fine size, prolific, color light and dark green stripes, color of flesh red, flavor fine, very thin rind, good yielder.

Kentucky Wonder.—Northrump, Braslan & Goodwin Co. A most excellent variety, of medium size, very prolific, shape oblong, color dark green, flesh scarlet, fine flavor, one of the best varieties grown. Kentucky Wonder was raised by us in 1889, with the same results as above.

MUSK MELONS.

Superior.—Maule. Planted May 8, ripe August 10. A globe shape melon, of medium size, finely netted, flesh green, fine flavor, very sweet.

Princess.—Salzer. Planted May 8, ripe August 15. A globe shape melon, deeply ribbed, finely netted, size medium, flesh salmon, excellent flavor.

Queen of All.—Salzer. Planted May 8, ripe August 15. A globe shape melon, deeply ribbed, slightly netted, medium size, flesh salmon, very thick, excellent.

Osage.—Everett. Planted May 8, ripe August 15. Shape oblong, slightly ribbed and netted, flesh salmon, very thick, flavor very rich and sweet, excellent.

Miller Cream.—Liyingston. Planted May 8, ripe August 15. An oblong melon, green rind, slightly ribbed, flesh salmon, very fine, rich and juicy.

Perfection.—Livingston. Planted May 8, ripe August 15. A globe shape melon, deeply ribbed, finely netted, flesh golden or salmon, flavor very fine, good.

Emerald Gem.—Everett. Planted May 8, ripe August 18. A globe shaped melon, deeply ribbed, smooth, flesh salmon color and very thick, flavor choice, very rich, splendid.

Growers' Pride.—Everett. Planted May 8, ripe August 18. A globe shape, deeply ribbed and netted melon, flesh green, very juicy and sweet.

Extra Early June.—Landreth. Planted May 8, ripe August 12. A medium size flat melon, deeply ribbed and netted, green rind and flesh, flavor very good.

Extra Early Cape May.—Landreth. Planted May 8, ripe August 12. A round melon, ribbed and netted, flesh green, very good.

Salmon and Green.—Landreth. Planted May 8, ripe August 18. An oval shape melon, very lightly ribbed and netted, rind dark green, flesh orange, almost solid, flavor the very choicest, none better.

Reedland Giant.—Landreth. Planted May 8, ripe August 20. A large, oblong melon, pointed at ends, yellow rind, flesh green, very good.

Large Black Paris.—Landreth. Planted May 8, ripe August 15. A large oblong melon, deeply ribbed and very little netted, very dark rind, flesh yellow, flavor good.

BULLETIN No. 33.

EXPERIMENTS WITH CORN.

These experiments are a continuation of those begun two years ago. They may be discussed under the following heads:

1. The effect of the leading elements of plant food, used in various combinations, on the production of corn.

2. Permanency of effect of potash fertilizers.

3. The relation of fertilizers to shrinkage, and to the proportion of cob to kernel.

The results obtained this year are almost identical with those of the last two years; that is:

First. That in those plots, where potash was one of the ingredients of the fertilizers used, there was a marked increased yield, both in corn and fodder.

Second. That in plot 15, where a fertilizer was used without

potash, there was scarcely any increase in yield over those plots receiving no fertilizer.

Third. That the greatest increased yield was made by using a combination of potash and nitrogen.

Fourth. The use of muriate of potash alone resulted in a marked increased yield over the plots receiving no fertilizers.

Fifth. That there was a profit in the use of fertilizers in every instance where potash was one of the ingredients, the largest net profit arising from the use of the mixture of nitrate of soda and muriate of potash.

Sixth. That there was a loss by the use of fertilizers where potash was not one of the ingredients.

Seventh. That so far, potash fertilizers have shown their effect the third season after application.

EXPERIMENTS IN DETAIL.

THE SEASON.

The season was unfavorable to the growth of corn. Continued rains in the early part of the season hindered cultivation, and later a drouth checked the growth of corn to a considerable extent. The latter part of the season was favorable.

The following table gives the summary of rain-fall, the mean temperature and the average per cent. of sunshine during the months of April, May, June, July, August, September and October:

Month.	Rainfall. Inches.	Degrees Mean Temperature.	Per Cent. Sunshine.
April	3.59	55.6	36
May	4.71	63.2	38
June	7.43	76.6	47
July	3.14	75.8	57
August	7.32	71.3	43
September	1.82	66.8	42
October	2.38	56.3	35

The Soil.—The soil of the Experiment Station Farm is what is termed a "Blue Grass" soil. It is derived from the Lower Silurian limestone, rich in phosphoric acid. The subsoil is a light colored clay, so retentive as to make the soil deficient in natural drainage The land is worn, having been in cultivation for many years. It is believed that no stable manure or other fertilizers were applied before the farm was purchased by the Station.

1. *Experiments showing the effect of the leading elements of plant food, used in various combinations, on the production of corn.*

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

The field used for the fertilizer experiments was the same as that used for the experiments heretofore. The plots receiving no

fertilizers the past years received none this year, and likewise the plots receiving fertilizers during the past years received the same kind in each case this year. The field in question is nearly level, slightly sloping lengthwise of the plots. Size of plots, one tenth of an acre.

The plots were treated exactly alike except as to fertilizers, care being taken to plow the entire acre the same day at every working. The hills were thinned to two stalks.

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

TABLE 1.

Showing Fertilizers Applied Per Acre, and Per Cent. of Ingredients in the Fertilizers.

Number	Fertilizer Used.	Number of pounds.	Number of pounds of the leading elements of plant food.			Per cent. of the leading elements of plant food in fert'lz'rs used.		
			Phosphoric Acid . .	Potash . .	Nitrogen .	Phosphoric Acid . .	Potash . .	Nitrogen .
2	No Fertilizer.	. .	. . .	. . .	. . .	. . .	. . .	. . .
3	Acid Black. . . . . 320 Muriate of Potash . . . . 160 Nitrate of Soda. 160		57.6	80	25.6	9.00	12.5	4
4	Acid Black. . . . . 320 Muriate of Potash . . . . 160 Dry Dirt. 160		57.6	80	0	9.00	12.5	0
5	Acid Black. . . . . 320 Nitrate of Soda. . . . . 160 Dry Dirt. 160		57.6	0	25.6	9.00	0	4
6	Muriate of Potash . . . . 160 Nitrate of Soda. . . . . 160 Dry Dirt. 320		0	80	25.6	0	12.5	4
7	No Fertilizer.	. . .	. . .	. . .	. . .	. . .	. . .	. . .
8	Muriate of Potash . . . . 160 Dirt 480		0	80	0	. . .	12.5	. . .
9	Acid Black. . . . . 320 Dirt 320		57.6	0	0	9.00	. . .	. . .
10	Nitrate of Soda. . . . . 160 Dirt 480		0	0	25.6	. . .	. . .	4

By reference to the table, it will be seen that acid black containing 18 per cent. of phosphoric acid was used to supply that ingredient, muriate of potash containing 50 per cent. of potash, for potash, and nitrate of soda containing 16 per cent. of nitrogen to supply nitrogen.

FIELD NOTES.

The following field notes are given to show the effects of the fertilizers at the various stages of the growth of the corn. These notes were taken in the field on the date given.

Plot 2. No fertilizer, planted May 12th, up May 25th; June 15th, very poor; July 1st, poor; July 15th, very poor; July 19th, tasseling; July 22d, shooting; July 26th, silking. Height 6½ feet.

Plot 3. Fertilizers, 16 pounds nitrate of soda, 32 pounds acid black, 16 pounds muriate of potash. Planted May 12th, up May 25th; June 15th, looks well; July 1st, good; July 15th, good; July 16th, tasseling; July 17th, shooting. Height 8 feet.

Plot 4. Fertilizers, 16 pounds muriate of potash, 32 pounds acid black. Planted May 12th, up May 25th; June 15th, good; July 1st, good; July 15th, good; July 16th, tasseling; July 18th, shooting; July 23d, silking. Height 7½.

Plot 5. Fertilizers, 16 pounds nitrate of soda, 32 pounds acid black. Planted May 12th, up May 25th. June 15th, fair; July 1st, very fair; July 15th, looks very well; July 18th, tasseling; July 20th, shooting; July 25th, silking. Height 6½ feet.

Plot 6. Fertilizers, 16 pounds of muriate of potash, 16 pounds nitrate of soda. Planted May 12th, up May 25th. June 15th, choice; July 1st, choice, very even; July 15th, choice, tasseling; July 18th, shooting; July 22d, silking. Height 8 feet.

Plot 7. No fertilizer. Planted May 12th, up May 25th. June 15th, only fair; July 1st, fair; July 15th, fair, very uneven; July 20th, tasseling; July 22d, shooting; July 26th, silking. Height 6½ feet.

Plot 8. Fertilizer, 16 pounds muriate of potash. Planted May 12th, up May 25th. June 15th, good; July 1st, good; July 15th, very good; July 16th, tasseling; July 20th, shooting; July 24th, silking. Height 8 feet.

Plot 9. Fertilizer, 32 pounds acid black. Planted May 12th, up May 25th. June 15th, only fair; July 1st, only fair; July 15th, fair; July 22d, tasseling; July 22d, shooting; July 26th, silking. Height, 7 feet.

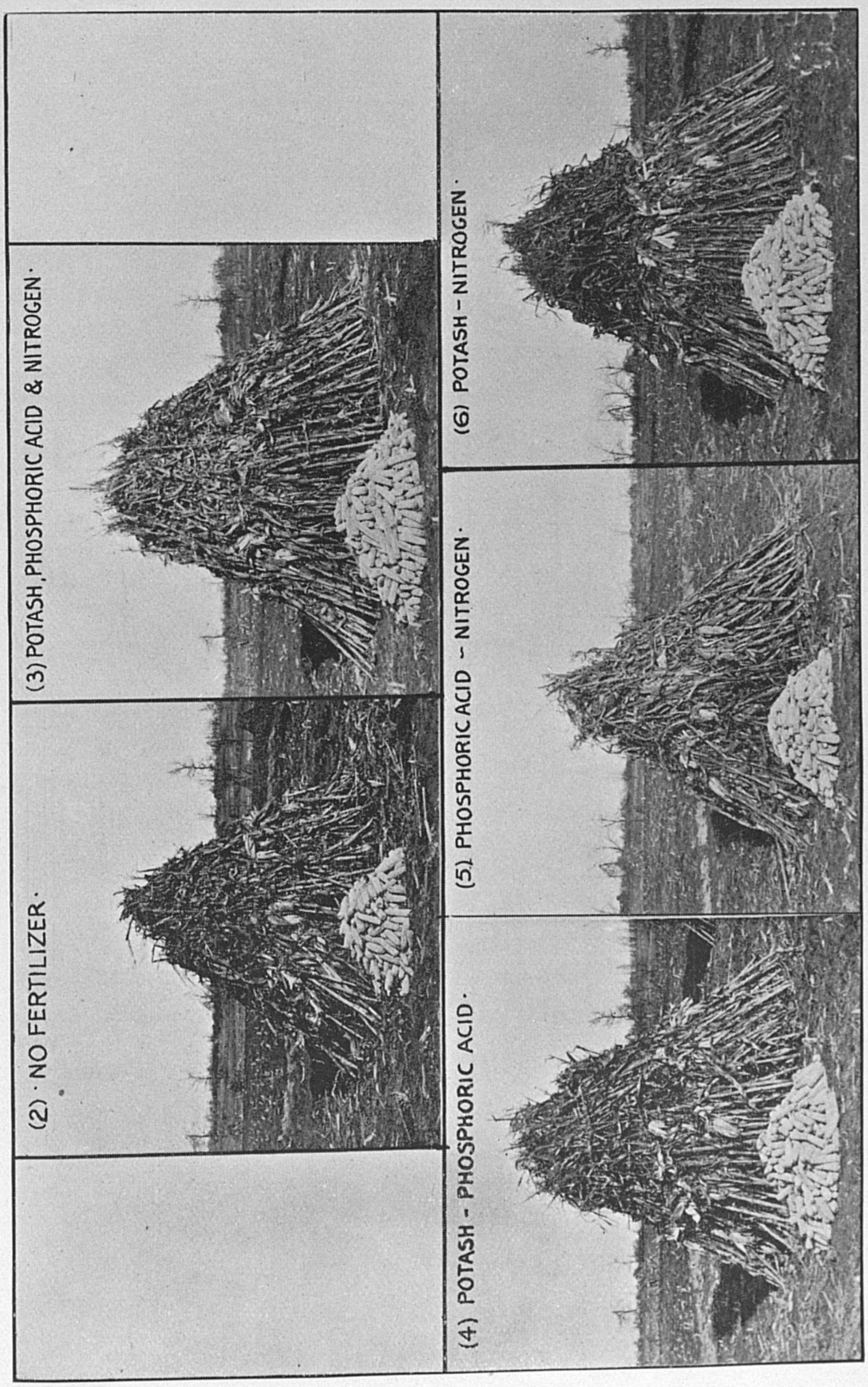
Plot 10. Fertilizer, 16 pounds nitrate of soda. June 15th, fair; July 1st, fair; July 15th, only fair; July 18th, tasseling; July 22d, shooting; July 26th, silking. Height, 6½ feet.

