TWENTY-FIRST ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE.

1905.

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MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

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Gilbert M. Gowell	Poultry Investigations
Walter Anderson	Poultry Investigations
Edith M. Patch	Entomologist
‡Bessie G. Tower	Microscopist and Photographer
Annie M. Snow	Clerk and Stenographer
Henry A. Millett	Meteorological Observer and Janitor

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*Resigned June 30, 1905.

†Appointed October 20, 1905.

‡Appointed September 1, 1905.

TABLE OF CONTENTS.

	PAGE
Officers of the Station	II
Announcements	V
Historical notes	VII
Rotting of Potatoes due to late Blight (Bulletin 112)	1
Experiments with dry Bordeaux (Bulletin 112)	6
Soluble Bordeaux for Potato Blight (Bulletin 112)	8
Experiments with Potatoes on home mixed Fertilizers (Bulletin 112)	13
Summary of Experiments in Practical Horticulture (Bulletin 113)	21
Red Clover from various Sources (Bulletin 113)	28
Fertilizer Inspection—Manufacturers Samples (Bulletin 114)	37
Feeding Stuffs Inspection (Bulletin 115)	53
Low grade and high grade Cottonseed Meal compared (Bulletin 115)	71
Food Inspection—Law (Bulletin 116)	77
Food Inspection—Standards (Bulletin 116)	80
Poultry Experiments (Bulletin 117)	93
Cereal Foods (Bulletin 118)	117
Food Inspection—Baking Powders (Bulletin 119)	137
Food Inspection—Vinegars (Bulletin 119)	143
Fertilizer Inspection—Station Samples (Bulletin 120)	153
Cottony Grass Scale (Bulletin 121)	169
Experiments in Orchard Culture (Bulletin 122)	181
Strawberry Crown Girdler (Bulletin 123)	205
Insect Notes for the Year (Bulletin 123)	213
Meteorological Observations (Bulletin 124)	229
Report of the Treasurer (Bulletin 124)	232
Index to Report for 1905 (Bulletin 124)	234
Index for Annual Reports 1901-1905 (Bulletin 124)	243

The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

ANNOUNCEMENTS.

THE AIM OF THE STATION.

Every citizen of Maine concerned in agriculture has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glass-ware; to identify grasses, weeds, injurious fungi and insects, etc.; and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

INSPECTIONS.

The execution of the laws regulating the sale of food, commercial fertilizers, concentrated commercial feeding stuffs, and agricultural seeds, and the inspection of chemical glassware used by creameries is entrusted to the Director of the Station. The Station takes pains to obtain for analysis samples of all brands of fertilizers and feeding stuffs coming under the law. It also draws samples of agricultural seeds and foods in the hands of dealers. The co-operation of dealers and consumers is, however, essential for the full and timely protection of their interests.

Foods. Dealers and consumers are invited to send by prepaid express original and unbroken packages of food materials on sale in Maine of whose purity they are for any reasons suspicious. As prompt free analysis will be made of such samples as circumstances will allow.

Feeding Stuffs. The Station will promptly analyze samples of feeding stuffs sold in Maine taken in accordance with directions which will be furnished on application. The results will be reported without charge to interested parties. This applies to dealers and consumers alike.

Commercial Fertilizers. It is difficult to draw accurate samples of commercial fertilizers. On this account it is only in rare instances that the Station undertakes analyses of fertilizers other than the samples collected by its representatives. In case there is special reason for an examination, the Station invites correspondence on the subject.

Agricultural Seeds. Samples of agricultural seeds on sale in Maine, taken in accordance with directions which can be obtained on application to the Station, will be examined as promptly as possible and the results reported free of charge.

In all cases samples should be accompanied by a full description of the goods, including the name and address of the dealer and the sender. Small samples other than liquids can be forwarded by mail. Others should be forwarded by express, charges prepaid.

STATION PUBLICATIONS.

The Station publishes several bulletins each year, covering in detail its expenses, operations, investigations and results. The bulletins are mailed free to all citizens who request them. The annual report is made up of the bulletins issued during the year.

CORRESPONDENCE.

As far as practicable, letters are answered the day they are received. Letters sent to individual officers are liable to remain unanswered, in case the officer addressed is absent. All communications should, therefore, be addressed to the

Agricultural Experiment Station,
Orono, Maine.

The post office, railroad station, freight, express and telegraph address is Orono, Maine. Visitors to the Station can take the electric cars at Bangor and Old Town.

The Station is connected by telephone.

HISTORICAL NOTES FOR 1905.

FOOD AND SEED LEGISLATION.

The legislature of 1905 passed a pure food law and supplemented the law regulating the sale of agricultural seeds. The director of the Station is the executive officer of both of these controls. The details of the food legislation is given on pages 77 and following of this report. A bulletin on seed inspection is in preparation and will be published early in 1906.

CHANGES OF STAFF.

Mr. S. C. Dinsmore resigned as assistant chemist in June, 1905, to accept an appointment with the Nevada Experiment Station. Mr. Lewis I. Nurenburg, B. S., Harvard, 1905, has been appointed in his place. Miss Bessie G. Leeds, B. A., University of Minnesota, 1905, was appointed September 1 as a general assistant. Miss Leeds will do the photographic work of the Station and will assist in the analyses of foods and seeds.

THE INCUBATOR HOUSE.

The Station, as described on pages 105 and following of this report, is unusually well equipped along the lines of poultry investigation, with the exception that the rooms used for incubation work were unsatisfactory. An incubator house 31 x 31 feet, was erected in the fall of 1905. The building is one story in height with a good attic, and airy basement. The basement is used for the incubators and is supplied with 18 machines having a capacity of 6480 eggs. Two flues provide ample ventilation. The remainder of the building is finished as a tenement for the poultry man.

NOTES ON THE ROTTING OF POTATOES DUE TO THE LATE BLIGHT FUNGUS.

(*Phytophthora infestans.*)

CHAS. D. WOODS.

During the past few years, in connection with experiments at this Station, considerable data have accumulated on the rotting of potatoes due to the fungus that produces the late blight. Such as are believed to be of general interest are here reported.

ROTTING IN THE CELLAR DUE TO PREVIOUS INFECTION.

In 1902 a three-acre field of Green Mountain potatoes, which had been sprayed several times during the growing season and which had been kept practically free from the late blight, was harvested before the tops were dead, and stored in one bin in a cool cellar. The day of digging was warm and rather muggy. The tubers were fairly well dried off, however, before being put in the cellar. The following days were unusually warm for the season. At harvest there was very little evidence of rot. Perhaps there was one bushel of discolored potatoes in 100, but no really rotten potatoes were found. Early in November it was noticed the potatoes were rotting badly. They were carefully assorted and it was found that fully one-third of the crop was more or less affected with rot due to late blight.

As there were so few affected potatoes at harvest, and so much rot had developed in a few weeks, it was thought possible that the sound potatoes were infested after digging. To test this, two barrels of sound potatoes were selected at the time of assorting in November, and to each peck of sound tubers two potatoes showing unquestionable signs of incipient rot were added. To learn if the treatment of the tubers with different substances would tend to decrease the amount of infection, five lots of two barrels each of selected tubers were treated with (1) flowers of sulphur, (2) copper sulphate, (3) air slacked lime,

(4) Bordeaux mixture, and (5) a 3 per cent solution of formaldehyde. The 12 barrels were kept in the cellar until April. There was very little further rot in either the untreated or the treated barrels of potatoes. On the whole, about 90 per cent of the tubers were still perfectly sound and free from discoloration.

This seemed to justify the conclusion, which other tests have confirmed, that the danger of the transmission of rot due to the fungus which produces the late blight from one affected potato to another is remote. In this, as in other instances, the rot undoubtedly resulted from infection in the field. As the tops were kept green by the application of Bordeaux mixture and there were so little signs of the presence of the blight, the infection could hardly have been through the vines. The field was heavily dressed with stable manure only a short time before planting. There is little doubt that the fungus was carried to the field in the manure and that the tubers were directly infected, while the tops escaped the attack. This is in accord with the common experience so often noted before the use of Bordeaux mixture, that potatoes were more subject to blight and subsequent rot when grown on manure than on chemicals, or without the application of fertilizer of any kind. From the results of the experiments that follow, it is doubtful if there would have been anything like this loss from rot in the cellar, if the potatoes had been allowed to remain a few days in the ground after the tops had ripened, or after they had been killed by frost.

EFFECT OF TIME OF DIGGING UPON SUBSEQUENT DEVELOPMENT OF ROT.

In 1903 a variety test was conducted to study the differences in a few varieties in their abilities to resist blight. These results were given in detail in Bulletin 98 of this Station. Advantage was taken of this experiment to study the keeping qualities of the potatoes, comparing different varieties, sprayed with unsprayed, and early with late dug potatoes. At the distance these potatoes were planted and with a uniform stand, fifty-five hills almost exactly represents 1-300 acre. The yields at the time of digging are given in the following table.

Yields from fifty-five hills of ten varieties potatoes at time of digging.

Variety.	Date of harvesting.	Unsprayed.			Sprayed.		
		Good—lbs.	Rotten—lbs.*	Small—lbs.	Good—lbs.	Rotten—lbs.*	Small—lbs.
Early Michigan	Sept. 8	55	19	4	78	3	7
	Oct. 7	52	21	7	78	1	7
Average		54	20	6	78	2	7
Bovee	Sept. 8	45	33	6	60	12	8
	Oct. 7	59	28	5	57	11	7
Average		52	31	6	59	12	......
Early Ohio	Sept. 8	18	40	5	49	22	6
	Oct. 7	32	38	3	68	16	8
Average		25	39	4	59	19	7
Gem of Aroostook	Sept. 8	46	24	5	71	20	9
	Oct. 7	74	36	5	72	13	5
Average		60	30	5	72	17	7
Irish Cobbler	Sept. 8	95	20	9	111	12	5
	Oct. 7	66	13	7	107	6	6
Average		81	17	8	109	9	6
Hulett's Rust Proof	Sept. 8	......	......	......	......	......	......
	Oct. 7	81	1	7	99	......	6
Mill's Mortgage Lifter	Sept. 8	68	24	4	......	......	......
	Oct. 7	82	25	5	82	......	3
Average		75	25	5	82	......	3
Green Mountain	Sept. 8	68	37	4	......	......	......
	Oct. 7	84	18	5	153	11	4
Average		76	28	5	......	......	......
Polaris	Sept. 8	63	40	5	......	......	......
	Oct. 7	59	41	6	105	20	7
Average		61	41	5	......	......	......
Maggie Murphy	Sept. 8	55	28	2	......	......	......
	Oct. 7	51	52	2	87	14	2
Average		53	40	2	......	......	......
Average of 5 earlier varieties	Sept. 8	52	27	5	74	13	7
	Oct. 7	57	27	5	76	10	7
Average of 5 later varieties	Sept. 8	54	27	5	75	11	7
	Oct. 7	71	27	5	104	9	6

*All discolored potatoes are here included.

The potatoes as soon as dug were put in bags, and stored in a cool cellar, so as to be kept dry and not subject to heat. The very last of December and early in January the potatoes were carefully assorted, and any potatoes that showed the slightest indications of even incipient decay, were rejected. In this, as in all such work by the Station, many potatoes were rejected that in ordinary sorting would be sent to market. The pounds of apparently sound potatoes that were put into the cellar at the date of harvest, the pounds of sound potatoes that were found about January 1 when the potatoes were next examined, and the percentage of potatoes that had remained sound, are given in the table which follows.

Merchantable potatoes from fifty-five hills of nine varieties of potatoes at time of digging and after storing.

Variety.	Date of harvesting.	Weights and Per Cent Merchantable Potatoes.					
		Unsprayed.			Sprayed.		
		At harvest —lbs.	Jan. 1—lbs.	Per cent.	At harvest —lbs.	Jan. 1—lbs.	Per cent.
Early Michigan	Sept. 8	55	27	50	78	51	66
	Oct. 7	52	44	85	78	69	89
Bovee	Sept. 8	45	10	22	60	39	65
	Oct. 7	59	53	90	57	52	92
Early Ohio	Sept. 8	18	11	61	49	36	73
	Oct. 7	32	29	90	68	63	93
Gem of Aroostook	Sept. 8	46	10	22	71	26	54
	Oct. 7	74	58	78	72	55	76
Irish Cobbler*	Sept. 8	95	62	65	111	72	64
	Oct. 7	66	64	97	107	93	87
Mill's Mortgage Lifter	Sept. 8	68	49	72	......	......	......
	Oct. 7	82	75	92	82	81	91
Green Mountain	Sept. 8	68	35	52	......	......	......
	Oct. 7	84	80	95	153	130	85
Polaris	Sept. 8	63	33	52	......	......	......
	Oct. 7	59	53	90	105	94	90
Maggie Murphy	Sept. 8	55	9	16	......	......	......
	Oct. 7	51	44	86	87	75	86
Average of 4 early varieties	Sept. 8	41	15	39	74	45	64
	Oct. 7	54	46	86	76	66	87
Average of 4 later varieties	Sept. 8	64	32	48	75	......	......
	Oct. 7	69	63	91	104	95	90
Average of 8 varieties	Sept. 8	54	23	43	......	......	......
	Oct. 7	62	55	88	......	79	88

*Omitted from averages.

Experiments made at the Vermont Station* showed that in the case of potatoes dug every 12 days, August 25 to September 30 in 1902, and every 7 days, August 31 to September 28 in 1903, there was a much larger weight of potatoes still sound at the time of the later digging than from the earlier diggings. This is in accord with the experiments here reported, except that

*The relation of date of digging potatoes to the development of rot; L. R. Jones and W. J. Morse, Proceedings Society for Promotion of Agricultural Science, 1904 in the latter case the potatoes were subjected to the much severer test of three months storage.

CONCLUSIONS.

From experiments on the keeping of potatoes and upon the development of rot due to the late blight fungus, the following conclusions appear warranted:

The infection of the potatoes with the fungus occurs chiefly, if not entirely, in the field before digging.

The infection is usually the result of diseased vines.

The disease is transmitted, in the majority of cases, not directly through the vine, but indirectly through the soil.

Potatoes may be infected directly in the field from spores introduced in the manure, or from rotten potatoes spread upon or left in the land the preceding year.

Jones and Morse* conclude that the mycelium which produces the rot normally passes into a dormant stage after infesting the potato, but that abnormal conditions of moisture or temperature may cause abnormal activity in the fungus, and hence the rotting of the tubers.

Whatever may be the explanation, these experiments all agree in showing that, whether the vines have or have not been protected with Bordeaux mixture, there is far less liability of loss from rotting in the cellar in the case of late dug potatoes.

* Loc. cit.

EXPERIMENTS WITH DRY BORDEAUX.

CHAS. D. WOODS.

For a number of years dry Bordeaux has been upon the market. The best known is that made by Leggett and Brother, New York, and first sold under the trade name of fungiroid. This is made by using equal weights of lime and sulphate of copper. As used by us the past season, this dry Bordeaux carried practically the amount of copper claimed by the makers. It would therefore take 10 pounds of the dry Bordeaux mixture to furnish the same weight of copper as carried in 50 gallons of Bordeaux mixture prepared in accordance with the directions of this Station. Dry Bordeaux has been used successfully upon fruit trees, particularly in the middle west and southwest. Thus used it is greatly reduced with dry powdered lime. For potatoes the manufacturers recommend that it be reduced with one part of fine lime to 2 parts of dry Bordeaux. While it can be wet up and applied with a spray, it is designed to be used dry and applied with a powder gun.

In some localities it is a difficult problem to obtain the needed water for spraying and this, because of the labor involved, is, at times, the most expensive part of spraying. For this reason it was deemed of value to test dry Bordeaux applied as a dust against the ordinary Bordeaux mixture applied as a spray. Since it would be impracticable to use it on a large field while the foliage was still wet from dew, it was in this test applied in bright sun with the tops perfectly dry and even when the wind was quite strong. If it would not protect under these conditions, however valuable it might be for the garden where it can be applied on vines wet from dew or rain, it would be of no value for extended field use.

THE EXPERIMENT.

Two acres planted to Green Mountain potatoes, on the farm of John Watson, Houlton, were selected for the experiment. The field was planted about the twentieth of May and at the time it was selected there was a good even stand, and the field had been sprayed once, on June 28, with Bordeaux mixture and Paris green. One acre was dusted with 8 pounds of dry Bordeaux mixture on the following dates: July 5, 13, 20 and 28; August 3, 10, 16, and 22. July 5 and 13, Paris green was used with the Bordeaux. At no time were there potato bugs of any amount on the vines, nor did the flea beetle do any appreciable damage. Late in August there were more plant lice than usual, but not enough to damage the vines at all seriously. During the growing season there was no appreciable difference in the appearance of the dusted from the sprayed, except the dusted were lighter in color and the vines were less broken in the latter part of the season by the man walking through than by the horses on the sprayer. The darker color of the sprayed acre was more conspicuous at a distance and was doubtless due to the adhering Bordeaux mixture. At digging, the vines were dead on both plots from frost. At no time was there blight of any amount upon either acre. The yields were as follows:

Yield of potatoes upon one acre sprayed with regular Bordeaux and a corresponding acre dusted with dry Bordeaux. The fungicides were applied nine times during the season.

	Large bbls.*	Small bbls.	Rotten bbls.†
Regular Bordeaux mixture...........	122	17	none
Dry Bordeaux mixture...............	114	17	5

From the above results it would seem that the dry Bordeaux applied to dry vines is not effective in preventing blight and subsequent rot. It will be tested another season on damp vines to see if it is of value as a fungicide in garden culture of potatoes.

A Kansas manufacturer of dusting apparatus claims that ready prepared Bordeaux mixture is inert and that satisfactory results can be obtained by dusting on a mixture of finely pulverized copper sulphate and lime. The claim is made that these materials react as soon as moistened by dew and that the Bordeaux mixture thus freshly formed is as effective as the regular Bordeaux mixture applied as a spray. This will also be tested another season.

* One barrel is 2¾ bushels or 165 pounds.

† All discolored potatoes are included under rotten.

SOLUBLE BORDEAUX FOR POTATO BLIGHT.

Chas. D. Woods.

In the preparation of Bordeaux mixture from slacked lime and sulphate of copper, a chemical change takes place whereby hydrate of copper and sulphate of lime (gypsum) are formed. Both of these materials are insoluble in water, and Bordeaux mixture consists of these materials mechanically suspended in water. The gypsum is so heavy that, unless the mixture is kept thoroughly stirred, it will speedily separate out and bring down with it the lighter hydrate of copper. This necessitates the use of an agitator, and much of the unsatisfactory work of the spray as applied by some of the outfits on the market is due to imperfect agitation. Commercial Bordeaux mixtures have been made in which part of the gypsum has been taken out. Such mixtures are more easily kept in suspension, but there has not been sufficient gain to compensate for the extra labor involved in the preparation of such Bordeaux mixtures. For many years it has been known that the addition of sugar would render the hydrate of copper soluble. If the sugar is added to the slacked lime and allowed to stand for some time before adding it to the sulphate of copper solution, hydrate of copper, soluble in water, with only a trace of gypsum results.

Obviously Bordeaux in solution would present many desirable features. The director of the Wisconsin Experiment Station wrote that they were to experiment during the season of 1904 with such a Bordeaux mixture and invited the co-operation of this Station to test its efficacy upon potatoes in order that data might accumulate faster. Some of the possible merits of this new Bordeaux mixture were pointed out as follows:

"It is believed, on account of the soluble condition of the copper hydrate in this preparation, that its efficiency as a fungicide will be much greater than in the ordinary Bordeaux mixture, and consequently that it may be diluted at least ten and possibly fifty times and still protect plants from the ordinary fungus diseases. In addition to this advantage, the absence of solid particles permits the use of a much finer spray than is now employed, and it is evident that with a fine spray much more surface can be covered with the same amount of material. In these two ways it is hoped that the expense for the materials used in spraying may be greatly reduced."

The soluble Bordeaux used in the experiments here reported was prepared in accordance with the following directions furnished by Dr. S. M. Babcock, chemist to the Wisconsin Agricultural Experiment Station.

PREPARATION OF SOLUBLE BORDEAUX.

1. Copper sulphate solution—Dissolve 1 lb. of copper sulphate in 2 gallons of cold water. Will keep indefinitely.

2. Solution of sucrate of lime—Slake 10 lbs. fresh lime in 30 lbs. of water, strain the milk of lime through a wire strainer and add a solution of 25 lbs. of granulated sugar in 50 lbs. of water. Stir thoroughly at frequent intervals, and after two or three hours decant or siphon the clear liquid from the undissolved lime. The lime and sugar solution can be conveniently mixed in a revolving barrel churn.

The quantities named are sufficient for about 8 gallons of standard solution of sucrate of lime.

The solution will keep indefinitely if placed in well stoppered bottles, but if open to the air will gradually absorb carbonic acid gas and the lime will separate.

After siphoning off the clear solution, the residue still contains some sugar which may be recovered by adding considerable water and allowing the residue to settle a second time. The clear solution obtained may be used in place of an equal quantity of water in the preparation of the next lot.

SOLUBLE BORDEAUX.

Take equal parts of solution 1 and 2 and add three parts of water. Agitate until the copper hydrate which is at first precipitated is entirely dissolved. Upon standing, a slight deposit of gypsum is formed, leaving a deep blue solution of hydrate of copper. If desired, the spray may be applied immediately after preparation, as the small amount of finely divided gypsum will not interfere. Prepared in this manner, the solution contains about the same amount of copper hydrate as the ordinary Bordeaux mixture. It may be diluted indefinitely with water without a precipitate forming. The solution should be kept in well stoppered bottles and is best if used within 48 hours after preparation.

In case complete solution of the copper hydrate is not obtained, add a little more of solution No. 2 of sucrate of lime. As prepared, the soluble Bordeaux is, because of the sugar, much more expensive than regular Bordeaux carrying the same amount of copper. In the experiments here reported the soluble Bordeaux carried about one-half, one-fourth and one-seventh as much copper as the usual mixture.

The field of potatoes selected for the experiment was upon the farm of Mr. Clarence A. Powers, Maple Grove. It was planted to Green Mountains, and the rows were of such length that 12 rows made about an acre. The rows ran east and west. The field was apparently quite uniform, and sloped slightly toward the south and east. The potatoes were liberally fertilized, and thoroughly cared for during the growing season. The soluble Bordeaux as well as the regular Bordeaux mixture was applied with a one-horse Getchell sprayer that was provided with a powerful pump and an agitator that kept the solutions thoroughly stirred. Vermorel nozzles were used, so that with the pressure obtained the materials were all applied in a fine spray.

The arrangement of plots and their treatment was as follows:

Plot A. Twelve rows (one acre) on south side of field, sprayed with regular Bordeaux mixture.

Plot B. Twelve rows (one acre) next north were treated with soluble Bordeaux at such a rate that the copper applied at each application was equivalent to about 2⅔ pounds of sulphate of copper to the acre.

Plot C. Twelve rows (one acre) next north were treated with soluble Bordeaux equivalent to 1⅓ pounds of sulphate of copper each application.

Plot D. Twelve rows (one acre) next north were treated with soluble Bordeaux equivalent to 2/3 pounds of sulphate of copper per acre each application.

Plot E. Twelve rows (one acre) next north were sprayed with the regular Bordeaux mixture.

DATES OF SPRAYING AND NOTES.

July 8. (The soluble Bordeaux experiment had not at this time been planned.) The whole field was sprayed with regular Bordeaux mixture. The plants were in early bloom.

July 15. Plots A and E sprayed with 2-3 pound Paris green and 3 pounds lime. Plots B, C and D sprayed in both directions with soluble Bordeaux and 2-3 pound Paris green.

July 22. Plots A and E sprayed in both directions with regular Bordeaux mixture and 2-3 pound Paris green per acre. Other plots sprayed as the 15th.

July 27. All plots sprayed on the 22d, except that no Paris green was used.

July 29. All plots in fine shape. No signs of disease.

August 5. Potatoes in full bloom. No signs of blight. Very few rumors of any blight in the county.

August 10. All plots sprayed as before, but without Paris green.

August 13. Quite a few plant lice on some plants on all the plots.

August 20. Possibly a little blight on soluble Bordeaux plots. Plant lice are doing some damage.

September 1. Quite a heavy frost. But little damage on this field.

As will be observed from the notes, this field was sprayed only 4 times, or about half the number that is desirable. As it proved in this particular year, it was apparently sufficient to keep off blight and rot. At digging there was no sign of rot upon the potatoes from the plots treated with regular Bordeaux mixture.

YIELDS.

Through a misunderstanding, the potatoes on plot E were dug in the absence of a Station representative, and while the yield was taken, it is so much larger than that on the other plots that it may have been an error. There were so few small potatoes and practically no rotten ones that no separation was made in the field.

Yield plot A, regular Bordeaux, 103 barrels.

Yield plot B, soluble Bordeaux 2 2/3 pounds copper sulphate, 102 barrels.

Yield plot C, soluble Bordeaux 1⅓ pounds copper sulphate, 97 barrels.

Yield plot D, soluble Bordeaux ⅔ pound copper sulphate, 91 barrels.

Yield plot E, regular Bordeaux, 120 barrels.*

The potatoes on plot D were smaller than on the other plots and the skins of many of them darkened somewhat, resembling rot. Still, only a very few were rotten.

The experiments at the Wisconsin Station, through unavoidable complications, were a failure. In experiments upon potatoes made at the New York (Geneva) Experiment Station in 1903 the yields per acre were as follows: Unsprayed, 107 bushels per acre; soluble Bordeaux, 118 bushels per acre; soda Bordeaux mixture, 160 bushels per acre; regular Bordeaux mixture, 175 bushels per acre.

CONCLUSIONS.

The soluble Bordeaux of equal strength to regular Bordeaux mixture costs much more, both in materials and labor, than regular Bordeaux mixture. The yields were smaller and the quality inferior from the plots sprayed with soluble Bordeaux. For both of these reasons its use is not recommended.

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* Yield not taken by a station officer.

EXPERIMENTS WITH POTATOES ON HOME MIXED FERTILIZERS.

CHAS. D. WOODS.

In answer to numerous inquiries for a formula for potatoes in which tankage could be used, the following newspaper bulletin was sent out and generally printed in the papers of the State in the early spring.

A crop of 300 bushels of potatoes removes from the soil about 55 pounds nitrogen, 25 pounds phosphoric acid and 85 pounds potash. A formula on this basis would carry five parts nitrogen, two parts phosphoric acid, and eight parts potash.

In preparing a field for a crop, the needs of the soil to render it fertile are, however, of greater moment than the special needs of a particular crop. The results of numerous field experiments indicate that the potato does best in a soil abundantly supplied with all fertilizing elements.

If a farmer has not experimented with his soil so as to know to what fertilizing elements it most readily and profitably responds, he must use a formula, and one carrying about 3 to 3½ per cent nitrogen, 5 to 6 per cent available phosphoric acid, and 4 to 5 per cent potash will usually be found as profitable as any. Bearing in mind that there is no such thing as a "best" fertilizer and that different conditions make different demands, some such formula as the following can be satisfactorily used per acre until, by experimental knowledge of his own soil requirements, the individual farmer has learned a better one.

One hundred pounds nitrate of soda, 200 pounds cottonseed meal, 500 pounds fine bone tankage, 400 pounds acid phosphate, and 200 pounds muriate, or perhaps better, sulphate, of potash. These goods are very concentrated and would probably be more evenly applied if mixed with 500 pounds dry loam, muck, or some similar fine material. This weight of materials would carry 62 pounds nitrogen, of which about two-fifths is water soluble, 158 pounds phosphoric acid, of which two-thirds is available, and 102 pounds potash.

While the 100 pounds of available phosphoric acid in this formula is about four times the amount removed by the crop, the best experimental evidence indicates that a liberal application of available phosphoric acid is profitable for potatoes. Since phosphoric acid does not leach from the soil, the excess will be available for the following grain and grass crops. Following a crop of potatoes manured as above, usually a good crop of clover could be grown by the use of 200 pounds per acre of a complete fertilizer for a "starter," and 200 pounds of muriate of potash. This last with the phosphoric acid left in the soil would furnish the needed minerals, and the clover would obtain its needed nitrogen from the air.

Nitrate of soda carries about 16 per cent nitrogen, all of which is water soluble. High grade cottonseed meal, carrying 43 per cent of protein, has about 7 per cent nitrogen, 2 per cent phosphoric acid and 1 per cent potash. High grade finely ground bone tankage carries 5 to 6 per cent nitrogen, about one-third of which is water soluble, and about 15 per cent phosphoric acid, one-half of which is available. Muriate or sulphate of potash each carry about 50 per cent potash.

As the result of correspondence on this subject, the writer assisted farmers in Brunswick, Houlton and Fort Fairfield in mixing goods for use with potatoes. The formula used at Brunswick was: Portland Rendering Company's screened tankage 500 pounds; cottonseed meal 200 pounds; nitrate of soda 100 pounds; acid phosphate 400 pounds; and sulphate of potash 200 pounds. This 1,400 pounds of materials carried nitrogen 55 pounds; available phosphoric acid 103 pounds; total phosphoric acid 154 pounds; and potash 103 pounds. The percentage composition as found by analysis was water soluble nitrogen 1.39 per cent; insoluble nitrogen 2.52 per cent; total nitrogen 3.91 per cent; water soluble phosphoric acid 4.51 per cent; citrate soluble phosphoric acid 2.84 per cent, making the available phosphoric acid 7.35 per cent; insoluble phosphoric acid 3.67 per cent and total phosphoric acid 11.02 per cent; and potash 7.38 per cent. This was used by several farmers in Brunswick. The fields were not visited by the writer. Mr. W. S. Morrill, Brunswick, who was especially interested in having the formula for his own use, wrote relative to the yields as follows: "The yield as compared with last year (1903) was light—on the whole about 50 per cent of that crop. This was due to the season and not the fertilizer. Only one (Mr. Hill) tried the home mixed in comparison with regular ready mixed goods. The difference between the two, while not very marked, was slightly in favor of the home mixed. All that used the formula are perfectly satisfied with their crop, taking all things into consideration, and will surely use the home mixed goods next season."

Mr. J. W. West of Auburn used the home mixture and reports as follows: "It gives me pleasure to reply to your letter of the 19th inst., in regard to the "home mixed fertilizer" compounded by the formula that you published in the Station bulletin last spring.

"I used 500 pounds bone tankage from the Portland Rendering Company, 400 pounds plain phosphate, 200 pounds sulphate of potash, 200 pounds cottonseed meal, and 100 pounds nitrate of soda, thoroughly pulverized and mixed without any carrier. The materials cost at the average rate of about $1.50 per 100 pounds.

"One-half ton of it was used for potatoes on five-eighths of an acre. The soil is a sandy loam, recently cleared and seeded to grass. A portion of the plat was a black loam and rather wet. It was broken up last fall and harrowed thoroughly with a spring tooth and disc harrow. About 500 pounds of the fertilizer were spread broadcast and harrowed in. The ground was then furrowed, and the balance scattered in the hill and mixed with the soil before dropping the seed. This was planted the last of May, using the Green Mountain and Carmen No. 1 varieties. They were sprayed three times with Bordeaux mixture and Paris green. They should have been sprayed once or twice more to kill the bugs which were very plenty, but the press of other work prevented. The vines remained green until the heavy frosts in September. They were dug soon after, yielding 150 bushels full measure (or at the rate of 240 bushels to the acre). There was not over a bushel rotten at the time of digging, but they have rotted some since."

Mr. O. Y. Russell of Danforth used the home mixture and reports as follows. "The formula for potatoes, as I used it, was

100 pounds nitrate of soda, 500 pounds bone tankage, 400 pounds acid phosphate, 200 pounds sulphate of potash, 200 pounds cottonseed meal. I planted four barrels of potatoes, and when I hoed them I estimated that nearly one-third of the seed did not come on account of the wet. I used 1,200 pounds of the mixture on the piece and I got 80 barrels of good ones, and 10 barrels of small ones. I used no barn dressing. I broke up the piece late last fall. It has been down to grass about eight years, and cut about ½ ton to the acre last year. I did not use it in comparison with any other fertilizer, but I think it gave me better results than any other fertilizer I ever used. Several of my neighbors will use it next year."

Several others who used the formula made more or less complete reports to the Station. None of them seemed to have experienced any difficulty in the preparation and application of the home mixed goods. The nearest to a complaint as to the effect of the fertilizer was from a man who called the writer up by telephone at the time of digging and said "the potatoes are so large and the yield so great that the work of digging is greatly increased because of the fertilizer."

These cases are typical of the results obtained outside of Aroostook county. While the formula gave satisfaction, the writer believes that the modifications suggested on pages 140 to 143 of Bulletin 107 would in most instances be found advantageous.

The materials for the home mixed goods used at Houlton and Fort Fairfield were bought at one time and were all mixed at Houlton. The formula was: Portland Rendering Company's (rescreened) tankage 420 pounds; acid phosphate 400 pounds; cottonseed meal 200 pounds; sulphate of potash 200 pounds; and nitrate of soda 100 pounds. Analysis showed the mixed goods to have the following composition: Water soluble nitrogen 1.37 per cent; available nitrogen 2.72 per cent; total nitrogen 4.09 per cent; available phosphoric acid 7.01 per cent; total phosphoric acid 9.87 per cent; and potash 7.61 per cent.

It was designed to apply this at the rate of the 1,320 pounds per acre, but it was actually used quite differently by the different co-operative experimenters. One acre or more was grown upon this formula by John Watson, Houlton, W. S. Blake, Houlton, A. H. Porter, Houlton, E. L. Cleveland, Houlton, R. S. Hoyt, Fort Fairfield, C. A. Powers, Fort Fairfield, F. H. Haines, Fort Fairfield.