The following table shows the yield of the field cured ear corn and fodder, calculated per acre, as well as the fertilizers used, and the increased yield of corn and fodder resulting from the use of the fertilizers. The corn is given in bushels, containing 70 pounds per bushel. Under "yield of fodder" we include the whole amount of stalks, leaves, etc., after removing the ears, and it should be noted that the corn was cut near the ground for the sake of uniformity.

TABLE 2.

Showing Results of Fertilizers on Corn.

No. of Plot	Fertilizer Used.	No. of Pounds of Fertilizer Applied Per Acre	Yield of Ear Corn Per Acre, in Bushels of Seventy Pounds	Yield of Fodder in Pounds Per Acre	Increased Yield of Corn in Bushels Per Acre.	Increased Yield of Fodder in Pounds Per Acre
2	No Fertilizer		40	2,870		
3	Nitrate of Soda Acid Black Muriate of Potash	160 320 160	72	3,490	35	680
4	Muriate of Potash Acid Black	160 320	65	3,350	28	740
5	Nitrate of Soda Acid Black	160 320	33	2,620	0	
6	Muriate of Potash Nitrate of Soda	160 320	76	3,790	39	980
7	No Fertilizer		34	2,750		
8	Muriate of Potash	160	67	3,270	30	460
9	Acid Black	320	36	2,490	0	
10	Nitrate of Soda	160	35	2,430	0	



FROM PHOTOGRAPHS.—SHOWING EFFECT OF FERTILIZERS ON CORN.

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corn

Number of Plot.
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9
10

FINANCIAL RESULTS.

The Financial Results obtained by the use of the fertilizers in various combinations may be seen in the following table. The acid black costs at the rate of $4.00 per acre, the muriate of potash $3.60, and nitrate of soda $3,60. In these estimates, the corn is rated at 40 cents per bushel:

TABLE 3.

Showing Financial Results.

Number of Plot.	Fertilizer Used.	Cost of Fertilizer Used Per Acre.	Value of Corn Per Acre.	Value of Increased Yield of Corn Per Acre.	Profit or Loss.
2	No Fertilizer.		$16 00		
3	Nitrate of Soda. Acid Black. Muriate of Potash	$11 20	28 80	$14 00	$2 80
4	Muriate of Potash. Acid Black.	7 60	26 00	11 20	3 60
5	Nitrate of Soda. Acid Black.	7 60	13 20		*1 60
6	Muriate of Potash. Nitrate of Soda.	7 20	30 40	15 60	8 40
7	No Fertilizer.		13 60		
8	Muriate of Potash	3 60	26 80	12 00	8 40
9	Acid Black.	4 00	14 40		*4 40
10	Nitrate of Soda.	3 60	14 00		*4 40

* Loss.

THE PERMANENCY OF EFFECT OF POTASH FERTILIZERS.

The following tables give results of a set of experiments made to test the length of time potash fertilizers will remain in the soil and still be available as plant food. This series was begun three years ago to test the comparative value of Phosphatic fertilizers, but finding our land unsuitable for that purpose, it was determined to use these plots to test the permanency of effect of potash fertilizers. The results in 1888 were as follows:

TABLE 4.

Results in 1888.

No. Plot.	Fertilizer Used.	No. of Pounds of Fertilizer Applied Per Acre.	Yield of Ear Corn Per Acre in Bushels.	Yield of Fodder in Pounds Per Acre.	Increased Yield of Corn in Bushel Per Acre.	Increased Yield of Fodder in Pounds Per Acre.
1	No Fertilizer		27.9	3,500		
2	Potash Sulphate Ammonia Sulphate. Dried Blood.	160 260 100	64.1	5,150	37.5	1,580
3	Same as No. 2		79.9	5,920	53.3	2,350
4	Same as No. 2		73.6	5,200	47.	1,630
5	Same as No. 2		75.4	5,465	48.8	1,890
6	Same as No. 2		73.	5,640	46.4	1,890
7	Same as No. 2		76.7	6,090	50.1	2,520
8	Same as No. 2		75.1	6,115	48.5	2,540
9	Same as No. 2		77.6	6,310	51.	2,740
10	No Fertilizer		25.3	3,640		

Here follow tables showing the fertilizers applied in 1889 and 1890, and results:

TABLE 5.

Results of 1889.

No. of Plot.	Fertilizers Used.	No. Pounds of Fertilizer Applied Per Acre.	Yield of Ear Corn Per Acre in Bushels.	Yield of Fodder in Pounds Per Acre.	Increased Yield of Corn Per Acre in Bushels.	Increased Yield of Fodder Per Acre in Pounds.
1	No Fertilizer		39	2,400		
2	Cotton Seed Hull Ashes	500	78	3,260	39	860
3	No Fertilizer this year		69	3,200	30	800
4	Muriate of Potash	200	76	3,940	37	1,540
5	Sulphate of Potash	200	78	3,600	39	1,200
6	Kainit	800	76	3,970	37	1,570
7	No Fertilizer this year		67	3,480	28	1,080
8	Tobacco Stems	3,000	84	3,270	45	870
9.	No Fertilizer this year		71	3,220	32	820

Results in 1890.

Number of Plot	Fertilizer Used.	Number of Pounds of Fertilizer Used per Acre	Yield of Ear Corn in Bushels per Acre	Yield of Fodder in Pounds per Acre	Increased Yield of Corn in Bushels per Acre	Increased Yield of Fodder in Pounds per Acre
1	No Fertilizer	....	30.5	1,970	...	....
2	No Fertilizer (Cotton Seed Hull Ashes in 1889)	(500)	61	3,270	37.3	1,733
3	No Fertilizer since 1888	....	51	2,780	27.3	1,243
4	Muriate of Potash 1889 and 1890	160	59	3,030	35.3	1,493
5	No Fertilizer (Sulphate Potash in 1889)	(200)	51	2,530	27.3	993
6	No Fertilizer (Kainit in 1889)	(800)	44	3,300	20.3	1,763
7	No Fertilizer since 1888	....	44	2,530	20.3	993
8	Tobacco Stems in 1889 and 1890	2,000	71	3,580	47.3	2,043
9	No Fertilizer since 1888	....	47	3,040	23.3	1,503
10	No Fertilizer	....	17	1,105	....	....

By a study of the tables it will be seen that the fertilizers applied 1888 were of benefit to the crops of 1890, as shown by the yield of plots 3, 7 and 9.

THE RELATION OF SHRINKAGE AND PROPORTION OF KERNEL TO CORN.

For the purpose of continuing the study of the above question, the corn on Plots 2 to 10 (see table first), after being husked and weighed, was spread on the floor of the barn loft and allowed to cure. The loft is well ventilated. After curing, it was shelled. The following table shows the data obtained, and also the num-

ber of ears required to make a bushel of corn, and number of pounds:

Table Showing the Size of Ears, Loss for Shrinkage, and Weight of Seventy Pounds Ear Corn Shelled.

Number of Plot.	Fertilizer Used.	Number of Ears Per Bushel of 70 Pounds.	Weight of Corn when Husked.	Weight of Corn when Cured February 7.	Weight of 70 lbs of Ear Corn after being Shelled.
2	No Fertilizer	115	207	183	58
3	Nitrate of Soda, Acid Black, Muriate of Potash	90	454	400	58¾
4	Muriate of Potash, Acid Black	91	408	361	58
5	Nitrate of Soda, Acid Black	115	207	181	57½
6	Muriate of Potash, Nitrate of Soda	84	512	453	58
7	No Fertilizer	112	221	201	58
8	Muriate of Potash	91	457	411	58
9	Acid Black	125	233	204	57
10	Nitrate of Soda	123	229	205	56½

BULLETIN No. 34.

COMMERCIAL FERTILIZERS.

In order that farmers may use commercial fertilizers intelligently, they should understand—

First. The wants of their soil to produce given crops.

Second. The "make-up" of fertilizers at their disposal, that they may know whether these wants can be supplied by the use of these fertilizers.

The best way to determine the first question is by field experiments conducted on each farm. The manner of carrying out these trials has been presented in Bulletins 21, 22, 23, 26, 27, 28, 30 and 33, which give the plan of applying the fertilizers, and the results obtained by their use on wheat, potatoes, corn, hemp, tobacco and meadow land. The object of this Bulletin is to consider the second question, that is, the material out of which commercial fertilizers are made, and also to give the analysis of the various brands legally on sale in this State during the year. But first some explanations seem advisable.

EXPLANATIONS.

Sources of Plant Food.—Plants receive their food first from the atmosphere, and second from the soil. The atmosphere supplies by far the greater quantity. The atmospheric supply is always furnished to the plant in abundance, and therefore we need not concern ourselves about it when studying how to supply plant food.

Soil Supply.—The food furnished to the plant by the soil has received a great deal of attention from farmers and scientists. It is well known that plants do not thrive on all soils. Sometimes it is the physical condition of the soil, sometimes because the soil is incapable of giving to the plant the quantity of food

it requires for full development, or kind of food it needs, or both.

Besides the water and the food a plant gets from the atmosphere, it must take up the following substances from the soil in order to thrive. Namely: *Potassium, phosphorus, nitrogen, iron, calcium, magnesium and sulphur.* These elements, although forming a very small portion of the plant, are indispensable to its life. A plant can not be made to grow and develop if *any one of these is absent*, neither can one element be replaced by another. Besides these elements just named, sodium, silicon, chlorine, and manganese, and perhaps traces of other elements are taken up by the plant from the soil, but these last named elements do not appear to be essential to, although some of them play a useful part in, plant life.

NECESSITY OF BECOMING FAMILIAR WITH THE NAMES OF THESE ELEMENTS.

These food elements enumerated above, are the alphabet to the true understanding of artificial fertilization of our soils. It is impossible to understand the whys and wherefores of the fertilization and of plant growth, without becoming familiar with these elements. Before a child can learn to read he must know his alphabet, and for a farmer to use fertilizers intelligently, he must understand the alphabet of elements.

All Matter Made Up of Elements.—All matter, as the rock, soil, water and atmosphere, every thing is made up of elements. Every one is familiar with some of the elements. When we speak of gold every one knows that it is a yellow metal. Gold is an element. It is called an element because we can, by no means now known, separate it into other forms; it is as simple as it can be made, and for this reason it is called *an element.* So also is metallic iron, copper and lead. Water is not an element, because it can be separated into two elements; one is called hydrogen, the other oxygen. Oxygen and hydrogen, however, are each elements because we can not take either separately and make any thing else but hydrogen and oxygen. Now potassium, nitrogen, phosphorus, calcium and magnesium are

also elements, because they can not be changed, however treated, when taken separately into other substances.

DESCRIPTION OF ESSENTIAL ELEMENTS.

Potassium.—Potassium is a solid. It is a metal. It has the property of readily combining with the element oxygen, which is always present in the atmosphere, but when it combines with oxygen it is called potassium oxide, or more commonly, potash. On account of this property of potassium combining so readily with oxygen it is rarely ever seen, except in the laboratory or manufacturing shop in the form of the element, but more frequently in the form of its combination with oxygen.

Nitrogen.—Nitrogen, as a gas, makes up the greater bulk of the air. We are not familiar with it, because it is not perceptible. It combines with the gas oxygen to form nitric acid, and also with hydrogen to form ammonia.

Calcium.—Calcium is a metal, but is rarely ever seen as such. When the element calcium combines with oxygen, the substance formed is known as lime, with which every one is familiar; therefore, when we speak of lime we mean the element calcium combined with oxygen, which is sometimes called calcium oxide.

Magnesium.—The element magnesium combines with oxygen, and the substance formed is called magnesia.

Sulphur.—Sulphur is an element, and we see it in commerce in the form of brimstone or flowers of sulphur; it may also be made to combine with the element oxygen. When combined with oxygen and hydrogen in certain proportions, it makes what is called *oil of vitriol* or sulphuric acid.

Phosphorus.—Phosphorus is an element. It is a solid, and unless it is kept from the air it will combine with oxygen to form phosphoric acid so readily that it will take fire. It is generally seen in sticks covered with water.

The Food Elements Generally Combined with Oxygen in the Soil.—The elements which the plant takes up from the soil as food are, generally speaking, combined with oxygen, and, therefore, instead of using the names of the elements, we use the names of their oxides. For illustration, we say lime instead of calcium, because it is calcium oxide that is used as a plant food.

We say phosphoric acid instead of phosphorus, because the plant always takes up the element phosphorus in the form of the oxide of phosphorus. We say potash, because potassium is combined with oxygen in the soil or with an acid.

Salts.—A salt is a substance formed by the action of an acid on a base, the latter being simply another name for metallic oxide. For example, common salt is formed by the action of hydrochloric acid on soda, and when lime and phosphoric acid are put together they combine and form a salt called calcium phosphate; so also, when lime and sulphuric acid are put together, they combine and form calcium sulphate. In place of lime, if we put in potash they combine and form potassium phosphate or sulphate, according to the acid used. If in place of sulphuric acid we use nitric acid, then potassium nitrate is formed or calcium nitrate, according to the base used. In commercial fertilizers these salts are generally used to furnish the elements required to enrich the soil, because these are the cheapest and most available forms in which they can be obtained.

The Use of Fertilizers.—A rich soil contains an abundant supply of elements for plant food in such a form that the plant can readily assimilate them. As stated before, these elements are *phosphorus*, *potassium*, *nitrogen*, *calcium*, *magnesium*, *iron and sulphur*. A virgin soil usually contains an abundant supply of plant food, as the elements taken from the soil by the plants are returned to it again when the plants decay. Such soil needs no manuring. As soon as the land is brought under cultivation, however, the vegetable and animal products are taken from the soil in the form of wheat, tobacco, cattle, sheep, &c. Sooner or later, under this drainage, the land will become infertile. If permanent fertility is to be maintained, provision must be made at least to return a part of the plant food taken from it, hence the necessity of fertilizing. On worn and very poor soils it is sometimes necessary to make a complete return of the elements of plant food taken off by the crops. Fortunately, in most soils there is an abundance of some of these elements, and consequently a partial fertilization will answer. Generally speaking, the elements iron, sulphur and magnesium are found in abundance to supply a maximum crop. Many

soils also contain a sufficient quantity of calcium or lime, therefore the principal fertilizing elements to be looked after are

POTASSIUM, PHOSPHORUS AND NITROGEN

It will be found generally that the worn soil is deficient, either in one of these elements, or any two, or all three of them; *or if the soil contains them* in sufficient quantity, they are not in a form to be taken up by the plants.

This last statement is a very important one, as the proper treatment can sometimes make a rich soil out of a poor one, by getting the elements into an available form for the plants, as by the application of lime or plaster, or cultivating the soil, or under-draining, or by the use of soiling crops, as clover, rye, &c.

HOW TO FURNISH CROPS WITH THE IMPORTANT ELEMENTS OF PLANT FOOD.

First. The poor worn soil is not always deficient in the important elements of plant food, potash, nitrogen and phosphoric acid; but these elements may be in such combinations with other elements that the plant cannot appropriate them as plant food. It is evident, therefore, any method that will make these elements available to the plant will enrich the soil. Tillage assists in disintegrating the soil. Drainage also assists, as, when the water is drained from the soil, the air circulates through it better, and thus decomposes it. The application of indirect fertilizers also assists in liberating for the plant the important elements. Gypsum or plaster liberates potash; and thus, very often, soils that need potash fertilizers are enriched by the applicatton of plaster. Lime and salt are also indirect fertilizers; they also assist the physical condition of the soil. Rotation of crops has its influence on making the plant food of the soil available, or bringing it from the subsoil. Thus, a deep-rooted crop, as clover, gets some of its food from the subsoil, and brings it up to the surface soil in the roots, which becomes available for the next crop. Leguminous plants, or those plants which have their seed inclosed in a pod opening on either side, as clover, peas, etc., are supposed also to make some of the nitrogen in the soil available, which other plants cannot.

Second. The soil can be enriched by the application of natural fertilizers, as barnyard manure, refuse vegetable matter of all sorts, tobacco stems, cotton seed meal, cotton seed hull ashes, wood ashes, etc , and green crops for plowing under. Barnyard manure is a complete fertilizer—that is, it supplies all the essential elements of plant food. Tobacco stems supply potash and nitrogen. Cotton seed meal, principally, nitrogen. Cotton seed hull ashes, mostly, potash These natural fertilizers should be husbanded by every farmer and used, as far as they will go, in renovating the soil, as in most cases they are in the cheapest form for supplying the potash, nitrogen and phosphoric acid where they are already on the farm; but where crops are continually taken from the farm, these sources will not always supply the wants of the soil. This leads us to the consideration of artificial fertilizers.

Third. Artificial Fertilizers.—Artificial fertilizers are manufactured and sold for the purpose of furnishing nitrogen, phosphoric acid and potash. Various substances are used to furnish these ingredients.

Nitrogen.—Nitrogen is generally supplied from the following substances:

First. Nitrate of Sodium. An enormous deposit of this salt, containing much common salt, is found in the dry plains of Peru. Before shipping this fertilizer it is purified by dissolving in water and crystalizing. It contains about 16 per cent. of nitrogen. It is an excellent fertilizer for all crops requiring an artificial supply of nitrogen. Nitrate of sodium should not be mixed with damp acid phosphates, else some of the nitrogen will be lost on keeping. It is quicker in its action than any other nitrogenous manure, and, therefore, it is the best manure to employ for nitrogen when a late application has to be given. It is easily washed out of the soil, and, therefore, should not be applied until needed.

Second. Sulphate of Ammonium. This substance contains about 20 per cent. of nitrogen. It is prepared from the ammonical products of gas works, coke ovens, bone distilleries, etc.

Third. Organic nitrogen, from dried blood, tankage, waste of slaughter-houses, bones and fish scrap, or from cotton seed meal,

castor pomace, or other vegetable products rich in nitrogen. Dried blood contains from 10 to 16 per cent. of nitrogen. Tankage varies from 3 to 10 per cent. Bones from 2 to 5 per cent. Cotton seed meal from 7 to 8 per cent.

Nitrogen from these organic substances is not as readily available as the nitrogen from the nitrate of sodium, and, therefore, is best for fall crops where action is desired in the spring of the year, as it is retained in the soil longer.

Fourth. Guanos.

Nitrogen is the most expensive element in fertilizers, and it is generally the element soonest exhausted in the soil.

Phosphoric Acid.—Next in importance to nitrogen, as a plant food, comes phosphoric acid. This acid usually combines in the soil with lime, magnesia and iron. In these forms it is insoluble in water, so that practically there is no loss by drainage. The source of loss is that carried off by the crops. The loss can be supplied only by the use of fertilizers. Phosphate of lime is the general source of phosphoric acid in fertilizers. There are many sources from which the phosphoric acid is obtained for commercial fertilizers, such as :

1. Bone meal.
2. Bone ash.
3. Bone black.
4. Phosphate rock.
5. Superphosphate of lime, or acid phosphate.
6. Thomas slag and guano.

1. *Bone Meal.*—Bone meal is valuable not only for the phosphoric acid which it contains, but also for its nitrogen. "Bones are composed of two distinct substances which interpenetrate one another." There is, as it were, a skeleton of earthy matter, which is called phosphate of lime or bone phosphate, and a flesh of organic matter, which is called ossein. Ossein is a highly nitrogenized substance.

The fineness to which bones are ground is an important consideration as to their value. The finer the meal, so much more readily will it putrefy and dissolve in the soil, and so much sooner will the crops be fed. There is some difficulty in grinding fresh raw bones. To obviate this difficulty they are gen-

erally steamed, or carried through some process whereby the fat is extracted. Steamed or desiccated bones, if not very strongly steamed, are better for fertilizers than raw bones. This is contrary to the general belief, but raw bones contain the fat, which is not only useless to the plant, but adds weight and clogs the meal, and hinders decomposition of the bone in the soil. Of course the steaming process must not be carried on to such an extent as to extract the nitrogenous portion of the bone. It is true that some of the nitrogen is lost, nevertheless the meal from steamed bone has proved itself to be better than from ordinary raw bone.

2. *Bone Ash* is sometimes used as a fertilizer. It is shipped from South America. It is generally used to make other forms of phosphates, such as superphosphates.

3. *Bone Black.*—The spent black from sugar refineries is sold to manufacturers of fertilizers. When bones are heated in iron cylinders, into which air is not allowed to enter, gas, water, oily matters, and other products are driven off, while bone charcoal is left in the cylinders. This product is used to take the coloring out of raw sugars. After a time it becomes worthless for this purpose, when it is sold for fertilizing purposes, as all the lime phosphate still remains. The decomposition of bone black in the soil goes on slowly, and therefore it is not generally applied as such, but after treatment with sulphuric acid.

4. *South Carolina and Florida Rock, Apatite, Etc.*—These mineral sources of phosphates are with great difficulty decomposed in the soil, and so slowly that in general it does not pay to put these ground rocks on the soil before putting them through a process which will make the most of the phosphoric acid readily available to the plant. This leads us to the consideration of

5. *Superphosphates.*—In order to make these various phosphates more rapid in their action they are treated with sulphuric acid, commonly called oil of vitriol. This treatment converts the insoluble phosphate into a soluble phosphate of lime called *superphosphate of lime*, sulphate of lime or gypsum being formed at the same time.

When bone, bone ash, bone black, or mineral phosphates are

treated with sulphuric acid in sufficient quantity, the superphosphate formed contains the phosphoric acid in a form soluble in water. After standing, or when superphosphate is applied to the soil, the phosphoric acid is in the reverted form, as it has gone back to a form insoluble in water. This reverting of the phosphoric acid does not materially change its value as a fertilizer, for experiments have shown that plants can take up the phosphoric acid in this state as readily as in the soluble form. When the sulphuric acid is added in insufficient quantities to dissolve all the phosphates, some of the phosphoric acid remains in the insoluble form. This insoluble phosphoric acid is not as available to the plant, and it is much cheaper in the markets. In making an analysis of a fertilizer, therefore, we separate the phosphoric acid into three divisions of *soluble*, *reverted* and *insoluble phosphoric* acid, giving to each its value.

The "soluble" and "reverted" forms of phosphoric acid are both readily assimilable by plants, and hence are sometimes included under the common name of "available phosphoric acid." The "available phosphoric acid" in an analysis is equal to the sum of the "soluble" and "reverted" phosphoric acid.

Potassium.—Potassium ranks next to phosphorus as a valuable food for plants. Plants consume this element in comparatively large quantities, and some soils are unable to supply the demand; especially is this the case with light, sandy soils.

Primarily, the plants obtain potash from the decomposition of minerals or rocks containing potash. Thus feldspar contains from 10 to 16 per cent. of potash. It is potash combined with silica and alumina. As such it is insoluble and not available to the plant. In the decomposition of this rock clay is formed and a soluble potash salt, which then becomes available. This decomposition goes on gradually, and thus in most clay soils available potash salts are being continually liberated for the use of the plant. Stirring the soil accelerates this decomposition, and the presence of lime or gypsum increases decomposition. In such soils, therefore, the application of lime has another use besides that of plant food.

Plants vary largely as to the amount of potash they require. For example, an acre of wheat yielding 20 bushels, requires

about 28 pounds of potash; while an average crop of potatoes requires 100 pounds of potash per acre, and an acre of tobacco yielding 3,800 pounds of leaves and stalks assimilates over 200 pounds of potash. It is evident, therefore, that the continual cropping of soils with potatoes or tobacco will, in time, exhaust the potash supply. Light and sandy soils require this element almost from the start.

The sources of potash, as generally found in fertilizers, are—

1. Sulphate of potash.
2. Muriate of potash.
3. Kainit and sylvinite.
4. Cotton seed hull ashes.
5. Wood ashes.
6. More rarely the nitrate of potash.

The sulphate and muriate of potash and kainit and sylvinite are imported from Germany, where they are mined in great abundance.

DIFFERENT FORMS OF FERTILIZERS.

Usually commercial fertilizers contain two or all of the *essential ingredients*, viz: nitrogen, phosphoric acid and potash, but sometimes only one. Plain superphosphates contain only *phosphoric acid.* Ammoniated superphosphates contain nitrogen and phosphoric acid. Bone contains, and is valuable for, both nitrogen and phosphoric acid. Potash salts, of course, are valuable for their potash only. A complete fertilizer is one containing *nitrogen, phosphoric acid and potash.*

EXPLANATIONS IN REGARD TO THE TABLES.