The field at Mr. Watson's was planted, grown and harvested under the oversight of the Station. Mr. Powers' and Mr. Hoyt's fields were frequently visited during the growing season and most of the harvesting was under the care of a member of the Station staff. The other fields were, as shown by the yields, well cared for and the data are believed to be accurate. The results at harvest, so far as returns have been obtained, and extracts from the notes taken at different times, follow. Beyond these data, the results are briefly discussed.

At Mr. Watson's, 3 acres were grown upon the home mixed in comparison with the same number of acres grown on Watson's Improved High Grade Potato Manure. The whole formula (1320 pounds per acre) was used, about 1100 at time of planting and the remainder at first cultivation, when the potatoes were breaking through the ground. About the same weight of Watson's Improved High Grade Potato Manure was used, about 1200 pounds at planting and the remainder when the potatoes were breaking through the ground. The potatoes were well cared for during the season. They were sprayed 9 times with Bordeaux mixture, to which at the first 3 sprayings Paris green was added. The field was free from the potato bug, was not damaged by the flea beetle and only slightly by plant lice. There were no signs of blight and no rot at harvest. The whole field was too immature when killed by frost, and the home mixed plots were not as mature as the Watson Improved plots. The comparison would have been fairer if the field had been planted a fortnight earlier, or frost had held off longer. The potatoes on the home mixed plots were all smaller and less matured than on the Watson Improved plots. Each plot contained one acre. The details are given in the table on the top of page 18.

Yields of potatoes grown on home mixed fertilizers compared with a standard potato fertilizer.

	Barrels of Potatoes. Large.	Small.	Total.
Home Mixed Fertilizer.			
Plot 1	109	15	124
Plot 3	101	20	121
Plot 5	112	18	130
Average	107	18	125
Watson's Improved Manure.			
Plot 2	118	15	133
Plot 4	120	15	135
Plot 6	122	17	139
Average	120	16	136

Mr. Blake grew 4 plots upon home mixed and 4 plots upon Watson's Improved. The plots were 1-20 acre in area. On the home mixed the fertilizer was used at the rate of 975 pounds per acre and on the other plots Watson's Improved was used at the rate of 1450 pounds per acre. The field was quite early planted, and the potatoes were well along when frost came. It was sprayed 5 times and was free from blight, and no rot. There were practically no small potatoes.

The yield from the home mixed plots were, per acre, as follows: 102, 107, 107, 109, average 106 barrels per acre. The yield from the Watson's Improved plots were, per acre, as follows: 107, 111, 111, 113, average 110½ barrels per acre.

Mr. Porter grew two acres on home mixed, using it at the rate of 1300 pounds per acre in the midst of a field of 27 acres planted with 1700 to 1800 pounds per acre of Watson's Improved. The rows were 32 inches apart, and the plants 12 inches apart in the row. The land was very uniform, was early planted, well cultivated and kept free from weeds. It was sprayed 6 times. There was no blight and no rot at digging. There were practically no small potatoes. The yield from the 27 acres was 3800 barrels or at the rate of a little over 140 barrels per acre. Mr. Porter did not measure the yield from the home mixed portions, but states that "there was no perceptible difference in appearance or yield."

Mr. Powers at Maple Grove grew several acres on home mixed compared with Darling's Blood, Bone and Potash. The plots alternated. On the home mixed there was used 960 pounds per acre, against 1,000 pounds of Darling's. The yields from the home mixed plots ran from 115 to 123 barrels, with an average of 119. The yields from the two of the plots where Darling's Blood, Bone and Potash were used were 118 and 119 barrels per acre. One plot ran considerably below this, but it was evidently due to the condition of the land. There was practically no difference in the yield with the different fertilizers. The potatoes were quite early planted and while at the first killing frost the home mixed were greener, they were sufficiently matured so as not to materially affect the yield or the appearance of the tubers.

Mr. Hoyt at Maple Grove grew three acres, one each of White Elephant, Dakota Red, and Green Mountain, on home mixed fertilizer in a large field where Crocker's fertilizer was used. The home mixed was applied at the rate of 975 pounds per acre, and the Crocker's at the rate of 1000 pounds. The field was well cared for, including spraying. There was neither blight nor rust. The yields were as follows per acre:

White Elephant	On home mixed, 96 barrels large, 8 barrels small. On Crocker's, 100 barrels large and 6 barrels small.
Green Mountain	On home mixed, 118 barrels large, 9 barrels small. On Crocker's, 124 barrels large, 10 barrels small.
Dakota Red	On home mixed, 113 barrels large, 3 barrels small. On Crocker's, 118 barrels large, and no small.

The potatoes were smaller on the home mixed and the vines were tenderer and were killed by frost earlier than on Crocker's.

CONCLUSIONS.

In general, large crops were obtained on the home mixed goods. On early planted potatoes, and where the season was long enough for the crop grown on the home mixture to mature, the yields were as large as where the standard commercial fertilizers were liberally used. The tops kept greener in color during the last half of the growing season with the home mixture. September 1, there was a severe frost all over Northern Maine. The late potatoes grown upon the home mixture had greener and more succulent vines than those upon the standard fertilizers and in consequence were damaged much more by the frost. In fact, the vines of the late planted potatoes on the home mixed goods were practically killed at this time, while the same varieties planted at the same time upon the standard potato fertilizer continued to grow after this frost. As a result, the potatoes were larger and better ripened with these than upon the home mixed plots. For quick maturing, the home mixed goods apparently carried too much slowly available nitrogen and too little available phosphoric acid—a condition that can be readily remedied in a formula. This is discussed on pages 140 to 143 of Bulletin 107 of this Station.

SUMMARY OF EXPERIMENTS IN PRACTICAL HORTICULTURE.

W. M. Munson.

In the horticultural work of the Experiment Station two distinct lines are kept in view: a study of the principles and laws affecting plant growth; and practical investigations for immediate guidance in the culture of fruits and vegetables. Mere variety testing, as such, has never occupied a leading place in the plan.

To be of value, work must extend uninterruptedly over a series of years, and general principles can be established only after repeated efforts; so that immediate "practical" results are not always possible. The following notes represent, in brief, a summary of the more immediately practical phases of the work which has received attention, with references to the particular bulletin or annual report where the details are published in full.

VEGETABLE GARDENING.

Vegetable gardening, while not of the commercial importance of some other lines of horticultural work in Maine, is nevertheless of interest and direct value to every citizen of the State—whether farmer or laborer or professional man. The leading questions considered have to do with the tomato, cabbage, cauliflower, egg plant, corn, radish and celery; also with the forcing of vegetables under glass.

Tomato.

With the tomato, the following questions were considered: The effect of trimming the vines; effect of bagging the fruit to produce early ripening; the effect of crossing; the cumulative effect of culture under glass.

It was found that a chill to tomato plants after setting is not necessarily fatal to success, and that, other things being equal, the earliness and productiveness of tomatoes were in direct ratio with the earliness of setting in the field. Unless conditions are very unfavorable, the plants should be in the field by June 1st. Trimming the plants after a part of the fruit had set, increased the yield by more than one-third. The results from bagging the fruit were in general of a negative character, but this treatment reduced the loss from rot. Crossing between small fruited plants of prolific habit and the ordinary large fruited type was found to be a promising method of securing a valuable type for localities where the season is short, and for securing a productive sort for forcing under glass. The increase in yield of the Lorillard-Peach cross over that of the pure Lorillard was nearly 50 per cent. A derivative hybrid between Lorillard and Currant produced a type of special excellence for forcing. In some instances seed from plants grown under glass gave better results in house culture than did seed of the same variety grown in the field. Results were not uniform, however, and there appeared to be distinct varietal differences. (Reports for 1891-5.)

Cabbage.

Cabbage studies included investigations as to the importance of deep setting of the plants; the effect of trimming at the time of setting; the frequency of transplanting; the effect of mulching.

Contrary to the general notion concerning the treatment of "leggy" plants, it was found that depth of setting had very little influence upon the size of the heads. Plants handled three or four times invariably gave better results than those handled once or twice before transfer to the field. Frequent transplanting increased the average size of the heads. Handling the plants in pots before setting in the field increased the percentage of marketable heads; but trimming the plants at the time of setting appeared to be of no special importance. The practice of mulching instead of cultivating was found to give very satisfactory results. (Reports for 1891-5.)

Cauliflower.

Work with the cauliflower included studies of the relative influence of pot and box culture of young plants; the effect of trimming at time of setting in the field; the effect of mulch as compared with frequent cultivation; a comparison of varieties.

Plants handled in pots were kept at a more nearly uniform rate of growth, and produced a higher percentage of marketable heads; this difference in some cases amounting to 20 per cent. As a result of trimming it was found that there was practically no difference in earliness nor in size of head, while as a rule the per cent of heads formed was greater from plants not trimmed. In no case were as satisfactory results obtained from the mulching as from frequent cultivation.

Nearly all of the leading varieties have been grown, and it is evident that the cauliflower may be successfully cultivated in this region. The most valuable sorts are of the Dwarf Erfurt and Snowball types, with Algiers for late in the season. (Report for 1893 and Bulletin 10.)

Egg Plant.

Egg plant studies included methods of culture; varieties; and crossing.

It was demonstrated that with careful treatment the egg plant may be successfully grown in central Maine, the most important requisites being: early sowing; vigorous plants; late removal to the field; warm, rich soil. Most of the well-known varieties are too late for this climate, but Early Dwarf Purple, Early Long Purple and Long White were satisfactory. Several crosses were made between white-fruited and black-fruited types. After four years of breeding it was found that no type sufficiently constant in color to be of value commercially was produced. There was, however, a marked increase in vigor and productiveness as a result of crossing. In the first generation the purple-fruited types seem stronger in their power to transmit color to the offspring than do the white-fruited types; and this law appears to hold whether the purple type is used as the male or the female parent. In later generations the inherent strength of the white-fruited types appears stronger than in the first. In all cases the white-fruited types appear stronger than the purple in the power to transmit form and productiveness. (See Annual Reports, 1891-3.)

Radish.

With the radish, the principal questions considered have been, the relative value of large and small seed; the effect of sub-watering in the greenhouse; the influence of different temperatures upon the period of maturity.

Large seeds were found to produce from 30 to 50 per cent more first-class roots than did small seed from the same lot. Sub-watering produced 12 to 15 per cent more first-class radishes on a given section of the greenhouse bench than did surface-watering on an equal area of the same bench. There was a much greater loss from damping off on the surface-watered section. Contrary to the usual notion, the crop matured earlier, and was of better quality, when grown in the tomato house, with a night temperature of 60 degrees, than when grown at a lower temperature. (See Annual Report, 1898.)

Celery.

The work with celery was mainly in the way of demonstration, and for the purpose of calling attention to this very useful garden plant. The questions of soil, fertilizers, planting, handling, blanching and storing were considered. (See Annual Report 1897 and Bulletin 40.)

WINTER GARDENING.

Principles and methods of building, heating, and ventilating greenhouses, and of managing the more important crops grown under glass, were discussed. In brief, it may be said, constant watchfulness and the exercise of good judgment are of more importance than adherence to set rules. One good man with occasional help should be able to do all of the work in houses covering 4,000 square feet of ground surface. In general, solid beds are advocated for plants requiring no bottom heat, such as cauliflower, lettuce and radishes, while for semi-tropical plants, like melons, beans, and tomatoes, benches are preferred. For large commercial houses, steam is the best method of heating, but for smaller houses hot water is preferable. (Annual Report, 1896.)

ORNAMENTAL GARDENING.

The ornamentation of rural homes is of the highest importance to the people of Maine, not only as a means of adding to the comfort and pleasure of home life, but as an attraction for the increasing number of summer visitors and as a means of enhancing the value of the property. For this reason suggestions were made concerning the location of buildings; construction of walks and drives; making of lawns; what, when and how to plant; native trees and shrubs valuable for planting; the best hardy sorts to get from nurseries; trees and shrubs tried and found wanting. (Annual Report 1897, and Bul. 42 and 46.)

FRUIT GROWING.

Fruit growing undoubtedly offers better opportunities than any other line of commercial horticulture in Maine, and its increasing importance demands more special attention on the part of the Experiment Station in the future. From the nature of the case, results are necessarily slow; but a large amount of work has been done, and partial reports have been made. Briefly summarized, the following statement indicates the nature and scope of this work:

Since 1890 the Station has had under observation, both at the home orchard and in northern Maine, hardy fruits from Russia and from the Northwest. All of these varieties are hardy and most of them are productive; very few of them, however, are worthy of general dissemination in those parts of Maine where the well known varieties of English and American origin will thrive. In the extreme northern part of the State some of them are valuable, and a few are worthy of culture under any conditions. (See Annual Reports, 1891, '92, '96, and Bulletin 82.)

Many fruits of unknown, or of doubtful value in this State, are sold by agents every year. For the information of growers, a catalogue of the leading sorts was prepared with a statement as to their character, quality and value for home use or for market, both for the northern and for the southern counties. (Annual Report 1893 and Bulletin 6.)

For a study of the comparative effect of cultivation and mulching, as well as for experiments with fertilizers, a young orchard in Kennebec county was selected in 1898. In the same region an old orchard is the basis of work in orchard renovation; and more recently another young orchard has been chosen for experiments in top-grafting. Studies in the use of cover crops are made in the Station orchard at Orono, and in orchards in other sections of the State. From data thus far published, it is found that, in the case of the Gravensteins, the number of trees producing some fruit was nearly 50 per cent greater on the cultivated than on the mulched land; while the average yield was as 72 and 59 respectively.

The use of different forms of potash as a factor in preventing apple scab gave negative results, agreeing in the main with results published elsewhere. .

In the work of orchard renovation, the effect of cultivation was visible a half mile distant, the foliage being large, dark and healthy, as compared with the small, pale, sickly leaves on the adjacent check trees. The plot receiving complete fertilizer presented the best appearances at the end of the growing season. (For details see Bulletin 89.)

SPRAYING.

Spraying with fungicides and insecticides has received considerable attention, especially in the years 1891-5. Among the questions studied are the following: The effectiveness of the treatment in producing perfect fruit; the relative number of windfalls on sprayed and unsprayed trees; the preparation of spraying mixtures; the best time for spraying.

All trees sprayed with arsenical poisons had a smaller percentage of wormy fruit than did the unsprayed. Paris green was found less injurious to the foliage than was London purple or white arsenic. A mixture of one pound Paris green in 250 gallons of water was effective in reducing the amount of wormy fruit, but a stronger mixture (one pound to 100 gallons) was required to kill the tent caterpillar. The number of windfalls was greatly lessened by spraying with Paris green and the proportion of wormy fruit among the windfalls was also smaller from the sprayed trees. It was observed that most of the wormy fruits from sprayed trees are entered from the side or base, while in fruits from unsprayed trees the entrances at the calyx were largely in excess. Spraying three times with an ammoniacal solution of copper carbonate destroyed the apple scab fungus and resulted in saving 52 per cent of the crop, but the foliage and fruit were slightly injured. The most satisfactory and effective fungicide used was Bordeaux mixture and this is now generally used throughout the State. The effectiveness of Bordeaux mixture as a fungicide, and of Paris green as an insecticide for the orchard, was fully established by the work of the Station in 1891-3. (Reports for 1891-3, Bulletins 8 and 52; and How to Fight Apple Enemies.)

THE BLUEBERRY.

There are vast areas in Maine which, while bearing a considerable number of blueberry bushes and yielding a profitable return to the few people who make a practice of gathering the wild fruit, are not utilized as they might be. Systematic treatment in the way of burning, planting and managing might with profit be given to these lands and extended to other sections.

Another phase of the subject which is worthy of careful attention is that of domestication and the improvement of types by selection and crossing. The fruit in its wild state is superior to that of most other small fruits, and is very susceptible to the influence of environment. Systematic experiments in this direction are in progress at the Station. The most promising species for this work is the high-bush blueberry, *Vaccinium corymbosum*. (Report for 1898 and Bulletin 76.)

PLANT BREEDING.

The general question of the improvement of plants, or "plant breeding," is a perennial one. Much of the work done at the Station has never been published, but certain phases have been touched upon. A general statement of the problem is given in the Annual Report for 1893.

From evidence at hand it appears that the secondary results of crossing may be of fully as much importance as are directly inherited qualities. Among these secondary effects are: The possible immediate influence of pollen upon the mother plant; the stimulating effect of pollen upon the ovary; and the influence of varying amounts of pollen. In a few important species there may be an immediate apparent effect of foreign pollen on the female organism of the current generation, but the greater portion of the food plants studied do not exhibit such effect. That pollen has a direct stimulating effect upon the ovary, independently of its action upon the ovules, seems a well established fact. Variations in the amount of pollen available may, to a large extent, determine the form and consequent value of the fruits of some species. (Annual Report 1892.)

RED CLOVER FROM VARIOUS SOURCES.

W. M. Munson.

During the seasons of 1902 and 1903 a coöperative study of red clover was made in connection with the United States Department of Agriculture. The object of this study was to determine, if possible, the best source from which to obtain seed for general farm purposes. To this end, seed obtained from various parts of the world, by the Department of Agriculture, was sent to this Station and careful notes were made as to rate and per cent of germination; date of blooming and consequent earliness of crop; date of cutting; yield per acre; general condition of the stand; and characteristics of the plants.

GERMINATION TESTS.

The sprouting of seeds in a "seed tester" or on blotting paper often gives erroneous impressions as to the real value of the seed. With this fact in mind, seeds of each lot were placed upon blotting paper under a bell jar, and two duplicate lots were planted in soil in the greenhouse. The comparative results, as also the percentage of germination obtained in case of each at Washington, before the seeds were sent out, are shown in the accompanying table.

In many cases seed which showed a high percentage of sprouting when placed under favorable conditions, both at Washington and at the Experiment Station, did not possess sufficient vitality to insure a heavy stand of plants when covered with soil, a fact which would indicate the necessity of heavy seeding and of light covering in such instances.

In most cases, the best results in the germination tests were obtained from seed grown in the higher regions of central Europe—though two lots of seed from Bohemia showed rather low vitality in the soil tests. The most vigorous seeds seemed to be those from Upper Austria, Styria, Hungarian Transylvania, and Russia; while one lot from England and that from Denmark were specially low in vitality. Seed from Brittany showed a high percentage of germination (sprouting) at Washington, but was rather low both in the blotting paper and in the soil tests at the Station. Of the American seed tested, that from Ohio and Illinois were, in this trial, the strongest.

Results of Germination Tests.

Accession number.	Source of Seed.	Per cent germination Washington.	Per cent germination blotting paper.	Per cent germination in soil, 1st test.	Per cent germination in soil, 2d test.
10964	Oregon	89	90	41	30
10965	Tennessee	89	93	40	–
10990	Missouri	95	97	25	33
11791	Iowa	93	84	37	–
11813	Michigan	95	95	49	–
12010	Ohio	93	97	47	60
12090	Indiana	96	90	35	35
12165	Illinois	–	93	39	75
12169	Russia	91	93	55	80
12170	Brittany	96	72	27	40
12171	England	81	71	13	34
12172	Denmark	96	92	17	20
12173	New Zealand	77	72	27	40
12174	England	78	95	49	–
12175	Bohemia	96	93	34	38
12186	Nebraska	80	71	19	38
12223	Wisconsin	92	94	71	64
12540	Russia	96	91	45	80
12541	Minnesota	94	92	51	60
12635	Italy	88	90	29	35
12663	Upper Austria	97	94	75	83
12664	Silesia	88	89	77	48
12665	Hungarian Mountain Region	95	94	57	80
12666	Styria	91	93	78	85
12667	Galizia	85	89	77	40
12668	Hungarian Plains	97	85	81	42
12669	Bohemia	95	80	33	45
12670	Hungarian Transylvania	95	92	85	70

The above facts are presented for consideration. Only the most general inferences can be drawn, however, from a single sample, or even from two or three samples from any given source.

FIELD WORK, 1902.

Duplicate plats of twenty-nine different lots of seed were sown, May 19, on plats of two square rods each, at the rate of 12 pounds standard seed per acre. The location of the plats has a slightly northeastern aspect. The soil is a rich sandy loam, with a strong clay subsoil. A crop of buckwheat was grown upon the land in 1901, and there was much trouble from young buckwheat plants, as well as from witchgrass and *Gnaphalium* which infested the ground. In general, however, the plats were kept free from weeds and the clover plants were given the best possible chance for growth.

The soil was in excellent condition at the time of planting. With the exception of very light showers, there was no rain until May 24. Between May 24 and 28, however, several inches of rain fell, and there was an abundance of rain thereafter.

Plants in all plats began to appear May 26. On the 28th no marked difference was observed in the appearance of the several plats. It was to be expected that seed from the far northern regions would germinate more rapidly than that from other parts of the world, but such difference was not detected. One plat, from Michigan seed, seemed rather behind the others at first, but this condition was attributed to a possible difference in depth of covering the seed.

The season as a whole was cool and moist, and in most cases growth was luxuriant. Marked differences were noted, however, and some of these differences are very significant. A particularly noticeable feature of the plants from European seed was an almost invariable absence of hairiness of stem and leaves, while all American grown seed produced very hairy plants. This characteristic may be of importance as affecting the amount of dust in the clover hay, though we have not as yet had sufficient quantity of hay to determine positively this point.*

The plants from northern Europe were, as a rule, later in maturing than were those from farther south and from American seed.

On August 30, or 3½ months after seeding, plats 17 and 19, from Indiana and Bohemia respectively, were in prime condition for hay. Plats 18 and 20—duplicate plats from the same sources—were slightly less mature, but in accordance with the plan, one plat from seed of every source was cut and weighed at this time.

*Since this paper was ready for the press a personal communication to the writer from Professor N. E. Hansen of South Dakota Experiment Station confirms this observation. While travelling in Russia, Professor Hansen found that because of a shortage in the Russian crop of clover seed, American seed had been imported, and there was a very general complaint of the dustiness of the hay from such seed.

Relative yield and shrinkage of red clover grown in 1902 from seed from different localities.

Plat number.	Source of Seed.	Date of Cutting.	Yield green —lbs.	Yield dry —lbs.	Shrinkage in drying —per cent.	Yield per acre —lbs.
1	Illinois	August 30	150	39	74	3120
2	Illinois	September 3	135	37	73	2960
3	Hungarian Mountain Region	August 30	138	36	74	2880
4	Hungarian Mountain Region	September 3	126	33½	73	2680
5	Bohemia	August 30	91	23	74	1840
6	Bohemia	September 3	101	27	73	2160
7	Wisconsin	August 30	81½	21	73	1680
8	Wisconsin	September 3	146	45	69	3600
9	Russia	August 30	98½	26	73	2080
10	Russia	September 12	115½	29	74	2320
11	Styria	August 30	122½	30	75	2400
12	Styria	September 12	134	34	80	2720
13	Galizia	August 30	107	27	74	2160
14	Galizia	September 12	95½	21½	76	1720
15	Hungarian Plains	August 30	129	31	75	2480
16	Hungarian Plains	September 3	142	37½	73	3000
17	Indiana	August 30	138½	35½	74	2840
18	Indiana	September 3	173	49	70	3920
19	Bohemia	August 30	160½	40	75	3200
20	Bohemia	September 3	160	50½	68	4040
21	Minnesota	August 30	159½	41	74	3280
22	Minnesota	September 3	164½	50½	69	4040
23	Oregon	August 30	154	35½	76	3440
24	Oregon	September 3	164½	44	73	3520
25	Denmark	August 30	131	32	82	2560
26	Denmark	September 12	134½	31	76	2480
27	England	August 30	85	22½	72	1800
28	England	September 12	113	26½	77	2120
29	Norway	August 30	65	13	80	1040
30	Norway	September 12	63½	17	71	1560
31	Ohio	August 30	174½	42	74	3360
32	Ohio	September 9	151	37	75	2960
33	New Zealand	August 30	158	36	77	2880
34	New Zealand	September 3	128	36½	71	2920
35	Brittany	August 30	188½	44	75	3520
36	Brittany	September 3	133	36½	72	2920
37	Michigan	August 30	110	27	75	2160
38	Michigan	September 12	118½	27½	76	2200
39	Hungarian Transylvania	August 30	147½	35	77	2800
40	Hungarian Transylvania	September 12	128	34½	73	2760
41	Nebraska	August 30	128	31	75	2480
42	Nebraska	September 9	112	29	74	2120
43	England	August 30	124	33	73	3520
44	England	September 3	119	32	73	2560
45	Russia	August 30	141½	34	75	2720
46	Russia	September 9	153	34½	77	2760
47	Italy	August 30	145	33	77	3520
48	Italy	September 9	153½	35½	76	2840

Relative yield and shrinkage of red clover grown in 1902 from seed from different localities.

Plat number.	Source of Seed.	Date of Cutting.	Yield green —lbs.	Yield dry —lbs.	Shrinkage in drying —per cent.	Yield per acre —lbs.
49	Missouri	August 30	182	40½	78	3240
50	Missouri	September 9	132½	31	77	2480
51	Iowa	August 30	151	32½	78	2600
52	Iowa	September 12	131	32½	75	2600
53	Tennessee	August 30	137	31½	78	2520
54	Tennessee	September 9	135	32	76	2560
55	Silesia	August 30	156	34½	71	2760
56	Silesia	September 12	130	33	74	2740
57	Upper Australia	August 30	192	42	70	3360
58	Upper Australia	September 12	127	35	71	2800

RELATIVE YIELDS OF DIFFERENT PLATS.

While conclusions cannot be drawn from a single season's work, a comparison of the yields and of the different lots is of interest. As already stated, one plat from every lot of seed was cut at the time the earliest plats—which happened to be Numbers 17 and 19—were ready for harvest. The duplicate plats were cut as they matured or, in a few cases, at the end of the season, to save them from destruction by rust.

The preceding tables give the results in detail.

The largest yields were obtained, in the order given, from plats with seed from Minnesota, Bohemia, Indiana, Wisconsin, Brittany and Ohio.

The shrinkage in drying ranged from 68 per cent on plat 20 (Bohemia), to 82 per cent on plat 25 (Denmark). The mature crop from Wisconsin and Minnesota plats each shrank 69 per cent, and from Indiana 70 per cent. The usual shrinkage, however, was about 73 to 75 per cent. In considering weights and shrinkages it should be borne in mind that green clover leaves are more numerous and in the aggregate heavier than the mature stalks, because of the greater amount of water contained. For this reason the weight of the undried product of some plats, which were late and very immature, appears greater than that of other plats which were in every way superior; the shrinkage in drying is, however, correspondingly greater.

All plats were very uneven in maturing, but the cutting was done so as to get as nearly as possible average conditions. Recovery after cutting was uniformly rapid, because of the favorable season.

FIELD NOTES, 1903.

The winter of 1902-3 was exceptionally favorable for clover seeding, as the ground was almost continuously covered with snow. In March, however, heavy rains and subsequent freezing caused some of the plats to suffer. But, with the exception of those indicated in the table, all plats were in excellent condition in the spring of 1903.

The early part of the season was exceptionally unfavorable to growth. Sharp frosts, which occurred May 23 and 24, severely checked the young growth, and the prolonged drought which prevailed throughout New England caused the first crop to mature early, with a very light yield.

The earliest plats to mature were those from Indiana, Hungarian Mountain Region, and Ohio, which were ready to cut June 29. These were closely followed by plats from Bohemia, Italy, Illinois and Wisconsin. As in the previous year, one plat of each lot was cut at the time the first one was ready, June 29, and the duplicate plats were cut as they matured.

Abundant rains soon after the first cutting insured rapid recovery and a vigorous growth for the second crop. The first plats ready for the second cutting were Nos. 1, 17, and 31, from Illinois, Indiana and Ohio, respectively, on August 13.

Relative yield and shrinkage of red clover in 1903, seeded in 1902 with seed from different localities.

Plat.	Source of Seed.	First Cutting. Date of cutting.	Yield green, pounds.	Yield dry, pounds.	Shrinkage in drying, per cent.	Yield per acre dry, pounds.	Second Cutting. Date of cutting.	Yield green, pounds.	Yield dry, pounds.	Shrinkage in drying, per cent.	Yield per acre, dry, pounds.	Total yield per acre, pounds.	Remarks.
1	Illinois	June 29	101½	28	72	2240	Aug. 13	216½	46½	78	3720	5960	One of the best plats; vigorous, erect, height 23 inches, conspicuously hairy.
2	Illinois	July 1	74	22½	69	1800	Aug. 21	201½	44½	78	3560	5560	
3	Hung. Mt. Region	June 29	70½	20½	70	1640	Aug. 13	201½	43½	78	3480	5120	Very good; stems smooth; very little rust.
4	Hung. Mt. Region	July 1	73	20	72	1600	Aug. 21	200	46	77	3680	5280	Same as No. 3. Considerable rust.
5	Bohemia	June 29	90	26½	70	2120	Aug. 13	215½	45	79	3600	5720	Good stand; little rust; nearly smooth stem, recovery irregular.
6	Bohemia	July 1	52½	16	69	1280	Aug. 21	168½	41¼	76	3300	4580	Same as No. 5; but recovery very slow.
7	Wisconsin	June 29	87½	26½	69	2120	Aug. 13	188	37	79	2960	5080	
8	Wisconsin	July 1	94	30¾	67	2460	Aug. 21	207	46	77	3680	6140	
9	Russia	June 29	80½	22½	72	1800	Aug. 13	202	38	81	3040	4840	
10	Russia	July 1	45	14½	69	1160	Aug. 21	199	42	78	3360	4520	
11	Styria	June 27	63	16½	73	1320	Aug. 13	204	40	80	3200	4520	
12	Styria	July 7	43½	24	44	1920	Aug. 21	179½	56	69	4480	6400	Some witch grass.
13	Galizia	June 27	64½	25½	60	2040	Aug. 13	188¾	39½	74	3160	5200	
14	Galizia	July 7	27½	7¾	74	620	Aug. 13	177½	56	69	4480	5100	Somewhat weedy.
15	Hung. Plains	June 29	46¾	14	74	1120	Aug 13	165½	35½	79	2840	3960	
16	Hung. Plains	July 1	92	27	70	2160	Aug. 21	192	47½	75	3800	5960	
17	Indiana	June 29	114	31	72	2480	Aug. 13	193½	43½	77	3480	5960	
18	Indiana	July 1	185	45	75	3600	Aug. 21	215½	52½	80	4200	7800	The best plot.
19	Bohemia	June 29	105½	32½	69	2600	Aug. 13	232½	49½	79	3960	6560	
20	Bohemia	July 1	84	28¾	65	2300	Aug. 21	192½	46½	76	3720	6020	
21	Minn	June 29	73	21	71	1680	Aug. 13	148	34½	70	2760	4440	
22	Minn	July 1	74½	20	73	1600	Aug. 21	187½	43	77	3440	5040	
23	Oregon	June 29	78	24½	69	1980	Aug. 13	167½	34	79	2720	4700	
24	Oregon	July 1	63	20½	67	1640	Aug. 21	65½	28¼	56	2280	3920	

25	Denmark	June 29	76	20½	73	1640	Aug. 13	158	28	82	2240	3880	
26	Denmark	July 7	58½	18	69	1240	Aug. 28	108	44½	59	3560	4800	
27	England	June 29	46½	14½	70	1160	Aug. 13	107	20	81	1600	2760	Badly killed out.
28	England	July 29	89	30½	65	2440	.....	.....	.....	.....	.....	2440	Discarded; very weedy.
29	Norway	June 29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Winter killed.
30	Norway	July 28	85	28	67	2240	Aug. 28	175	57	68	4560	6800	
31	Ohio	June 29	103	31	69	2480	Aug. 13	173	31	79	2720	5200	
32	Ohio	July 1	101½	35	65	2800	Aug. 28	131	38	76	3040	5840	Exceptionally good.
33	N. Zealand	June 29	105½	19	82	1520	Aug. 13	192½	38	80	3040	4560	
34	N. Zealand	July 1	83½	27½	67	2200	Aug. 28	134	50	62	4000	6200	Considerable witch grass.
35	Brittany	June 29	58½	17½	74	1400	Aug. 13	192	38	80	3040	4440	
36	Brittany	July 1	50	17	66	1360	Aug. 28	143	51	64	4080	5440	Considerable witch grass.
37	Michigan	June 29	64½	20	60	1600	Aug. 13	166	31½	81	2520	4120	
38	Michigan	July 7	44½	13	70	1040	Aug. 28	141	50	64	4000	5040	
39	Hung.Transylvania	June 29	62	13½	78	1080	Aug. 13	164	32½	80	2600	3680	
40	Hung.Transylvania	July 7	35½	10½	70	840	Aug. 28	140	48½	65	3880	4720	
41	Nebraska	June 29	53½	15	71	1200	Aug. 13	146	31	78	2480	3680	
42	Nebraska	July 7	36½	10½	71	840	Aug. 28	158½	50	68	4000	4840	
43	England	June 29	28½	6½	77	520	Aug. 13	91½	18½	89	1480	2000	
44	England	July 7	17½	6	64	480	Aug. 28	94½	31½	65	2520	3000	
45	Russia	June 29	41½	7½	81	600	Aug. 13	149½	28½	80	2280	2880	Weedy; clover partly killed out.
46	Russia	July 7	78	24	79	1920	Aug. 28	149½	51½	66	4120	6040	One of the best.
47	Italy	June 29	36½	12	69	960	Aug. 13	69½	14	79	1120	2080	
48	Italy	July 7	32½	10½	67	840	.....	.....	.....	.....	.....	.....	Winter killed.
49	Missouri	June 29	80½	16	80	1280	Aug. 13	164½	32½	80	2600	3880	
50	Missouri	July 1	68	23½	66	1880	Aug. 28	154½	56½	63	4520	6400	Probably not quite dry.
51	Iowa	June 29	62	22½	63	1800	Aug. 13	139¾	24½	82	1960	3760	
52	Iowa	July 29	108½	46	58	3680	.....	.....	.....	.....	.....	3680	Injured by drought; failed to recover.
53	Tennessee	June 29	44½	14½	60	1160	Aug. 13	141	27	80	2160	3320	Winter killed in spots.
54	Tennessee	July 29	48	16½	65	1320	.....	.....	.....	.....	.....	1320	Badly winter killed.
55	Silesia	June 29	20	4½	75	360	.....	.....	.....	.....	.....	.....	Badly winter killed.
56	Silesia	July 28	51	18½	63	1480	.....	.....	.....	.....	.....	.....	Badly winter killed.
57	Upper Austria	June 29	37½	10	73	800	.....	.....	.....	.....	.....	.....	Badly winter killed.
58	Upper Austria	July 28	29	10½	63	840	.....	.....	.....	.....	.....	.....	Badly winter killed.