The farmers should study carefully the tables of analyses in this Bulletin before purchasing commercial fertilizers.

It will be noticed that besides moisture (which is noted simply to compare the different analyses of the same brand), there is given in the tables the *amount of phosphoric acid* in its *soluble, reverted* and *insoluble form, nitrogen*, and its equivalent in ammonia, and *potash* for each brand. Now the selling value of a commercial fertilizer should depend upon the amount of the

various forms of phosphoric acid, the nitrogen, and the potash it contains; for, as has been said, it is to supply the plants with *phosphoric acid, nitrogen and potash* that the fertilizer is mainly applied to the soil. As regards phosphoric acid, the *soluble and reverted* forms should be particularly noted. They are the forms capable of being readily taken up as a food for the plant, while the *insoluble phosphoric acid* does not, in all probability, serve as food to the plant at once, and probably not for a year or more. For this reason this form of phosphoric acid is not as valuable to the farmer as the other forms. It is also the cheapest form of phosphoric acid in the market. Nitrogen is another element of great importance and value as a fertilizer, and is needed in most every soil where fertilizers are applied with benefit. Potash is the cheapest essential ingredient of a commercial fertilizer, but in some crops, and especially tobacco and potatoes, it is a very important element.

The Estimated Value.—In the last column of each table is given the value in dollars and cents of the different fertilizers. These values are estimated from the essential ingredients contained in the fertilizers, and the forms in which they exist. In other words, they express the *commercial value*, or about the price the ingredients could be bought for on the open market, mixed and put upon the market as fertilizers. These values are not intended to express the *agricultural value* of the fertilizers, or the profit they will give the farmer by their use. They are intended rather to notify him, if he intends to purchase fertilizers, that from quotations this year of the essential ingredients of these fertilizers, he should be able to purchase them for about the estimated price given in the table. Another, and perhaps the most important use of these estimated values, is to assist the farmer in determining which is the cheapest fertilizer for him to purchase. In choosing between several fertilizers of the same kind—that is, containing the same essential ingredients in about the same proportion, the one that has the highest "estimated value per ton" in the table of analyses would be preferable at the same cost. Or, if the "estimated value per ton" is about the same in all, the one that sells for the least is to be preferred. Take, for example, a supposable case: A farmer desires to purchase ten tons of some commercial fertilizer

for his tobacco crop. His land is poor, and he concludes to purchase a fertilizer containing all three of the essential ingredients, namely, phosphoric acid, potash and nitrogen. He goes to his merchant, and finds that he has two brands for sale. No. 1 is priced at $40 per ton, and No. 2 at $30. The farmer refers to the table in this Bulletin, and finds the two brands relatively alike as to the essential ingredients. No. 1 is estimated at $40, and No. 2 at $25. It is evident, from the estimated values, that he should purchase the higher-priced fertilizer, for if he paid $40 for this brand, he should pay but $25 instead of $30 for the cheaper one.

The Analyses.—But the analyses given on the tags, signed by the Director, attached to each sack or package of fertilizer, or in the tables of this Bulletin, should be carefully considered, as well as the estimated value, *for the estimated value is not a sufficient guide to determine which of two or more fertilizers to purchase*, except in those cases where the proportions of phosphoric acid, potash and nitrogen are relatively the same. To illustrate the importance of considering the analyses, as well as the estimated value, let us take an example: Suppose a farmer desires to purchase a fertilizer for his tobacco crop. He goes to his merchant, and is offered either of two brands at the same price. The price, fortunately, does not help him to decide in this case. He next looks at the tags attached to the sacks, and finds that the Director has estimated each fertilizer at $30 per ton. He next looks at the analyses, and finds fertilizer No. 1 to contain:

Soluble Phosphoric Acid	8 per cent.
Reverted " "	7 per cent.
Potash	None.
Nitrogen	None.

And fertilizer No. 2 to contain:

Soluble Phosphoric Acid, Reverted " "	7.5 per cent.
Nitrogen	3.0 per cent.
Potash	4.2 per cent.

He is now able to judge quickly which of the two fertilizers

to purchase. If his soil needs phosphoric acid, he will quickly decide on No. 1, for he will get twice as much for the same money, while did he purchase No. 2 he would have paid $15 for the phosphoric acid which he needed, and $15 for the nitrogen and potash which he did not need. But should he be in doubt whether his land needed one or all the elements of a fertilizer, he would be wise in purchasing No. 2. For should his soil need potash or nitrogen, or all three of the essential elements, to produce a large tobacco crop, and should he have purchased No. 1, it is doubtful whether he would have received any benefit from it.

On account of the differences in soils, no rule can be given by which to tell what fertilizer is the best for any particular crop, and this question must be decided by actual trial, systematically and carefully made. Some such trials are made at the Station each year, and the Director will be glad to furnish a plan for similar experiments to any one who desires to test the effect of fertilizers on his land.

HOW TO APPLY FERTILIZERS.

In regard to the manner of applying fertilizers, it is generally best to sow broadcast, or drill and work well into the soil before planting. When a small quantity of fertilizer is applied to each hill or row at planting time, it acts mainly as a stimulant to produce an early and vigorous start, which is considered necessary for the tobacco crop, but often renders the crop more sensitive to drouth. *In any case care should be taken to mix the fertilizer with the soil, so that it will not come in contact with the seeds or plants. Most fertilizers, and especially those containing much nitrogen, soluble phosphoric acid or potash, will injure or destroy young plants if brought directly in contact with them.*

FERTILIZERS ANALYZED.

The following tables give the names of all the manufacturers who have complied with the law in 1891, and the names of the brands legally on sale; also the analysis and valuation of each brand.

The following are the values used for the essential ingredients: Phosphoric acid soluble in water, 8½ cents; "reverted" phosphoric acid, 8½ cents; insoluble phosphoric acid, 3 cents; phosphoric acid in fine bone, 4½ cents; in medium bone, 4 cents per pound; potash from muriate, 5½ cents; from sulphate, 7 cents; and nitrogen, 20 cents per pound.

Fine bone is all that passes through a sieve with meshes $\frac{1}{25}$ inch square. Medium bone passes through a sieve with meshes $\frac{1}{6}$ inch square, but does not include fine bone.

TABLE I.—RAW BONE MANURES—ANALYSES AND VALUATIONS.

Station Number	Name and Address of Manufacturer	Name of Brand.	Pounds in the Hundred.							Estimated Value Per Ton.
			Moisture	Phosphoric Acid.			Equivalent to Bone Phosphate	Nitrogen	Equivalent to Ammonia	
				In Fine Bone.	In Medium Bone.	Total				
1501	Thompson & Edwards Fertilizer Co., Chicago, Ill.	World-of-Good Raw Bone Corn Grower	6.06	14.75	1.27	16.02	34.98	4.01	*4.87	$31 03
1510	Northwestern Fertilizing Co., Chicago, Ill.	Fine Raw Bone	8.34	20.67	1.80	22.46	49.06	3.82	4.64	35 31
1511	Same	Ralston's Bone Meal	8.60	9.67	8.24	17.91	39.12	3.10	3.76	27 69
1522	Same	Pure Ground Bone	10.39	26.98	. . .	26 98	58.93	2.24	2.72	33 24
1523	Same	Ground Raw Bone	6.59	17.33	0.84	18.17	39.67	3.02	3 67	28 35
1525	L. Lippman, South Bend, Ind.	Hoosier Bone Meal	6.06	13.94	2.78	16.72	36.52	4.49	5.45	32 73
1531	J. B. Jones, Louisville, Ky	Pure Ammoniated Bone Meal	7.15	14.30	5.96	20.26	44.26	3.19	3.87	30 40
1540	A. B. Mayer Manufacturing Co., St. Louis, Mo.	Anchor Brand Pure Bone Meal	6.77	15.94	6 36	22.30	48.70	4.14	5.03	36 00
1544	J. B. Jones, Louisville, Ky.	Pure Raw Bone Meal	7.11	7.61	14.02	21.63	47.25	4.38	5.32	35 59
1554	Currie Fertilizer Co., Louisville, Ky.	Currie's Raw Bone Meal	7.79	8.54	9.59	18.13	39.59	3.86	†4.69	32 25
1558	Cincinnati Desiccating Co., Cincinnati, O.	Pure Raw Bone Meal	6.06	17.65	5.88	23.53	51.38	3.90	4.73	36 19
1559	Same	Fine Ground Bone	7.55	11.38	8.59	19.97	43.61	3.51	4.26	31 15
1587	Cleveland Dryer Co., Cleveland, Ohio	Superior Bone	7.16	15,92	7.08	23,00	50,24	4.56	5,54	38 23
1602	Thompson & Edwards Fertil-									

1587	Cleveland Dryer Co., Cleveland, Ohio	Superior Bone.	7.16	15,92	7.08	23,00	50,24	4.56	5,54	38 23
1602	Thompson & Edwards Fertilizer Co., Chicago, Ill. . . .	Pure Fine Ground Bone . .	7.13	23.45	. . . .	23 45	51.21	2.97	3.61	32 99
1603	Same	Coarse Raw Bone	7.04	11.89	12.48	24.37	53.23	4.07	4.94	36 96
1615	Same	Pig's Foot Brand Chicago Bone Meal	6.67	11.12	1.63	12.75	26.86	4.19	‡5.09	35 32

* Potash from Muriate, 0.63 per cent.

† Potash from Muriate, 1.32 per cent.

‡ Potash from Muriate, 1.27 per cent.; from Sulphate, 4.18 per cent.

TABLE II.—COMPLETE FERTILIZERS, SUPERPHOSPHATES, ETC.—ANALYSES AND VALUATIONS.

Station Number	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred.								Estimated Value Per Ton.
			Moisture	Phosphoric Acid.			Nitrogen	Equivalent to Ammonia	Potash.		
				Soluble	Reverted	Insoluble			From Sulphate	From Muriate	
1500	Currie Fert. Co., Louisville, Ky.	Currie's Tobacco Grower	6.27	6.82	2.28	2.84	1.58	1.94	7.50	0.72	$34 78
1502	Thompson & Edwards Fert. Co., Chicago, Ill	World-of-Good Potato, Tobacco and Vegetable Grower	8.07	1.29	4.91	7.96	2.92	3.54	7.45	. . .	37 43
1503	J. F. Singer, Nashville, Tenn.	Singer's Tobacco Grower	10.19	4.29	3.73	3.71	1.36	1 65	. . .	4.22	25 94
1512	North-Western Fertilizing Co., Chicago, Ill.	Horse Shoe Brand Tobacco Grower.	10.34	3.01	5.19	5.54	2.85	3.46	1.36	0.43	31 03
1513	Same	Challenge Corn Grower	10.25	2.44	6.17	5.49	2.44	2.96	0.84	0.46	29 38
1517	Same	Kentucky Tobacco Grower	9.68	1.91	6.43	7.37	1.50	1 82	0.49	0.44	25 77
1518	Same	Horse Shoe Brand Potato Grower.	9.93	3.25	5.05	5 39	2.95	3 58	1.07	0.46	31 15
1519	Same	Kentucky-Ana Phosphate	6.03	2.14	6.73	7.66	1.64	1.99	. . .	. . .	26 24
1520	Same	Superphosphate & Raw Bone Mixt.	8.34	1.68	6.66	9.56	2.99	3.63	0.70	0.29	33 18
1521	Same	National Bone Dust	9.97	2.41	5.75	5.86	2.35	2.85	1.28	0.40	29 02
1527	Globe Fert. Co., Louisville, Ky.	Ky. Standard Tobacco Grower	9.83	3.88	3.62	3 81	2.68	3.25	. . .	3.61	29 73
1528	Same	Eagle Fertilizer	7.32	4.50	4.21	4.71	1.99	2 42	. . .	2.07	27 88
1529	Same	Progress Phosphate	8.25	4.89	2.67	4 36	1.76	2 14	. . .	2.98	25 79
1530	Same	Globe Bone Dust	3.21	3.12	4.53	5.26	1 46	1.77	. . .	.	22 01
1533	P. B. Mathiason & Co., St. Louis, Mo.	Increscent Brand Corn Grower	9.96	6.49	2.51	3.79	2.44	2.96	. . .	1.36	28 83
1534	Currie Fert. Co., Louisville, Ky.	Currie's Falls City Phosphate.	5.43	4.94	3.62	4.12	1.59	1.81	0.86	. . .	24 58
1535	Same.	Currie's Dissolved Bone	6.59	7.20	2.19	1 13	0.86	1 04	2.74	. . .	23 92
1536	Same.	Currie's Corn Grower	5.17	4.55	3.82	4 07	1.52	1.75	0.88	. . .	24 66
1537	Same.	Currie's Guano	6.10	7.14	2.26	1.22	0.84	1 02	2.77	. . .	23 95