Plat No. 18 with seed from Indiana, and cut both times when in the best condition for hay, gave the highest total yield for the season; the amount being 3.9 tons per acre. Plat 19, seed from Bohemia, stands second in the list with a record of 3.28 tons. Plat 46, Russia, third with 3.02 tons, and Plat 20, Bohemia, fourth with 3.01 tons. Plats 1, Illinois, and 17, Indiana, follow with 2.98 tons each, while 32, Ohio, and 5, Bohemia, come next with 2.92 and 2.86 tons respectively.

It is interesting to note that with the exception of plat 17, Indiana, and plat 20, Bohemia, those which proved best in the long run are not included in the list of those giving the highest yields the first year. Nor are those lots which showed the highest per cent of germination in laboratory tests the ones which give the best final returns. Both Indiana and Bohemia seed showed a relatively low vitality in the soil test in the laboratory. Ohio, Illinois and Russia, however, were among those showing the best results in the laboratory.

FERTILIZER INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in Charge of Fertilizer Analysis.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer, guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

In the tables which follow the discussion there are given the results of the analyses of the manufacturers' samples of licensed brands. The tables include all the brands which have been licensed to March 1, 1905. Dealers are cautioned against handling any brands not given in this list without first writing the Station.

The figures which are given as the percentages of valuable ingredients guaranteed by the manufacturers are the minimum percentages of the guarantee. If, for instance, the guarantee is 2 to 3 per cent of nitrogen, it is evident that the dealer cannot be held to have agreed to furnish more than 2 per cent, and so this percentage is taken as actual guarantee. The figures under the head of "found" are those showing the actual composition of the samples.

To produce profitable crops and at the same time to maintain and even to increase the productive capacity of the soil may rightly be termed "good farming." Many farmers are able to do this, and the knowledge of how to do it has been largely acquired through years of experience, during which the character of the soil, its adaptability for crops, and the methods of its management and manuring have been made the subjects of careful study, without, however, any definite and accurate knowledge concerning manures and their functions in relation to soils and crops. To those who desire to study this question, the Station will, on application, send a list of suitable books. Experience in the field, explained by experiments in the laboratory, has clearly demonstrated a few principles which underlie the successful and economical use of fertilizers.

Soils vary greatly in their capabilities of supplying food to crops. Different ingredients are deficient in different soils. The way to learn what materials are proper in a given case is by observation and experiment. The rational method for determining what ingredients of plant-food a soil fails to furnish in abundance, and how these lacking materials can be most economically supplied, is to put the questions to the soil with different fertilizing materials and get the reply in the crops produced. How to make these experiments is explained in Circular No. 8 of the Office of Experiment Stations of the U. S. Department of Agriculture. A copy of this circular can be had by applying to the Secretary of Agriculture, Washington, D. C., or to the Maine Agricultural Experiment Station.

The chief use of fertilizers is to supply plant-food. It is good farming to make the most of the natural resources of the soil and of the manures produced on the farm, and to depend upon artificial fertilizers only to furnish what more is needed. It is not good economy to pay high prices for materials which the soil may itself yield, but it is good economy to supply the lacking ones in the cheapest way. The rule in the purchase of costly commercial fertilizers should be to select those that supply, in the best forms and at the lowest cost, the plant-food which the crop needs and the soil fails to furnish.

Plants differ widely with respect to their capacities for gathering their food from soil and air; hence the proper fertilizer in a given case depends upon the crop as well as upon the soil. The fertility of the soil would remain practically unchanged if all the ingredients removed in the various farm products were restored to the land. This may be accomplished by feeding the crops grown on the farm to animals, carefully saving the manure and returning it to the soil. If it is practicable to pursue a system of stock feeding in which those products of the farm which are comparatively poor in fertilizing constituents are exchanged in the market for feeding stuffs of high fertilizing value, the loss of soil fertility may be reduced to a minimum, or there may be an actual gain in fertility.

CONSTITUENTS OF FERTILIZERS.*

The only ingredients of plant-food which we ordinarily need to consider in fertilizers are potash, lime, sulphuric acid, phosphoric acid, and nitrogen. The available supply of sulphuric acid and lime is often insufficient; hence one reason for the good effect so often observed from the application of lime, and of plaster, which is a compound of lime and sulphuric acid. The remaining substances, nitrogen, phosphoric acid and potash, are the most important ingredients of our common commercial fertilizers, both because of their scarcity in the soil and their high cost. It is in supplying these that phosphates, bone manures, potash salts, guano, nitrate of soda, and most other commercial fertilizers are chiefly useful.

The term "form" as applied to a fertilizing constituent has reference to its combination or association with other constituents which may be useful, though not necessarily so. The form of the constituent, too, has an important bearing upon its availability, and hence upon its usefulness as plant food. Many materials containing the essential elements are practically worthless as sources of plant food because the form is not right; the plants are unable to extract them from their combinations; they are "unavailable." In many of these materials the forms may be changed by proper treatment, in which case they become valuable not because the element itself is changed, but because it then exists in such form as readily to feed the plant.

Nitrogen is the most expensive of the three essential fertilizing elements. It exists in three different forms, organic nitrogen, ammonia and nitrate.

Organic nitrogen exists in combination with other elements either as vegetable or animal matter. All materials containing organic nitrogen are valuable in proportion to their rapidity of decay, because change of form must take place before the nitrogen can serve as food. Organic nitrogen differs in availability not only according to the kind of material which supplies it, but according to the treatment it receives. The nitrogen in the tables of analyses marked "insoluble in water" is organic nitrogen.

* Farmers Bulletin 44 of the U. S. Dept. of Agriculture, "Commercial Fertilizers, Composition and Use," can be had free by applying to your Congressman.

Nitrogen as ammonia usually exists in commercial manures in the form of sulphate of ammonia and is more readily available than organic nitrogen. While nitrogen in the form of ammonia is extremely soluble in water, it is not readily removed from the soil by leaching, as it is held by the organic compounds of the soil.

Nitrogen as nitrate exists in commercial products chiefly as nitrate of soda. Nitrogen in this form is directly and immediately available, no further changes being necessary. It is completely soluble in water, and diffuses readily throughout the soil. It differs from the ammonia compounds in forming no insoluble compounds with soil constituents and may be lost by leaching. The "Nitrogen soluble in water" of the tables includes both the nitrogen as ammonia and as nitrate.

Phosphoric acid is derived from materials called phosphates, in which it may exist in combination with lime, iron, or alumina as phosphates of lime, iron or alumina. Phosphate of lime is the form most largely used as a source of phosphoric acid. Phosphoric acid occurs in fertilizers in three forms: That soluble in water and readily taken up by plants; that insoluble in water, but still readily used by plants, also known as "reverted;" and that soluble only in strong acids and consequently very slowly used by the plant. The "soluble" and "reverted" together constitute the "available" phosphoric acid. The phosphoric acid in natural or untreated phosphates is insoluble in water, and not readily available to plants. If it is combined with organic substance, as in animal bone, the rate of decay is more rapid than if with purely mineral substances. The insoluble phosphates may be converted into soluble forms by treatment with strong acids. Such products are known as acid phosphates or superphosphates. The "insoluble phosphoric acid" of a high cost commercial fertilizer has little or no value to the purchaser because at the usual rate of application the quantity is too small to make any perceptible effect upon the crop, and because its presence in the fertilizer excludes an equal amount of more needful and valuable constituents.

Potash in commercial fertilizers exists chiefly as muriates and sulphates. With potash the form does not exert so great an influence upon availability as is the case with nitrogen and phosphoric acid. All forms are freely soluble in water, and are believed to be nearly if not quite equally available as food. The form of the potash has an important influence upon the quality of certain crops. For example, the results of experiments seem to indicate that the quality of tobacco, potatoes, and certain other crops is unfavorably influenced by the use of muriate of potash, while the same crops show a superior quality if materials free from chlorides have been used as the source of potash.

Valuation of Fertilizers.

The agricultural value of any fertilizing constituent is measured by the value of the increase of the crop produced by its use, and is, of course, a variable factor, depending upon the availability of the constituent, and the value of the crop produced. The form of the materials used must be carefully considered in the use of manures. Slow-acting materials cannot be expected to give profitable returns upon quick growing crops, nor expensive materials profitable returns when used for crops of relatively low value.

The agricultural value is distinct from what is termed "commercial value," or cost in market. This value is determined by market and trade conditions, as cost of production of the crude material, methods of manipulation required, etc. Since there is no strict relation between agricultural and commercial or market value, it may happen that an element in its most available form, and under ordinary conditions of high agricultural value, costs less in market than the same element in less available forms and of a lower agricultural value. The commercial value has reference to the material as an article of commerce, hence commercial ratings of various fertilizers have reference to their relative cost and are used largely as a means by which the different materials may be compared.

The commercial valuation of a fertilizer consists in calculating the retail trade-value or cash-cost at freight centers (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer. Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates, and similar articles, for which $20 to $45 per ton are paid, depend for their trade value exclusively on the substances, nitrogen, phosphoric acid and potash, which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce. The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the trade-value of the above-named ingredients a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

For many years this Station has not printed an estimate of the commercial value of the different brands licensed in the State. If anyone wishes to calculate the commercial value he can do so by using the trade values adopted for 1904 by the Experiment Stations of Connecticut, Massachusetts, Rhode Island and New Jersey. These valuations represent the average retail prices at which these ingredients could be purchased during the three months preceding March 1, 1904, in ton lots at tide water in the states named. On account of the greater distance from the large markets the prices for Maine at tide water would probably be somewhat higher than those quoted.

TRADE VALUES OF FERTILIZING INGREDIENTS FOR 1904.

	Cents per pound.
Nitrogen in nitrates	16
in ammonia salts	17½
Organic nitrogen in dry and fine ground fish, meat and blood, and in mixed fertilizers	17½
in fine bone and tankage	17
in coarse bone and tankage	12½
Phosphoric acid, water-soluble	4½
citrate-soluble	4
of fine ground bone and tankage	4
of coarse bone and tankage	3
of cotton seed meal, castor pomace, and ashes	4
of mixed fertilizers, if insoluble in ammonium citrate	2
Potash as high grade sulphate and in forms free from muriate (or chlorides)	5
as muriate	4½

The commercial valuation will be accurate enough as a means of comparison if the following rule is adopted:

Multiply 3.5 by the percentage of nitrogen.

Multiply 0.8 by the percentage of available phosphoric acid.

Multiply 0.4 by the percentage of insoluble phosphoric acid.

Multiply 1.0 by the percentage of potash.

The sum of these four products will be the commercial valuation per ton on the basis taken.

Illustration. The table of analyses shows a certain fertilizer to have the following composition: Nitrogen 2.00 per cent; Available phosphoric acid 8.50 per cent; Insoluble phosphoric acid 3.50 per cent; Potash 3.25 per cent. The valuation in this case will be computed thus:

Nitrogen,	3.5×2.00,	7.00
Available phosphoric acid,	.8×8.50,	6.80
Insoluble phosphoric acid,	0.4×3.50,	1.40
Potash,	1.0×3.25,	3.25
Valuation per ton,		$18.45

Since this rule assumes all the nitrogen to be organic and all the potash to be in the form of the sulphate, it is evident that the valuations thus calculated must not be taken as the only guide in the choice of a fertilizer. At best the valuations can only serve to show the approximate cost of the several ingredients contained in the fertilizer in question. In every case the farmer should consider the needs of his soil before he begins to consider the cost. In many instances a little careful experimenting will show him that materials containing either nitrogen, potash, or phosphoric acid alone will serve his purpose as fully as a "complete fertilizer," in which he must pay for all three constituents, whether needed or not.

The results of the analyses of the manufacturers' samples of fertilizers are given on the following pages.

Descriptive List of Manufacturers' Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK, N. Y.
20004	Bradley's Alkaline Bone with Potash
20005	Bradley's Complete Manure for Potatoes and Vegetables
20006	Bradley's Complete Manure with 10% Potash
20007	Bradley's Corn Phosphate
20008	Bradley's Eureka Fertilizer
20009	Bradley's Niagara Phosphate
20010	Bradley's Potato Fertilizer
20011	Bradley's Potato Manure
20012	Bradley's X. L. Superphosphate of Lime
20013	Clark's Cove Bay State Fertilizer
20014	Clark's Cove Bay State Fertilizer, G. G
20015	Clark's Cove Bay State Fertilizer for Seeding Down
20016	Clark's Cove Defiance Complete Manure
20017	Clark's Cove Great Planet Manure, A. A
20018	Clark's Cove King Philip Alkaline Guano
20019	Clark's Cove Potato Fertilizer
20020	Clark's Cove Potato Manure
20021	Cleveland Fertilizer for All Crops
20022	Cleveland High Grade Complete Manure
20023	Cleveland Potato Phosphate
20024	Cleveland Seeding Down Fertilizer
20025	Cleveland Superphosphate
20026	Complete Manure with 10% Potash
20027	Crocker's Aroostook Potato Special
20028	Crocker's Corn Phosphate
20029	Crocker's Grass and Oats Fertilizer
20030	Crocker's New Rival Ammoniated Superphosphate
20031	Crocker's Potato, Hop and Tobacco
20032	Crocker's Special Potato Manure
20033	Cumberland Guano for All Crops
20034	Cumberland Potato Fertilizer
20035	Cumberland Seeding Down Manure
20036	Cumberland Superphosphate
20037	Darling's Blood, Bone and Potash
20038	Fine Ground Bone
20039	Grass and Lawn Top Dressing
20040	Great Eastern General Fertilizer
20041	Great Eastern Grass and Oats Fertilizer
20042	Great Eastern High Grade Potato Manure
20043	Great Eastern Northern Corn Special
20044	Great Eastern Potato Manure
20045	High Grade Fertilizer with 10% Potash
20046	High Grade Sulphate of Potash
20047	Lazaretto Aroostook Potato Guano
20048	Lazaretto Corn Guano

Analyses of Manufacturers' Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
20004	......	......	......	......	6.27	4.51	2.60	10.78	11.00	13.38	12.00	2.01	2.00
20005	1.06	2.40	3.46	3.30	5.36	3.32	1.51	8.68	8.00	10.19	9.00	6.91	7.00
20006	1.99	1.31	3.30	3.30	3.59	3.19	2.44	6.78	6.00	9.22	7.00	11.20	10.00
20007	0.66	1.42	2.08	2.06	7.05	2.55	2.56	9.60	8.00	12.16	10.00	2.01	1.50
20008	0.11	1.06	1.17	1.03	5.93	2.35	1.55	8.28	8.00	9.83	10.00	2.32	2.00
20009	0.40	0.64	1.04	0.82	5.41	3.15	1.38	8.56	7.00	9.94	8.00	1.49	1.00
20010	0.77	1.22	1.99	2.06	5.74	4.74	2.54	10.48	8.00	13.02	10.00	3.17	3.00
20011	0.81	1.58	2.39	2.50	2.89	3.80	3.18	6.69	6.00	9.87	8.00	5.15	5.00
20012	1.10	1.36	2.46	2.50	6.74	3.16	1.80	9.90	9.00	11.70	11.00	2.68	2.00
20013	1.14	1.32	2.46	2.50	7.26	3.08	1.80	10.34	9.00	12.14	11.00	2.35	2.00
20014	0.62	1.40	2.02	2.06	7.21	2.42	2.36	2.63	8.00	11.99	10.00	1.95	1.50
20015	0.41	0.74	1.45	1.03	5.93	2.80	2.42	8.73	8.00	11.15	10.00	2.57	2.00
20016	0.40	0.68	1.08	0.82	5.24	2.74	1.48	7.98	7.00	9.46	8.00	1.59	1.00
20017	1.88	1.52	3.40	3.30	5.20	3.01	1.96	8.21	8.00	10.17	9.00	7.43	7.00
20018	0.43	0.68	1.11	1.03	5.71	2.67	1.47	8.38	8.00	9.85	10.00	2.12	2.00
20019	0.91	1.03	1.94	2.06	6.49	5.31	0.40	11.80	8.00	12.20	10.00	3.35	3.00
20020	0.56	2.11	2.67	2.50	3.96	3.03	3.49	6.99	6.00	10.48	8.00	5.59	5.00
20021	0.34	0.72	1.06	1.03	5.50	2.87	2.60	8.37	8.00	10.97	10.00	2.30	2.00
20022	2.02	1.21	3.23	3.30	4.96	3.41	2.27	8.37	8.00	10.64	9.00	7.53	7.00
20023	0.62	1.34	1.96	2.06	5.95	3.99	2.74	9.94	8.00	12.68	10.00	3.03	3.00
20024	0.11	1.06	1.17	1.03	5.79	2.89	1.27	8.68	8.00	9.95	10.00	2.20	2.00
20025	0.66	1.40	2.06	2.06	7.17	2.35	2.62	9.52	8.00	12.14	10.00	2.03	1.50
20026	1.34	1.72	3.06	3.30	3.84	2.33	2.11	6.17	6.00	8.28	7.00	10.19	10.00
20027	0.81	1.29	2.10	2.06	5.17	3.33	2.03	8.50	8.00	10.53	......	6.61	6.00
20028	0.26	2.06	2.32	2.06	4.52	3.65	3.87	8.17	8.00	12.04	......	2.26	1.50
20029	......	......	......	......	7.54	4.28	1.79	11.82	11.00	13.61	......	2.03	2.00
20030	0.23	1.14	1.37	1.03	4.82	3.70	2.47	8.52	8.00	10.99	......	2.12	2.00
20031	1.10	1.10	2.20	2.06	5.98	2.07	2.68	8.05	8.00	10.73	......	3.34	3.00
20032	2.01	1.30	3.31	3.29	3.84	3.29	2.34	7.13	6.00	9.47	......	10.80	10.00
20033	0.03	1.23	1.26	1.03	6.22	3.00	2.49	9.22	8.00	11.71	10.00	2.28	2.00
20034	0.72	1.34	2.06	2.06	6.13	4.17	2.33	10.30	8.00	12.63	10.00	3.38	3.00
20035	0.44	0.72	1.16	1.03	5.42	2.98	2.53	8.40	8.00	10.93	10.00	2.53	2.00
20036	0.56	1.38	1.94	2.06	7.01	2.38	2.55	9.39	8.00	11.94	10.00	2.35	1.50
20037	2.26	1.64	3.90	4.10	2.81	4.44	2.40	7.25	7.00	9.65	8.00	7.41	7.00
20038	......	......	......	2.50	......	......	......	......	......	......	21.00	......	......
20039	4.44	0.08	4.52	3.91	1.03	5.16	.97	7.69	5.00	8.66	6.00	3.56	2.00
20040	*	*	1.10	0.82	0.69	9.25	2.26	9.94	8.00	12.20	......	4.72	4.00
20041	......	......	......	......	4.11	6.88	4.08	10.99	11.00	15.07	......	2.15	2.00
20042	2.38	1.00	3.38	3.29	4.87	3.25	1.86	8.12	6.00	9.98	......	10.64	10.00
20043	0.42	1.84	2.26	2.06	5.02	4.60	2.35	9.62	8.00	11.98	......	2.26	1.50
20044	0.85	1.23	2.08	2.06	5.92	2.31	2.76	8.23	8.00	10.99	......	3.37	3.00
20045	1.50	1.03	2.53	2.40	5.82	1.76	2.63	7.58	6.00	10.21	7.00	10.44	10.00
20046	......	......	......	......	......	......	......	......	......	......	......	49.80	48.00
20047	0.19	0.78	0.97	0.82	5.69	3.36	2.11	9.05	8.00	11.16	......	4.57	4.00
20048	0.95	1.02	1.97	1.64	4.47	3.20	2.74	7.67	8.00	10.41	......	2.53	2.00

*Undetermined.

Descriptive List of Manufacturers' Samples, 1905.

Station number.	Manufacturer, place of business and brand.
20049	Lazaretto High Grade Potato Guano
20050	Lazaretto Propeller Potato Guano
20051	Lazaretto Wheat, Oats and Clover Fertilizer
20052	Muriate of Potash
20053	Nitrate of Soda
20054	Otis' Potato Fertilizer
20055	Otis' Seeding Down Fertilizer
20056	Otis' Superphosphate
20057	Pacific Dissolved Bone and Potash
20058	Pacific Grass and Grain Fertilizer
20059	Pacific High Grade General Fertilizer
20060	Pacific Nobsque Guano
20061	Pacific Potato Special
20062	Packers Union Animal Corn Fertilizer
20063	Packers Union Economical Vegetable Guano
20064	Packers Union Gardeners Complete Manure
20065	Packers Union Potato Manure
20066	Packers Union Universal Fertilizer
20067	Packers Union Wheat, Oats and Clover Fertilizer
20068	Plain Superphosphate
20069	Quinnipiac Climax Phosphate for All Crops
20070	Quinnipiac Corn Manure
20071	Quinnipiac Market Garden Manure
20072	Quinnipiac Mohawk Fertilizer
20073	Quinnipiac Potato Manure
20074	Quinnipiac Potato Phosphate
20075	Read's Farmer's Friend
20076	Read's High Grade Farmer's Friend
20077	Read's Potato Manure
20078	Read's Practical Potato Special
20079	Read's Standard Superphosphate
20080	Read's Sure Catch Fertilizer
20081	Read's Vegetable and Vine Fertilizer
20082	Soluble Pacific Guano
20083	Standard A Brand
20084	Standard Bone and Potash
20085	Standard Complete Manure
20086	Standard Fertilizer
20087	Standard Guano for All Crops
20088	Standard Special for Potatoes
20089	Williams and Clark's Americus Ammoniated Bone Superphosphate
20090	Williams and Clark's Americus Corn Phosphate
20091	Williams and Clark's Americus High Grade Special
20092	Williams and Clark's Americus Potato Manure
20093	Williams and Clark's Royal Bone Phosphate for all Crops

Analyses of Manufacturers' Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
20049	1.21	1.82	3.03	3.29	4.00	1.90	2.27	5.90	6.00	8.17	......	10.60	10.00
20050	0.70	1.30	2.00	2.06	5.69	2.56	2.88	8.25	8.00	11.13	......	6.52	6.00
20051	......	......	......	......	8.60	3.56	1.00	12.16	11.00	13.16	......	2.78	2.00
20052	......	......	......	......	......	......	......	......	......	......	......	49.64	50.00
20053	......	......	15.28	15.60	......	......	......	......	......	......	......	......	......
20054	0.77	1.22	1.99	2.06	5.68	5.03	2.42	10.71	8.00	13.13	10.00	3.20	3.00
20055	0.49	0.62	1.11	1.03	5.46	2.89	1.35	8.35	8.00	9.70	10.00	1.56	2.00
20056	0.68	1.38	2.06	2.06	6.94	2.92	2.43	9.86	8.00	12.29	10.00	2.16	1.50
20057	......	......	......	......	5.98	4.81	1.91	10.79	10.00	12.70	11.00	2.43	2.00
20058	0.42	0.64	1.06	0.82	5.46	3.01	1.43	8.47	7.00	9.90	8.00	2.99	1.00
20059	2.13	1.41	3.54	3.30	5.15	2.92	2.14	8.07	8.00	10.21	9.00	7.18	7.00
20060	0.40	0.66	1.06	1.03	5.52	2.66	1.63	8.18	8.00	9.81	10.00	1.97	2.00
20061	0.76	1.34	2.10	2.06	5.69	4.27	2.70	9.96	8.00	12.66	10.00	3.15	3.00
20062	0.31	2.10	2.41	2.47	5.64	3.22	3.46	8.86	9.00	12.32	......	1.91	2.00
20063	0.26	1.47	1.68	1.25	4.65	2.55	2.15	7.20	6.00	9.35	......	3.59	3.00
20064	1.38	1.16	2.54	2.47	5.58	0.47	2.06	6.05	6.00	8.11	......	10.99	10.00
20065	0.96	1.10	2.06	2.06	4.85	3.16	1.85	8.01	8.00	9.86	......	6.54	6.00
20066	0.25	0.96	1.21	0.82	6.05	3.22	1.46	9.27	8.00	10.73	......	5.04	4.00
20067	......	......	......	......	......	......	1.20	10.92	11.00	12.12	......	2.39	2.00
20068	......	......	......	......	9.04	4.41	2.45	13.95	14.00	16.40	......	......	......
20069	0.39	1.06	1.45	1.03	5.10	3.54	1.63	8.64	8.00	10.27	10.00	2.91	2.00
20070	0.67	1.38	2.05	2.06	6.69	2.63	2.41	9.32	8.00	11.73	10.00	1.95	1.50
20071	2.19	1.39	3.58	3.30	4.23	4.67	1.47	8.90	8.00	10.37	9.00	7.57	7.00
20072	0.03	0.83	0.86	0.82	2.60	4.87	3.86	7.47	7.00	11.33	8.00	1.58	1.00
20073	1.03	1.50	2.53	2.50	2.55	4.03	3.06	6.58	6.00	9.64	8.00	5.15	5.00
20074	0.74	1.30	2.04	2.06	5.61	4.71	2.36	10.32	8.00	12.68	10.00	3.34	3.00
20075	0.81	1.05	1.86	2.06	6.41	2.92	2.49	9.33	8.00	11.82	10.00	3.33	3.00
20076	1.60	1.58	3.18	3.30	3.89	2.20	2.17	6.09	6.00	8.26	7.00	10.02	10.00
20077	0.42	2.28	2.70	2.40	4.59	1.89	1.25	6.48	6.00	7.73	7.00	10.94	10.00
20078	0.42	0.74	1.16	0.82	1.64	2.56	1.99	4.20	4.00	6.19	5.00	8.03	8.00
20079	0.10	0.94	1.04	0.82	5.87	2.89	2.23	8.76	8.00	10.99	10.00	4.81	4.00
20080	......	......	......	......	4.46	5.17	1.58	9.81	10.00	11.39	11.00	1.91	2.00
20081	0.32	1.80	2.12	2.06	5.94	2.25	1.38	8.29	8.00	9.67	10.00	6.35	6.00
20082	0.52	1.46	1.98	2.06	6.72	2.72	2.32	9.44	8.00	11.76	10.00	1.91	1.50
20083	0.31	0.90	1.21	0.82	3.64	4.10	2.08	7.74	7.00	9.82	8.00	1.56	1.00
20084	......	......	......	......	7.66	2.60	1.96	10.26	10.00	12.22	11.00	2.08	2.00
20085	2.40	0.90	3.30	3.30	7.02	1.99	1.04	8.81	8.00	9.85	9.00	7.56	7.00
20086	0.60	1.42	2.02	2.06	6.82	2.43	2.55	9.25	8.00	11.80	10.00	2.01	1.50
20087	0.37	0.70	1.07	1.03	5.31	3.03	1.44	8.34	8.00	9.74	10.00	2.10	2.00
20088	0.82	1.20	2.02	2.06	5.65	5.16	2.40	10.81	8.00	13.21	10.00	2.93	3.00
20089	0.95	1.32	2.27	2.50	6.72	3.08	1.94	9.80	9.00	11.74	11.00	2.35	2.00
20090	0.56	1.42	1.98	2.06	6.75	2.85	2.29	9.60	8.00	11.89	10.00	1.95	1.50
20091	2.15	1.39	3.54	3.30	3.80	4.10	2.15	7.90	8.00	10.05	9.00	7.48	7.00
20092	0.64	1.32	1.96	2.06	5.52	4.89	2.23	10.41	8.00	12.64	10.00	3.03	3.00
20093	0.29	0.82	1.11	1.03	5.47	3.14	2.55	8.61	8.00	11.16	10.00	2.59	2.00

Descriptive List of Manufacturers' Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	THE BOWKER FERTILIZER CO., BOSTON, MASS.
20094	Bowker's Bone, Blood and Potash
20095	Bowker's Bone and Potash Square Brand
20096	Bowker's Corn Phosphate
20097	Bowker's Early Potato Manure
20098	Bowker's Farm and Garden Phosphate
20099	Bowker's Fresh Ground Bone
20100	Bowker's Hill and Drill Phosphate
20101	Bowker's Market Garden Fertilizer
20102	Bowker's Potash Bone
20103	Bowker's Potash or Staple Phosphate
20104	Bowker's Potato and Vegetable Fertilizer
20105	Bowker's Potato and Vegetable Phosphate
20106	Bowker's Six Per Cent Potato Fertilizer
20107	Bowker's Superphosphate with Potash for Grass and Grain
20108	Bowker's Sure Crop Phosphate
20109	Bowker's Ten Per Cent Manure
20110	Monticello Grange Chemicals
20111	Stockbridge Special Manures (for Corn, etc., Class D 107)
20112	Stockbridge Special Manures (for Grass, etc., Class F 56)
20113	Stockbridge Special Manures (for Potatoes, etc., Class D 610)
20114	Stockbridge Special Manures (for Seeding Down, etc., Class C 610)
	E. FRANK COE CO., NEW YORK CITY, N. Y.
20115	E. Frank Coe's Celebrated Special Potato Fertilizer
20116	E. Frank Coe's Columbian Corn Fertilizer
20117	E. Frank Coe's Columbian Potato Fertilizer
20118	E. Frank Coe's Excelsior Potato Fertilizer
20119	E. Frank Coe's Grass and Grain Special
20120	E. Frank Coe's High Grade Ammoniated Bone Superphosphate
20121	E. Frank Coe's High Grade Potato Fertilizer
20122	E. Frank Coe's New Englander Corn Fertilizer
20123	E. Frank Coe's New Englander Special Potato Fertilizer
20124	E. Frank Coe's Prize Brand Grain and Grass Fertilizer
20125	E. Frank Coe's Red Brand Excelsior Guano
20126	E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate
	JOHN WATSON COMPANY, HOULTON, ME.
20127	Watson's Improved High Grade Potato Manure
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
20133	Lister's Animal Bone and Potash
20134	Lister's High Grade Special for Spring Crops
20135	Lister's Oneida Special
20136	Lister's Potato Manure
20137	Lister's Special Corn Fertilizer
20138	Lister's Special Potato Fertilizer
20139	Lister's Success Fertilizer
	NATIONAL FERTILIZER CO., BRIDGEPORT, CONN.
20140	Chittenden's Complete Root
20141	Chittenden's Market Garden