1537	Same.	Currie's Guano	6.10	7.14	2.20	1.22					
1538	North-Western Fertilizing Co., Chicago, Ill.	Kentucky Corn Grower	18.62	2.72	4.96	5.09	2.31	2.80	0.67	0.30	26 62
1539	Same.	Kentucky Tobacco Grower. . . .	18.38	2.71	5.16	5.35	2.27	2.76	0.64	0.30	26 90
1541	A. B. Mayer Manufacturing Co., St. Louis, Mo.	Anchor Brand Complete Fertilizer.	6.10	0.29	3.10	3.91	3.12	3.79	. . .	1.57	22 32
1542	North-Western Fertilizing Co., Chicago, Ill.	Prairie Phosphate	17.76	2 52	5.42	5.26	2.25	2.73	. . .	. . .	25 66
1543	Same.	Twenty-six Dollar Phosphate. . .	17.33	2.41	5.35	5 46	2.20	2.67	. . .	. . .	25 27
1546	Crocker Fertilizer and Chemical Co., Buffalo, N. Y. . . .	Crocker's Potato, Hop and Tobacco Phosphate.	14.83	7.55	1.24	1.94	2.06	2.50	. . .	3.80	28 52
1547	Same.	Crocker's New Rival Ammoniated Superphosphate.	11.05	5.60	3.61	2.89	1.27	1.54	. . .	1.64	24 27
1550	Same.	Guano Tobacco Grower	13.40	8 47	2.76	2.64	0.97	1.18	. . .	0.92	25 26
1551	Currie Fert. Co., Louisville, Ky.	Currie's Wheat Grower	3.61	5.03	3.91	3.98	1.59	1.93	0.52	0.40	25 12
1552	Same.	Currie's Black Diamond Phosphate.	3.63	7.11	2.41	0.42	0.39	0.47	. . .	0.91	19 26
1553	Same.	Currie's Fal's City Raw Bone Meal.	3.76	4 36	3 88	6.79	0.98	1.19	. . .	1.88	24 63
1560	Cincinnati Desiccating Co., Cincinnati, Ohio	Pure Acidulated Bone	8.10	1.84	8.54	10 89	3.01	3.65	. . .	. .	36 22
1561	Same.	Gilead Phosphate	8.57	2.00	4.45	4.41	3.27	3.97	. . .	2.62	29 58
1562	Same.	Tobacco and Potato Fertilizer . .	8.49	2.70	5.35	3.51	4.34	5.27	2.82	2.70	40 08
1563	Same.	Phœnix Phosphate.	13.79	3 16	4.29	6.40	2.54	3.08	. . .	1.14	27 92
1564	Michigan Carbon Works, Detroit, Mich.	Homestead Tobacco Grower . . .	11.34	8.71	1.98	1.09	3.38	4.10	. . .	4.76	39 58

TABLE 2. Complete Fertilizers, Superphosphates, etc.—Analyses and Valuations—Continued.

Station Number	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred.								Estimated Value Per Ton
			Moisture	Phosphoric Acid.			Nitrogen	Equivalent to Ammonia	Potash.		
				Soluble	Reverted	Insoluble			From Sulphate	From Muriate	
1566	Michigan Carbon Works, Detroit, Mich.	Jarves' Tobacco Fertilizer	7.13	5.77	1.19	1.16	2.18	2.65	. . .	1.68	$23 10
1567	Same	Jarves' Drill Phosphate	6.31	7.51	0.98	1.77	1.24	1.51	. . .	. . .	20 45
1571	John S. Reese & Co., Baltimore, Md.	Crown Bone and Potash	15.26	8.57	2.73	0.81		. .	. .	2.10	22 01
1572	Same	Pacific Guano	8.28	3.81	5.90	1.23	2.51	3.05	. . .	1.47	28 91
1573	Same	Monarch Guano	8.34	3.85	5.94	1.24	2.70	3.28	. . .	1.18	29 48
1574	Same	Excellenza Soluble Guano	8.52	3.94	5.95	1.32	2.68	3.25	. . .	1 19	29 63
1575	Cincinnati Desiccating Co., Cincinnati, Ohio	Ohio Valley Phosphate	11.47	1.46	5.36	4.53	2.27	2.76	1.88	0.46	26 53
1588	Cleveland Dryer Co., Cleveland, O.	Square Bone	7.59	6.20	3.92	9.79	2.62	3.18	. . .	. . .	33 55
1589	Same	Ammoniated Dissolved Bone	10.91	6.04	3.17	4.40	1.72	2.09	. . .	. . .	25 18
1590	Same	White Burley Tobacco Fert.	9.70	8.34	1.61	3.65	2.36	2.87	. .	6.17	35 34
1591	Same	Buckeye Phosphate	8.21	7.82	4.38	4.49	2.57	3.12	. . .	. . .	33 71
1596	Furman Farm Improvement Co., Atlanta, Ga.	Furman High Grade Guano	8.20	6.69	3.04	1.82	3.03	3.68	. . .	3.09	33 15
1597	Same	Buffalo Bone Guano	5.87	6.54	3.68	2.38	2.75	3.34	. .	2.68	32 75
1598	Same	Furman Soluble Bone With Ammonia and Potash	8.39	6.92	3.49	1.97	1.18	1.43	. . .	1.25	24 98
1599	Michigan Carbon Works, Detroit, Mich.	Homestead Corn & Wheat G'wr	10.66	8.29	1.12	1.20	2.37	2.88	. . .	1.79	28 17
1600	P. B. Mathiason & Co., St. Louis, Mo.	Increscent Brand Tobacco G'wr	8.74	4.71	2.58	3.65	3 55	4.31	. . .	3.51	32 64

August 1, 1891

M. A. SCOVELL, Director.

BULLETIN No. 35.

1. *EXPERIMENTS WITH WHEAT, 1891.*

By the Director and C. L. CURTIS, Ass't Agriculturist.

This is the third year of our wheat experiments. The work has been conducted along the following lines:

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

Place of making the experiments, Station farm. The character of the soil has been fully described in preceding Bulletins.

Season.—The season throughout, generally speaking, was favorable to the growth of wheat. In May the weather was too dry for rapid growth, but rains in early June caused the heads to develop more. The following table shows the average rainfall for the month, the average temperature, highest and lowest temperature, and the amount of sunshine during the growing months of the wheat:

TABLE 1.—SEASON.

MONTHS, 1890–1891.	Per Cent. Sunshine . .	Amount of Rainfall—Inches	TEMPERATURE. Mean	Highest	Lowest . . . .
September	42	1.82	66.8°	86°	45°
October	35	2.38	56.3	82	31
November	47	3.54	48.6	73	26
December	38	4.05	36.8	58	14
January	40	4.70	37.1	62	20
February	38	4.36	41.1	72	8
March	21	7.63	40.4	67	15
April	51	1.85	57.4	87	28
May	50	1.17	61.4	84	36
June	42	5.33	77.2	91	58

Test of Varieties.—Thirty-one varieties were tested. Each variety was planted in drills seven inches apart. Most of the plots contained one-twentieth of an acre; four were one-fortieth acre plots. The varieties were all planted on the 3d of October. All varieties were very slow in getting started, owing to the dry weather. December fifteenth all the plots looked well. The weather up to this date mild. April first the following note was taken: "Up to date there has been but little cold weather, barely enough to check the growth of the wheat." The soil of the plot in which the varieties grew was well worn. The subjoined table will show the condition of the wheat in the spring, and the dates on which the various varieties were jointing, heading, blooming, time when ripe, and characteristics of the wheat:

TABLE 2.—Summary.

TABLE 2.—Summary.

Number of Plot	Name of Variety.	Appearance.		Jointing, April	Heading, May	Cut, June	Head Length, Inches	S, Smooth; B, Bearded	Color of Grain
		March 1	April 1						
1	Hybride Dattel	Good	Good	25	18	27	2½	S	White.
2	Hybride Lamed	Good	Good	26	18	27	2½	S	Amber.
3	Golden Cross	Good	Good	28	15	25	2½	B	Amber.
4	New Monarch	Good	Good	26	15	25	2½	S	Red.
5	Jones' Winter Fife	Good	Choice.	27	15	25	2½	S	Amber.
6	Canada Velvet Chaff	Fair.	Good	28	18	25	3	S	White.
7	High Grade	Good	Good	23	12	24	3	S	Amber.
8	Early Red Clawson	Good	Good	18	15	24	3½	S	Red.
9	Rudy	Fair.	Good	24	16	24	3½	B	Amber.
10	New Genesee	Fair.	Good	24	15	24	3	B	White.
11	Red Fultz	Fair.	Good	20	10	23	3	S	Red.
12	Fulcaster	Good	Good	23	12	23	2½	B	Red.
13	Wisconsin Triumph	Good	Choice.	22	10	23	3	S	Amber.
14	Velvet Chaff	Good	Good	22	14	24	2½	B	Red.
15	Extra Early Oakley	Good.	Good	15	April 25	18	2½	S	Amber.
16	Ontario Wonder	Good	Good	18	May 15	22	2¾	S	Amber.
17	Improved Rice	Good	Good	19	10	22	2½	S	Amber.
18	Martin's Amber	Fair.	Good	20	15	24	2½	S	Amber.
19	Mealy	Fair.	Good	20	12	24	2½	S	Red.
20	German Amber	Fair.	Fair.	22	12	24	2¼	S	Amber.
21	Hunter's White	Good	Good	24	18	24	3¾	B	Amber.
22	Golden Amber	Good	Good	20	14	24	2½	B	Amber.

TABLE 2.—Summary.—Continued.

Number of Plot	Name of Variety.	Appearance.		Jointing, April	Heading, May	Cut, June	Head Length, Inches	S, Smooth; B, Bearded	Color of Grain
		March 1	April 1						
23	Hicks	Fair	Fair	23	15	23	3	S	Red.
24	Egyptian	Fair	Good	22	12	18	3	S	Red.
25	Buckeye	Good	Good	21	15	23	3	B	Red.
26	Canadian Finley	Fair	Good	20	10	23	3	S	Red.
27	German Emperor	Fair	Good	21	12	23	2¾	S	Red.
28	Landreth	Fair	Fair	26	18	25	3	S	White.
30	Silver Chaff	Fair	Good	26	20	25	3	S	White.
31	Royal Australian	Good	Good	22	12	25	3	S	White.

Here follows yield of the different varieties and weight of wheat per bushel:

TABLE 3.—YIELD OF VARIETIES.

Number of Plot	Name of Variety.	Yield Per Acre.		Weight Per Bushel
		Wheat, Bushels	Straw, Pounds	
1	Hybride Dattel	17	2,205	57
2	Hybride Lamed	19	2,115	59
3	Golden Cross	23	2,632	62
4	New Monarch	21	2,407	60
5	Jones' Winter Fife	30¾	2,880	60
6	Canada Velvet Chaff	30	2,790	59
7	High Grade	27	2,745	61
8	Early Red Clawson	29	2,745	59
9	Rudy	32	2,610	61
10	New Genesee	27	2,745	61
11	Red Fultz	26½	2,677	61
12	Fulcaster	26½	3,105	62
13	Wisconsin Triumph	28	3,037	62
14	Velvet Chaff	23¼	3,105	62
15	Extra Early Oakley	21¾	2,722	61
16	Ontario Wonder	22½	2,520	59
17	Improved Rice	20	2,587	61
18	Martin's Amber	26	2,835	61
19	Mealy	26	2,812	60
20	German Amber	18	2,407	63
21	Hunter's White	31	3,307	63
22	Golden Amber	28	3,307	63
23	Hicks	28½	2,790	60
24	Egyptian	33½	3,285	63
25	Buckeye	30	3,240	61
26	Canadian Finley	32¼	3,285	60
27	German Emperor	26¼	3,172	60
28	Landreth	29½	2,992	59
30	Silver Chaff	28½	2,992	60
31	Royal Australian	30¾	2,915	61

From this table it will be seen that the following varieties yielded over 25 bushels per acre:

RED.

Egyptian	33¾
Canadian Finley	32¼
Buckeye	30
Early Red Clawson	29
Hicks	28½
Fulcaster	26½
Red Fultz	26½
German Emperor	26¼
Mealy	26

WHITE.

Hunter's White	31
Royal Australian	30¾
Canada Velvet Chaff	30
Landreth	29½
Silver Chaff	28½
New Genesee	27

AMBER.

Rudy	32
Jones' Winter Fife	30¾
Wisconsin Triumph	28
Golden Amber	28
High Grade	27
Martin's Amber	26

Some of these varieties we have been testing for three years, and the comparative yield is given in the following table:

TABLE 4.—COMPARATIVE YIELD.

Name of Variety.	Yield in Bushels. Per Acre.		
	1889.	1890.	1891.
Hybride Dattel	....	....	17
Hybride Lamed	....	....	19
Golden Cross	....	17 2/3	23
New Monarch	22 1/2	24 3/4	21
Jones' Winter Fife	....	....	30 3/4
Canada Velvet Chaff	....	....	30
High Grade	17	20 1/4	27
Early Red Clawson	....	21 1/2	29
Rudy	....	22 1/2	32
New Genesee	....	24 3/4	27
Red Fultz	....	15 1/2	26 1/2
Fulcaster	23 1/3	23 1/4	26 1/2
Wisconsin Triumph	....	....	28
Velvet Chaff	....	20 5-6	23 1/4
Extra Early Oakley	....	....	21 3/4
Ontario Wonder	15	15 3/4	22 1/2
Improved Rice	....	18	20
Martin's Amber	22 1/2	24	26
Mealy	16 2/3	18	26
German Amber	....	17 1/4	18
Hunter's White	27	24 3/4	31
Golden Amber	21	20 1/4	28
Hicks	19 1/6	17 1/4	28 1/2
Egyptian	30 1/2	19 1/2	33 1/2
Buckeye	17	21 1/2	30
Canadian Finley	26	17 1/4	32 1/4
German Emperor	30 1/2	24 3/4	26 1/4
Landreth	....	....	29 1/2
Silver Chaff	....	....	28 1/2
Royal Australian	....	....	30 3/4

It will be seen from the table that the Egyptian wheat has made the highest average yield for three years; then comes Hunter's White and German Emperor. Of thirteen varieties that have been tested for three years, all but one made an average yield of twenty bushels or over. Farmers will do well to try either of the first three named varieties, all of them having made a high average yield. We have for distribution, in small lots, seed of all the varieties raised by us.

Different Methods of Seeding.—The Fultz was planted for these three experiments. The land adjoined that on which the

varieties were grown, and the wheat was sown at the same time the varieties were planted. The following table explains itself:

TABLE 5.—DIFFERENT METHODS OF SEEDING.

Number of Plot. . . .	Method of Seeding.	Yield Per Acre.		Remarks.
		Wheat, Bushels.	Straw, Pounds.	
34	½ bushel per acre. Drilled	29¼	2,360	Stooled well, heads large and well filled.
35	¾ bushel per acre. Drilled	33	2,745	Stooled finely, fine heads.
36	1 bushel per acre. Drilled	31½	3,060	Did not stool or head as well as 34 or 35.
37	1¼ bushels per acre. Drilled	36¾	3,600	Heavy crop straw. Heads thick and fair size.
38	1½ bushels per acre. Drilled	30	3,105	
39	2 bushels per acre. Drilled	35¼	3,960	
40	Drilled 1 in. deep, 5½ pecks per acre	36	3,465	
41	Drilled 2 in. deep, 5½ pecks per acre	39¾	3,870	
42	Drilled 3 in. deep, 5½ pecks per acre	35¼	3,330	
43	Drilled 4 in. deep, 5½ pecks per acre	39	3,645	
44	½ bushel per acre. Broadcast . . .	18¾	1,665	
45	¾ bushel per acre Broadcast . . .	27	2,745	
46	1 bushel per acre. Broadcast . . .	26¼	2,205	
47	1¼ bushels per acre. Broadcast . .	27¾	2,565	
48	1½ bushels per acre. Broadcast .	39	3,555	
49	2 bushels per acre. Broadcast . . .	38¼	3,645	

In testing the different amounts of seed used per acre, both the drill and broadcast seeding were resorted to. The amount used both ways varied from two pecks to two bushels per acre, the same number of plots being used for each. In addition to these methods, four plots were sown at depths varying from one to four inches in depth. It will be seen from the table that plots 48 and 49, sown broadcast, yielded more than plots 38 and 39, which were the corresponding plots drilled. While on the other hand, when a smaller amount of seed was used the difference was very much in favor of the drilling process.

Test of Fertilizers.—The plot used for these experiments is the same as that used for the past two years for the same experiments. The field is quite level. Each plot is one-tenth of an acre in size, separated from each other by paths three feet wide. The wheat was drilled in October 4th, at the rate of five pecks per acre. The Buckeye drill was used, with fertilizer attachments. The fertilizer was drilled in at the same time the wheat was planted. The Fultz variety was used. The plan for the arrangement of plots, kind and amount of fertilizer used on each is given on the following page:

1 No Fertilizer.
2 Acid Black 32 lbs.
3 No Fertilizer.
4 Muriate of Potash 16 lbs.
5 Dried Blood 16 lbs.
6 No Fertilizer.
7 Acid Black 32 lbs. Muriate of Potash 16 lbs.
8 Acid Black 32 lbs. Dried Blood 16 lbs.
9 Muriate of Potash 16 lbs. Dried Blood 16 lbs.
Acid Black 32 lbs. 10 Dried Blood 16 lbs. Muriate of Potash 16 lbs.
11 Tobacco Stems 200 lbs.

These experiments were planned for the purpose of ascertaining whether fertilizers would be beneficial to wheat on this particular field, and if so, to learn what essential ingredient or ingredients of the fertilizers were needed for the wheat crop. If potash only was needed, plot 4 would show it. If phosphoric acid was the ingredient wanted, then plot No. 2 would show it. If nitrogen, plot No. 5 would demonstrate it. If the soil needed a combination of any two of these ingredients then plots Nos. 7, 8 or 9 would show which combination was needed, or if all the ingredients were needed No. 10 would show it. Plots 1, 3 and 6 were left blank for comparison.

The following table gives the fertilizers used, amount applied per acre, and the yield of wheat and straw calculated per acre:

TABLE 6.—EFFECT OF FERTILIZERS ON WHEAT.

No. of Plot	Fertilizer Applied.	Amount in Pounds Used Per Acre	Yield of Wheat, Bushels	Yield of Straw, Pounds
1	No Fertilizer	....	31 1/3	3,390
2	Acid Black	320	30	3,170
3	No Fertilizer	....	29	3,420
4	Muriate of Potash	160	26	3,090
5	Dried Blood	160	29 1/3	2,980
6	No Fertilizer	....	28	2,840
7	Acid Black Muriate of Potash	320 160	26 2/3	3,020
8	Acid Black Dried blood	320 160	29 2/3	3,040
9	Muriate of Potash Dried Blood	160 160	28 1/3	3,730
10	Acid Black Muriate of Potash Dried Blood	320 160 160	27	3,000
11	Tobacco Stems	2,000	35	4,095

This wheat made good growth in the fall, and showed well all winter, having but little freezing weather to check growth. There was no noticeable difference in any of the plots until after March 1st, and but little then, the plots fertilized with nitrogen having a darker cast than others. All the plots ripened alike and grew to about the same height, all having straw of a beautiful golden yellow color.

Conclusions.—The results are the same as they have been for the last two seasons, that fertilizers, whether used in combination or singly, have no effect upon the yield of wheat. On the same lands for corn, potatoes, hemp and tobacco, the results of potash fertilizers show very favorably.

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2. *EXPERIMENTS WITH OATS.*

Owing to the lateness of the season for sowing, our experiments with oats were narrowed down to a test of varieties only. The field used for making these tests was sloping a little to the north, and was used for potatoes in 1890, and potash was applied at that time at the rate of 160 pounds per acre. When the oats were about three inches high, tobacco stems were applied at the rate of one ton per acre. The varieties were all sown April 16, and were up nicely in about eight or ten days. The season was very dry for about six weeks after sowing, and for quite a while looked very much like a failure. The straw grew very short, but finally headed out very well. The following table will show the yield of grain per acre in bushels, also the amonnt of straw in pounds, and the weight of a measured bushel of each variety:

TABLE 7.—YIELD OF VARIETIES.

Name of Variety.	Yield Per Acre.		Wt Measured Bushel.
	Bushels Grain.	Pounds Straw.	
Welcome	26¾	1,395	31
Haggett's White Seizure	36	1,383	33
Improved American	29½	1,417	30
White Russian	32⅓	1,530	30
White Canadian	33¾	1,485	30
Probsteier	33	1,406	29
White Victoria	32⅓	1,575	33
Clydesdale	35	1,552	31
Barley Oats	38	1,845	30
Welch	37¼	1,665	32
Early Dakota	35	1,672	28
Pringle's American Triumph	30	1,732	34
Early Lackawana	23	1,620	30
Badger Queen	24	1,800	32
Race Horse	30	1,822	32
American Banner	33⅓	1,755	32
Golden Giant Side	42	1,755	32
Black Prolific	23½	1,248	33
White Wonder	23	1,575	36
Bohemian	30	1,575	31
Monarch	32⅔	1,743	30
Black Tartarian	30½	1,417	30

From this table it will be seen that but one variety yielded above forty bushels, viz: Golden Giant Side. This variety is entirely new to us, but from its growth and appearance we think farmers will do well to give it a trial. The grain grows entirely to one side, and is a beautiful golden color. Several other varieties yielded well, the best being Barley, Welch and Early Dakota.

The following table shows the comparative yield of fifteen varieties that have been tested at the Station for three years, from which it will be seen that the Barley Oats and Early Dakota have made the best average, both of which we consider good standard varieties:

TABLE 8.—COMPARATIVE YIELD.

Name of Variety.	Yield in Bushels Per Acre.			Average. . . . .
	1889.	1890.	1891.	
Welcome	46	17	26¾	30
Haggett's White Seizure	40	14	36	30
Improved American	41	7	29½	26
White Russian	28	17½	32⅓	26
White Canadian	38	17	33¾	29
Probsteier	39	19⅔	33	30
White Victoria	46½	14	32⅓	31
Clydesdale	27	19⅔	35	27
Barley Oats	46½	18	38	34
Welch	43	14	37¼	31
Early Dakota	44	22½	35	34
Pringle's American Triumph	29	22½	30	27
Bohemian	24	11¼	30	22
Monarch	43	12⅔	32⅓	29
Black Tartarian	37	17	30½	28

BULLETIN No. 36.

COMMERCIAL FERTILIZERS.

Since the publication of Bulletin No. 34, the following analyses have been made for manufacturers in compliance with the fertilizer law, and these fertilizers are now legally on sale in the State, in addition to those given in the Bulletin referred to above. For explanations see Bulletin 34.

M. A. Scovell, *Director.*

TABLE I—Raw Bone Manures—Analyses and Valuations.

Station Number	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred.							Estimated Value per Ton
			Moisture	Phosphoric Acid.			Equivalent to Bone Phosphate	Nitrogen	Equivalent to Ammonia	
				In Fine Bone	In Medium Bone	Total				
1615a	Thompson & Edwards Fertilizer Co., Chicago, Ill.	Pigs Foot Brand. Chicago Bone Meal	6.03	11.96	1.26	13.22	28.37	3.45	4.19	*$30 07
1624	Wm. Skene & Co., Louisville, Ky.	Skene's Pure Raw Bone Dust or Meal	8.07	10.29	12.62	22.91	50.04	4.14	5.03	35 92
1637	National Fertilizer Co., Nashville, Tenn.	Bone Meal	5.43	15.56	5.36	20.92	45.68	4.46	5 41	36 13
1639	J. F. Singer, Nashville, Tenn.	Raw Bone Meal	6.83	12.74	5.41	18.15	39.65	3.64	4.42	30 36
1641	Armour & Co., Chicago, Ill.	Bone Meal	3.34	23.01	3.87	26.88	58.70	2.96	3 59	35 65
1645	Sim Klinglesmith, Franklin Cross Roads, Ky.	Simon Pure Bone	8.33	5.40	17.53	22.93	50.07	4 06	4.93	35 12

* Potash from Muriate 1.44 per cent, from Sulphate 2.09 per cent.

TABLE II.—Complete Fertilizers, Superphosphates, Etc.—Analyses and Valuations.

* Potash from Muriate 1.44 per cent, from Sulphate 2.09 per cent.