Analyses of Manufacturers' Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
20094	2.21	1.75	3.36	4.10	3.27	4.83	2.11	8.10	8.00	10.21	10.00	6.77	7.00
20095	1.03	0.81	1.84	1.65	1.04	3.68	7.10	4.72	6.00	11.82	7.00	2.34	2.00
20096	0.40	1.14	1.54	1.65	2.27	5.90	2.19	8.17	8.00	10.36	9.00	2.52	2.00
20097	1.19	1.95	3.14	3.29	3.57	3.49	2.23	7.06	7.00	9.29	8.00	7.33	7.00
20098	0.52	1.16	1.68	1.65	2.20	6.62	2.50	8.92	8.00	11.42	9.00	2.80	2.00
20099	......	......	2.50	2.42	......	......	......	......	......	19.09	18.00	......	......
20100	0.71	1.73	2.44	2.47	3.27	5.48	2.76	8.75	9.00	11.51	10.00	2.16	2.00
20101	1.59	0.79	2.38	2.47	5.55	2.12	1.34	7.67	6.00	9.01	7.00	9.85	10.00
20102	0.90	......	0.90	0.82	3.05	1.93	3.03	4.98	6.00	8.01	7.00	2.10	2.00
20103	0.18	0.74	0.92	0.82	1.69	6.43	2.15	8.12	8.00	10.27	9.00	3.37	3.00
20104	0.61	1.73	2.34	2.47	7.26	2.32	0.83	9.58	8.00	10.41	10.00	4.30	4.00
20105	0.30	1.18	1.48	1.65	2.28	6.79	2.31	9.07	9.00	11.38	10.00	2.32	2.00
20106	0.35	0.65	1.00	0.82	1.39	4.82	3.05	6.21	6.00	9.26	7.00	6.48	6.00
20107	......	......	......	......	4.39	5.30	1.71	9.69	10.00	11.40	11.00	2.84	2.00
20108	0.35	0.72	1.07	0.82	4.93	3.50	2.42	8.43	9.00	10.85	10.00	2.37	2.00
20109	0.17	0.69	0.86	0.82	1.29	3.92	1.99	5.21	5.00	7.20	6.00	10.34	10.00
20110	1.15	1.09	2.24	2.50	5.34	2.80	1.67	8.14	8.00	9.81	12.00	4.17	4.00
20111	1.93	1.40	3.33	3.29	7.89	2.30	.91	10.19	7.00	11.10	8.00	7.39	7.00
20112	3.18	1.88	5.06	4.94	3.01	2.69	2.26	5.70	4.00	7.96	6.00	6.11	6.00
20113	1.32	1.88	3.20	3.29	2.57	3.54	2.27	6.11	6.00	8.38	7.00	10.34	10.00
20114	0.79	1.59	2.38	2.47	2.97	2.88	4.24	5.85	6.00	10.09	9.00	10.04	10.00
20115	1.26	0.62	1.88	1.65	7.34	1.19	2.71	8.53	8.00	11.24	10.00	4.73	4.00
20116	0.60	0.74	1.34	1.23	7.29	2.77	2.53	9.46	8.50	12.01	10.50	2.98	2.50
20117	0.54	0.80	1.34	1.23	6.30	2.16	2.49	9.46	8.50	11.95	10.50	3.08	2.50
20118	1.46	0.96	2.41	2.47	6.03	1.97	2.22	8.00	7.00	10.22	9.00	9.35	8.00
20119	0.07	0.73	0.80	0.80	6.73	2.57	2.81	9.30	8.50	12.11	......	2.28	1.50
20120	1.02	1.06	2.08	1.85	6.76	2.26	2.30	9.02	9.00	11.32	11.00	3.09	2.25
20121	1.68	0.92	2.60	2.40	7.15	1.53	2.76	8.68	8.00	11.44	10.00	6.48	6.00
20122	0.63	0.70	1.33	0.80	7.15	2.42	2.60	9.57	7.50	12.17	9.00	3.11	3.00
20123	0.37	0.66	1.03	0.80	6.09	2.36	2.78	8.45	7.50	11.23	9.00	3.28	3.00
20124	......	.....	......	......	6.64	3.96	3.06	10.55	10.50	13.61	12.00	2.59	2.00
20125	2.30	1.07	3.37	3.30	7.59	2.14	1.77	9.73	9.00	11.50	10.00	6.74	6.00
20126	0.63	0.56	1.19	1.20	6.03	2.50	2.70	8.53	8.50	11.23	10.00	3.90	2.00
20127	2.20	1.06	3.26	3.00	4.59	1.96	1.39	6.55	6.00	7.94	......	5.20	5.00
20133	......	......	......	......	6.44	3.84	2.19	10.28	11.00	12.47	11.00	2.26	2.00
20134	0.45	1.50	1.95	1.65	3.75	4.34	3.07	8.09	8.00	11.16	......	11.16	10.00
20135	0.34	0.83	1.17	0.83	4.42	3.71	2.48	8.13	7.00	10.61	8.00	1.16	1.00
20136	1.92	1.25	3.17	3.30	5.50	2.46	3.09	7.96	8.00	11.05	9.00	7.22	7.00
20137	0.70	1.12	1.82	1.65	5.63	3.72	2.39	9.35	8.00	11.74	9.00	3.66	3.00
20138	0.64	1.22	1.86	1.65	5.66	3.94	2.19	9.60	8.00	11.79	9.00	3.52	3.00
20139	0.31	0.99	1.30	1.24	6.16	3.02	2.58	9.18	9.00	11.76	11.00	2.37	2.00
20140	1.71	1.73	3.44	3.30	6.51	1.49	1.78	8.00	8.00	9.78	10.00	6.01	6.00
20141	1.16	1.26	2.42	2.40	3.70	2.49	2.17	6.19	6.00	8.36	8.00	5.63	5.00

Descriptive List of Manufacturers' Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.
20142	New England Complete Manure
20143	New England Corn and Grain Fertilizer
20144	New England Corn Phosphate
20145	New England High Grade Potato Fertilizer
20146	New England Hign Grade Special (with 10% potash)
20147	New England Potato Fertilizer
20148	New England Superphosphate
	THE PARMENTER & POLSEY FERTILIZER CO., PEABODY, MASS.
20149	A A Brand Fertilizer
20150	Aroostook Special Fertilizer
20151	Muriate of Potash
20152	Nitrate of Soda
20153	P. & P. Grain Grower
20154	P. & P. Potato Fertilizer
20155	Plymouth Rock Brand Fertilizer
20156	Pure Ground Bone
20157	Special Potato Fertilizer
20158	Star Brand Superphosphate
	PORTLAND RENDERING CO., PORTLAND, ME.
20159	Bone Dust Tankage
	PROVINCIAL CHEMICAL FERTILIZER CO., LIMITED, ST. JOHN, N. B.
20160	Special Potato Phosphate
20161	10% Complete Aroostook Potato
	RUSSIA CEMENT CO., GLOUCSETER, MASS.
20162	Essex A 1 Superphosphate
20163	Essex Complete Manure for Corn, Grain and Grass
20164	Essex Complete Manure for Potatoes, Roots and Vegetables
20165	Essex Corn Fertilizer
20166	Essex Market Garden and Potato Manure
20167	Essex XXX Fish and Potash
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, ME.
20168	Acid Phosphate
20169	Aroostook Potato Manure
20171	Dirigo Fertilizer
20172	Muriate of Potash
20173	Nitrate of Soda
20174	Sagadahoc High Grade Superphosphate
20175	Sagadahoc Special Potato Fertilizer
20176	Special Clover Fertilizer
20177	XX Chemical Fertilizer
20178	Yankee Fertilizer
	THE SCIENTIFIC FERTILIZER CO., PITTSBURG, PA.
20179	Scientific "Bone, Meat and Potash" Fertilizer
20180	Scientific "Corn and Grain" Fertilizer
20181	Scientific "Economy" Fertilizer
20182	Scientific Potato Fertilizer
20183	Scientific Potato and Vegetable Fertilizer
	SWIFT'S LOWELL FERTILIZER CO., BOSTON, MASS.
20184	Swift's Lowell Acid Phosphate

Analyses of Manufacturers' Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
20142	2.40	0.90	3.30	3.28	6.76	1.79	1.24	8.55	8.00	9.79	9.00	7.56	7.00
20143	0.44	0.76	1.20	1.22	5.66	1.40	0.55	7.06	7.00	7.61	8.00	2.05	2.00
20144	0.76	1.02	1.78	1.64	3.85	4.93	1.33	8.78	8.00	10.11	9.00	3.23	3.00
20145	1.28	1.20	2.48	2.46	5.65	2.38	2.16	8.03	8.00	10.19	9.00	6.18	6.00
20146	2.32	1.40	3.72	3.69	5 38	3.53	1.17	8.91	7.00	9.08	8.00	10.54	10.00
20147	0.88	0.88	1.76	1.64	3.46	4.89	0.98	8.35	7.00	9.33	8.00	4.28	4.00
20148	1.24	1.24	2.48	2.46	7.58	1.63	1.05	9.21	9.00	10.26	10.00	4.54	4.00
20149	2.93	0.92	3.85	4.10	2.81	4.75	0.64	7.56	7.00	8.20	8.00	8.79	8.00
20150	2.49	1.16	3.65	3.70	4.33	3.21	0.66	7.54	7.00	8.20	8.00	10.33	10 00
20151	......	......	......	......	......	......	......	......	......	......	......	50.28	50.00
20152	15.42	......	15.42	15.00	......	......	......	......	......	......	......	......	......
20153	0.59	0.61	1.20	0.82	3.30	4.45	4.32	7.75	7.00	12.07	8.00	2.70	2.00
20154	1.00	0.84	1.84	1.64	2.36	5.15	0.99	7.51	6.00	8.50	7.00	6.91	6.00
20155	0.21	2.08	2.29	2.47	3.81	4.21	1.38	8.02	8.00	9.40	9.00	4.19	4.00
20156	......	......	1.80	2.47	......	......	......	......	5.00	20.13	23.00	......	......
20157	1.69	1.29	2.98	3.29	4.21	4.27	1.29	8.48	8.00	9.77	9.00	7.41	7.00
20158	1.01	0.79	1.80	1.64	3.80	3.54	1.15	7.34	7.00	8.49	8.00	2.60	2.50
20159	2.69	3.43	6.12	5.30	......	......	4.85	9.57	7.10	14.42	15.30	......	......
20160	1.06	1.08	2.14	2.05	7.73	1.13	4.30	8.86	8.00	13.16	......	6.15	6.00
20161	3.39	0.76	4.15	3.29	6.83	1.11	0.87	8.00	8.00	8.87	......	11.55	10.00
20162	0.18	1.34	1.52	1.00	1.96	5.32	4.93	7.29	7.00	12.22	9.00	2.11	2.00
20163	0.97	2.91	3.88	3.30	5.90	3.75	1.50	9.65	7.00	11.15	9.50	9.36	9.50
20164	0.96	3.22	4.18	3.70	6.33	2.62	3.14	8.95	7.00	12.09	9.00	8.39	8.50
20165	0.52	1.72	2.24	2.00	5.31	4.03	4.14	9.34	8.50	13.48	10.50	3.33	3.00
20166	0.79	1.55	2.34	2.00	5.25	5.17	2.65	10.42	8.00	13.07	10.00	5.06	5.00
20167	0.56	1.82	2.38	2.10	6.14	2.70	3.28	8.84	9.00	12.12	12.00	4.11	2.25
20168	......	......	......	......	16.86	0.95	0.80	17.81	16.00	18.61	17.00	......	......
20169	0.92	0.08	1.00	1.05	7.11	1.44	0.45	8.55	6.00	9.00	7.00	4.97	4.00
20171	0.13	0.44	0.57	0.85	6.62	0.89	5.46	7.51	6.00	12.97	9.00	3.32	3.00
20172	......	......	......	......	......	......	......	......	......	......	......	53.20	50 00
20173	15.58	......	15.58	14.00	......	......	......	......	......	......	......	......	......
20174	1.54	0.38	1.92	1.85	6.86	1.14	3.50	8.00	7.00	11.50	8.00	4.37	3.00
20175	1.33	0.58	1.91	2.00	4.63	1.66	4.54	6.29	7.00	10.83	8.00	9.83	8.00
20176	0.45	0.75	1.20	0.85	3.94	6.20	2.76	10.14	5.00	12.90	8.00	......	......
20177	7.03	1.07	8.10	7.00	......	......	3.76	4.29	3.00	8.05	7.00	10.05	8.00
20178	0.35	0.41	0.76	0.40	7.30	2.73	1.04	10.03	7.00	11.07	8.00	3.05	2.00
20179	0.70	2.32	3.02	3.33	4.43	1.55	3.14	5.98	8.00	9.12	10.00	8.55	8.00
20180	0.52	1.32	1.87	1.66	5.55	1.71	1.51	7.26	8.00	8.77	9.00	2.47	2.00
20181	0.52	1.24	1.76	1.66	6.16	1.71	1.64	7.87	9.00	8.51	10.00	4.16	4.00
20182	0.71	1.92	2.63	2.50	4.26	1.20	2.70	5.46	8.00	8.16	10.00	6.23	6.00
20183	0.68	2.62	3.30	3.33	4.12	1.99	3.70	6.11	7.00	8.87	8.00	10.62	10.00
20184	......	......	......	......	10.43	2.38	1.58	12.81	12.00	14.39	......	......	......

Descriptive List of Manufacturers' Samples, 1905.

Station number.	Manufacturer, place of business and brand.
20185	Swift's Lowell Animal Brand
20186	Swift's Lowell Bone Fertilizer
20187	Swift's Lowell Cereal Fertilizer
20188	Swift's Lowell Dissolved Bone and Potash
20189	Swift's Lowell Empress Brand
20190	Swift's Lowell Ground Bone
20191	Swift's Lowell Muriate of Potash
20192	Swift's Lowell Nitrate of Soda
20193	Swift's Lowell Potato Manure
20194	Swift's Lowell Potato Phosphate
20195	Swift's Superior Fertilizer with 10% Potash

Analyses of Manufacturers' Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
20185	.86	1.46	2.32	2.46	7.85	1.34	0.94	9.19	9.00	10.13	10.00	4.55	4.00
20186	0.73	0.94	1.67	1.64	5.26	2.76	1.79	8.02	8.00	9.81	9.00	3.20	3.00
20187	0.34	0.50	0.84	0.82	5.22	1.76	1.32	6.98	7.00	8.30	8.00	1.18	1.00
20188	0.54	1.08	1.62	1.64	7.11	1.65	1.02	8.76	9.00	9.78	10.00	2.14	2.00
20189	0.35	0.77	1.12	1.23	6.03	1.12	0.66	7.15	7.00	7.81	8.00	2.11	2.00
20190	......	......	2.87	2.46	......	......	......	......	......	22.86	23.00	......	......
20191	......	......	......	......	......	......	......	......	......	......	......	50.48	50 00
20192	15.34	......	15.34	15.00	......	......	......	......	......	......	......	......	......
20193	0.56	0.96	1.52	1.64	4.55	2.34	1.40	6.89	7.00	8.29	8.00	4.24	4.00
20194	1.31	1.16	2.47	2.46	5.66	2.49	1.71	8.15	8.00	9.86	9.00	6.35	6.00
20195	2.52	1.28	3.80	3.69	5.60	1.98	1.30	7.58	7.00	8.88	8.00	10.23	10.00

FEEDING STUFF INSPECTION.

Chas. D. Woods, Director.

J. M. Bartlett, Chemist in charge of feeding stuff analyses.

Chief Requirements of the Law.

The points of the law of most interest both to the dealer and consumer concisely stated, follow.

Kinds of Feed Exempt Under the Law. The law applies to all feeding stuffs *except* the following: hays and straws; whole seeds, meals, brans and middlings of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn, sold separately; wheat bran and middlings mixed together and pure grains ground together.

Kinds of Feed Coming within the Law. The principal feeds coming under the provisions of the law are linseed meals, cottonseed meals, cottonseed feeds, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, dried distillers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, corn and oat feeds, corn bran, ground beef or fish scraps, condimental foods, poultry foods, stock foods, patented proprietary and trade-marked stock and poultry foods, mixed feeds other than those composed solely of wheat bran and middlings mixed together or pure grains ground together, and all other materials of similar nature.

The Brand. Each package of feeding stuffs coming within the law shall bear, conspicuously printed, the following statements:

The number of net pounds contained in the package.

The name or trade-mark under which it is sold.

The name of the manufacturer or shipper.

The place of manufacture.

The place of business of manufacturer or shipper.

The percentage of crude protein.

The percentage of crude fat.

The Adulteration of Feeding Stuffs. If any foreign substances are added to whole or ground grain or wheat offals, the true mixture must be plainly marked upon the packages.

Duties of the Director. The Director shall in person or by deputy analyze at least one sample of each feeding stuff coming within the requirements of the law, and publish the results with such additional information as circumstances advise. He shall report all violations of the law to the Commissioner of Agriculture.

Penalties. The sale or offering for sale of feeding stuffs not properly branded, or containing a smaller percentage of protein and fat than are guaranteed, or of adulterated feeding stuffs, is punishable by a fine not exceeding 100 dollars for the first, and $200 for each subsequent offense.

The Results of the Inspection for 1904-5.

The last bulletin on feeding stuff inspection was published in April, 1904. It contained the results of a large number of analyses of feeding stuffs collected in different parts of the State. The present year more attention has been paid to the *inspection* and less to analyses. A station chemist, experienced in feeding stuff analyses, has visited the chief dealers four times during the season. Samples have been drawn so that at least one sample has been taken of all goods found that come under the requirements of the law. Beyond that, the chief duties of the inspector have been to see that the provisions of the law were being complied with, and to carefully examine the stock in the hands of the dealers for adulterated or falsely branded goods. In no season in the seven years that the law has been in effect has the market been so free from poor goods. The following table gives the results of the analyses.

The results are discussed on page 59 and following.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Cotton Seed Meal, Paris Flouring Co	45.44	43.00	8.20	9.00	10756
Crescent Cotton Seed Meal, Crescent Cotton Oil Co., Memphis	43.06	43.00	11.07	9.00	10747
Dixie Brand Cotton Seed Meal, Humphreys, Goodwin & Co	41.50	43.00	10.00	9.00	10723
	40.56	43.00	–	9.00	10738
	41.63	43.00	–	9.00	10741
	42.06	43.00	–	9.00	10742
Eagle Brand Cotton Seed Meal, W. A. Kaiser & Co., Memphis	42.25	43.00	10.31	9.00	10765
Green Diamond Brand, Cotton Seed Meal, Chapin & Co., St. Louis	42.13	43.00	6.26	9.00	10694
	42.10	43.00	–	9.00	10718
Horse Shoe Brand Cotton Seed Meal, Hugh Petette & Co., Memphis	40.88	43.00	–	9.00	10632
	40.00	43.00	–	9.00	10633
	42.25	43.00	–	9.00	10634
	42.50	43.00	–	9.00	10635
	42.75	43.00	9.99	9.00	10636
	40.00	43.00	–	9.00	10637
Indian Brand Cotton Seed Meal, National Cotton Seed Products Co., Memphis Tenn	46.38	40.00	–	8.50	10634
	42.63	40.00	–	8.50	10644
	46.31	40.00	–	8.50	10649
	40.06	40.00	–	8.50	10651
	43.94	40.00	–	8.50	10671
	38.00	40.00	8.52	8.50	10713
Magnolia Brand Cotton Seed Meal, Chas. M. Cox & Co., Boston	42.50	43.00	8.95	9.00	10753
Old Gold Cotton Seed Meal, T. H. Bunch, Memphis	46.88	43.00	8.28	9.00	10698
	40.88	43.00	–	9.00	10776
	42.38	43.00	–	9.00	10796
Owl Brand Cotton Seed Meal, F. W. Brode & Co	46.13	43.00	–	9.00	10675
	46.06	43.00	8.92	9.00	10689
	40.50	41.00	–	7.00	10800
Phenix Cotton Seed Meal, D. L. Marshall, Agent	42.63	43.00	8.17	9.00	10759
	40.31	43.00	–	9.00	10751
Prime Cotton Seed Meal, American Cotton Oil Co	41.50	43.00	–	9.00	10658
	43.88	43.00	8.52	9.00	10682
Prime Cotton Seed Meal, H. E. Bridges & Co	43.75	43.00	8.87	9.00	10755
Prime Cotton Seed Meal, A. R. Hopkins Co	40.69	43.00	–	9.00	10798
Prime Cotton Seed Meal, Hunter Bros. Milling Co	37.50	43.00	–	9.00	10614
	46.44	43.00	8.45	9.00	10696
	40.00	43.00	–	9.00	10795
Prime Cotton Seed Meal, McKellar Bros	43.56	43.00	9.67	9.00	10697
Prime Cotton Seed Meal, J. E. Soper & Co	45.56	43.00	8.27	9.00	10768

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Star Brand Cotton Seed Meal	43.25	43.00	–	9.00	10631
Sledge & Wells Co., Memphis	43.63	43.00	–	9.00	10638
	43.13	43.00	–	9.00	10639
	42.50	43.00	–	9.00	10640
	43.63	43.00	–	9.00	10641
	43.63	43.00	–	9.00	10642
	41.75	43.00	–	9.00	10740
	39.25	43.00	11.07	9.00	10763
	41.63	43.00	–	9.00	10786
	41.63	43.00	–	9.00	10787
	42.38	43.00	–	9.00	10788
Southern Beauty Cotton Seed Meal	41.19	43.00	–	9.00	10716
J. G. Falls & Co., Memphis	41.44	43.00	11.32	9.00	10729
Sunny South Cotton Seed Meal Sledge & Wells Co., Memphis	22.56	25.00	5.90	6.00	10722
Chicago Gluten Meal Glucose Sugar Refining Co	34.88	38.00	3.12	3.00	10683
Gluten Meal Doten Grain Co	36.81	39.81	5.68	5.42	10619
* Gluten Meal	40.06	–	6.27	–	10657
Huron Milling Co	35.31	–	–	–	10664
	33.75	–	–	–	10672
	41.88	–	–	–	10673
	45.88	–	–	–	10679
Buffalo Gluten Feed	22.63	28.00	2.44	3.00	10684
Glucose Sugar Refining Co	20.63	28.00	–	3.00	10799
Continental Gluten Feed	31.35	35.00	–	12.50	10744
Continental Cereal Co	34.06	35.00	12.68	13.00	10760
Globe Gluten Feed New York Glucose Co	27.00	27.00	2.45	3.38	10754
* Gluten Feed	24.13	–	–	–	10656
Huron Milling Co	25.88	–	–	–	10662
	28.94	–	–	–	10663
Jinks Gluten Feed	*17.31	27.00	8.62	7.50	10710
Huron Milling Co	27.56	27.00	–	7.50	10750
	27.56	27.00	–	7.50	10758
Pekin Gluten Feed Illinois Sugar Refining Co	25.19	28.00	3.47	3.00	10691
Tiger Gluten Feed	27.13	28.00	3.85	2.96	10773
St. Louis Syrup and Preserving Co	24.69	28.00	–	2.96	10779
Warner Gluten Feed	23.50	27.50	3.74	3.00	10661
Warner Sugar Refining Co	24.63	27.50	–	3.00	10674
	24.13	27.50	3.35	3.00	10764
Green Oval Old Process Linseed Oil Meal Flint Milling Co., Milwaukee and Buffalo	32.00	32.00	7.60	5.00	10707

* See discussion page 61.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Linseed Oil Meal American Linseed Co	37.88	38.00	2.47	1.00	10695
Old Process Oil Meal American Linseed Co	35.38	32.00	7.40	5.00	10692
Old Process Ground Linseed Cake Midland Linseed Co	35.56 31.13	32.00 32.00	9.17 8.62	5.50 5.00	10712 10748
Old Process Oil Meal Metygar Linseed Oil Co	31.38	32.00	7.72	5.00	10727
Viscid Oil Meal Milwaukee Elevator Co	32.38 30.88	31.00 31.00	8.97 5.03	7.50 7.50	10693 10717
Blatchford's Sugar and Flax Seed J. W. Boswell, Waukegan	27.94	28.25	10.98	11.25	10725
Ajax Flakes Chapin Co., Boston	31.13 33.31 30.50 30.13	34.00 34.00 34.00 34.00	15.52 14.80 – –	12.00 12.00 12.00 12.00	10652 10708 10743 10793
Biles Fourex J. W. Biles Co., Cincinnati	31.63	33.00	12.15	11.00	10687
Dirigo High Grade Corn Grains	31.75	33.00	11.03	11.00	10731
Peoria Distillers' Dried Grain American Milling Co	37.38	33.00	11.72	11.00	10702
Union Grains J. W. Biles Co., Cincinnati	22.38 24.75	24.00 24.00	– 7.78	7.00 7.00	10615 10686
Armour's Beef Scraps Armour Fertilizer Works	45.88	–	42.95	–	10749
Beef Scraps Portland Rendering Co	44.63	40.00	17.37	15.00	10794
Bowker's Animal Meal Bowker Co. Boston	43.88	30.00	11.76	5.00	10721
Bowker's Fresh Ground Beef Scrap Bowker Co	52.19	30.00	13.40	20.00	10699
Bradley's Superior Meat Meal American Agricultural Chemical Co	42.50	30.00	10.65	8.00	10757
Brand L. Beef Scrap Swift Lowell Fertilizer Co	50.00	–	–	–	10629
Brookside Farm Ground Bone and Scrap S. H. Nash, Brewer	38.69	39.10	32.67	35.67	10734
Dow's Beef Scrap John C. Dow Co., Boston	44.38	30.00	19.20	15.00	10732
Swift's Lowell Bone and Meat Meal Swift Lowell Fertilizer Co	37.00	40.00	11.97	8.00	10724

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Boss Corn and Oat Feed Great Western Cereal Co	7.50	9.00	4.20	4.00	10701
Empire Stock Feed Empire Mills, Olean, N. Y.	8.44 8.00	7.63 7.63	4.08 3.65	2.97 2.97	10668 10690
Excelsior Stock Feed Great Western Cereal Co	8.63	9.00	5.22	4.20	10700
Gee's Extra Fancy Sharps Middlings Gee Grain Co., Minn	12.38 13.56	13.25 13.25	2.17 -	2.07 2.07	10620 10648
Haskell's Stock Feed W. H. Haskell & Co	8.69	10.00	4.09	6.25	10667
H-O Co.'s Horse Feed H-O Co., Buffalo	12.31	12.00	5.05	4.50	10767
Hominy Feed Chas. M. Cox, Boston	9.75	10.50	6.32	7.50	10766
Hominy Feed Suffern Hunt & Co	10.75	11.02	8.65	7.70	10761
Joko Poultry Food* Isaac C. Stetson, Damariscotta	21.12	-	4.68	-	10653
New England Stock Feed H-O Co.'s Mills, Buffalo	10.06	10.00	4.15	4.00	10711
Protena Dairy Feed* Purina Mills	20.38	-	3.89	-	10769
Schumacher's Stock Feed American Cereal Co	12.38	13.00	3.44	5.00	10709
Victor Corn and Oat Feed American Cereal Co	8.75	9.00	3.28	4.00	10704
Vim Oat Feed American Cereal Co	6.50	7.50	2.41	2.75	10752
Worthmore Hominy Feed Chas. M. Cox Co., Boston	9.88	10.50	6.35	7.50	10621
Acme Feed Acme Milling Co	16.75	-	4.65	-	10705
Adrian Bran Detroit Milling Co	14.81	-	-	-	10736
Blish Mixed Feed Blish Milling Co	15.31 14.50	- -	5.23 3.91	- -	10654 10703
Feed Flour Brooks, Evaton Co	13.50	-	-	-	10647
Feed Flour Jennings & Fulton, Boston	14.06	-	-	-	10665

* Manufacturer's sample.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Golden Ball Mixed Feed .... Lawrenceberg Roller Mills, Indiana	15.63	–	–	–	10737
Mixed Feed.. Huron Milling Co	12.06	–	–	–	10735
Mixed Feed.. Ohio Cereal Co	15.50	–	–	–	10680
Mixed Feed.. Lawrenceberg Roller Mills, Indiana.........	16.40	–	–	–	10720
Mixed Bran and Shorts........................... Farmers Milling Co............................	16.63	–	–	–	10676
Peerless Mixed Feed	14.93 15.13	– –	– –	– –	10646 10726
Pillsbury's Daisy Feed Flour	20.75	–	–	–	10630
Vermont Mixed Flour .... Flint Mill Co..	15.06	–	4.50	–	10728
Winterwheat Bran.......... .... Lawrenceberg Roller Mills, Ind	15.00	–	–	–	10719
Worthmore Wheat Feed.......................... C. M. Cox Co. Boston	16.38	17.00	4.95	4.00	10685
Blue Grass Mixed Feed .... A. Waller & Co., Henderson, Ky.........	10.88	–	2.30	–	10677
Indiana Mixed Feed...............................	11.00 11.38	– –	3.07 –	– –	10762 10778
Jersey Mixed Feed .... Kentucky Milling Co	10.63	11.00	3.00	3.00	10733

DISCUSSION OF THE RESULTS OF ANALYSES.

With so limited an amount of money as the State appropriates for the purpose of the inspection of the sale of feeding stuffs, it is not possible to make in any given year as exhaustive a study, either in the field or the laboratory, as is desirable. From the standpoint of the average purchaser of commercial feeding stuffs in this State, protein is the most important constituent, and is always determined in all samples collected. In at least one sample of each brand collected, the fat (ether extract) is determined. In special cases further studies, particularly of the amount of crude fiber, are made. An extensive study of low grade compared with high grade cottonseed meal has been made, and is reported on pages 71-76 beyond. More and more the jobbers of feeding stuffs are looking to the Station for its opinion on new feeds, and the result has been that during the past year an increasing number of samples have come from the large handlers of feeding stuffs, who wished to learn the chemical analysis of new goods before deciding whether they would handle them or not. In this way the consumer is getting a protection that a few years ago would have seemed impossible.

COTTONSEED MEAL (ANALYSES PAGES 55 AND 56.)

Cottonseed meal is a by-product from the manufacture of cottonseed oil. After the cotton has been taken from the seed in the cotton gin, the remaining down or "linters," and the hard black seed coats or hulls are removed by machinery. What remains of the seed is cooked, and the oil expressed by high pressure. The resulting cottonseed cake is ground into the bright yellow cottonseed meal of commerce. Such a meal carries from 40 to 50 per cent protein.

The shippers of cottonseed meal for the most part guarantee 43 per cent protein and 9 per cent fat. According to the classification of the Cotton Seed Crushers' Association, "prime" cottonseed meal from the Gulf States must carry not less than 7½ per cent ammonia. As 8 per cent ammonia is equivalent to only 41.19 per cent protein, it is evident that the minimum guarantee is placed higher by the shippers than the association calls for in prime meal. Hence a meal that carries 41 per cent protein is "prime" in the trade sense, but is below the guarantee usually placed upon cottonseed meal sold in Maine.

The National Cotton Seed Products Company are putting a guarantee of 41 per cent protein and 8.50 per cent fat on their Indian brand cottonseed meal and F. W. Brode are at least occasionally putting a guarantee of 41 per cent protein and 7 per cent fat on their Owl brand. Both of these meals are on the average as good as any sold in the State and it would probably be much better if the other companies doing business in the State were to lower guarantees for protein to the standard of the Cotton Seed Crushers' Association.

While the cottonseed meal sold in the State has for the most part been of good quality, the number of samples that have run above 43 per cent have been less than they were a few years ago. The Star brand cottonseed meal of the Sledge & Wells Company, that a year ago was running poor, has this season been as high in protein content as most other brands. While half of the samples of this brand carried a trifle over 43 per cent protein, a guarantee of 41 per cent would have placed their goods above criticism so far as protein content is concerned. The Dixie brand of Humphreys, Goodwin and Co., the Eagle brand of W. A. Kaiser and Co., the Green Diamond brand of Chapin & Co., the Horse Shoe brand of Hugh Petette and Co., the Magnolia brand of Chas. M. Cox and Co., two of the three samples of the Old Gold brand of T. H. Bunch, the Phoenix brand, D. L. Marshall, agent, and Southern Beauty brand of J. G. Falls & Co., and the prime cottonseed meal of A. R. Hopkins and Co., and Hunter Bros. Milling Co., were below 43 per cent in protein. All these brands would better be guaranteed 41 per cent protein and 8 per cent fat.

One sample of low grade cottonseed meal, Sunny South brand of Sledge and Wells, was found in the hands of a small retailer. This carried 22.56 per cent protein and 5.90 per cent fat with a guarantee of 25 per cent protein and 6 per cent fat.

GLUTEN MEALS AND FEEDS (ANALYSES PAGE 56.)

Gluten meals and gluten feeds are by-products left in the manufacture of starch and glucose from Indian corn. Gluten feeds differ from gluten meals in that they contain a good deal of the corn bran, and hence relatively less of protein, fat and digestible carbo-hydrates, and more of the indigestible woody fiber.

Gluten products continue to be the most unsatisfactory of any concentrated feeds on the market. This is partly because different lots of the same brand vary somewhat in composition, but is chiefly because certain companies persist in putting a guarantee upon their goods that the goods do not come up to in any instance. This trouble is general throughout the New England States. The Glucose Sugar Refining Company is perhaps the worst offender, but the Continental Cereal Company, the

Illinois Sugar Refining Company, and the Warner Sugar Refining Co., are also makers of brands whose guarantees must be discounted.

The single sample examined of the Globe gluten feed of the New York Glucose Company, and two of the samples of the Jinks gluten feed of the Huron Milling Co., were up to their guarantee of 27 per cent protein. Twenty-five per cent protein and 3 per cent fat is about all that a gluten feed can be counted upon as carrying.

Five samples of gluten meal and three samples of gluten feed from one car shipped by the Huron Milling Company were received from the state agents. The goods were exceedingly variable, the meal carrying from about 34 to 46 per cent protein, and the feed from about 24 to 29 per cent protein. It was said in explanation that the company were experimenting with new machinery and methods of separation. One sample of Jinks gluten feed made by the same company sent in by a correspondent ran exceptionally low in protein. As two samples collected by the Station representative were well up in protein content, it would seem there must be some explanation, such as faulty sampling, to account for this abnormal specimen.

LINSEED MEAL (ANALYSES PAGES 56 AND 57.)

Linseed meal is made by grinding flax seed from which the oil has been more or less completely removed. "Old process" meal is made from oil cake, from which as much as possible of the oil has been removed by pressure. In the "new process" the oil is extracted by the use of naphtha. Old process meal carries more fat and less protein than new process. Because of the method of manufacture, new process meal is somewhat more uniform in composition. Most of the oil meal was up to its guarantee in protein. No evidence of any adulteration of this class of feeds was found. Because of the relatively lower price, linseed meal is coming into quite general use again.

VISCID OIL MEAL (ANALYSES PAGE 57.)

Oil meal is quite a common trade name for old process linseed meal, and for this reason the use of the term as part of the name of a product made from other materials is to be deprecated.

Two samples of these goods were examined. The manufacturers submitted for analysis a sample of Viscid Oil Meal which we examined with the following results.

Water	7.98	per cent.
Ash	6.58	"
Protein	30.88	"
Crude fiber	11.86	"
Nitrogen-free extract	37.67	"
Fat	5.03	"

About the same time (December, 1904) a sample was taken from stock by the inspector. This sample carried 32.38 per cent protein and 8.97 per cent fat.

From the chemical composition the goods seem to have a good feeding value. The taste is (to a man) very unpleasant and it would seem doubtful if cattle would eat it readily. A feeding test would be necessary to answer the question as to its feeding value. Unless it could be bought for a much lower price than good oil meal, it would seem to be a good feed to let alone, for the present.

DISTILLERS' GRAINS (ANALYSES PAGE 57.)

Dried distillers' grains resemble in composition the gluten feeds. They are, however, much more bulky. They are derived chiefly from corn from which the starch is removed by fermentation. A feeding experiment conducted at this Station* showed these grains to be a valuable source of protein.

Four brands of these grains are now offered in Maine. Ajax Flakes of Chapin & Co., are guaranteed 34 per cent protein and 12 per cent fat, the three other brands are guaranteed 33 per cent protein and 11 per cent fat. The protein of the Ajax Flakes, Biles Fourex and Dirigo High Grade Corn Grains run a little below their guarantees. It would more nearly correspond to fact if these brands were all guaranteed 31 per cent protein, for that is about all the consumer can count upon from them.

The one sample examined of the Peoria Distillers' Dried Grains carried the phenomenal amount of 37.38 per cent pro-

* Bulletin 92, page 65.

tein. After the high protein content of this sample was ascertained, it has not been practicable to procure a sample from another shipment to see if this was accidental or if it regularly carries this large amount of protein. The goods have not been reported by other New England stations.

UNION GRAINS (ANALYSES PAGE 57.)

Union grains are a ready made mixture, carrying for the most part the protein and fat according to the guarantee. They are based upon a feeding experiment with Holstein cattle in which Biles Fourex was fed in combination with wheat bran, gluten feed, ground corn, ground oats, and oil meal. For the farmer who must buy all his feeds, Union grains at a fair price would probably prove profitable. As a rule, oats and corn are profitable for cows when the feeds are home grown and expensive feeds to purchase. A feeding test at this Station with Union grains is reported in Bulletin 106.

MEAT MEALS AND GROUND SCRAPS (ANALYSES PAGE 57.)

The meat meals and ground beef scraps are used chiefly for feeding poultry, and while they are very generally distributed, it is probable that the sales are not large as compared with other materials coming under the feeding stuffs law. The guarantees placed upon the goods are only a very general guide to the actual composition. While all the brands are quite irregular in composition, some uniformly run higher in protein than others.

MISCELLANEOUS FEEDING STUFFS (ANALYSES PAGE 58.)

The use of the various oat feeds, corn chops, corn and oat feeds and similar offals by themselves, or blended with concentrated feeds, still continues. They vary in composition from the straight oat hull refuse, with less than 6 per cent protein, to blends that carry from 15 to 18 per cent protein. For the most part these goods are fairly well up to their guarantees. No fault can be found with the manufacturer for desiring to sell these waste products. They make few claims for nutrients which the goods do not actually carry. The feeder has himself to blame if, with barns filled with hay, corn fodder and silage, he buys this class of feeds low in protein, instead of those high in protein. An oat feed with 6 per cent protein is a little better feed and is somewhat better digested than oat straw with the same protein content. It is finely ground and saves some work in mastication for the animal that eats it. This class of goods carries from 12 to 17 per cent of indigestible woody fiber.

Gee's extra fancy sharps middlings are made from wheat refuses and the weed seeds removed in cleaning wheat before milling. They are not sold at such prices as to invite their use in preference to the materials they more or less resemble in protein content. The sample of Joko poultry food was sent for analysis by the maker; at that time it was not on the market.

Protena Dairy feed, made by the Purina Mills, is a new feeding stuff introduced late in the winter. Norton-Chapman Company of Portland are the State agents. They use as a basis in its manufacture, alfalfa meal "specially milled from the leaves and upper tendrils of the plants; with this we combine natural grains and concentrated feeds in such proportion as to give us a ration analyzing about as follows: 20.0 per cent protein, 3.5 per cent fat, 50.0 per cent carbohydrates."

The sample sent to us by the State agent analyzed as follows:

Water	6.85	per cent.
Ash	7.59	"
Protein	20.38	"
Crude fiber	18.87	"
Nitrogen-free extract	42.46	"
Fat	3.85	"

The Station arranged to make a feeding test with these goods, but was unable to do so the present season because of their failure to arrive in Bangor until so late in the year that it was feared that climatic causes would tend to make the results of a feeding trial uncertain.

Two samples of a "stock food" (not a condimental food) to be offered in the State were submitted by a jobbing house for examination. They analyzed as follows:

	Sample 10774	Sample 10785
Protein	7.63	7.31
Fat	——	3.97
Crude fiber	9.90	9.60
Nitrogen-free extract	3.85	"

These were a mixture of oat feed and hominy chop and were highly recommended by the manufacturers. In the letter reporting the results of the analyses, it was stated, "so far as its protein content is concerned, it has about the same feeding value as corn stalks. I do not believe it is the kind of feed that should be furnished to Maine feeders. For the most part, they can grow all of the feeds low in protein on their own farms, and when they purchase they should buy the concentrates that are high in protein." The goods were not offered in the State, so far as the writers know.

WHEAT BRAN AND MIDDLINGS (ANALYSES PAGE 59.)

Only a few samples of the refuses from the milling of wheat were examined, and these for the most part were sent in by correspondents. Several of the brands have run much lower in protein than in years past. This was particularly true of the so-called mixed feed of the Huron Milling Company, which was found to carry only 12.06 per cent protein. It is not a mixed feed in the usual sense of the word, but was bran and apparently carried nothing but wheat bran. This particular sample was carefully examined under the miscroscope and was found to be free from foreign admixtures. Its crude fiber, 8.18 per cent, is about the average of that of winter wheat brans: The feed flour of the Brooks-Evaton Company is unusually low in protein, but we found no evidence in the sample submitted of adulteration.

ADULTERATED MIXED FEED (ANALYSES PAGE 59.)

In the fall of 1899 the State was flooded with low grade adulterated wheat brans and mixed feeds. Because of the publicity given to this class of goods and the co-operation of the best of the large dealers, they have quite largely disappeared, or else are sold under a proper guarantee. Three brands of this class of goods were found in the State this year. The Jersey mixed feed of the Kentucky Milling Company is guaranteed to carry 11 per cent protein and 3 per cent fat, while the sample examined carried only 10.63 per cent protein and 3 per cent fat. The Blue Grass mixed feed of A. Walls & Co., Henderson, Ky., was sent to us by a correspondent. This was without guarantee; it carried 10.88 per cent protein, 2.30 per cent fat, and 15.80 per cent crude fiber. This is a mixture of winter wheat bran, middlings and cob meal. Of the Indiana mixed feed, two samples were obtained from the same car, one of which carried 11 per cent and the other 11.38 per cent protein and 3.07 per cent fat. The crude fiber in one of these samples was 16.40 and in the other 12.80 per cent. This, in composition and make-up, was very similar to the Blue Grass mixed feed containing wheat bran, middlings, and cob meal. If these goods are to be sold in Maine, they must not only carry the guarantee or percentage of protein and fat, but under section 32, chapter 39, of the Revised Statutes, defining the adulteration of mixed feeds, it is necessary to state the character of the admixture. It is to be hoped that the consumers will be so alive to their own interests that they will not purchase this class of feeds, no matter at what price they may be offered.

There is so much profit in selling ground corn cobs, broom corn and other valueless materials at the price of wheat bran, that the consumer must ever be on the watch against this fraud. The safest thing is to buy only well known reliable brands of this class of goods. If consumers will see to it that all of this class of feeds which they buy carries the name of the miller, there will be little likelihood of their being defrauded. In case of any doubt, any resident of Maine is invited to mail a sample to the Station. An analysis will be made and the results reported promptly without charge.

CORN MEAL.

The corn meal sold in the State is very largely locally ground and the Station inspector does not sample it. This year, because of two complaints, a special examination was made in two sections of the State.

In December, while at Lewiston, it was reported to the inspector that a firm in Augusta was grinding corn bran with their corn and thus making a low grade of corn meal, which they were putting on the market at the regular price of good corn meal. The same report was heard from a dealer in Augusta when the inspector reacher that city. The inspector took two samples of corn meal ground by the suspected firm. They analyzed as follows:

Sample No. 10,714 carried 9.38 per cent protein and 2.97 per cent fiber; sample No. 10,715 carried 9.50 per cent protein and 3.43 per cent fiber.

If enough corn bran had been added to have made it any object to use it for the purpose of adulteration, the crude fiber would have been much higher and the protein lower than the results of the analyses show. The average of 77 samples of corn meal show it to carry 9.2 per cent protein, and 2 per cent crude fiber. The fiber in the samples drawn at Augusta are somewhat higher than this average, but are no higher than samples of straight corn meal sometimes run.

In February a dealer in Oxford county wrote as follows: "There is a lot of corn meal shipped into this section that I have to compete with from which a part is bolted out and sold as "bolted" or "granulated" meal. The residue that is sold here as "meal" can, of course, be sold cheaper than anyone can who puts in the whole corn into the meal as I do."

On our request this correspondent sent a sample of his own meal and of the suspected meal. The analyses were made at once and were reported as follows:

"The two samples of corn meal which you sent us analyzed as follows:

	Suspected meal, per cent.	Straight meal, per cent.
Water	15.64	17.25
Protein	8.36	8.06
Crude fiber	2.41	2.18

Put upon the water free basis your meal would carry 9.74 per cent protein and the other 9.88 per cent. The fiber in your meal would be 2.64 per cent and the other 2.85. If these two samples of meal had been submitted to us without an explanatory letter, I should have written that they were practically alike in composition, but that the suspected one was a trifle the better, because of its lower water content and consequent larger content of dry matter."

In both of these cases there was no chemical evidence that the meals were not straight goods, and they had as high feeding value as the average corn meal.

CONDIMENTAL FOODS.

This subject is an old one and were it not for the large profits in the sale of these mixtures and the credulity of the race as regards nostrums, they would have long since disappeared from the markets. At more or less irregular intervals something has arisen to call for renewed attention to this class of usually harmless but expensive materials. The whole subject was tersely stated in the first report of this Station.* "The foods have no greater nutritive value than the feeding stuffs from which they are made. The small quantities of fenugreek and sulphur are utterly valueless to a well animal and are a poor reliance as a means of curing a sick one."

This opinion was restated in 1895† in a more ample form. In 1896 a feeding experiment was made in which a herd of 5 cows were fed alternately for nine weeks with and without condimental food.‡ This experiment showed a slight falling off in milk production in the periods that the condimental food was used. In 1902 it seemed necessary to again refer to these articles,§ and now because of two samples submitted by a dealer, who stated that his customers were dissatisfied, and wanted their money back in accordance with the agreement on the package, it becomes necessary to again take up this rather threadbare subject. Strangely enough, 20 years ago it was the requested analyses of a stock food and of an egg producer that lead to the writing of the sentence above quoted. The Security Poultry Food and Egg Maker, Albuminized, and the Security Stock Food, Glutenized, here reported, are with some minor changes the same as the Imperial Egg Food, The Continental Food and the English Patent Food of two decades ago. The analyses of these modern marvels correspond as nearly to the analysis of wheat bran as did their precursors. If it were not for the sobering effects of the thought of the credulity and gullibility of the public exhibited by the continued expenditure for these materials, it would be difficult to treat the matter seriously. For men to pay at the rate of $200 a ton for wheat bran to which

* Rep. Maine Station 1885, pages 52 and 53.
† Bul. 20, Maine Station.
‡ Rep. Maine Station 1896, pages 51-55.
§ Bul. 80, Maine Station, pages 62-63.

has been added charcoal, cayenne, rosin, salt, copperas, sulphur, gentian, Venetian red and possibly a few other materials of like nature, seems so much of a joke that it is not easy to appreciate the seriousness of the situation. The Security Stock Food Glutenized, that will prevent or overcome all the ills that horse, cow, cattle, colt, sheep, or hog flesh is heir to, differs from Security Poultry Food, Albuminized, which is invaluable for young chicks, ducks, turkeys and geese, by *not* containing charcoal.

A correspondent claimed that the United Breeders Dairy Food, made by the United Breeders Company of America, was locally sold as a food and not as a medicine. It was accordingly sampled and analyzed. It does not claim to be a food in the usual sense of that word, but is "a tonic for purifying the blood." The manufacturers use ground linseed as a basis, instead of wheat bran, the foundation of the two other condimental foods here reported upon. It contains in addition to the flax seed the usual "simples," such as fenugreek, sulphur, charcoal, common salt, Epsom salts, etc. The analyses of the three condimental foods follow:

	Security Poultry Food, Albuminized, per cent.	Security Stock Food, Glutenized, per cent.	United Stock Breeders Stock Food, per cent.
Water	7.26	5.70	8.23
Ash	25.42	31.18	13.68
Protein	11.88	11.88	26.63
Fiber and charcoal	8.80	5.53	18.70
Nitrogen free extract	36.63	35.91	25.15
Ether extract	10.01	9.80	7.61

LOW GRADE AND HIGH GRADE COTTONSEED MEAL COMPARED.

J. M. Bartlett.

The work here reported was undertaken in order to compare the value of the low grade cottonseed meals, which are sometimes found on the market, with that of high grade goods, and to point out to the consumer the desirability and economy of purchasing only the best of this class of foods.

Cottonseed meal is a highly nitrogenous feed, manufactured from the decorticated seed in the cotton growing regions of the South. The best meal is of a light yellow color, quite free from lint and hulls, and has a fine nutty flavor.*

COTTONSEED MEAL AS A FEED.

Cottonseed meal has been extensively fed to cows in the New England States for the past 20 years and stands pre-eminent among nitrogenous feeds as the most economical source of protein. Practical experience, supplemented by carefully conducted experiments, both in the United States and Europe, has demonstrated the high feeding value of this material for all kinds of farm animals, with the possible exception of horses, calves and pigs. Its value for producing meat, milk and butter have long been established. It is the most highly nitrogenous of the feed stuffs on the market, and is, therefore, the most economical for balancing rations of feeds deficient in protein, such as corn silage, timothy hay, corn meal, etc. The price has advanced considerably of late years, owing partly to its more extensive use in the South and West for fattening steers, and partly to the advance in price of other feed stuffs.

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*For a full description of the process of manufacture of cottonseed meal see Farmers Bulletin No. 36 of the U. S. Dept. of Agriculture, which can be obtained free from Members of Congress.

EFFECT ON THE HEALTH OF ANIMALS.

The injurious effects of feeding cottonseed meal to pigs and calves have been observed and the cause has been made a subject of careful investigation. It is still an open question whether the injurious principle is an original constituent of the cottonseed products, whether it is developed as the result of decomposition before feeding or of a change within the animal body. There is always danger of injurious or poisonous principles being produced in materials rich in protein when they undergo fermentation, and on this account fermented materials of high nitrogen content should be avoided.

All experience goes to show that fresh cottonseed meal can be safely fed to beef cattle, milch cows, and sheep, but on account of its extreme richness it should be used only in connection with less concentrated feeds and should never be fed in large quantities. Two to 4 pounds per day, fed with silage or bran and corn meal, is as much as a milch cow should receive.

FERTILIZING VALUE.

Cottonseed meal is used quite extensively in some sections of the country as a fertilizer. A good grade meal will carry about 6.8 per cent nitrogen, 2.9 per cent phosphoric acid and 1.8 per cent potash. Based upon the valuations that will be used by New England experiment stations in 1905 for computing the value of commercial fertilizers, a meal analyzing as above will be worth about $29 a ton as a fertilizer. Notwithstanding its high value when used directly in this way, it will usually be found more economical to use it as a feed for stock and to apply the resulting manure to the land. When thus used, from 80 to 95 per cent of the nitrogen and phosphoric acid and practically all of the potash will be contained in the manure.

HOW CAN THE FARMER DISTINGUISH BETWEEN GOOD AND POOR MEAL?

As the demand increases and the price advances, the temptation to adulterate or put inferior goods on the market becomes greater. Consequently from time to time there appear in our eastern markets inferior lots of cottonseed meals, and probably many more would be found if the inspection laws did not drive them out. In spite of the laws, occasionally bad lots may appear, and it is essential that the farmer should be able in a measure to tell the quality of goods himself. The first thing for him to look for is the guarantee tag, required by law, giving the name of the manufacturer and composition of the goods. A first-class cottonseed meal should contain over 40 per cent protein and about 9 per cent fat. It should be a light yellow color. If it is dark in color with many fine black specks, it indicates that ground hulls have been added. If it is a rusty brown color, it indicates that the meal is old or the material has at some time undergone fermentation. Such meals are not safe to use. The texture of the meal should be about the same as finely ground corn meal, and it should be practically free from cotton lint. The presence and amount of lint can be determined by sifting a portion in a flour or meal sieve. The cotton fiber will remain in the sieve. The lint and hulls are also quite easily detected by stirring the meal up with water. Put one teaspoonful in half a glass of water, mix thoroughly and allow the mixture to stand a few minutes to settle. The black hulls will be found on the bottom and can be seen through the glass. The good meal will be in the next layer and the lint on top. A first-class meal should show only a few black hulls and scarcely any lint.

An expert can judge very well of the quality of cottonseed meal by means of tasting. The best fresh meals have a very agreeable nutty flavor not found in inferior goods. The presence of much fiber is readily noted by the sense of touch in the mouth. The absence of the nutty flavor and the presence of a rancid taste indicates that the meal is old.

DIFFERENT GRADES OF COTTONSEED MEAL.

Roughly speaking, the meals which are in the market can be divided into four groups.

A. The high grade meal, carrying 43 or more per cent protein; bright yellow in appearance, free from cotton and hull, and with a sweet nutty flavor.

B. A dark colored cottonseed meal, analyzing not very differently from the preceding, but made from seed that has undergone more or less fermentation.

C. A medium grade goods which carries considerable cotton and some hull, very good in color, but of poor flavor. Such meal will usually carry about 35 per cent protein.

D. A cottonseed meal of very good appearance, with the hulls and cotton so finely ground as not to be readily detected. This class is, however, lacking in the good flavor of high grade meals. Such meal will usually carry about 25 per cent protein and because of its good appearance is the most dangerous adulterated meal in the market.

COMPOSITION OF THE COTTONSEED MEAL USED IN THIS EXPERIMENT.

When this study was undertaken, the two grades of cottonseed meal referred to as A and B in the preceding paragraph, were readily found. About this time a jobber received several car loads of a meal of "grade C" and because of its poor appearance sent samples to the Station for analysis. These goods proved so poor that they were shipped out of the State, but the jobber kindly furnished us with enough for the purpose of this investigation. It was only after considerable correspondence that we were able to obtain from a Massachusetts house enough of the poorest grade ("D") cottonseed meal for the experiments here reported.

COMPOSITION OF THE COTTONSEED MEALS STUDIED.

The description of the samples and the analyses of the four grades of cottonseed meal follow.

Cottonseed meal A was prime meal in color, taste and composition.

Cottonseed meal B was of good texture and carried but little lint or hulls. It was, however, dark in color. This together with its higher water content indicates that it had undergone some, probably slight, fermentation.

Cottonseed meal C was a medium grade goods with considerable lint and hulls. It was of good color, but poor flavor.

Cottonseed meal D appeared at first glance to be fairly good. It was of good color and apparently contained but little lint or hulls. It was lacking in the nutty flavor of the high grade meals and was, as the analysis shows, very low grade goods.

Composition of the samples of the four grades of cottonseed meal here reported upon.

	Station number.	Water—per cent.	Ash—per cent.	Protein—per cent.	Crude fiber—per cent.	N-free extract—per cent.	Ether extract—per cent.
A—Very high grade	4311	8.01	7.59	46.75	6.23	21.64	9.78
B—Dark colored	4423	12.72	7.05	42.50	7.67	14.64	8.62
C—Medium grade	4424	11.60	6.50	34.13	13.58	19.83	8.90
D—Very low grade	4425	9.52	4.70	23.81	21.43	30.53	6.20

As cottonseed meal is chiefly used in this State to supplement feeding stuffs poor in protein, this constituent is of the first importance. The very low grade meal (D) carried about one-half as much protein as the best grade. The uniform relation between the protein content of the meal and that of woody fiber is noteworthy; as the crude fiber increases, the protein decreases.

THE DIGESTIBILITY OF DIFFERENT GRADES OF COTTONSEED MEAL.

The chemical analysis of a feeding stuff helps to an understanding of its food value, but the real value is more clearly brought out by actual feeding trials. The four grades of meal were fed to sheep and their differences in digestibility and feeding values are shown in the tables which follow.

The digestion coefficients obtained on the different grades of cottonseed meal with sheep.

	Station number.	Dry matter—per cent.	Organic matter—per cent.	Protein—per cent.	Crude fiber—per cent.	N-free extract—per cent.	Fat—per cent.
A—Very high grade	4311	90.0	95.3	83.3	....	95.9	100
B—Dark color	4423	85.8	89.9	82.2	....	94.7	97.2
C—Medium grade	4424	73.0	78.0	83.6	43.5	82.1	94.6
D—Low grade	4425	61.4	64.1	72.6	37.8	67.8	90.1

Pounds of digestible nutrients in 100 pounds of the different grades of cottonseed meal and their comparative money values as a source of protein.

	Organic matter—pounds.	Protein—pounds.	Nitrogen-free ext.—pounds.	Fat—pounds.	Value per hundred.
A—Very high grade	80.4	39.0	20.8	9.78	$1 40
B—Poor color	72.2	35.0	13.9	8.4	1 25
C—Medium grade	63.9	28.5	16.3	7.3	1 02
D—Low grade	55.0	17.3	16.5	5.6	0 62

According to the analyses alone, the low grade goods would be worth about half as much as the high grade, but as a matter of fact they are worth less than half, for the reason that the protein is of poorer quality and less digestible than that of the high grade goods. The coefficients for the organic matter and protein of the low grade goods are only 64.1 and 72.6 per cent respectively, while those of high grade are 95.3 and 83.3 per cent. The pounds of digestible protein in 100 pounds of the low grade goods is considerably less than half that of the high grade, and if the high grade meal is assumed to be worth $1.40 per 100 pounds on the basis of its digestible protein, 100 pounds of the low grade meal are worth only 62 cents. As the difference in price on the market for the different grades of goods is only slight, rarely more than one or two dollars per ton, the above results show how very necessary it is for a buyer of cottonseed meal to know the quality of the goods he is getting. To the ordinary observer meal classed as "D" would look nearly as good as that called "A." The excess of hulls it contains are so finely ground that they do not show unless separated by mixing with water, so the color is very good and many buyers would be tempted to purchase it if the price were 10 or 15 cents a hundred lower than that of the high grade.

Such figures as those of the tables are at least suggestive to the users of cottonseed meal. They point out the importance of care in the purchase and use of this class of goods and justify the feeding stuffs inspection laws which have almost entirely driven the lowest grades out of the State.

FOOD INSPECTION.

Chas. D. Woods, Director.

L. H. Merrill, Chemist in charge of food analysis.

The legislature of 1905 enacted a law to regulate the sale and analysis of food. This is, however, by no means the pioneer attempt in food legislation. Several years ago Massachusetts, Connecticut, New York, Pennsylvania, North Carolina and other eastern states enacted laws looking to the prevention of adulteration of foods. Naturally many mistakes were made and these from time to time were corrected by special acts. Profiting by the experience of these eastern states, some states in the middle west, notably Ohio, Wisconsin, Kentucky and North Dakota, have since enacted laws which are simpler and yet more far reaching in their effects.

In the last few years there has been a large amount of agitation looking toward national legislation to regulate the interstate commerce as regards the purity of food. This discussion has crystalized into a bill, which has been before several Congresses, known as the Hepburn bill, because of its introduction by Senator Hepburn. Several moneyed trade interests have thus far prevented the passage of this national bill.

Profiting by all this experience, the agricultural committee of the Maine legislature of 1905 discussed this matter, and formulated a bill, which was introduced and after the customary hearing was reported unanimously and enacted. The text of the law follows.

Chapter 68 of the Laws of 1905.

An Act to Regulate the Sale and Analysis of Food.

Sec. 1. It shall be unlawful for any person, persons or corporation within this state to manufacture for sale, to sell, or to offer or expose for sale any article of food which is adulterated or misbranded within the meaning of this act.

Sec. 2. The term food, as used in this act, shall include every article used for food or drink by man, horses or cattle.

Sec. 3. For the purpose of this act an article of food shall be considered as adulterated or misbranded:

First. If any substance or substances be mixed or packed with it so as to reduce or lower or injuriously affect its quality or strength.

Second. If any inferior substance or substances be substituted wholly or in part for this article.

Third. If any necessary or valuable constituent of the article be wholly or in part abstracted.

Fourth. If it be in imitation of, or sold under the name of another article.

Fifth. If it be colored, coated, polished or powdered whereby damage is concealed, or if it be made to appear better or of greater value than it is.

Sixth. If it contains poisonous ingredients, or if it contains any antiseptic or preservative not evident or not known to the purchaser.

Seventh. If it consists wholly or in part of a diseased, filthy, decomposed or putrid animal or vegetable substance.

Eighth. If the package or label shall have any statement purporting to name any ingredient or substance as not being contained in the article, which statement shall be untrue in any particular.

Ninth. If the package or label shall bear any statement purporting to name the substance or substances of which the article is made, which statement shall not fully give the names of all substances contained therein.

Tenth. If it be labeled or branded so as to deceive or mislead the purchaser in any particular.

Provided, that any article of food which is adulterated within the meaning of this act, but which does not contain any poisonous or deleterious ingredient, may be manufactured or sold if the same shall be plainly labeled, branded or tagged so as to show the exact character thereof. Provided further, that nothing in this act shall be construed as requiring proprietors, manufacturers or sellers of proprietary foods which contain no unwholesome substances to disclose their trade formulas, except that in the case of baking powders each can or package shall be plainly labeled so as to show the acid salt or salts contained therein.

Sec. 4. The director of the Maine Agricultural Experiment Station shall analyze, or cause to be analyzed, samples of articles of food on sale in Maine, suspected of being adulterated, and at such times and to such extent as said director may determine. And said director, in person or by deputy, shall have free access at all reasonable hours to any place wherein articles of food are offered for sale, and upon tendering the market price of any such article may take from any person, persons or corporations samples for analysis.

Sec. 5. The results of all analyses of articles of food made by said director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the persons from whom the samples were obtained, and the names of the manufacturers thereof. The said director may also adopt or fix standards of purity, quality or strength when such standards are not specified or fixed by law and shall publish them, together with such other information concerning articles of food as may be of public benefit.

Sec. 6. Whoever adulterates or misbrands any article of food as defined in this act, or whoever sells, offers or exposes for sale any adulterated or misbranded article of food, shall be punished by a fine not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

Sec. 7. Whenever said director becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the commissioner of agriculture, and said commissioner shall prosecute the party or parties thus reported.

Sec. 8. No action shall be maintained in any court in this state on account of any sale or other contract made in violation of this act.

Sec. 9. Sections ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen and seventeen of chapter one hundred and twenty-nine of the revised statutes and all acts or parts of acts inconsistent herewith, are hereby repealed.

Sec. 10. This act shall take effect when approved.

Approved March 15, 1905.

Food Standards.

It is from the nature of the case impracticable for a legislature to establish food standards. This is a matter that calls for careful research on the part of experts. It has, therefore, become customary, both in state and national legislation, to place the responsibility of the establishment of standards upon the executive officer. Section 5 of the above cited law empowers the Director of the Maine Agricultural Experiment Station "to adopt or fix standards of purity, quality or strength when such standards are not specified or fixed by law and shall publish them, together with such other information concerning articles of food as may be of public benefit."

The Association of Official Agricultural Chemists of the United States has for some years been preparing definitions and schedules for such standards. The demand for these standards became so urgent as to lead Congress by an act approved June 3, 1902, to authorize the Secretary of Agriculture to co-operate with the above named association for the accomplishment of this work. As a result, although the work is still incomplete, standards for the more important food products have already been fixed and established by the Secretary of Agriculture, acting for the United States.

PRINCIPLES ON WHICH THE STANDARDS ARE BASED.

The general considerations which guided the committee of the Association of Official Agricultural Chemists in preparing the standards for food products are thus stated by them:

1. The standards are expressed in the form of definitions, with or without accompanying specifications of limit in composition.

2. The main classes of food articles are defined before the subordinate classes are considered.

3. The definitions are so framed as to exclude from the articles defined substances not included in the definitions.

4. The definitions include, where possible, those qualities which make the articles described wholesome for human food.

5. A term defined in any of the several schedules has the same meaning wherever else it is used in this report.

6. The names of food products herein defined usually agree with existing American trade or manufacturing usage, but where such usage is not clearly established or where trade names confuse two or more articles for which specific designations are desirable, preference is given to one of the several trade names applied.

7. Standards are based upon data representing materials produced under American conditions and manufactured by American processes or representing such varieties of foreign articles as are chiefly imported for American use.

8. The standards fixed are such that a departure of the articles to which they apply, above the maximum or below the minimum limit prescribed, is evidence that such articles are of inferior or abnormal quality.

9. The limits fixed as standard are not necessarily the extremes authentically recorded for the article in question, because such extremes are commonly due to abnormal conditions of production and are usually accompanied by marks of inferiority or abnormality readily perceived by the producer or manufacturer.

As empowered in Section 5, Chapter 68 of the laws of 1905, the Director of the Maine Agricultural Experiment Station hereby adopts the following standards for purity of food products together with their precedent definitions as the official standards of these food products for the State of Maine. These are the standards above referred to as fixed by the Secretary of Agriculture of the United States.

I. ANIMAL PRODUCTS.

A. Meats and the Principal Meat Products.

a. MEATS.

1. *Meat* is any sound, dressed, and properly prepared edible part of animals in good health at the time of slaughter. The term "animals," as herein used, includes not only mammals, but fish, fowl, crustaceans, mollusks, and all other animals used as food.

2. *Fresh meat* is meat from animals recently slaughtered or preserved only by refrigeration.

3. *Salted, pickled,* and *smoked meats* are unmixed meats preserved by salt, sugar, vinegar, spices, or smoke, singly or in combination, whether in bulk or in packages.

b. MANUFACTURED MEATS.

1. *Manufactured meats* are meats not included in paragraphs 2 and 3, whether simple or mixed, whole or comminuted, in bulk or packages, with or without the addition of salt, sugar, vinegar, spices, smoke, oils, or rendered fat. If they bear names descriptive of composition they correspond thereto and when bearing such descriptive names, if force or flavoring meats are used, the kind and quantity thereof are made known.

d. LARD.

1. *Lard* is the rendered fresh fat from slaughtered, healthy hogs, is free from rancidity, and contains not more than one (1) per cent of substances, other than fatty acids, not fat, necessarily incorporated therewith in the process of rendering.

2. *Leaf lard* is lard rendered at moderately high temperatures from the internal fat of the abdomen of the hog, excluding that adherent to the intestines, and has an iodin number not greater than sixty (60).

3. *Neutral lard* is lard rendered at low temperatures.

B. Milk and its Products.*

II. VEGETABLE PRODUCTS.

A. Grain Products.

(a) GRAINS AND MEALS.

1. *Grain* is the fully matured, clean, sound, air-dry seed of wheat, maize, rice, oats, rye, buckwheat, barley, sorghum, millet, or spelt.

2. *Meal* is the sound product made by grinding grain.

*The inspection of milk and other dairy products, and their imitations is intrusted by Chapter 39 of the Laws of 1905 to the Commissioner of Agriculture. The standard for milk is fixed by statute. Standards for other dairy products will be fixed by the Director of the Station on request from the Commissioner of Agriculture.

3. *Flour* is the fine, sound product made by bolting wheat meal and contains not more than thirteen and one-half (13.5) per cent of moisture, not less than one and twenty-five hundredths (1.25) per cent of nitrogen, not more than one (1.0) per cent of ash, and not more than fifty hundredths (0.50) per cent of fiber.

4. *Graham flour* is unbolted wheat meal.

5. *"Whole wheat flour," "entire wheat flour,"* improperly so called, is fine wheat meal from which a part of the bran has been removed.

6. *Gluten flour* is the product made from flour by the removal of starch and contains not less than five and six-tenths (5.6) per cent of nitrogen and not more than ten (10) per cent of moisture.

7. *Maize meal, corn meal,* or *Indian corn meal* is meal made from sound maize grain and contains not more than fourteen (14) per cent of moisture, not less than one and twelve hundredths (1.12) per cent of nitrogen, and not more than one and six-tenths (1.6) per cent of ash.

8. *Rice* is the hulled and polished grain of *Oryza sativa.*

9. *Oatmeal* is meal made from hulled oats and contains not more than eight (8) per cent of moisture, not more than one and five-tenths (1.5) per cent of crude fiber, not less than two and twenty-four hundredths (2.24) per cent of nitrogen, and not more than two and two-tenths (2.2) per cent of ash.

10. *Rye flour* is the fine sound product made by bolting rye meal and contains not more than thirteen and one-half (13.5) per cent of moisture, not less than one and thirty-six hundredths (1.36) per cent of nitrogen, and not more than one and twenty-five hundredths (1.25) per cent of ash.

11. *Buckwheat flour* is bolted buckwheat meal and contains not more than twelve (12) per cent of moisture, not less than one and twenty-eight hundredths (1.28) per cent of nitrogen, and not more than one and seventy-five hundredths (1.75) per cent of ash.

C. Sugars and Related Substances.

a. SUGAR AND SUGAR PRODUCTS.

Sugars.

1. *Sugar* is the product chemically known as sucrose (saccharose) chiefly obtained from sugar cane, sugar beets, sorghum, maple, or palm.

2. *Granulated, loaf, cut, milled,* and *powdered sugars* are different forms of sugar and contain at least ninety-nine and five-tenths (99.5) per cent of sucrose.

3. *Maple sugar* is the solid product resulting from the evaporation of maple sap.

4. *Massecuite, melada, mush sugar,* and *concrete* are products made by evaporating the purified juice of a sugar-producing plant, or a solution of sugar, to a solid or semi-solid consistence in which the sugar chiefly exists in a crystalline state.

Molasses and Refiners' Sirup.

1. *Molasses* is the product left after separating the sugar from massecuite, melada, mush sugar, or concrete, and contains not more than twenty-five (25) per cent of water and not more than five (5) per cent of ash.

2. *Refiners' sirup* ("treacle") is the residual liquid product obtained in the process of refining raw sugars and contains not more than twenty-five (25) per cent of water and not more than eight (8) per cent of ash.