TABLE II.—Complete Fertilizers, Superphosphates, Etc.—Analyses and Valuations.

Station Number	Name and Address of Manufacturer.	Name of Brand.	Pounds in the Hundred.								Estimated Value Per Ton.
			Moisture	Phosphoric Acid.			Nitrogen	Equivalent to Ammonia	Potash.		
				Soluble	Reverted	Insoluble			From Sulphate.	From Muriate.	
1613	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Wheat and Corn Phosphate	10.85	4.95	4.48	2.88	2.52	3.06	. . .	3.92	$32 15
1614	Same	New Rival Ammo. Super'hate	9.27	6.18	2.27	2.35	1.55	1.88	. . .	3.17	25 47
1617	Cincinnati Desiccating Co., Cin., O.	Pure Acidulated Bone	4.68	5.46	6.41	7.54	3.15	3.82	. . .	. . .	37 30
1618	Same	Tobacco and Potato Fertilizer	8.34	6.06	3.18	3.48	3 67	4.46	4.89	. . .	39 33
1619	Ky. Seed Warehouse Co., Louisville	German Kainit	4.57	. .	. . .	. . .	. . .	. . .	. . .	12.60	*13 86
1620	Thompson & Edwards Fertilizer Co., Chicago, Ill.	Ky. Sure Growth Phosphate	7.35	3.11	6.10	7.75	2 20	2.67	. .	0.42	29 57
1621	Globe Fert Co., Louisville, Ky.	Globe Wheat Grower	7.16	2.83	4 77	5.60	1.90	2.31	0.40	0.66	25 17
1622	Same	Golden Harvest Bone Meal	6.20	2.84	4 71	7.56	3.35	4.06	. . .	0.84	31 70
1623	Wm. Skene & Co., Louisville, Ky.	Skene's Ky. Bone Meal & Po'sh.	4.03	2 92	3.11	5 27	2.01	2.44	. . .	3.18	†24 95
1638	National Fert. Co., Nashville, Tenn.	Dissolved Bone Phosphate	15.79	10.41	1 54	0.78	. . .	.	. . .	. . .	20 79
1640	Wm. Skene & Co., Louisville, Ky.	Louisville Superphosphate	7.15	0 60	7 01	6.92	2.06	2.50	7.91	. . .	‡36 40
1643	National Fert. Co., Nashville, Tenn.	National Dissolved Bone	10.58	8.84	2.34	3.88	0.95	1.15	. . .	1.07	26 32
1654	Jarecki Chem. Works, Sandusky, O.	Lake Erie Fish Guano	10.72	6.65	1.86	3.54	1.81	2.20	. . .	0.44	24 31
1655	Same	Superphosphate	8.09	7.16	2.79	3.29	0.60	0.73	. . .	0.43	21 76

* Chloride of Sodium, 37.17 per cent.
† Magnesia, 2.77 per cent.
‡ Magnesia, 3.42 per cent.; Soluble Silica, 2.43 per cent.

BULLETIN No. 37.

POTATO EXPERIMENTS—1891.

1. TEST OF VARIETIES.
2. EFFECT OF FERTILIZERS.

RESULTS.

1. In the test of varieties the best yielders were—Charter Oak, 216 bushels; Yellow Elephant, 204 bushels; Chautauqua, New Champion, and Everett.

2. In the test of fertilizers, where potash was used, the yield was largely increased this year, as has been the result heretofore.

TEST OF VARIETIES.

The soil in which these tests were made has been described in previous Bulletins. This field was sown in English Blue-grass in 1888, and was broken late in the spring for potatoes. The season was a dry one, having no rain till the latter part of May. No fertilizer was used. All the varieties were planted April 18th. The plots were all treated the same as to cultivation, etc. In nearly all the plots the stand was almost a perfect one. In calculating the yield allowance was made for missing hills, great care having been taken in planting to have the same number of hills in each plot.

Field Notes.

Notes as to the growth and appearance of vines were taken every fifteen days. A summary of the field notes will be found in the following table.

TABLE 1.—GIVING SUMMARY OF FIELD NOTES, ETC.

Name of Variety.	When Up.	Appearance.				
		May 15.	June 1.	Bloom.	July 1.	Dying.
Home Comfort	May 8	good	good	June 20	good	July 20
Early New Zealand	May 8	good	fair	June 10	good	July 1
White Beauty of Hebron	May 5	good	good	July 1	fine	July 20
Irish Wonder	May 8	good	good	June 28	good	July 20
Early Puritan	May 8	fair	fair	June 10	good	July 15
Electric	May 5	fair	fair	June 10	good	July 1
Unknown	May 5	good	good	June 15	choice	July 25
Burpee's Superior	May 6	good	good	June 15	choice	July 20
Dakota Seedling	May 5	good	good	July 5	choice	July 23
Summit	May 5	good	good	July 3	choice	July 25
Cayuga	May 8	good	good	June 25	choice	July 25
Lombard	May 10	fair	fair	July 5	good	July 20
Silver Skin	May 10	fair	good	July 5	good	July 20
American Giant	May 8	good	good	June 25	choice	July 23
Polaris	May 10	fair	fair	June 10	fair	July 20
White Elephant	May 5	good	good	June 28	choice	July 20
Burbank	May 10	fair	fair	July 1	good	July 20
Alexander's Prolific	May 8	good	good	June 28	choice	July 20
Everett	May 8	fair	fair	June 28	good	July 20
Yellow Elephant	May 6	good	good	July 3	choice	July 23
Chautauqua	May 6	good	good	July 5	choice	July 20
Nero Queen	May 10	fair	fair	June 20	fair	July 25
Charter Oak	May 6	choice	choice	July 5	choice	July 28
Hamden Beauty	May 12	fair	only fair	June 15	only fair	July 20
The Peoples	May 12	fair	fair	June 12	fair	July 20
Alexander's No. 1	May 8	good	good	July 8	choice	July 20
Rural New Yorker	May 10	good	good	July 10	good	July 20
Six Weeks Market	May 6	fair	fair	June 10	good	July 1
Nevada White	May 6	fair	fair	June 20	good	July 20
June Eating	May 8	fair	fair	June 25	fair	July 12
Way	May 8	good	good	July 1	good	July 20
Green Mountain	May 8	fair	fair	June 20	good	July 20
Farina	May 8	fair	fair	July 5	good	July 20
Brownell's 55	May 5	good	choice	July 5	fine	July 23
Alpha	May 10	fair	fair	June 15	good	July 15
Early Ohio	May 6	poor	poor	June 10	poor	July 15
Ideal	May 8	good	good	July 1	good	July 25
Queen of Roses	May 6	good	good	July 5	good	July 20
Gen. Logan	May 6	good	good	June 28	good	July 28
Fearnaught	May 8	fair	fair	June 23	good	July 25
Rubicund	May 6	good	choice	July 5	fine	July 25
New Champion	May 5	choice	choice	July 1	choice	July 18
Boley's Northern Spy	May 8	fair	good	July 1	good	July 23
Chas. Downing	May 6	fair	good	July 1	good	July 18
Lee's Favorite	May 6	fair	fair	July 3	good	July 20
James G. Blaine	May 6	fair	fair	July 5	fair	July 25
Early Harvest	May 5	good	choice	June 10	choice	July 26
Early Wisconsin	May 6	fair	fair	June 25	good	July 15
Brownell's 31	May 8	fair	fair	June 18	fair	July 20
Hotel Favorite	May 5	good	good	June 25	good	July 28
Weld's Jumbo	May 8	fair	fair	June 25	fair	Aug. 1
Hoffman	May 6	good	good	July 1	good	July 25
Governor Rusk	May 6	fair	fair	July 1	good	July 28
Pride of the West	May 10	fair	good	July 5	good	July 20

TABLE 1.—GIVING SUMMARY OF FIELD NOTES, ETC.—Continued.

Name of Variety.	When Up.	Appearance.				
		May 15.	June 1.	Bloom.	July 1.	Dying.
Bill Nye	May 6	good	good	June 18	good	July 25
McFadden's Earliest.	May 6	good	good	June 12	good	July 15
Iron Clad	May 8	fair	fair	June 18	fair	July 28
American Mag. Bonum.	May 8	fair	fair	June 20	fair	July 28
Mammoth Prolific	May 6	fair	fair	June 12	fair	Aug. 5
Seneca Beauty	May 8	fair	fair	June 15	fair	July 23
Rodger's Seedling	May 8	fair	fair	June 10	fair	July 20
Monroe Co. Prize	May 5	good	good	June 18	good	July 23
Lake Erie	May 10	good	good	June 10	good	July 25
Dakota Red	May 8	good	good	June 8	good	July 20
Tonhock	May 8	fair	fair	June 15	fair	July 15
Minister	May 6	good	good	June 10	good	July 26
Nigger	May 6	good	good	June 15	fine	July 26
Harbinger	May 8	fair	fair	June 15	fair	July 28
Early Maine	May 6	good	good	June 15	good	July 20
Early Sunrise	May 6	fair	fair	June 15	good	July 18
Early Modena	May 6	good	good	June 15	good	July 18
Governor Foraker	May 6	good	good	June 15	good	July 20
Badger State P. Blow.	May 10	fair	fair	June 15	fair	July 28
Weld's No. 22	May 8	good	good	June 15	good	July 23
Pearl of Savoy	May 6	good	choice	June 12	fine	July 28
Boston Market	May 6	good	good	June 12	good	July 20
Weld's No. 40	May 6	good	good	June 12	good	July 20

YIELD OF VARIETIES.

Table two gives the yield per acre of the different varieties; also the yield of large and small potatoes of each variety.

TABLE 2.—YIELD OF VARIETIES.

Name of Variety.	Yield in Bushels Per Acre.		
	Large.	Small.	Total.
Charter Oak	188	28	216
Yellow Elephant	166	38	204
Chautauqua	152	44	196
New Champion	182	12	195
Everett	140	50	190
Weld's No. 40	124	56	180
Cayuga	148	28	176
Brownell's 55	141	29	170
Hoffman	140	28	168
Lombard	139	28	167
Dakota Seeding	115	50	165
Early Harvest	112	50	162
Alexander's Prolific	102	56	158
Nero Queen	111	46	157
White Elephant	112	43	154
Pearl of Savoy	86	68	154
Summit	111	43	154
Monroe Co. Prize	114	36	150
General Logan	92	58	150
Dakota Red	90	60	150
Burpee's Superior	120	27	147
American Giant	107	39	146
Fearnaught	139	7	146
White Beauty of Hebron	94	51	145
Way	111	34	145
Unknown	98	42	140
Silver Skin	114	22	136
Lee's Favorite	114	22	136
Early Modena	83	53	136
Alexander's No. 1	113	22	135
Rubicund	108	27	135
Early Sunrise	100	32	132
Nevada White	105	22	127
Irish Wonder	91	33	124
Burbank	79	43	123
Hotel Favorite	101	20	121
Queen of the Roses	62	58	120
Early Maine	89	30	119
The Peoples	70	45	115
Lake Erie	92	22	114
Badger State Peach Blow	83	30	113
Brownell's 31	54	58	112
Bill Nye	99	13	112
Boley's Northern Spy	94	16	110
Harbinger	60	50	110
Polaris	82	28	110
Boston Market	95	14	109
Chas. Downing	68	40	108
James G. Blaine	86	22	108
Governor Foraker	86	22	108
Rural New Yorker	88	18	106
Early Wisconsin	84	22	106
Alpha	70	35	105
McFadden's Earliest	48	51	100
Minister	77	19	96

TABLE 2.—YIELD OF VARIETIES.—Continued.

Name of Variety.	Yield in Bushels Per Acre.		
	Large	Small.	Total.
Nigger	69	26	95
Farina	64	30	94
Governor Rusk	62	32	94
Hamden Beauty	77	17	94
Weld's No. 22	93	. . . . .	93
Weld's Jumbo	61	21	82
Early Puritan	45	36	81
Green Mountain	67	13	80
American Magnum Bonum	58	22	80
Pride of the West	62	12	74
Early Ohio	35	35	70
June Eating	31	38	69
Tonhock	45	24	69
Seneca Beauty	54	11	65
Rodgers' Seedling	35	28	63
Home Comfort	40	20	60
O. K. Mammoth Prolific	43	16	59
Six Weeks' Market	50	8	58
Iron Clad	34	20	54
Electric	25	27	52
Early New Zealand	23	22	45

From the table it will be seen that the Charter Oak made the largest yield, while some others made a proportionately larger yield of large potatoes, as was the case with New Champion, Fearnaught, etc. In 1889, Charter Oak was No. 16 in the list as to yield, Irish Wonder at that time making the largest yield, 389 bushels per acre.