Sirups.

1. *Sirup* is the product made by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar and contains not more than thirty (30) per cent of water and not more than two and five-tenths (2.5) per cent of ash.

2. *Sugar-cane sirup* is sirup made by the evaporation of the juice of the sugar cane or by the solution of sugar-cane concrete.

3. *Sorghum sirup* is sirup made by the evaporation of sorghum juice or by the solution of sorghum concrete.

4. *Maple sirup* is sirup made by the evaporation of maple sap or by the solution of maple concrete.

5. *Sugar sirup* is sirup made by dissolving sugar to the consistence of a sirup.

b. GLUCOSE PRODUCTS.

1. *Starch sugar* is the solid product made by hydrolyzing starch or a starch-containing substance until the greater part of the starch is converted into dextrose. Starch sugar appears in commerce in two forms, anhydrous and hydrous. The former, crystallized without water of crystallization, contains not less than ninety-five (95) per cent of dextrose and not more than eight-tenths (0.8) per cent of ash. The latter, crystallized with water of crystallization, is of two varieties—70 sugar, also known as brewers' sugar, contains not less than seventy (70) per cent of dextrose and not more than eight-tenths (0.8) per cent of ash; 80 sugar, climax or acme sugar, contains not less than eighty (80) per cent of dextrose and not more than one and one-half (1.5) per cent of ash.

The ash of all these products consists almost entirely of chlorids and sulphates.

2. *Glucose, mixing glucose,* or *confectioner's glucose* is a thick, sirupy, colorless product made by incompletely hydrolyzing starch, or a starch-containing substance, and decolorizing and evaporating the product. It varies in density from forty-one (41) to forty-five (45) degrees Baumé at a temperature of one hundred (100) degrees F. (37.7° C.), and conforms in density, within these limits, to the degree Baumé it is claimed to show, and for a density of forty-one (41) degrees Baumé contains not more than twenty-one (21) per cent and for a density of forty-five (45) degrees not more than fourteen (14) per cent of water. It contains on a basis of forty-one (41) degrees Baumé not more than one (1) per cent of ash, consisting chiefly of chlorids and sulphates.

3. *Glucose sirup* or *corn sirup* is glucose unmixed or mixed with sirup, molasses, or refiners' sirup and contains not more than twenty-five (25) per cent of water and not more than three (3) per cent of ash.

c. CANDY.

1. *Candy* is a product made from a saccharine substance or substances with or without the addition of harmless coloring, flavoring, or filling materials and contains no terra alba, barytes, talc, chrome yellow, or other mineral substances, or poisonous colors or flavors, or other ingredients injurious to health.

d. HONEY.

1. *Honey* is the nectar and saccharine exudations of plants gathered, modified, and stored in the comb by honey bees *(Apis mellifica).* It is laevo-rotatory, contains not more than twenty-five (25) per cent of water, not more than twenty-five hundredths (0.25) per cent of ash, and not more than eight (8) per cent of sucrose.
2. *Comb honey* is honey contained in the cells of comb.
3. *Extracted honey* is honey which has been separated from the uncrushed comb by centrifugal force or gravity.
4. *Strained honey* is honey removed from the crushed comb by straining or other means.

D. CONDIMENTS (EXCEPT VINEGAR).

a. SPICES.

1. *Spices* are aromatic vegetable substances used for the seasoning of food and from which no portion of any volatile oil or other flavoring principle has been removed and which are sound and true to name.
2. *Allspice* or *pimento* is the dried fruit of *Pimenta pimenta* (L.) Karst. and contains not less than eight (8) per cent of quercitannic acid;* not more than six (6) per cent of total ash; not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than twenty-five (25) per cent of crude fiber.
3. *Anise* is the fruit of *Pimpinella anisum* L.
4. *Bay leaf* is the dried leaf of *Laurus nobilis* L.
5. *Capers* are the flower buds of *Capparis spinosa* L.
6. *Caraway* is the fruit of *Carum carui* L.

*Calculated from the total oxygen absorbed by the aqueous extract.

7. *Red pepper* is the red, dried ripe fruit of any species of *Capsicum.*

8. *Cayenne pepper* or *cayenne* is the dried ripe fruit of *Capsicum frutescens* L., *Capsicum baccatum* L., or some other small-fruited species of *Capsicum,* and contains not less than fifteen (15) per cent of nonvolatile ether extract; not more than six and five-tenths (6.5) per cent of total ash; not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid; not more than one and five-tenths (1.5) per cent of starch, and not more than twenty-eight (28) per cent of crude fiber.

9. *Celery seed* is the dried fruit of *Apium graveolens* L.

10. *Cinnamon* is the dried bark of any species of the genus *Cinnamomum* from which the outer layers may or may not have been removed.

11. *True cinnamon* is the dried inner bark of *Cinnamomum zeylanicum* Breyne.

12. *Cassia* is the dried bark of various species of *Cinnamomum,* other than *Cinnamomum zeylanicum,* from which the outer layers may or may not have been removed.

13. *Cassia buds* are the dried immature fruit of species of *Cinnamomum.*

14. *Ground cinnamon* or *ground cassia* is a powder consisting of cinnamon, cassia, or cassia buds, or a mixture of these spices, and contains not more than eight (8) per cent of total ash and not more than two (2) per cent of sand.

15. *Cloves* are the dried flower buds of *Caryophyllus aromaticus* L. which contain not more than five (5) per cent of clove stems; not less than ten (10) per cent of volatile ether extract; not less than twelve (12) per cent of quercitannic acid;* not more than eight (8) per cent of total ash; not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

16. *Coriander* is the dried fruit of *Coriandrum sativum* L.

17. *Cumin seed* is the fruit of *Cuminum cyminum* L.

18. *Dill seed* is the fruit of *Anethum graveolens* L.

19. *Fennel* is the fruit of *Fœniculum fœniculum* (L.) Karst.

20. *Ginger* is the washed and dried or decorticated and dried rhizome of *Zingiber zingiber* (L.) Karst. and contains not less

* Calculated from the total oxygen absorbed by the aqueous extract.

than forty-two (42) per cent of starch, not more than eight (8) per cent of crude fiber, not more than eight (8) per cent of total ash, not more than one (1) per cent of lime, and not more than three (3) per cent of ash insoluble in hydrochloric acid.

21. *Limed* or *bleached ginger* is whole ginger coated with carbonate of lime and contains not more than ten (10) per cent of ash, not more than four (4) per cent of carbonate of lime, and conforms in other respects to the standard for ginger.

22. *Horse-radish* is the root of *Roripa armoracia* (L.) Hitchcock either by itself or ground and mixed with vinegar.

23. *Mace* is the dried arillus of *Myristica fragrans* Houttuyn and contains not less than twenty (20) nor more than thirty (30) per cent of nonvolatile ether extract, not more than three (3) per cent of total ash, not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

24. *Macassar* or *Papua mace* is the dried arillus of *Myristica argentea* Warb.

25. *Bombay mace* is the dried arillus of *Myristica malabarica* Lamarck.

26. *Marjoram* is the leaf, flower, and branch of *Majorana majorana* (L.) Karst.

27. *Mustard seed* is the seed of *Sinapis alba* L. (white mustard), *Brassica nigra* (L.) Koch (black mustard), or *Brassica juncea* (L.) Cosson (black or brown mustard).

28. *Ground mustard* is a powder made from mustard seed, with or without the removal of the hulls and a portion of the fixed oil, and contains not more than two and five-tenths (2.5) per cent of starch and not more than eight (8) per cent of total ash.

29. *Nutmeg* is the dried seed of *Myristica fragrans* Houttuyn deprived of its testa, with or without a thin coating of lime, and contains not less than twenty-five (25) per cent of nonvolatile ether extract, not more than five (5) per cent of total ash, not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

30. *Macassar, Papua, male,* or *long nutmeg* is the dried seed of *Myristica argentea* Warb. deprived of its testa.

31. *Paprica* is the dried ripe fruit of *Capsicum annuum* L., or some other large-fruited species of *Capsicum.*

32. *Black pepper* is the dried immature berry of *Piper nigrum* L. and contains not less than six (6) per cent of non-volatile ether extract, not less than twenty-five (25) per cent of starch, not more than seven (7) per cent of total ash, not more than two (2) per cent of ash insoluble in hydrochloric acid, and not more than fifteen (15) per cent of crude fiber. One hundred parts of the nonvolatile ether extract contain not less than three and one-quarter (3.25) parts of nitrogen. *Ground black pepper* is the product made by grinding the entire berry and contains the several parts of the berry in their normal proportions.

33. *Long pepper* is the dried fruit of *Piper longum* L.

34. *White pepper* is the dried mature berry of *Piper nigrum* L. from which the outer coating or the outer and inner coatings have been removed and contains not less than six (6) per cent of nonvolatile ether extract, not less than fifty (50) per cent of starch, not more than four (4) per cent of total ash, not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than five (5) per cent of crude fiber. One hundred parts of the non-volatile ether extract contain not less than four (4) parts of nitrogen.

35. *Saffron* is the dried stigma of *Crocus sativus* L.

36. *Sage* is the leaf of *Salvia officinalis* L.

37. *Savory* or *summer savory* is the leaf, blossom, and branch of *Satureja hortensis* L.

38. *Thyme* is the leaf and tip of blooming branches of *Thymus vulgaris* L.

E. Beverages and Vinegar.

c. COCOA AND COCOA PRODUCTS.

1. *Cocoa beans* are the seeds of the cacao tree, *Theobroma cacao* L.

2. *Cocoa nibs,* or *cracked cocoa* is the roasted, broken cocoa bean freed from its shell or husk.

3. *Chocolate, plain* or *bitter,* or *chocolate liquor,* is the solid or plastic mass obtained by grinding cocoa nibs without the

removal of fat or other constituents except the germ, and contains not more than three (3) per cent of ash insoluble in water, three and fifty hundredths (3.50) per cent of crude fiber, and nine (9) per cent of starch, and not less than forty-five (45) per cent of cocoa fat.

4. *Sweet chocolate* and *chocolate coatings* are plain chocolate mixed with sugar (sucrose), with or without the addition of cocoa butter, spices, or other flavoring materials, and contain in the sugar- and fat-free residue no higher percentage of either ash, fiber, or starch than is found in the sugar- and fat-free residue of plain chocolate.

5. *Cocoa* or *powdered cocoa* is cocoa nibs, with or without the germ, deprived of a portion of its fat and finely pulverized, and contains percentages of ash, crude fiber, and starch corresponding to those in chocolate after correction for fat removed.

6. *Sweet* or *sweetened cocoa* is cocoa mixed with sugar (sucrose), and contains not more than sixty (60) per cent of sugar (sucrose), and in the sugar- and fat-free residue no higher percentage of either ash, crude fiber, or starch than is found in the sugar- and fat-free residue of plain chocolate.

e. VINEGAR.

1. *Vinegar, cider vinegar,* or *apple vinegar* is the product made by the alcoholic and subsequent acetous fermentations of the juice of apples, is lævo-rotatory, and contains not less than four (4) grams of acetic acid, not less than one and six-tenths (1.6) grams of apple solids, and not less than twenty-five hundredths (0.25) gram of apple ash in one hundred (100) cubic centimeters. The water-soluble ash from one hundred (100) cubic centimeters of the vinegar requires not less than thirty (30) cubic centimeters of decinormal acid to neutralize the acidity and contains not less than ten (10) milligrams of phosphoric acid (P_2O_5).

2. *Wine vinegar* or *grape vinegar* is the product made by the alcoholic and subsequent acetous fermentations of the juice of grapes and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid, not less than one and four-tenths (1.4) grams of grape solids, and not less than thirteen hundredths (0.13) gram of grape ash.

3. *Malt vinegar* is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt or cereals whose starch has been converted by malt, and is dextro-rotatory and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid, not less than two (2) grams of solids, and not less than two-tenths (0.2) gram of ash. The water-soluble ash from one hundred (100) cubic centimeters of the vinegar requires not less than four (4) cubic centimeters of decinormal acid to neutralize its alkalinity and contains not less than nine (9) milligrams of phosphoric acid (P_2O_5).

4. *Sugar vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of a sugar, sirup, molasses, or refiners' sirup, and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

5. *Glucose vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of starch sugar, glucose, or glucose sirup, is dextro-rotatory, and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

6. *Spirit vinegar, distilled vinegar, grain vinegar* is the product made by the acetous fermentation of dilute distilled alcohol and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

ANALYSIS OF FOOD PRODUCTS.

The law regulating the sale and analysis of foods apparently contemplates two things: the proper and truthful branding of all articles of food, and the exclusion from the markets of deleterious food materials. The law does not seek to prevent the sale of any article of wholesome food; but in case a food material is other than it appears to be, it "shall be plainly labeled, branded or tagged so as to show the exact character thereof."

Broadly speaking, the adulterants of food are of two types: those which do not particularly affect the nutritive value of a food; and those which either lower the nutritive value or actually add deleterious articles. The common adulterant of maple sugar is cane sugar, the sweetening quality of which is identical with that of the maple. Molasses is often adulterated with glucose, a cheaper, and somewhat less sweet, but equally nutritious food material. Cottonseed oil is frequently sold for olive oil. The market price of such substituted commodities is below that of the article imitated. Such adulterations are frauds upon the pocket book. On the other hand, some baking powders contain alum. Sausages frequently carry borax. Ketchups usually contain questionable preservatives and coloring matters. Such adulterants are a greater or less menace to public health. Since the limited funds available for the analysis of foods makes it impossible to inspect them all, greater attention will be given to adulterations injurious to health than to those concerning the pocket book alone. Because of the expense involved it will be impracticable for the inspector to visit any considerable number of the towns of the State. Dealers and consumers are invited to send by prepaid express original and unbroken packages of food materials on sale in Maine of whose purity they are for any reason suspicious. Such samples should be accompanied by a full description of the goods, including the name and address of the dealer and of the sender, together with other known data not given on the package. As prompt free analysis will be made of these samples as circumstances will allow. In case more samples are received than can be analyzed, preference will be given to the examination of food materials the purity of which affects the public health.

POULTRY EXPERIMENTS.

G. M. GOWELL.

[The poultry work of the Experiment Station was undertaken primarily to study breeding for egg production and has been in progress for several years. A year ago the Bureau of Animal Industry of the U. S. Department of Agriculture desired to cooperate in the work and is now contributing $1,000 per year to assist in the carrying forward of the breeding experiments. Considerable unpublished data from these experiments have accumulated, but it has been decided to hold this matter for another year before it is published, at which time it will probably be issued as a bulletin of the Bureau of Animal Industry.

The following papers on poultry experiments have been published. With the exception of Bulletin 100, these are no longer available for distribution.

Number of Laying Hens that can be profitably kept in one Pen, Annual Report for 1898.
Feeding Chickens for Growth, Bulletin 64.
Breeding for Egg Production, Bulletin 64.
Feeding Chickens for Growth, Bulletin 79.
Experiments in Incubation, Bulletin 79.
Breeding for Egg Production, Bulletin 79.
Breeding for Egg Production, Bulletin 93.
Floor Space, etc., in relation to Egg Production, Bulletin 93.
Poultry Management as practiced at the Maine Station, Bulletin 100.

This bulletin (117) presents some of the results of the breeding work and supplements Bulletin 100 by outlining the methods of housing and handling our stock that have been adopted since that bulletin was issued.—C. D. W.]

Investigations Relating to Breeding to Increase Egg Production in Hens.

SUMMARY OF RESULTS OBTAINED.

In order to select good producing hens for foundation breeding stock, we constructed 52 trap nests and placed them in the laying pens where 140 April and May hatched pullets commenced using them November 1, 1898.

In one year forward from that date the 140 birds laid an average of 120 eggs each. Twenty-five laid over 160 each and 22 less than 100 each. Hen No. 36 laid 201 eggs; No. 101 laid 204; and No. 286 laid 206 eggs. The eggs of No. 36 were light in color and she was therefore rejected as a breeder.

At the commencement of the next breeding season,—1900—Nos. 101 and 286 were mated with males that were unrelated to them, or to each other. The cockerels raised from the eggs of these two birds were the first males produced for use in this work.

In the early spring of 1901, several sons of hen No. 286, raised the previous year, were mated with the 24 two-year-old hens that laid 160 eggs and over, each, during 1899, and 25 others that laid 160 or over during the 1900 test. That season hen No. 303, who had laid 208 eggs during 1900, was bred to a son of 286. Hen No. 326 had laid 211 eggs during 1900 and she was bred to a son of No. 286 also. No. 318 had laid 237 good brown eggs in 1900. After she had laid 200 eggs the next dozen she laid weighed 1 lb. 11¼ ounces. She was bred to a son of No. 101 that season. The sons of No. 101 and 286 were in service only during the year 1901.

During 1902 one hundred pullets were tested for additional foundation stock. They yielded an average of 132 eggs each. Twelve birds laid over 200 eggs each; the highest number being 251 eggs laid by hen No. 617. In the same pens were six others that laid only from 23 to 70 eggs each. Thirty-seven laid over 160 each. No hens were used as breeders that had not laid 160 eggs, and all, as in the previous year, were bred to males whose dams had yielded over 200 eggs.

Males were raised this year, (1902) for the male breeding pens of the next year, from hens No. 635, record 201 eggs, and

No. 676, record 209 eggs. The eggs from both of these hens were very large and dark brown. They were mated to sons of No. 303 and 318 before spoken of. Males for the pullet breeding pens of the next year were bred from other matings of hens, that had produced 200 eggs, with males whose mothers had yielded over 200.

That year (1902-3) we were crowded for room and could accommodate only 53 pullets for testing. They were the first pullets that we tested that were sired by males bred from 200 egg producing hens and show the first results of the breeding practiced. They had been laying quite heavily out on their summer range during September and October, although they were not hatched until April and May. The 53 birds laid 7,952 eggs in the year forward from November 1st, a little better than 150 eggs each. Could they have been in quarters where their eggs could have been traced to them a month earlier, when they were laying so well, they would have shown a better year's work, as the twelfth month of their testing was really the thirteenth month of their laying, and the record sheets show it to be nearly bare of eggs. As it was, however, seven of the 53 show records of from 201 to 240 eggs each in the year, and 23 of the 53 laid over 160 eggs each.

During the breeding season of 1903, hens No. 1,001, record 213 eggs; No. 1,003, record 240 eggs; No. 1,005, record 222 eggs and No. 1,140, record 211 eggs, were bred to male birds raised the year before whose dams had yielded over 220 eggs each, for the purpose of procuring males, for the male breeding pens of 1904.

All pullets raised that year (1903) were, as in the preceding three years, out of hens that had laid over 150 eggs in a year, and they had the advantage over their predecessors, in that their dams and maternal grand dams were sired by males whose mothers had yielded 200 eggs, or over, as they themselves also were.

That year (1903-4) 160 pullets were tested in the trap nests. They laid 21,202 eggs; an average of 132 each. Forty-four laid over 160 eggs each; 8 laid 200 or over, viz. 200-205-210-217-220-221-222 and 225 each. We have not to seek far for an explanation for the lower average yield than that of the last preceding year. The pullets were hatched in April and May, and thinking to have them mostly in readiness for laying early in November, we fed them rather more beef scrap than usual during the growing season, while they were out on the range, and before we were aware of their development they were laying,—in August. They were nearly all laying heavily during September, October and November. They were splendid birds, but almost every one of them moulted, completely, in December, and we got very few eggs from them for more than two months. The most of the eggs secured from them were laid after the middle of January. Could they have commenced laying in October and continued for a year, moulting would probably have been avoided and the showing would have been much better.

The breeding season of 1904 opened with 170 yearling hens in our houses that had laid above 160 eggs each the year before; 80 pullets and hens whose mothers had laid over 200 eggs per year; and 28 hens that had themselves laid over 200 eggs per year. These birds were in 24 different pens and they were bred to selected cockerels whose mothers had yielded above 200 large brown eggs per year.

Among the pullets tested during the last preceding year (1903) were found the following; No. 263a yielded 220 eggs; No. 225a, 220 eggs; No. 222a, 221 eggs; No. 224a, 222 eggs; No. 205a, 225 eggs. These birds were bred during 1904 to cockerels raised in 1903 from heavy producing mothers whose other sons were never used in our breeding operations. The mating of these five pairs of birds was to secure cockerels for our next year breeding operations.

At the usual time for the commencement of the yearly test of 1904, viz. October 30, we had 300 good pullets that were laying well out on the range. The construction of the building being erected for their quarters was interfered with by a question of labor, over which we had no control, and they remained out in their small summer homes during a wet, cold fall and early winter, until December sixth, when they were moved in. This more than a month's delay and exposure cut into the year's work heavily and the average production of the 300 birds was reduced to 131 eggs each during a little less than eleven months. Eight birds yielded above 200 eggs each before the close of the following October.

All of the breeding females we are now carrying are tested hens that have laid from 160 to 251 eggs in a year; and 150 pullets and hens whose mothers produced 200, or over, eggs per year. All males used in breeding these two classes since 1901 had mothers that had laid 200 or more eggs in a year.

This season (1905) six hundred pullets out of hens that have laid above 160 eggs per year, and whose fathers, grandfathers and great grandfathers were out of hens that yielded above 200 eggs per year are being tested by the trap nests for additional breeding stock. All of the mothers of these pullets had fathers and grandfathers that had 200 egg producing mothers.

The stock is strong and vigorous and but few chickens that hatch are lost. The hardihood of the stock is shown by the fact that many cockerels have been sold to farmers and poultrymen in and out of the State during the past two years and this fall many of them have ordered again, with the frequent comment that their pullets are laying earlier in the season and giving better eggs than they have ever done before.

The numbers of the breeding stock now secured makes practicable the avoidance of in-breeding and this is strictly guarded against, as it is doubtful if the inbred hen has sufficient constitution to enable her to withstand the demands of heavy egg yielding. During only one season, have birds as closely related as first cousins been bred together. Line breeding is followed, the matings now being only with distantly related birds. These breeding investigations have now been in progress for six years. The first year was consumed in testing pullets to find foundation stock. The second year cockerels were raised from the large laying hens for future breeding, and the third year, the first lots of pullets were raised from the selected stock; so that we have only the last three years in which to note results and these three years can only show the first changes that have taken place. The stock that we commenced with was well bred, as flocks generally go. The hens were averaging about 120 good brown eggs a year, and had been doing so for several years. Three years ago they averaged 150 eggs and the last two years, with the great setbacks caused as above indicated, which was no fault of the stock, the average was 131½ eggs. It must be borne in mind that 1902 was the first year we had pullets from the 200 egg stock to collect eggs from. In the records, only the eggs laid in the nests are accounted for. Had those found on the floor been reckoned in, the average per bird would have been slightly increased.

As the housing, treatment and food, have been as nearly alike as we could make them during the last five years, there seems to be reason for assuming that the flock yields of 1902, 1903 and 1904 over those of previous years are the results of the breeding practiced.

Sufficient time has not yet elapsed since beginning these breeding tests to establish claims of increased productiveness, but the outlook is certainly very encouraging.

The plans on which we are working are based on every-day common sense. We are rejecting the drones and breeding producers together to secure producers. It is known that the laws of inheritance and transmission are as true with birds as with cattle, sheep and horses, and when we consider the wonderful changes that have been made in the form, feather and egg production of hens since their domestication commenced, there is ample reason for assuming that a higher average egg production than the present can be secured, by breeding only from those birds that are themselves great producers.

The purposes of this work should not be misunderstood;—we are not trying to breed stock that shall average to yield 200 eggs per year. If the average yield of the hens of the breed should be increased to the extent of a dozen eggs per bird, the value of the work would be many times its cost.

OTHER METHODS OF SELECTING BREEDING STOCK.

During last August we found 29 of the pullets that were hatched the first of April, were laying in the brooder houses out on the range. They were carried into the laying houses, banded and given access to trap nests. They were given our usual treatment and feed and we commenced keeping records with them September first and will continue doing so through the year.

On April 30 the 29 birds had laid 3,317 eggs. Their individual records were as follows, viz. 95, 93, 91, 133, 115, 58, 102, 149, 130, 100, 76, 95, 114, 101, 110, 127, 149, 68, 107, 134, 126, 135, 135, 136, 125, 130, 164, 86, 133. The average number to each bird was practically 115. We have no special market for our eggs as we need to use them in large numbers in experimental work when occasions require. At the prices which we received from the commission house in Boston for eggs sent there from September to April the 3,317 above mentioned would have returned $87.57, an average of $3.01 per bird for the eight months' work.

The above is not cited as phenomenal work, but it is better than our birds average when all of them are accounted for. These 29 were not the only promising pullets we had, but they were all there were in that division. What returns they will make during the four months that remain from April to the close of August can not be learned until the year's work ends, which with them will be August 31.

While the egg yields of this group of birds were very satisfactory, the money returns from them were particularly so, for the reason that they did their work during that part of the year when prices were highest.

We are making our selections of breeding stock by aid of the reliable data secured by the use of trap tests. It is only investigators and occasional poultrymen who can afford the equipment and expense of operating trap nests. Every poultryman can, however, by closely observing his young stock during autumn, select the pullets that are commencing or preparing to lay and secure a pen of birds for the next season's breeding, that have the function of egg production so strongly developed in them that they give evidence of it by the early exercise of that function. Of course not all prospective layers prove satisfactory; some are not able to stand the demands of heavy work and so lay irregularly or fall out altogether. In this group of 29 birds, four proved to be low producers and should be rejected as breeders. Four others yielded from 90 to 100, but as the work was done during the time when the products were valuable they are worth breeding from. Six others yielded from 100 to 114 during the same period and they are still more valuable. Fifteen of this group of 29, selected in the field, laid from 115 to 164 each.

Although there are some poor yielders in this pen of 29, it is probable that as a lot they average considerably better than the whole flock from which they were selected. The small number of unprofitable birds and the large proportion of good ones would warrant the method of selection as the best, when trap nests, or equally reliable methods of selection are not practicable.

Early maturity in pullets is generally accompanied by physical vigor and when the function of such birds is to produce eggs, and they give evidence of it, they are certainly the best of their race to breed winter egg producers from, if we accept past experiences in breeding as our guides.

The records of a full year's laying in trap nests would be better as that would enable the rejection of all poor workers; and as the birds would not be bred from until the year following, they would be more mature and the chicks would be larger when hatched and would develop into larger birds at maturity than they would if their mothers were doing their first year's laying. The differences in size from these causes, have been very noticeable in our work.

Poultry men are generally desirous of securing as many well bred pullets as possible and so use yearling hens as breeders, in addition to their two-year-olds. The work done by pullets from September to February or March is pretty good indication of their usefulness and their eggs are available for breeding during the pullet year. While the chickens from such eggs are not generally as large at maturity as those from older hens, we have not been able to discover any lack of constitution or vigor in them, and know no reasons why they are not desirable as workers.

THE PEDIGREE CHARTS.

In order to make clear our methods of breeding and registering, there are appended hereto two pedigree charts which illustrate the breeding of the two classes of birds which we designate as "registered" and "unregistered." We do not use these terms with reference to purity of blood, for ours is one of the oldest of the families of Barred Plymouth Rocks, having been bred by the writer for 25 years from the best Barred Rock stock which was procurable at the time of starting.

Every one of our birds is pure blooded in the same sense that all registered cattle, horses, sheep and swine are pure, and every one of our hens is numbered with duplicate bands, and individual book accounts are kept with each, whether she produces much or little. The same is true of all males so far as purity of blood is concerned.

In our work the term "registered" is used solely with reference to performance, which in work with Jersey or Holstein cattle would mean registered in the "advanced registries" of those breeds. We have registered no female unless she had laid 200 or more eggs during the first 12 months forward from the day on which she laid her first egg. We have registered none of her daughters unless they themselves had laid at least 200 eggs per year.

We register all of the sons of registered hens, and designate them as registered males. They are no better bred than their own sisters which we reject from registry when they do not prove to be heavy performers. Were there some practicable means by which we could determine the ability of the male to transmit to his offspring the high egg producing function of his dam, we would apply the same rigid rule of selection to him that we do to his sisters.

There was no reason why we should select 200 as the number of eggs necessary to entitle a bird to advanced registration. It is a high record—much higher probably than large flocks will ever be made to average, in our time. Perhaps we might have taken 190 or 210 with equal propriety,—just as horse men might have selected some other time than 2.30 by which to determine a *standard horse*.

The unregistered cockerels and pullets are as well bred on their fathers' side as the registered ones are, but, while the registered ones have dams that produced 200 eggs or over, the mothers of the unregistered ones laid from 150 to 199 eggs in their first laying year. It is among these unregistered pullets that we have found the most of the 200 egg producers who are each year added to the foundation breeding stock.

The charts shown are only given as examples of the breeding. In the male breeding pens nearly 30 different hens are employed this year, which give as many different pedigrees. In the unregistered female breeding pens are several hundred breeding hens, each giving pedigrees to their progeny. In the chart illustrating the breeding of the registered males, it is shown that his mother and her mother were both producers of over 200 eggs. We have two other similar instances where the daughters of 200 egg producers are themselves 200 egg producers. This has not generally been so, probably because the hen that laid heavily one year did not commence laying until so late the following year that their pullets came into laying too late in the year to make great records for themselves. Several hundreds of the unregistered cockerels have for each of the last three years been sold to poultrymen and farmers and a great deal of commendation has been expressed relative to the benefits derived from their use in securing earlier and increased egg yields.

The first chart shows the breeding of the registered males that were raised in the present breeding year of 1905. The registered males are designated by numbers. It will be noted that the mother and the grandmother of the registered males are registered birds in the sense in which we use the word, the mother having yielded 203 and the grandmother 213 eggs in their first laying years. Beyond that, while the birds are pure bred, we do not know their breeding except that their mothers laid not less than 150 and not more than 199 eggs in their first laying years. The breeding of the unregistered males and females raised in 1905 differs from the registered in that none of the mothers have laid over 199 eggs in their first laying year.

Diagram illustrating breeding of registered males raised in 1905.

Registered males raised in 1905.

- No. 304
  - No. 165
    - No. 66
      - No. 41
        - No. 44
          - ....
          - No. 286 (206)
        - No. 303 (208)
          - ....
          - ....
      - No. 676 (209)
        - No. 29
          - ....
          - No. 286 (206)
        - No. — 150 to 199
          - ....
          - ....
    - No. 1003 (240)
      - No. 52
        - No. 18
          - ....
          - No. 101 (204)
        - No. 326 (211)
          - ....
          - ....
      - No. — (150–199)
        - No. 21
          - ....
          - No. 286 (206)
        - No. — (150–199)
          - ....
          - ....
  - No. 205A. (225)
    - No. 61
      - No. 40
        - No. 17
          - ....
          - No. 101 (204)
        - No. 318 (237)
          - ....
          - ....
      - No. 635 (201)
        - No. 24
          - ....
          - No. 101 (204)
        - No. — (150–199)
          - ....
          - ....
    - No. — (150–199)
      - No. 36, 37, 38 or 39.
        - No. 17
          - ....
          - No. 101 (204)
        - No. 318 (237)
          - ....
          - ....
      - No. — (150 to 199)
        - No. 24
          - ....
          - No. 286 (206)
        - No. — (150–199)
          - ....
          - ....
- No. 520 (203)
  - No. 166
    - No. 51
      - No. 40
        - No. 17
          - ....
          - No. 101 (204)
        - No. 318 (237)
          - ....
          - ....
      - No. 635 (201)
        - No. 24
          - ....
          - No. 101 (204)
        - No. — (150–199)
          - ....
          - ....
    - No. 1003 (240)
      - No. 52, 53, 54 or 55.
        - No. 18
          - ....
          - No. 101 (204)
        - No. 326 (211)
          - ....
          - ....
      - No. — (150–199)
        - No. 21
          - ....
          - No. 286 (206)
        - No. — (150–199)
          - ....
          - ....
  - No. 1001 (213)
    - No. 62
      - No. 41
        - No. 44
          - ....
          - No. 286 (206)
        - No. 303 (208)
          - ....
          - ....
      - No. 676 (209)
        - No. 29
          - ....
          - No. 286 (206)
        - No. — (150–199)
          - ....
          - ....
    - No. — (150–199)
      - No. 45, 46, 47 or 48
        - No. 24
          - ....
          - No. 101 (204)
        - No. 318 (237)
          - ....
          - ....
      - No. — (150–199)
        - No. 13
          - ....
          - No. 286 (206)
        - No. — (150–199)
          - ....
          - ....

The figures in brackets below or at the right of the number of the hen indicate the egg yield for the first laying year

Diagram illustrating breeding of unregistered males and females raised in 1905.

- Unregistered males and females raised in 1905.
  - No. 302
    - No. 160
      - No. 66
        - No. 41
          - No. 44 — ....
          - No. 303 (208) — No. 286 (206) ....
        - No. 676 (209)
          - No. 29 — ....
          - No. — (150-199 — No. 286 (206) ....
      - No. 1003 (240)
        - No. 52
          - No. 18 — ....
          - No. 326 (211) — No. 101 (204) ....
        - No. — (150-199)
          - No. 21 — ....
          - No. — (150-199) — No. 286 (206) ....
    - No. 224 (222)
      - No. 61
        - No. 40
          - No. 17 — ....
          - No. 318 (237) — No. 101 (204) ....
        - No. 635 (201)
          - No. 24 — ....
          - No. — (150-199) — No. 101 (204) ....
      - No. — (150-199)
        - No. 36, 37, 38 or 39
          - No. 17 — ....
          - No. 318 (237) — No. 101 (204) ....
        - No. — (150-199)
          - No. 24 — ....
          - No. — (150-199) — No. 286 (206) ....
  - No. — (150-199)
    - No. 159
      - No. 51
        - No. 40
          - No. 17 — ....
          - No. 318 (237) — No. 101 (204) ....
        - No. 635 (201)
          - No. 24 — ....
          - No. — (150-199) — No. 101 (204) ....
      - No. 1003 (240)
        - No. 52, 53, 54 or 55
          - No. 18 — ....
          - No. 326 (211) — No. 201 (204) ....
        - No. — (150-199)
          - No. 21 — ....
          - No. — (150-199) — No. 286 (206) ....
    - No. — (150-199)
      - No. 62
        - No. 41
          - No. 44 — ....
          - No. 303 (208) — No. 286 (206) ....
        - No. 676 (209)
          - No. 29 — ....
          - No. — (150-199) — No. 286 (206) ....
      - No. — (150-199)
        - No. 45, 46, 47 or 48
          - No. 24 — ....
          - No. 318 (237) — No. 101 (204) ....
        - No. — (150-199)
          - No. 13 — ....
          - No. — (150-199) — No. 286 (206) ....