Quality of the Different Varieties.

While the yield should have its influence, the quality should have due consideration in the selection of potatoes. The quality of the potato is supposed to depend on the amount of starch it contains, or as the dry matter is mostly starch, it is often taken as a standard by which to judge the quality.

The following table shows the relative quality of the varieties as indicated by the amount of dry substance found in each, and the size by the average weight of one potato. A good potato should contain 23 to 25 per cent. of dry substance, or in other words, should not contain over 70 per cent. of water.

TABLE 3.

	Name.	Dry Substance in 100 parts . .	Water in 100 parts	Average w ight of one potato . .	Specific Gravity .
1	Home Comfort	24.3	75.7	3¼ oz.	1 0914
2	Charles Downing	24.2	75 8	3½	1.0907
3	Governor Foraker	23.9	76.1	3	1.0896
4	Rubicund	23.7	76.3	4¾	1.0887
5	Dandy	23.7	76.3	5½	1.0886
6	Nigger	23.6	76.4	4	1.0884
7	Pearl of Savoy	23.5	76.5	2¾	1.0881
8	Potentate	23.4	76.6	4¼	1.0877
9	Early Medeua	23.3	76.7	3½	1.0874
10	Farina	23 2	76.8	2¼	1.0868
11	Alexander's Prolific	23 2	76.8	4	1.0867
12	Dandy	23.1	76.9	5¾	1 0865
13	Minister	23.0	77.0	2¾	1.0860
14	Yellow Elephant	22.9	77.1	3½	1.0858
15	Lake Erie	22.9	77.1	3½	1.0858
16	Jas. G. Blaine	22.8	77.2	2¾	1.0851
17	Hamden Beauty	22.7	77.3	3	1.0849
18	Everett	22.6	77.4	3½	1.0844
19	Early Maine	22.5	77.5	3¾	1.0839
20	Tonhock	22 5	77.5	3	1.0837
21	Weld's Jumbo	22.4	77 6	3¾	1.0836
22	June Eating	22.4	77.6	3	1.0836
23	Bill Nye	22.4	77 6	4	1 0836
24	Early Sunrise	22.4	77.6	3½	1 0834
25	Dakota Seedling	22.3	77.7	3¾	1.0830
26	Lee's Favorite	22.3	77.7	3½	1.0830
27	Polaris	22.2	77 8	2¾	1.0828
28	Badger State Peach Blow	22.1	77 9	2¾	1.0822
29	Burbank	22.1	77.9	4¼	1.0821
30	Green Mountain	22.0	78.0	5½	1 0816
31	Fearnaught	21.8	78.2	5¾	1.0808
32	New Queen	21.8	78.2	4¼	1.0808
33	Hotel Favorite	21.7	78.3	4½	1.0805
34	Early Puritan	21.7	78.3	2¾	1.0805
35	Six Weeks Market	21.7	78.3	2½	1.0805
36	Lombard	21.7	78.3	3¾	1.0804
37	Early Harvest	21.7	78.3	4½	1.0804
38	Burpee's Superior	21.7	78.3	4¾	1.0803
39	White Elephant	21.7	78.3	3¾	1.0803
40	Unknown	21 6	78.4	3½	1.0801
41	Early Wisconsin	21.6	78.4	3¾	1.0801
42	Harbinger	21.6	78.4	4¼	1.0800
43	Brownell's 31	21.5	78 5	2¼	1.0796
44	Boston Market	21.4	78.6	3½	1.0792
45	Charter Oak	21.4	78.6	4½	1.0792
46	Chautauqua	21.3	78.7	4½	1.0785
47	American Giant	21.2	78.8	4¼	1 0783
48	New Champion	21.2	78.8	5½	1.0783
49	Summit	21.0	79.0	4¼	1.0773
50	Rogers' Seedling	20.9	79.1	3½	1.0771
51	General Logan	20.9	79.1	3¾	1.0771

TABLE 3.—Continued.

	Name.	Dry Substance in 100 Parts.	Water in 100 Parts.	Average Weight of one potato.	Specific Gravity.
52	Queen of the Roses	20.9	79.1	3¼ oz.	1.0769
53	Dakota Red	20.8	79.2	5¼	1.0766
54	Seneca Beauty	20.8	79.2	3¾	1.0764
55	Silver Skin	20.8	79.2	3¼	1.0764
56	Alexander's No. 1	20.7	79.3	3½	1.0760
57	White Beauty of Hebron	20.6	79.4	4	1.0759
58	McFadden's Earliest	20.6	79.4	3¾	1.0758
59	Early New Zealand	20.5	79.5	2	1.0754
60	New Early Oxford	20.5	79.5	3	1.0753
61	Weld's No. 40	20 5	79.5	3¾	1.0752
62	Governor Rusk	20.4	79.6	4½	1.0747
63	American Magnum Bonum	20.3	79.7	3¾	1.0743
64	Way	20.2	79.8	4¼	1.0738
65	Electric	20.1	79.9	2¼	1 0733
66	Hoffman	20.0	80.0	6¼	1.0729
67	Iron Clad	19.9	80.1	3¼	1.0726
68	Weld's No. 22	19.9	80.1	6½	1.0725
69	O. K. Mammoth Prolific	19.8	80.2	3¾	1.0723
70	Rural New Yorker	19.7	80.3	4¾	1.0716
71	Boley's Northern Spy	19.7	80.3	6	1.0716
72	Nevada White	19.6	80.4	3¾	1.0715
73	Brownell's No. 55	19.6	80.4	4¾	1.0715
74	Monroe Co. Prize	19.4	80.6	4	1.0705
75	Cayuga	19.3	80.7	4¼	1.0703
76	The Peoples	19.3	80.7	4¼	1.0700
77	Pride of the West	18.7	81.3	6¼	1 0678
78	Alpha	17.7	82.3	4	1.0637
79	Irish Wonder	17.6	82.4	4¼	1.0629

TEST OF FERTILIZERS.

In testing the effect of fertilizers on potatoes this year we used the same field as was used in 1889 and 1890 for the same purpose. The ground was described in Bulletin No. 22 as follows: "Taking into consideration the subsequent use that was to be made of these plots, two fields varying from each other in fertility were selected for these experiments. The field in which plots 1, 2, 3, 4 were situated is supposed to have received no fertilizer until this year (1889), whereas, the other field is supposed to have received barn-yard manure some four or five years ago. The surface of the ground is comparatively level, the soil of the general character of the Experiment Station Farm." In

these experiments the plots were one-tenth of an acre in size. The seed used was northern grown Early Rose, cut into halves, and placed cut side down fourteen inches apart in the row. Rows three feet apart. After the ground was well prepared by plowing and harrowing, the rows were marked out with a small plow. Fertilizer was scattered in the rows by hand, and afterwards slightly mixed with dirt. The potatoes were cultivated five times.

Field Notes.

Table four gives the summary of the field notes.

TABLE 4.—GIVING SUMMARY OF FIELD NOTES.

No. of Plot.	Appearance.				
	June 1.	June 15.	July 1.	July 15.	Dying.
1	Fair . . .	Fair . . .	Fair . .	Fair . . .	July 20
2	Good . . .	Fair . . .	Fair . . .	Fair . . .	" 25
3	Fair . . .	Fair . . .	Fair . . .	Fair . . .	" 25
4	Good . . .	Good . . .	Good . . .	Good . . .	" 25
5	Fair . . .	Fair . . .	Good . . .	Good . . .	" 25
6	Fair . . .	Fair . . .	Good . . .	Good . . .	" 25
7	Good . . .	Good . . .	Good . . .	Good . . .	" 20
8	Good . . .	Good . . .	Good . . .	Choice. . .	" 20
9	Good . . .	Choice. . .	Choice. . .	Choice. . .	" 20
10	Fair . . .	Fair . . .	Fair . . .	Fair . . .	" 20

Table five gives the amount of fertilizers calculated per acre; also the yield of potatoes.

TABLE 5.—EFFECT OF FERTILIZERS ON POTATOES.

No. of Plot.	Fertilizer Used.	Amount per Acre in Pounds.	Yield in Bushels per Acre.		
			Large.	Small.	Total.
1	No Fertilizer.	. . . . .	55	21	76
2	Nitrate of Soda	160	65	20	85
3	Acid Black	320	76	20	6
4	Muriate of Potash	160	127	17	144
5	No Fertilizer.	. . . . .	96	17	113
6	Nitrate of Soda . . . . . / Acid Black	160 / 320	113	17	130
7	Nitrate of Soda . . . . . / Muriate of Potash	160 / 160	151	22	173
8	Acid Black . . . . . / Muriate of Potash	320 / 160	165	30	195
9	Nitrate of Soda . . . . . / Acid Black . . . . . / Muriate of Potash	160 / 320 / 160	174	36	210
10	No Fertilizer	. . . . .	86	28	114

In studying these results it should be remembered that commercial fertilizers are applied to the soil for the purpose of furnishing the crops with nitrogen, phosphoric acid and potash.

From the above table it will be seen that Plot No. 1 received no fertilizer. This plot was left for the purpose of comparison. On plot No. 2 nitrate of soda was applied for the purpose of furnishing nitrogen. This substance contains about 16 per cent. of nitrogen. It is not the only substance that could have been used to furnish nitrogen. Ammonia sulphate, containing about 20 per cent. of nitrogen, or dried blood with about 16 per cent., or tankage, or cotton seed meal, or even bone, could have been used to furnish nitrogen. We used nitrate of soda because it was the cheapest form of nitrogen in the market at the time, and because, if we had used tankage, cotton seed meal or bone,

we would have had phosphoric acid also, and therefore would have been unable to tell, if there had been an increased yield, whether it was the nitrogen or phosphoric acid that produced it.

Acid black, or dissolved bone black, was used on Plot No. 3 to furnish phosphoric acid, and contained a little over 18 per cent. of this ingredient. Other phosphates could have been used in place of this to furnish phosphoric acid, as acid phosphate or superphosphate made by treating South Carolina or Florida phosphate rock with oil of vitriol, or bone or bone ash.

Muriate of potash was used on Plot No. 4 to furnish potash. The muriate contained 49.9 per cent. of potash. Sulphate of potash, kainite, cotton seed hull ashes, or even wood ashes, might have been used in the place of the muriate of potash to furnish potash.

By referring to the table, it would seem that potash greatly increased the yield, while phosphoric acid and nitrogen had some beneficial effects. While potash alone has a marked influence in increasing the yield, nevertheless, when combined with acid black or nitrate of soda, or both, the yield is still more increased.

Plots Nos. 5 and 10, receiving no fertilizer, were on the side of the field supposed to have received manure some years ago. To this is probably owing their increased yield over Plot 1.

The Financial Outcome.

It is evident that if the cost of the fertilizer applied in any case is greater than the increase in value of the crop by its use, there will result a financial loss, unless the recuperative powers of the fertilizers extend through more than one year. Leaving out this last consideration, a compilation has been made to show the profit or loss attending the use of the various fertilizers in this instance.

On account of previous use of manure on Plots 5 to 10, as mentioned on page 12, we use the mean of Plots 5 and 10 to represent the yield without fertilizers on these plots, and No. 1 for the others.

Table Showing Profit or Loss by Use of Fertilizers on Potatoes.

Number of Plot	Fertilizer Used.	Cost of Fertilizer	Value Large, at Forty Cents Per Bushel	Value Small, at Fifteen Cents Per Bushel	Total Value	Value of the Increased Yield	Profit or Loss
1	No Fertilizer		$22 00	$3 15	$25 15		
2	Nitrate of Soda	$4 80	26 00	3 00	29 00	$3 85	*$0 95
3	Acid Black	4 25	30 40	3 00	33 40	8 25	4 00
4	Muriate of Potash	4 80	50 80	2 55	53 35	28 20	23 40
5	No Fertilizer		38 40	2 55	40 95		
6	Nitrate of Soda. Acid Black	9 05	45 20	2 55	47 75	7 97	*1 8
7	Nitrate of Soda. Muriate of Potash.	9 60	60 40	3 30	63 70	23 92	14 32
8	Acid Black. Muriate of Potash.	9 05	66 00	4 50	70 50	30 72	21 7
9	Nitrate of Soda. Acid Black. Muriate of Potash.	13 85	69 60	5 40	75 00	35 22	21 37
10	No Fertilizer		34 40	4 20	38 60		

* Loss.

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