The figures in brackets below or at the right of the number of the hen indicate the egg yield for the first laying year.

Sizes of Flocks, Rooms and Individual Floor Spaces.

We are now using three large laying and breeding houses, and a smaller curtain front building known as the "Pioneer House."

House No. 1 is 16 feet wide and 150 feet long. This house is warmed by hot water and is always kept above the freezing point by the use of about four tons of coal each year. It has been in use seven years and the birds occupying it have laid well, and been in good health, but have not had as good color and were not as vigorous as their mates in the open front houses. The pens in this house are 10 by 16 feet in size and have been occupied by 20 hens, and during the breeding seasons generally by one or two males in addition.

House No. 2 is two years old. It is 12 feet wide and 150 feet long. Aside from the Pioneer House, this is the first curtain front elevated roosting closet house we built. It is fully described in Bulletin 100. The pens in this house are 12 by 20 feet in size and each one contains 50 hens, besides the cockerels at breeding time, which gives four and four-fifths square feet of floor space to each hen.

House No. 3 was constructed last fall. It is 16 feet wide and 120 feet long. It is of the same style as No. 2 except that it is wider. There are four pens in the building, each 16 feet wide and 30 feet long. Two of the pens are arranged for 100 hens each, and two of them for 150 each.

We have now used the Pioneer house four years with 50 pullets in it each year, the No. 2 house two years with 300 pullets each year and the No. 3 house one year. Besides these three houses, we have had the use of another house of the open front style of construction for three years with about 200 yearling, breeding hens in it each year.

These curtain front houses have all proved eminently satisfactory. Not a case of colds or snuffles has developed from sleeping in the warm elevated closets, with their cloth fronts, and then going directly down into the cold room, onto the dry straw, and spending the day in the open air. The egg yields per bird have been as good in these houses as in the warmed one. The purposes of the different sizes of rooms and flocks is to compare the results of the welfare and egg yields of the birds under the different conditions.

The conditions that were laid down years ago and accepted as imperative, that hens could only be kept profitably as layers in flocks not greater than 15, with allowances of at least 10 square feet of floor space per bird, required large space for small numbers of birds and was expensive. The small pen, even though sparsely populated, means close confinement to the occupants. If one hen was confined and compelled to remain on the generous allotment of a square yard, life would be very unsatisfactory to her. But give her 25 square yards of floor room to roam over at will and she will be happy, although she may meet 49 neighbors in her wanderings, and divide the room with them, yet the allotment to each individual is reduced to one-half a square yard.

The seven pens in House No. 2 each have 240 surface feet of floor and the 50 pullets in each pen averaged 150 eggs last year. The pullets this year, in the same pens, appear to be doing equally well.

In House No. 3 the pens are twice as large as those of No. 2, containing 480 square feet. In the first pen 100 pullets are kept, having four and eight-tenths square feet of floor per bird, just the same allotment as is given in the pens of 50 birds, in the No. 2 house. Some of the questions which it is hoped to get light upon by these comparisons are: Does the larger room have advantages over the smaller one when both are equally densely populated, by giving greater opportunities and freedom to the birds? Are there disadvantages when the numbers of birds in the flock are increased, the proportioned floor space per bird remaining the same.

Should the tests indicate that the greater liberties of the larger pens are advantageous, the question arises: are the advantages such that the number of birds in the large pens can be increased and the ratio of egg production be maintained, or; how far can the net profit from the pens be increased by increasing the number of birds in each pen, although the average egg yield be diminished by the denser population?

In House No. 3, pen No. 3 is a duplicate of pen No. 1 in size and construction, and in it 150 pullets were wintered. The floor allotment per bird in this flock is three and one-fifth square feet. Three roosts instead of two were required for the increased number of birds. The wider floor of the elevated closet makes the daily cleaning of the platforms, proportionately, a little greater, but not much so, as the roosts are elevated by a single rope pulley.

Although the cubic feet of air space per bird was the same in the flocks of 50, 100 and 150, the cloth covered fronts of the closets where 100 or 150 roosted were of the same size and it was very evident early in the winter that the supply of fresh air to the largest flock was not sufficient. It was not practicable to materially increase the cloth surface and allow more air to filter in, so three openings were made in the upper part of the curtain frame through which better ventilation could be secured. The openings were six inches wide and 30 inches long with wooden shutters provided for them. The shutters were kept entirely open into the outer room, during mild nights, but when high winds prevailed and the temperature fell to 10 or 30 degrees below zero, the openings were partially closed, but never more than half so.

The walls of the elevated closet are packed with sawdust four inches in thickness, and the curtains fit very closely, leaving very small cracks. The ten ounce duck of which the curtains are made is not oiled, as was the case with those in the original house built by us. The supply of fresh air was mostly admitted through the cloth, while the worn out air passed off through the openings above. By this arrangement the birds were not in drafts or currents or air. Where three roosts are arranged abreast, instead of two, the openings are absolutely essential and for smaller flocks they are convenient during the mild nights, especially towards spring.

The health of the birds in this flock of 150 in comparison with those in the flock of 100, in like sized pens, was apparently as good. In the pens of 50, 100, and 150 birds, the proportional losses did not materially differ, being very small in all pens.

It is yet too early to draw conclusions from the results as we have only the data of one year from November to June to compare. Next year we expect to have seven pens of 50 pullets each with floor space of 4.8 square feet per bird, and two pens of 100 birds each, with floor space of 4.8 feet per bird to compare with them. Also two pens of 150 birds each with floor space of 3.2 feet per bird to compare with the flocks of 100 birds above mentioned.

With pens of the same style and arrangement and birds of our own raising, matched in age, development and breed, and with the same system of feeding and attendance, information should be secured regarding the sizes of rooms and numbers in flocks which may be of incalculable value to the poultry industry of the country.

Feeding the Hens.

For 25 years we have been at work with the same family of Barred Plymouth Rocks and have learned several ways to feed and handle them to secure eggs, and to avoid the losses which are so common to mature hens of that breed, from over fatness. Other methods of feeding may be as good or even better. While it is true that only the full fed hen can lay to the limit of her capacity, it is equally true that full feeding of the Plymouth Rocks, unless correctly done, results disastrously.

Several years ago we gave up the morning mash and fed it late in the afternoon with far better results than when fed in the morning. The full meal in the morning had produced laziness, fatness and soft shelled eggs in our Plymouth Rocks, but these bad conditions and results were not encountered when the birds were required to eat slowly, and exercise by digging the hard grains out of the straw bedding.

The birds were fed throughout the year daily as follows: Each pen of 22 received one pint of wheat in the deep litter early in the morning. At 9.30 A. M. one-half pint of oats was fed to them in the same way. At 1 P. M. one-half pint of cracked corn was given in the litter as before. At 3 P. M. in winter and 4 P. M. in summer they were given all the mash they would eat up clean in half an hour. The mash was made of the following mixture of meals: 200 lbs. wheat bran; 100 lbs. corn meal; 100 lbs. wheat middlings; 100 lbs. linseed meal; 100 lbs. gluten meal; 100 lbs. beef scrap. The mash contained one-fourth of its bulk of clover leaves and heads obtained from the feeding floor in the cattle barn. The clover was covered with hot water and allowed to stand for three or four hours. The mash was made quite dry, and rubbed down with the shovel in mixing, so that the pieces of clover were separated and covered with the meal. Cracked bone, oyster shell, clean grit, and water were before them all of the time. Two large mangolds were fed to the birds in each pen daily in winter. They were stuck onto large nails which were partly driven into the wall a foot and a half above the floor. Very few soft shelled eggs were laid and so far as known, not an egg has been eaten by the hens during the last five years.

The records of several years' feeding show that from 50 to 55 pounds of the dry meals, not including the clover leaves of which the mash was made up, were eaten by each hen per year. The quantity of grain fed in the litter was the same every day, winter or summer. The quantity of mash was variable, being all they would eat in an hour at the close of the day. They ate more in cold than in warm weather; also considerably more when they were laying heavily than when they were yielding few eggs.

The feeding above described was with hens in a house kept warm enough by hot water pipes, so that the temperature was above the freezing point at all times. The amount of food required by the birds kept in this house for several years was always less during the winter season, than where birds were kept in the colder houses.

In addition to the 50 to 55 ℔s. of mash, the hens in this house have averaged each year 18.2 ℔s. wheat; 6.4 ℔s. cracked corn; 5.8 ℔s. of oats; 5.9 ℔s. oyster shell; 3.2 ℔s. dry poultry bone; 2.9 ℔s. mica grit; and 40 ℔s. mangolds. The straw for litter has averaged 36 ℔s. per bird.

The birds fed and housed as above described have averaged laying about 150 eggs each.

CRACKED CORN AND BEEF SCRAP SUBSTITUTE FOR THE MOIST MASH.

Last year 300 April and May hatched pullets were put in six pens in the open front house and the birds in all pens were selected so as to have the lots equal in quality. One hundred and fifty of the birds were fed on dry grains in the litter during

8

the day and a full feed of moist mash was given towards evening. The mash was made as above described.

The other 150 birds were fed the same quantities and kinds of dry grains in the litter, but instead of moist mash they were given all they would eat of dry cracked corn in troughs at evening. Dry beef scraps were kept within their reach at all times. Both lots were constantly supplied with oyster shell, dry crushed bone, and mica crystal grit. Mangolds were fed through the winter and when the runs were bare in summer, other green food was supplied.

The materials used by each lot during the full year average per bird as follows:

Pounds of dry grain, straw, mangolds, etc., per bird for one year.

Lot 1 with mash—Mash, 53.3 pounds; wheat, 23.8 pounds; cracked corn in litter, 7.7 pounds; oats, 6.9 pounds; oyster shell, 8.5 pounds; bone, 4.4 pounds; grit, 4.2 pounds; beef scrap, —; mangolds, 40 pounds; straw, 36 pounds.

Lot 2 without mash—Cracked corn, 45.4 pounds; wheat, 23.8 pounds; cracked corn in litter, 7.7 pounds; oats, 6.9 pounds; oyster shell, 4.4 pounds; bone, 1.7 pounds; grit, 2.9 pounds; beef scrap, 14.7 pounds; mangolds, 40 pounds; straw, 36 pounds.

Cost of food and straw, Lot 1, $1.73; Lot 2, $1.69.

Cost of food without mangolds, Lot 1, $1.48; Lot 2, $1.43.

Eggs yielded, Lot 1, 151; Lot 2, 149.

Comparisons of the costs of the two rations and the egg yields of the birds fed upon them do not show very great advantages of one ration over the other. There were no marked differences in the appearances and health of the birds in the two lots. They were in good general health, aside from the difficulties that arise when birds are induced to overload their crops after a period of partial fasting. The free use of cracked corn cheapened the cost of the ration, and the egg yield was not depressed sufficiently to indicate that that ration was faulty in its production. When compared with the food required to feed a hen a year in the warmed house, which was about 95 pounds, the 109 pounds used in this test is an increase of nearly 15 per cent.

As the birds in each house laid about the same number of eggs, it seems reasonable to suppose that the excess of food was needed for maintenance in the colder house, where the birds were in out-of-door temperature during the most of the day time throughout the year.

Although as many eggs were yielded by the birds eating less food in the warmed house, the greater vigor and less losses among birds in the open-front house more than compensated for the excess cost of maintenance.

In Lot 2, where the birds helped themselves at will to beef scrap, they ate of it on the average, 14.7 lbs. during the year; while in Lot 1 each bird received 8.7 lbs. of the scrap in the mash. This leaves a difference of 6 lbs. in the amount of animal food consumed by individuals in the two lots. Was this difference supplied by the materials rich in vegetable protein which made up a part of the mash, viz., the linseed and gluten meals?

It will also be noticed that the quantity of oyster shell, bone and grit eaten by the birds having a constant supply of beef scrap was markedly less than when the supply of scrap was limited to that contained in the mash.

DRY FEEDING.

On the first of last November we began feeding 550 April and May hatched pullets wholly on dry food. They were in the curtain-front houses with warm elevated roosting closets and in flocks of 50, 100 and 150. At five o'clock in the morning the flocks of 50 birds were given two quarts of cracked corn; at half past ten o'clock they had one quart of wheat and one quart of oats. This dry material was all spread on the litter on the floor but was not raked in. Along one side of the pens were feed troughs with slatted fronts, in which was kept a supply of the dry material of which the moist mash, before described, was composed. These troughs were never allowed to remain empty when the supply was exhausted. The dry mash was constantly within the reach of all birds and they helped themselves at will. Oyster shell, dry cracked bone, grit and charcoal were accessible at all times. A moderate supply of raw mangolds and plenty of clean warm water was furnished them. When they were first put upon this ration they were not acquainted with the dry mixture in the troughs and ate of it sparingly, but in three or four days they were using as much of it as at any later time until they got to laying heavily. When the feeds of cracked corn, wheat and oats were given, the birds were always ready and anxious for them and would scratch in the litter for the very last kernel before going to the troughs where an abundance of food was in store.

It was very evident that they liked the broken and whole grains better than the mixture of the fine materials; yet they by no means disliked it, for they helped themselves to it,—a mouthful or two at a time—whenever they seemed to need it, and never went to bed with empty crops so far as we could discover. They apparently did not like it well enough to gorge themselves with it, and sit down, loaf, get over fat and lay soft shelled eggs, as is so commonly the case with Plymouth Rocks when they are given warm morning mashes in troughs.

Some of the advantages of this method of feeding are that the mash is put in the troughs at any convenient time, only guarding against an exhaustion of the supply, and the entire avoidance of the mobbing that always occurs at trough feeding when that is made a meal of the day, whether it be at morning or evening. There are no tailings to be gathered up or wasted as is common when a full meal of mash is given at night. The labor is very much less, enabling a person to care for more birds than when the regular evening meal is given.

We cannot give the results of a full year's feeding in this way, as we have practiced it only from the first of last November to the close of June. The number of hens lost during the winter has been less than ever before, even when they were kept in the same style of houses. We can ascribe this to no other cause than that the birds did not overload with food at any time. We have never had so many eggs laid during the winter months by a like number of hens, but that may be due to better breeding, or to the open-front houses which the birds occupied.

During the 31 days of March the 550 birds consumed on the average, per bird, the following materials, viz.: Cracked corn, 2 lbs.; wheat, 1.09 lbs.; oats, .81 lbs.; mash, 5.68 lbs.; shell, .52 lbs.; bone, .25 lbs.; grit, .31 lbs.; mangolds, 3.30 lbs.

During the months when they were not laying so heavily the consumption of mash was but about four pounds and the demands for shell, bone and grit were less. It will be noticed that the proportion of wheat fed was less than in any former ration we have fed and that the cracked corn was increased, thus cheapening the ration.

The average yields of the 550 hens during March was 20.4 eggs per bird. The whole number of eggs laid by them during the six months from November 1st to April 30 was 42,126, an average of 76 per bird. It must be borne in mind that these birds were not selected but were the whole number of chickens reared last year.

FEEDING THE CHICKENS.

We used to bake bread* for the young chicks but have abandoned the practice, not because there is anything better for them, but we believe the work involved in preparing it is not necessary.

Infertile eggs are boiled for half an hour and then ground in an ordinary meat chopper, shells included, and mixed with about six times their bulk of rolled oats, by rubbing both together, enough to break the egg into small pieces. This mixture is the feed for two or three days until the little things have learned how to eat. It is fed sparingly, in the litter and sand on the brooder floor.

About the third day we commence to feed a mixture of hard, fine broken grains, i. e., cracked corn, wheat, millet and pinhead oats as soon as the birds can see to eat in the mornings. This is fed in the litter, being careful to limit the quantity so they shall be hungry at ten o'clock. We have used several of the prepared dry chick foods and like them when they are made of good clean grains and do not contain grit. The grit and charcoal can be supplied at less cost and must be freely provided.

At ten o'clock the rolled oats and egg mixture is fed, in tin plates, with low rims. After they have had the food before them five minutes the dishes are removed and they have nothing to lunch on except a little of the fine broken grain which they

* Bulletin 100 this station, page 8.

scratch for. At 1 o'clock the hard grains are again fed as in the morning and at 4.30 to 5 o'clock they are fed on the rolled oats and egg mixture, giving all they will eat until dark.

When they are about three weeks old the rolled oats and egg mixture is gradually displaced by a mixture made up of two parts by weight of good clean bran, 2 parts corn meal, 1 part middlings or Red Dog flour, 1 part linseed meal and 1 part fine beef scrap. This mixture is moistened just enough with water so that it is not sticky but will crumble when a handful is squeezed and then released. The birds are developed far enough by this time so that the tin plates are discarded for light flat troughs with low sides.

The hard broken grains may be safely used all the way along and the fine meals left out, but the chicks do not grow so fast as when the mash is fed. There seems to be least danger from bowel looseness when the dry grains only are fed and it is very essential that the mash be dry enough to crumble in order to avoid that difficulty. Young chicks like the moist mash better than though it was not moistened and will eat more of it. There is no danger from the free use of the properly made mash, twice a day, and being already ground the young birds can eat and digest more of it than when the food is all coarse. This is a very important fact and should be taken advantage of at the time when the young things are most susceptible to rapid growth. But the development must be moderate during the first few weeks. The digestive organs must be kept in normal condition by the partial use of hard foods and the gizzard must not be deprived of its legitimate work and allowed to become weak by disuse.

By the middle of June the chickens that were hatched in April are being fed on cracked corn, wheat and the mash. At about that time the portable houses with their contents of chickens are drawn from their winter locations out to an open hayfield where the crop has been harvested and the grass is short and green.

Until last season we had continued feeding two feeds of cracked corn and wheat and two of mash daily as long as the birds remained in the field. Last June we had 1,400 chickens well started and we changed the plan of feeding by keeping cracked corn, wheat, and beef scrap, in separate slatted troughs where they could help themselves whenever they desired to do so. Not more than one-fourth of the grain was wheat for the pullets, while in the cockerel division nothing but cracked corn and beef scrap were fed. Grit, bone and oyster shell were always supplied. There were no regular hours for feeding, but care was taken that the troughs were never empty.

The results were satisfactory. The labor of feeding was far less than that required by any other method we have followed. The birds did not hang around the troughs and over-eat, but helped themselves—a little at a time—and ranged off, hunting or playing and coming back again when so inclined to the food supply at the troughs. There was no rushing or crowding about the attendant as is usual at feeding time where large numbers are kept together. While the birds liked the beef scrap they did not over-eat of it.

During the range season—from June to the close of October—the birds ate just about one pound of the scrap to ten pounds of the cracked corn and wheat. They had opportunity to balance their rations to suit themselves by having the two classes of food to select from always at hand. It would seem that we had not been far wrong in our previous feeding, as the birds used just about the same relative amounts of scrap to other food, when they had liberty to do so, that we had formerly mixed in for them.

We are not able to say whether this method is more or less expensive of material, than when we fed the four feeds each day at regular hours. As near as we could calculate, there were no appreciable differences.

The birds did well under this treatment. The cockerels were well developed and we never raised a better lot of pullets. The first egg was laid when the oldest pullets were four months and ten days old. For the last six years the pullets have been from four months and ten days to four months and twenty days old when the first eggs were found. This year we shall make another change by adding dry mash to the menu,—having a trough of that material beside the ones containing beef scrap and cracked corn. The difficulty of keeping the food clean and dry during continued exposure is nearly overcome by using troughs with slatted sides and broad, detachable roofs. We make them from six to ten feet long, with the sides five inches high. The lath slats are two inches apart and the troughs are sixteen inches high from floor to roof. The roofs project about two inches at the sides and effectually keep out the rain except when high winds prevail.

The roof is very easily removed by lifting one end and sliding it endwise on the opposite gable end on which it rests. The trough can then be filled and the roof drawn back into place without lifting it. This arrangement is the best of anything we have found for saving food from waste and keeping it in good condition. When dry mash is used in it there is considerable waste by the finer parts being blown away. When used for that purpose it is necessary to put it in a sheltered place out of the high winds.

CEREAL FOODS.

L. H. Merrill.

[In co-operation with the Office of Experiment Stations of the U. S. Department of Agriculture, the Maine and Minnesota Experiment Stations have, during the past ten years, made special studies on the composition and digestibility of cereal foods. The technical results thus obtained are published chiefly in the bulletins of the Office of Experiment Stations. This Station has published two bulletins upon the composition of the breakfast cereal foods that were found in the Maine markets. In the present bulletin Professor Merrill presents many of the general results which have been obtained in the course of this work. While the results of these investigations have been freely used in this bulletin, yet for purposes of definite illustration he has drawn chiefly upon the analyses and digestion experiments made at this Station.—C. D. W.]

Few phases of our modern civilization furnish a more curious and interesting study than the rapid increase in the number and variety of our foods. Among the causes that have contributed to this development may be mentioned: The extension of our commerce, which has placed a constantly increasing range of food materials within our reach; the efforts of our national government, which is actively engaged in the introduction of new food plants, and the production of new varieties of old types; the ingenuity of manufacturers, who have been quick to see that their sales must depend to a great extent upon the variety and attractiveness of their output; and in no slight degree, to an increased knowledge of the functions of food—i. e., the demands of the body, and the methods by which these demands may be met. To these causes may also be added a more or less artificial demand, encouraged and stimulated by persistent advertising, for foods which may be quickly and easily digested. Perhaps it is a natural outcome of the strenuous age in which we live that the average business man is reluctant to devote the proper time and attention to his meals, with the result that dyspepsia in its various forms has become alarmingly prevalent. There has thus arisen a class of food products whose chief claim upon our attention is their alleged readiness to "slip into the tissues" of the consumer without the usual tax upon the digestive organs.

Just now we are passing through what might very properly be called the epoch of cereal breakfast foods. Never in our history have the cereal foods occupied so prominent a place in our dietaries. Twenty-five years ago practically the only cereal foods to be found upon our American market were wheat flour, corn meal, hominy, and hulled corn. Wheat and oat meals had been introduced by our Irish and Scotch immigrants, but their use was far from general. Barley, rye and rice were used only to a very limited extent. Today a half-hour's canvass of the shops of our large towns or cities would reveal fifty or more preparations of these cereals, most of which present special claims to our attention. Scarcely a week passes that does not see some new cereal claimant to the public favor and the list has grown to embarrassing proportions. Few of the brands appear to be long-lived and it is safe to say that of those on sale today fully one-half will disappear within three years or will survive only on the top shelf of the country grocery, a food for worms rather than for man.

A class of foods that has come to occupy so prominent a place in our dietaries certainly deserves more than a passing consideration. Many of these preparations have been analyzed at this Station and the results published in Bulletins 55* and 84. It is proposed here to study these foods from a more general standpoint. To do this, we must take into consideration not only their chemical composition, but their palatability, digestibility, ease of preparation, relative cost, the claims made for them, and the extent to which these claims are made good.

* Bulletin 55 is no longer available.

CLASSIFICATION.

Notwithstanding the large number and variety of the cereal breakfast foods, the most of them fall readily into one of three groups. In the first of these may be placed those which are prepared by simply grinding the decorticated grain. The second group includes those which have been steamed or otherwise partially cooked, and then ground or rolled. The third group includes all those preparations which have been acted upon by malt, by the action of which a portion of the starch has undergone a chemical change.

The earliest of these foods to come into general use in this country were of the first class, oats being the most widely consumed. While the old fashioned oatmeal found favor with many, there is reason to believe that it was not always welcomed, and in the memories of many of us the morning bowl of "oatmeal mush" went far to temper the joys of childhood. Although the dish possessed many virtues that seemed to adapt it peculiarly to the needs of growing children, the results of its enforced use were not always happy, and it can scarcely be regretted that it has been so largely supplanted by other preparations of oats, wheat, or corn, some form of which is quite sure to appeal to the palate and furnish a pleasing variety. The use of coarsely ground, uncooked wheat, does not seem to have become so general. Corn meal, however, has been widely used, and hominy continues in public favor.

Following the manufacture of the uncooked cereal meals came the foods of the second group, especially the so-called "rolled" oats and wheats. By far the larger part of the breakfast foods consumed today are of this class. The superiority of these goods over those formerly in use is easily demonstrated and will be referred to later.

It is claimed that the malted preparations represent a still greater advance in the perfection of these foods. The methods employed in their manufacture vary somewhat, but they are all based upon the same principle. Barley malt is mixed with the cereal under conditions favorable to the action of the ferment present, the result being that a portion of the starch is converted into a soluble form.

Some of the cereal foods are fully cooked and may be eaten dry without further preparation, or, as many prefer, with the addition of cream and sugar. In a few cases the manufacturers cater still farther to the popular taste by wetting the cereal with a salted or sweetened solution, after which it is again dried and slightly browned. Within a few years a statement has been quite generally circulated that certain foods of this class contain arsenic. Compounds of arsenic are not uncommon in soils; and since plants are unable to exclude many salts which occur dissolved in the water of the soil, it may be readily believed that arsenic may thus find its way into growing crops. The amount of this element which can accumulate in the cereal grains by natural methods is, however, too small to excite our apprehension. On the other hand it is difficult to conceive any motive which should lead to its intentional introduction. The writer has examined a number of samples of goods which for some reason had fallen under suspicion, using the most delicate tests, but always with negative results.

COMPOSITION.

The value of any food must depend primarily upon the kind and amount which they contain of certain proximate principles which experience has taught us are absolutely essential to the maintenance of life and health. The composition of these foods is, therefore, a matter of great importance. The accompanying table gives the average composition of those preparations of corn, oats and wheat which have been collected in Maine markets and analyzed at this Station. For purposes of comparison there is given in the same table the composition of three kinds of flour, all prepared from the same hard spring wheat.

The terms employed here for the most part require no explanation. For the benefit of non-scientific readers a few words regarding the "heat of combustion" may not be out of place.*

One very important function of food is to supply energy to the body, where it is developed in the form of muscular activity, body heat, and probably in mental processes also. It may be stated in a general way that the energy furnished the body by

*The reader is referred to Farmers' Bulletin No. 142, U. S. Dept. Agriculture The Principles of Nutrition and Nutritive Value of Food.

the digested portion of our food is believed to be proportional to the heat produced when an equivalent amount of these foods is burned in the laboratory under such conditions that the heat can be accurately measured. We know that this is not quite true of protein; yet the difference between the physiological and the physical fuel values of this class of bodies is so slight that the latter, which is readily obtained by laboratory methods, serves as a very useful index of the energy-producing power of our foods.

The method employed for determining the heat of combustion consists in burning a carefully weighed portion of the food examined and measuring the heat produced. The unit of measurement is the calorie—the amount of heat that will raise one kilogram (about two and one-fifth pounds) through one degree Centigrade; or, what amounts to nearly the same thing, one pound of water through four degrees Fahrenheit. Other things being equal, then, the food product yielding the highest heat of combustion will, if digested, yield the greatest amount of energy in the body.

Average composition of cereal breakfast preparations compared with wheat flour variously milled.

Number of analyses.		Water.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories per gram.
14	Corn meal and hominy*	10.7	8.6	0.7	79.7	0.3	3.854
28	Rolled oats†	8.4	15.6	7.5	66.6	1.9	4.323
35	Rolled wheat†	9.9	12.0	1.9	74.8	1.4	3.966
1	Malted oats†	6.4	16.7	5.4	69.7	1.8	4.318
4	Malted wheat†	6.9	13.3	1.2	77.0	1.6	4.017
4	Graham flour	10.7	14.8	2.3	70.3	1.9	4.029
4	Entire wheat flour	11.4	14.1	2.0	71.5	1.0	3.967
4	Standard patent flour	11.4	13.9	1.4	72.8	0.5	3.959

*Uncooked preparations only.

†Cooked or partially cooked preparations only.

Of the unmalted cereal foods, the oats contain 25 per cent more protein than the wheat preparations, and nearly double that of the corn. The oats also furnish four times as much fat as the wheat and ten times as much as the corn. They are richer in ash constituents and furnish more energy (heat of combustion) than either of the other two grains. The only respect in which oats are excelled by the corn and wheat is in the amount of carbohydrates, the most abundant and least valuable of the nutrients named. Corn in its natural condition contains on the average over 4 per cent of fat. The small amount in the corn meal and hominy is due to the removal of the germ. The wheat products are intermediate in composition between the corn and oats.

The malted foods seem to have been more thoroughly dried than the other products, containing only from 6½ to 7 per cent of water. Otherwise their percentage composition does not vary greatly from that of the same cereals in the unmalted conditions, although there are other differences to be mentioned later.

Analyses made at different times of the same brand show great variations in composition. This is not strange when it is remembered that there are many varieties of these cereal grains, varying much in composition, and that even the same variety will show wide differences in composition according to the character of the season, soil, and fertilizer used. In the manufacture of patent flours the variations are carefully offset by the miller, who first informs himself concerning the quality of the wheats at his disposal, and then by judicious blending of several grades is able to turn out a very uniform product. Equally exact results might be obtained with these goods if the manufacturer found it for his interest to give the matter his study and care. Variations in the composition of these goods are not as easily discoverable as with bread flours, and the composition of the output, except for the limits imposed by nature, becomes largely a matter of chance.

Graham flour is made by grinding the entire wheat kernel. It contains, therefore, everything found in the kernel, including the woody and indigestible outer coatings. The so-called "entire wheat flour" is usually prepared in precisely the same manner, except that it is afterward subjected to a bolting or sifting process by which some of the coarser bran is removed. It is sometimes claimed that only the least valuable portion of the bran is thus rejected, but a study of these products made at this laboratory does not substantiate this claim.* The composition of these flours is precisely what might have been expected. Starch attracts moisture much more than the woody bran. Hence we find the graham flour, which is rich in bran with a correspondingly less amount of starch, drier than the other flours. The aleurone layer, which forms a portion of the bran as usually milled, is very rich in protein. Hence the protein content is greatest in the graham and least in the patent flour. The germ is rich in fat and mineral constituents. Its removal in the patent flour brings down the percentage amount of fat and ash. The oxidation of fat produces more heat than that of any other constituent. Hence the same causes that reduce the amount of fat in the flour lower the heat of combustion. As the protein, fat, and ash fall, the amount of the remaining solids, the carbohydrates, must rise.

In looking over the table of composition one is likely to be impressed with the marked difference between the rolled oats and the other cereals in the amount of fat which they contain. Although corn in the kernel carries about 4 per cent of fat, most of this is in the germ, which in the manufacture of hominy is almost wholly removed, thus reducing the fat to about one-fifth of the original amount. Too much importance should not be attached to this difference in fat content, however, since fats and carbohydrates perform nearly the same function in the animal body, although the fats represent more than double the energy furnished by the carbohydrates.

Since the oxidation of the fats in the body produces heat, oats are often spoken of as "heating" food and their use in warm weather is sometimes discouraged by physicians. This fact might deserve more serious consideration if this cereal made up a larger part of our diet. As a rule they are eaten but once a day. An average serving of cooked rolled oats would be about 160 grams (5½ ounces), seven-eighths of which is water. The equivalent 20 grams of uncooked oats, containing 7½ per cent of fat, would furnish 1½ grams fat, or about one-twentieth of

* Bul. 103, Maine Expt. Station, pp. 68-69.

an ounce. If one were to take daily the amount of oats mentioned (160 grams cooked, or 20 grams dry) he would consume in eight months nearly as much fat as would be furnished by one pound of butter. If it be true that oats are a heating food, the fact cannot be due merely to the excess of fat which they carry.

DIGESTIBILITY.

The analyses of cereal foods show them to be rich in the compounds which are essential to life. It is evident, however, that the composition of our foods is a matter of little importance unless they can be converted into soluble and assimilable forms—that is, unless they are digestible. The experience of unnumbered generations, unassisted by any knowledge of chemistry, has led to the selection of foods which are both rich and digestible. In this list of time-approved foods the cereal grains occupy a deservedly prominent position. It still remains for us to ask if, in the light which modern research can cast upon the subject, it is possible to make a profitable discrimination in our selection from the large and increasing list of cereal products.

The cereals are no exception to the general rule that most vegetable foods require more cooking than those of animal origin. This is in part due to the fact that the composition of the animal foods more nearly approximates that of our bodies and they consequently require less change to fit them for absorption and assimilation. On the other hand, the nutrients of our vegetable foods are for the most part enclosed in small cavities (cells) the walls of which consist of woody matter (cellulose) upon which the digestive juices of man have but little action. The cellulose, therefore, is not only of no value as a food for man, but it prevents the digestive fluids from attacking the cell contents. In the crushing, rolling or flaking processes to which many of these preparations have been subjected, these insoluble cell walls have been ruptured and the cell contents are thus exposed to the action of the digestive juices. It is probable that this mechanical change in the grain is fully as important as the chemical changes which accompany the necessary preliminary softening of the grain by steam. The cereal foods contain from 60 to 80 per cent of carbohydrates, most of which is in the form of starch. Raw starch, while a valuable food for our farm stock, is digested by man with extreme slowness. This seems to be due in part to the very thin covering, apparently of cellulose, with which each kernel of starch is invested. When subjected to high temperature the starch grains swell and burst, very much as a grain of corn "pops" under similar conditions. At the same time a portion of the starch—the amount varying with the temperature and the duration of the heating process—undergoes a chemical change. Whereas raw starch is practically insoluble in cold water, prolonged heat converts it into dextrin, a soluble carbohydrate into which all starch must be changed before it is transformed into a sugar, in which form only it can be absorbed.

The conversion of starch into a soluble form may be accomplished by other means. During the germination of the cereal grains the large amount of starch there stored up is converted into maltose, a soluble sugar, through the action of a ferment (diastase) which is there produced for this special purpose. The amount of the ferment formed is much more than is required to transform the starch of the barley itself. Advantage is taken of this fact in the use of malt, so extensively employed in breweries. This malt is produced by causing barley to sprout, the germinating process being checked when the amount of the ferment is greatest. If a quantity of malt be mixed with a cereal food under conditions favorable to the action of the ferment, a "malted" or predigested food results.

It would appear from the advertising matter that many manufacturers attach great importance to the conversion of the cereal starches into soluble forms. No attempt has been made in these laboratories to determine how far the efforts to accomplish this end have been successful. The matter has received attention elsewhere,* however, and the results are of interest. The table given below shows the amount of dextrin found by McGill in eight different cereal products.

Perfectly sound and untreated cereal grains contain practically no dextrin or maltose. Their presence in these foods is due to the action of heat or malt upon the starch. McGill found that the Ralston Breakfast Food (a rolled wheat) and rolled oats contained but small amounts of dextrin; while in Force and Grape-Nuts from one-fifth to one-third of the total starch had been dextrinized.

Relative percentages of starch and dextrin in certain cereal breakfast foods.

	Starch.	Dextrin.	Extent of dextrinization.
	%	%	%
Corn meal	69.5	....	....
Oat meal	63.8	....	....
Rolled oats	60.5	3.6	5.6
Ralston breakfast food	67.9	2.6	3.7
Malt breakfast food	71.7	3.2	4.3
Malta vita	62.4	9.3	13.0
Force	55.4	14.5	20.7
Grape nuts	49.5	24.9	33.5

*A. McGill, Bul. 84, Laboratory Internal Revenue Department, Ottawa, Canada.

How far is the value of these foods proportional to the solubility of the carbohydrates which they contain? This is a difficult question to answer, since the operations that bring about the desired mechanical changes in the starch at the same time induce chemical changes. It is safe to say that the average person in good health is able to digest starches in which there has been but little dextrinization, provided the starch grains have undergone the exfoliation or "popping" previously alluded to. The figures just quoted reveal the presence of but little dextrin in the ordinary rolled wheat or rolled oats as purchased. In the cooking to which they are afterward subjected dextrin is produced in much larger quantities. We may conclude, therefore, that the dextrinization of these goods by the manufacturers is in itself of little importance, so far as the digestibility of the food is concerned, unless the preparations are to be eaten without further cooking.

There is no evidence that maltose as a food is of any more value than dextrin. So far as the writer is aware, the amount of this sugar in the malted foods has never been determined. It is probably not large, since the long continued action of the ferment by which it is formed would produce undesirable flavors.

The housewife finds a material gain in time in the use of cooked or partially cooked cereals. Do these preparations possess any advantage other than those already mentioned over the raw goods? In other words, if the purchaser obtains the uncooked cereals and devotes the necessary care and time to their preparation, does not the final product possess all the virtues of the prepared goods?

This, too, is a difficult question to answer, inasmuch as the opportunities for comparison are few. There are very few cereal breakfast foods now on the market that have not been subjected to some cooking process. Steaming, which results in a partial cooking, is a necessary preliminary to the rolling to which so many of our cereal foods have been subjected. Indeed, with the single exception of hominy, there is scarcely a wholly uncooked cereal breakfast food to be found upon the market. Out of 28 oat preparations examined at this station, only three were entirely raw, and one of these was an imported article. So far as relates to the difference between the old fashioned, wholly uncooked wheat and oat meals and the modern rolled articles, it may safely be stated that the important difference is mechanical rather than chemical.

During the past few years a series of experiments have been carried out at the experiment stations of Minnesota, Connecticut (Storrs), and Maine, for the purpose of determining the digestibility of certain cereal foods. In some of these experiments the food consisted exclusively of cereal foods, cream and sugar; in other cases the cereals were used with a mixed diet, including bread and meat, but in which the cereal still played a very important part. Since the digestibility of cream and sugar have been quite accurately determined, it is possible, where the simpler diet is used, to calculate the digestibility of the cereal alone with a considerable degree of accuracy.

The details of these experiments will be found elsewhere, but the general results of those obtained at this Station are given in the table below. This shows the digestibility of the organic matter of the food—i. e., the dry matter of the food less the ash or mineral constituents; the digestibility of the protein, one of the most important classes of the necessary constituents of our food; and the percentage of the heat of combustion utilized by the body.

Digestibility of cereal breakfast foods as determined by digestion experiments.

Diet.	Number of experiments.	Total organic matter.	Protein.	Heat of combustion.
		Per cent.	Per cent.	Per cent.
Rolled oats with a mixed diet	17	96.2	90.1	95.3
with a simple diet	16	95.4	84.7	94.2
alone	16	92.3	78.4	89.8
Rolled wheat with a mixed diet	3	96.2	93.2	95.3
with a simple diet	3	95.2	91.6	94.6
alone	3	92.4	85.0	90.7
Force with a mixed diet	3	95.7	92.7	95.2
with a simple diet	3	94.6	89.6	91.1
alone	3	90.4	76.1	88.3
Grape-Nuts with a mixed diet	3	96.6	92.8	95.6
with a simple diet	3	94.0	87.6	93.1
alone	3	91.7	76.1	89.4
Shredded Whole Wheat with a mixed diet	3	95.5	92.1	94.5
with a simple diet	3	92.8	84.1	91.4
alone	3	87.7	57.7	84.1
Hecker's Hominy with a mixed diet	4	97.1	88.9	96.3
with a simple diet	4	97.3	83.6	96.4
alone	4	–	74.5	94.4
Granulated corn meal, mixed diet	2	97.2	89.0	96.9
with a simple diet	4	97.2	82.3	95.9
alone	4	–	73.2	93.1

An inspection of the table shows that where the cereals were used with a mixed diet, they had but little apparent effect upon the digestibility of the total food. As regards the digestibility of the total organic matter, the corn products made a very favorable showing. At the same time a larger proportion of the energy of the food was utilized by the body than where the wheat and oat products were used. On the other hand, the use of the corn foods seemed to depress the digestibility of the protein of the total food.

When the simple diet was used, the corn products again made a favorable showing as regards both total organic matter and energy, least favorable of all, however, in digestibility of protein. If we value these foods in proportion to the digestibility of their protein when used with a mixed diet, we must place rolled wheat first and the corn products last. When the digestibility of the cereals alone is calculated, more striking results are obtained. It will be noticed that the rolled wheat now ranks first, not only in the digestibility of the total organic matter, but also with respect to the protein. The rolled oats rank next, and the corn preparations and shredded wheat the lowest of all.

One of the most noticeable differences in these cereal foods is found in the digestibility of the protein when the cereal is eaten with a simple diet. This difference is most marked in the various wheat products, especially when the results are calculated to the cereal alone. Thus, while the protein of rolled wheat is 85 per cent digestible, that of Force and Grape-Nuts is 76.1 per cent, and that of Shredded Whole Wheat only 57.7 per cent.

It is not claimed that the results given in the table for the cereal alone exactly represent the proportion of these foods which becomes available to the body when they are eaten under ordinary conditions. No one subsists on these cereals alone, and the conditions are therefore abnormal and the results exaggerated. It is fair to assume—and the assumption is quite in accordance with the results of other experiments recorded elsewhere—that most articles of food are more fully digested when eaten with a mixed diet than when eaten alone. On the other hand, there can be no doubt that these figures correctly indicate the *relative* digestibility of the foods studied. The brands named were chosen for these experiments merely because they were well known articles and representative of the groups indicated.

McGill found (see table, p. 125) that the rolled wheat which he examined contained only 2.6 per cent dextrin, while Force and Grape-Nuts contained 14.5 and 24.9 per cent respectively. These facts suggest that the processes to which these latter products have been submitted to render the starch soluble have at the same time diminished the digestibility of the protein.

This conclusion seems to be confirmed by Snyder in a study upon the comparative digestibility of bread and toast.* He found that the toasting of bread "changes the form and solubility of the nutrients, particularly of the carbohydrates, to a much greater extent than it does the percentage amounts. Dur-

* Minnesota Expt. Station, Bul. 74, p. 166.

ing the toasting process, a portion of the starch was changed to dextrin, a soluble carbohydrate. The proteid compounds also suffered changes in composition, but opposite in character from the carbohydrates; tests showed that the proteids were rendered less soluble, while the carbohydrates were rendered more soluble."

Further confirmation is found in the work of Colby of the California Experiment Station upon toasted bread. He found that "brown toast made at 170° shows a sudden large increase of soluble matter, more than doubling that obtained at 150°. But there is at the same time a notable decrease in the amount of soluble nitrogenous matter as compared with the extract from the raw bread."*

While differences in the treatment may account for variations in the digestibility of the protein of the wheat products, it throws no light upon the difference noticed in the digestibility of the proteids of the various grains. These may be due to intrinsic differences in the nature of the proteids themselves.

Gudeman† found that the raw cereals, if sufficiently cooked, were as quickly digested as the best malted cereals, more quickly than the prepared cereals and a large majority of the so-called malted cereals.

CLAIMS OF MANUFACTURERS.

The claims made for some of the cereal foods are so absurd that any mention of them seems almost superfluous. It may be said in general that there is but little waste or indigestible matter in the decorticated kernel of our cereal grains. Beyond the removal of the outer coatings and the expulsion of a possible excess of water, little or nothing can be done to condense them. There is no mysterious alchemy known to millers whereby the cereal grains may acquire the marvelous nutritive qualities ascribed to many of them. The various methods by which they are prepared may render the starch more soluble or convert it into other and more soluble forms. Whether at the same time the foods gain in digestibility is another question which has been already discussed.

* California Expt. Station, Rept. 1901-3, p. 101.

† Journal Am. Chem. Soc., 26 (1904), p. 323.

The advocates of these foods lay much stress upon the large amount of mineral constituents (ash) which they are said to contain, and which are so largely lacking in white flour. Phosphorus is formed in the brain and other tissues; phosphorus and lime are especially abundant in the bones; iron occurs in the hemoglobin of the blood. These elements are much more abundant in the seed coverings and in the germ of the cereal grains than in the endosperm. The oat and wheat breakfast foods contain from 1½ to 2 per cent of ash constituents, graham flour carries an equally large amount, while patent flour contains only about one-half of one per cent. Hence it is said that we should eat the coarser flours; or, if we persist in eating bread of patent flour, we should supplement our diet by the use of cereal breakfast foods.

If there is any force in this argument, it lies in these two assumptions: First, that white flour as now milled no longer contains enough ash constituents to satisfy the needs of the body. Second, that bread flour and the cereal breakfast foods are the only sources from which the body may derive mineral matters. In point of fact, an average diet, even though it does not include coarse flour and cereal breakfast foods, probably carries the mineral salts in quantities largely in excess of our needs.

While the modern methods of milling cereal breakfast foods have changed the mechanical condition of the cereal, and in many cases the form of the carbohydrates as well, yet the actual nutritive value is for the most part a characteristic of the cereal itself, and is changed but little by its method of preparation. Comparisons made by the Storrs Experiment Station* showed that the average of 26 analyses of several different brands of rolled oats was almost exactly the same as that of 18 analyses of old fashioned oatmeal.

It has been claimed that cooked or partially cooked cereals possess superior keeping qualities. If this be true, it is probably due to the sterilizing effect of the heat employed in their preparation and the greater dryness of the product.

*Storrs (Conn.) Expt. Station, 16th Annual Report (1904), p. 122.

COST.

Although these foods differ greatly in composition, we find an even greater difference in cost. Of the rolled oats examined, the prices range from 4 to 7.8 cents per pound. The rolled and partially cooked wheats range from 4 to 9.8 cents. But it is in the malted and otherwise "predigested" foods that we find the widest variation, the price running in one instance to 27.2 cents per pound, and in other cases from 13 to 22 cents.

Some of the standard preparations of rolled oats and wheat, of known excellence, may be obtained in bulk. When purchased from reliable dealers who are handling large quantities and whose stock is consequently frequently renewed, such goods are not only fresh, but, next to white flour, they are among our most economical foods. These cereals may often be purchased at 4 cents a pound, or even at a less rate. The same goods put up in pasteboard cartons retail for 2 or 3 cents more per pound.

The investigations made at this station have thus far failed to discover any fixed relation between price and nutritive value. It is only fair to add, however, that, whatever the relative food values of malted and unmalted foods, the cost of the former to the manufacturer is greater, and the increased price is to this extent justified. The following table gives the cost of wheat, oats, and corn breakfast foods purchased in packages, excluding the uncooked and malted oat and wheat foods.

Maximum, minimum and average cost per pound of wheat, oat, and corn breakfast foods purchased in packages.

Number of samples.	Kind of cereal.	Price per Pound.		
		Maximum—cents.	Minimum—cents.	Average—cents.
24	Wheat	11.4	4.9	7.8
17	Oats	7.8	4.1	6.0
10	Corn *	9.2	4.1	5.5

* Including only the hominies.

RELATIVE ECONOMY.

To find the relative economy of these goods, their cost should be considered in connection with their composition. By means of the data given in the tables on pages 121 and 132 it is easy to calculate the amount of nutrients which can be purchased for a given sum in any of these goods. This is done in the table below.

Pounds of nutrients and number of calories to be purchased for one dollar at the average price per pound.

	Average cost per pound.	Number of pounds for one dollar.	Pounds of Nutrients to be Purchased for One Dollar.				Heat of combustion.
			Protein.	Fat.	Carbo-hydrates.	Ash.	
	Cents		lbs.	lbs.	lbs.	lbs.	Cal.
Rolled Wheat	7.8	12.8	1.54	.24	9.57	.18	40.3
Rolled Oats	6.0	16.7	2.79	.90	11.64	.30	72.0
Hominy	5.5	18.2	1.56	.13	14.50	.05	70.2
Patent flour	3.5	28.6	3.98	.40	20.82	.14	113.2

At the prices given, flour is by far the most economical of the above named foods. It should be remembered, however, that few articles of food can compare with white flour in this respect. When it is possible to purchase rolled oats and wheat in bulk at prices scarcely exceeding one-half those given above, it will be found that they compare very favorably with flour as far as price is concerned, and present the double advantage of variety and ease of preparation. The latter consideration is one that should not be lost sight of. When it is found necessary to maintain a fire for the sole purpose of cooking food, the cost of preparation is largely increased and the consumer can readily afford to pay a reasonably higher price for goods the use of which will lighten his labors or effect a saving of fuel.

COOKING.

Too much cannot be said in favor of thorough cooking. The hominies and old fashioned oatmeals should be cooked an hour at least. It is asserted that some of the rolled products may be thoroughly prepared in from 10 to 20 minutes. In most cases it will be found advisable to use more time. Snyder attributes the difficulty in digesting imperfectly cooked oatmeal to "the large amounts of glutinous material which surround the starch grains and prevent their disintegration. When thoroughly cooked, the protecting action of the mucilagenous proteid material is overcome, and the compound starch granules are sufficiently disintegrated to allow the digestion juices to act."* The increased digestibility of fully cooked cereals he believes to be due largely to a physical change in the carbohydrates which renders them more susceptible to the action of the digestive solvents. In the digestion experiments carried on in the laboratories of this Station, the rolled oats and wheats were cooked 45 minutes in double boilers.

SUMMARY.

In selecting a cereal breakfast food the consumer may be guided by the claims of the manufacturers; by the chemical composition, as ascertained by a disinterested chemist; by the digestibility as determined by experimentation; by cost; by taste; by economy; or by their observed effect upon the individual.

Claims.—The claims printed upon the outside of the package are unfortunately not always to be relied upon. In some instances there can be but little doubt that they are intended to deceive the purchaser. In other cases the claims made are so reckless as to lead to a suspicion that their author was not familiar with the terms employed. Such claims are less harmful because less likely to deceive. The consumer has no difficulty in detecting the falsity of many of the statements made, and should be cautious in accepting those which appear too extraordinary.

Chemical Composition.—The chemical composition furnishes a more reliable guide, but should be considered in connection with digestibility and cost. Too much reliance should not be

* Minnesota Expt. Station, Bul. 74, p. 153.

placed upon a single analysis, since wide variations have been observed in the composition of two or more samples of the same brand. The differences in composition between foods of the three common cereals, wheat, oats and corn, are sufficiently constant and furnish reliable evidence.

Digestibility.—Digestibility is of no less importance than composition. In the digestion experiments made upon human subjects the rolled wheat seemed to be somewhat more digestible than the rolled oats, and so far as relates to protein, the most valuable constituents, both rolled oats and rolled wheat are superior to corn. The attempt to increase the digestibility of starch seems to have had a contrary effect upon the protein.

Cost.—The corn products are the cheapest of these foods, the hominies examined costing on the average 5½ cents a pound. The rolled oats cost on the average 6 cents and the rolled and granulated wheats (partially cooked preparations) 7¾ cents.

Taste.—A food should never be selected by taste alone, since a very inferior article may be so disguised as to prove acceptable to the palate. At the same time, palatability is a quality which should not be overlooked, since it seems to have some effect upon digestibility and also upon the amount eaten. It seems especially desirable that such foods as experience and a mature judgment have shown to be most fitting should appeal directly to the palate of the child. With the great variety of products now available, there should be little difficulty in finding a food which should be at once palatable, nutritious, and digestible.

Economy.—Economy in the use of a cereal food involves a consideration of several qualities. It by no means follows that the cheapest food is the most economical. The best food is that which for a given sum supplies the largest amount of digestible nutrients in a palatable form.

Individual Peculiarities.—Except in a very general way it is impossible to predict the choice of these foods to be made by the individual, or the effects of their use. Individual tastes are exceedingly capricious. In a family of four the writer has recently found three cereal foods served at the same meal. Cases frequently arise in which it is found necessary to discontinue the use of a food which has proved palatable. A food which disagrees with the consumer is not cheap at any price.

FOOD INSPECTION.

CHAS. D. WOODS, Director.

L. H. MERRILL, Chemist in charge of food analysis.

The law regulating the sale and analysis of foods, enacted by the legislature of Maine in 1905, apparently contemplates two things; the proper and truthful branding of all articles of food, and the exclusion from the markets of deleterious food materials. The law does not seek to prevent the sale of any article of wholesome food, but in case a food material is other than it appears to be, it "shall be plainly labeled, branded or tagged so as to show the exact character thereof." Bulletin 116 of this Station contains the full text of the law and food standards so far as they have been fixed for Maine. Copies of this bulletin may be had on application to the Station.

BAKING POWDERS.

As baking powders are the only food material mentioned by name in the law, it was decided to include them in the first trip of the inspector in order to see in how far the powders offered for sale in the State conformed to the requirements of the law, which demands that such powders "shall be plainly labeled so as to show the acid salt or salts contained therein." As is pointed out on page 139 beyond, all three classes of baking powder leave objectionable residues in the resulting breads, and there is great dispute as to which are the least objectionable. The food law of this State does not attempt to in any way answer the question as to which is best. They are all put on the same footing of correctly stating the source of the acid constituent. A baking powder is adulterated under the law only when the label does not truthfully name the kind of acid salt it contains; when it is falsely labeled in any particular; when it contains useless, inert foreign matter, mineral or otherwise.

There are practically three classes of baking powders on the market, differing chiefly in the source of the acid.

Tartrate powders, in which the acid is either cream of tartar (bi-tartrate of soda) or tartaric acid.

Phosphate powders, in which calcium or sodium acid phosphate is the acid constituent.

Alum powders, in which the acid constituent is the sulphate of aluminum as it occurs in the various alums.

There are of course many complex baking powders on the market which are made up of mixtures of two or more of the three classes above named. Of these mixtures, phosphate-alum powders are the most common. Indeed, phosphate-alum powders are far more common than straight alum powders.

Whether the acid principle be tartaric acid, calcium phosphate or aluminum sulphate, there is always a residual product which is undesirable as a food.* Cream of tartar powders leave a residue of Rochelle salt, the active principle of Seidlitz powders; tartaric acid powders leave a residue of sodium tartrate; phosphate powders leave a residue of sodium and calcium phosphates; and alum powders leave a residue of ammonium, potassium or sodium sulphate, in accordance with the kind of alum used. The residues of the phosphate-alum powders differ somewhat from those of either alum or phosphate powders and vary with the proportion of the different acid constituents used. When the ingredients are properly proportioned in the baking powder, neither alum or alum phosphate powders leave any considerable amount of alum in the resulting bread or cake.

The per cent of available carbonic acid gas furnished by the different classes of baking powders is, according to Wiley,† as follows:

Cream of tartar baking powder, 12 per cent available carbonic acid gas.

Phosphate baking powder, 13.0 per cent available carbonic acid gas.

Alum baking powder, 8.1 per cent available carbonic acid gas.

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* Many people seem to believe that the chemicals used in baking powders completely or nearly completely disappear. Cream of tartar baking powders belong to one of the best classes and yet, according to Wiley, the amount of Rochelle salt formed as a residue from a teaspoonful and a half of a cream of tartar baking powder equals that of one Seidlitz powder.

† The figures are quoted from Bul. 13 of Div. of Chemistry, U. S. Dept. of Agr.

Phosphate-alum powder, 10.4 per cent available carbonic gas.

The alum powders would require a half more than the tartrate or phosphate powders to produce the same leavening effect. There are however very few straight alum powders on the market. Because of the greater leavening effect of the mixed powders and the supposed less harmful residues, nearly all the alum now used is in the phosphate-alum powders.

The samples here collected and reported upon have not been tested for strength, but merely for correctness of labeling. Many of the less common brands were found by correspondence with the manufacturers to be three or more years old. Naturally such powders would not be nearly as effective as leavening agents as when they were fresher. As soon as it is possible to do so with the limited funds at our disposal, new samples will be tested for strength. The manufacturers so far as heard from are ready and anxious to conform to the law. The makers of mixed powders are apparently as desirous of selling their goods on what they claim to be their merits as are the makers of tartrate or phosphate powders.

The list of the brands collected and comments follow.

CREAM OF TARTAR AND TARTARIC ACID POWDERS.

7009. *Cleveland Superior Baking Powder,* made by Cleveland Baking Powder Co., N. Y. Purchased from A. A. Gilbert, Orono, March, 1905. In tin can. Price per can 25 cents. Cost of powder 3.1 cents per ounce. "A pure cream of tartar powder." "Free from alum, ammonia, lime or other adulterant." The acid salt is correctly named.

7012. *Cream Baking Powder,* made by Price Baking Powder Company, New York and Chicago. Purchased from W. L. Wilson & Co., Portland, April, 1905. In tin. Price per can 30 cents. Cost per ounce 1.8 cents. "A pure cream of tartar powder." "Free from aluminum, ammonia, lime or any other adulterant." The acid salt is correctly named.

7017. *Mrs. Lincoln's Baking Powder,* made by Mrs. Lincoln Baking Powder Company, Boston, Mass. Purchased from F. E. Plummer, Portland, April, 1905. In tin. Price per can 15 cents. Cost per ounce, 4 cents. The label states it to be a cream of tartar baking powder. The acid salt is correctly named.

7033. *Plume Baking Powder,* made by Plume Baking Powder Co., Malden, Mass. Purchased from Andrews & Harrigan, Biddeford, April, 1905. In tin. Price per can 40 cents. Cost per ounce 2.5 cents. The label states that it is a cream of tartar and tartaric acid powder. The acid salt is correctly named.

7022. *Royal Baking Powder,* made by Royal Baking Powder Company, New Jersey. Purchased from J. C. Norton & Co., Bangor, April, 1905. In tin. Price per can 25 cents. Cost per ounce 3.1 cents. The label states it to be a cream of tartar and tartaric acid powder. The acid salt is correctly named.

7021. *Schilling's Best Baking Powder,* made by A. Schilling & Co., San Francisco, Calif. Purchased from Morrill and Ross, Portland, April, 1905. In tin. Price per can 25 cents. Cost per ounce 1.8 cents. The acid salt was not named on the label. The company state that these were old goods and that all goods now sent out are labeled cream of tartar baking powder. The acid salt is as claimed.

7020. *Shaw's Baking Powder,* Geo. C. Shaw and Co., Portland. Purchased from Geo. C. Shaw & Co., Portland, April, 1905. In tin. Price per can 43 cents. Cost per ounce 2.6 cents. The package bears two certificates of analyses which state it to be a cream of tartar baking powder. The acid salt is correctly named.

7011. *Slade's Congress Yeast Powder,* made by D. & L. Slade Co., Boston, Mass. Purchased from W. L. Wilson and Co., Portland, April, 1905. In tin. Price per can 35 cents. Cost per ounce 2.1 cents. "Cream of tartar baking powder." The acid salt is correctly named.

7023. *Solar Baking Powder,* made by Fidelity Manufacturing Co., N. Y. Purchased from A. A. Gilbert, Orono, April, 1905. In tin. Price per can 25 cents. Cost per ounce 2.6 cents. "Made of absolutely pure cream of tartar." The acid salt is correctly named.

7024. *Wilde's Baking Powder,* made by Samuel Wilde & Sons, N. Y. Purchased from A. A. Gilbert, Orono, April, 1905. In tin. Price per can 50 cents. Cost per ounce 2.6 cents. No statement on label as to nature of acid salt, and the company when written to did not reply. It is a cream of tartar powder.

PHOSPHATE POWDERS.

7010. *Boston Baking Powder,* made by Boston Baking Powder Co., Boston, Mass. Purchased from W. L. Wilson & Co., Portland, April, 1905. In tin. Price per can 10 cents. Cost per ounce 1.3 cents. The label did not state the nature of the acid salt. The company write that all goods hereafter sent into the State will bear their formula. It is a straight phosphate powder.

7015. *Horsford's Self Raising Bread Preparation,* made by Rumford Chemical Works, Providence, R. I. Purchased from W. L. Wilson & Co., Portland, April, 1905. In paper. Price per package 20 cents. Cost per ounce 1.7 cents. The label states that it is a phosphate powder. The acid salt is correctly named.

7008. *Rumford Baking Powder,* made by Rumford Chemical Works, Providence, R. I. Purchased from A. A. Gilbert, Orono, March, 1905. In tin. Price per can 25 cents. Cost per ounce 3.1 cents. "A strictly pure phosphate powder." The acid salt is correctly named.

ALUM POWDER.

7031. *J. C. Grant's Bon Bon Baking Powder,* made by J. C. Grant Chemical Co., East St. Louis, Ill. Purchased from John F. Hannaway, Biddeford, April, 1905. In tin. Price per can 10 cents. Cost per ounce .7 cents. The label states that the powder is made from "double sulphate of sodium and aluminum." The claim that it is an alum powder is correct.

PHOSPHATE-ALUM POWDERS.

7030. *Biskit Baking Powder,* made by Biskit Baking Powder Company, Boston, Mass. Purchased from J. L. Sullivan and Sons, Biddeford, April, 1905. In tin. Price per can 10 cents. Cost per ounce 2.5 cents. The label states that the powder contains calcium phosphate and alumina sulphate. The acid salts are correctly named.

7013. *Davis O. K. Baking Powder,* made by R. B. Davis, New York, and Hoboken, N. J. Purchased from F. E. Plummer, Portland, April, 1905. In tin. Price per can 20 cents. Cost per ounce 2.6 cents. The label on this can did not state the acid salt. On the labels now used this powder is stated to contain acid phosphate and sodium aluminic sulphate. The acid salts are correctly named on the new label.

7034. *Diamond Baking Powder,* made by J. Smith Brockway & Co., Boston. Purchased from S. L. Somerville, Houlton, April, 1905. In tin. Price per can 50 cents. Cost per ounce 3.2 cents. The label did not state the nature of the acid salt. The labels now used state that the powder contains phosphate and basic alumina sulphate. The acid salts are correctly named on the new label.

7014. *Grand Union Tea Company Baking Powder,* made by the Grand Union Tea Company, Brooklyn, N. Y. Purchased from the Grand Union Tea Company, Portland, April, 1905. In tin. Price per can 50 cents. Cost per ounce 2.8 cents. The label did not state the nature of the acid salts. The label now in use states that the powder contains acid phosphate and calcined aluminum sulphate. The acid salts are correctly named on the new label.

7016. *I. C. Baking Powder,* made by Jacques Manufacturing Company, Chicago, New York and Kansas City. Purchased from Morrill and Ross, Portland, April, 1905. In tin. Price per can 25 cents. Cost per ounce 0.9 cents. The label did not state the acid salt. The label now used states that the powder contains calcium acid phosphate and basic aluminum sulphate. The acid salts are correctly named on the new label.

7032. *Pilgrim Baking Powder,* made by Pilgrim Baking Powder Co., Boston, Mass. Obtained from Murphy Bros., Biddeford, April, 1905. In tin. Price not given. The Pilgrim Baking Powder is no longer made. The Puritan Baking Powder Company are their successors and make an alum-phosphate powder. The label on this powder states that it contains acid phosphate and basic alumina sulphate.

7019. *Reliable Baking Powder,* put up for Boston Tea and Butter Co., Portland. Purchased from Boston Tea and Butter Co., Portland, April, 1905. In tin. Price per can 25 cents. Cost per ounce 2.8 cents. The label did not state the nature of the acid salt. The company write that all goods hereafter will be labeled in accordance with the requirements of the law. It is an acid phosphate and alum powder.

TARTRATE-PHOSPHATE POWDERS.

7018. *Purity Baking Powder,* made by Purity Baking Powder Company, Boston. Purchased from Boston Tea and Butter Store, Portland, April, 1905. In tin. Price per can 30 cents. Cost per ounce 1.7 cents. The label states that the powder contains cream of tartar and phosphate of calcium. The acid salts are correctly named.

7035. *The Pure Baking Powder,* made by the Pure Baking Powder Company, Albany, N. Y. Purchased from Fisher and Crocker, Bangor, April, 1905. In tin. Price per can 10 cents. Cost per ounce 3.2 cents. The label states it to be a pure cream of tartar baking powder. This is false as it also contains acid phosphate.

TARTRATE-ALUM-ACID-PHOSPHATE POWDER.

7238. *Superb Baking Powder,* made by Hudson Valley Preserving Co., Glens Falls, N. Y. Purchased from W. J. Elbridge, Foxcroft. In tin. Price per can 8 cents. Cost per ounce 2 cents. "An absolutely pure compound being wholly composed of chemically pure cream of tartar and bicarbonate of soda with the addition of a little starch or flour." The label is false in that while the powder contains some tartaric acid it also carries alum and acid phosphate.

VINEGARS.

When alcohol is placed under favorable conditions it takes up oxygen from the air and is converted into acetic acid,—the acid that gives the sour taste to vinegar. Whatever the source of the vinegar, and however it is made, the acetic acid is the same.

When a fruit juice, such as cider, is allowed to ferment, its sugar is changed into alcohol by natural yeast-like ferments that are in the juices. Under the influence of another organism that is always present in old vinegar and in "mother of vinegar," this alcohol is changed into acetic acid. In the old process of vinegar making, which is still followed by many farmers, the apple cider is put into barrels with open bungs and kept in a warm cellar or other suitable place until both the alcoholic and acetic fermentations have taken place. This is a slow process and two or three years are needed to complete it. The addition of old vinegar or mother of vinegar hastens the process somewhat. While some vinegar is still made in this way, the quick process, used first for malt and distilled vinegars, is now generally employed by manufacturers of cider vinegar. In this process the fermented cider or other alcoholic solution is made to pass slowly through beech shavings which have been previously saturated with old vinegar, and at the same time a current of air is forced through the shavings. The shavings are used to increase the surface exposed to the air. Beech is commonly employed because it is an odorless and tasteless wood. Under proper conditions two or three days are sufficient to complete the process.

Besides acetic acid, vinegar always contains more or less of other substances which vary widely with the source from which the vinegar was made. It is because of these foreign matters, characteristic of vinegar of the same kind, that it is possible for the chemist to quite readily distinguish one variety of vinegar from another. The sour taste of a vinegar is due to its acetic acid, the other flavors are due to foreign matters in solution. The standards which have been adopted take these other foreign matters into account.

The following standards for vinegars were adopted and published as directed by law in May, 1905.

VINEGAR STANDARDS OF MAINE.

1. *Vinegar, cider vinegar,* or *apple vinegar* is the product made by the alcoholic and subsequent acetous fermentations of the juice of apples, is lævo-rotatory, and contains not less than four (4) grams of acetic acid, not less than one and six-tenths (1.6) grams of apple solids, and not less than twenty-five hundredths (0.25) gram of apple ash in one hundred (100) cubic centimeters. The water-soluble ash from one hundred (100) cubic centimeters of the vinegar requires not less than thirty (30) cubic centimeters of decinormal acid to neutralize the acidity and contains not less than ten (10) milligrams of phosphoric acid (P_2O_5).

2. *Wine vinegar* or *grape vinegar* is the product made by the alcoholic and subsequent acetous fermentations of the juice of grapes and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid, not less than one and

four-tenths (1.4) grams of grape solids, and not less than thirteen hundredths (0.13) gram of grape ash.

3. *Malt vinegar* is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt or cereals whose starch has been converted by malt, and is dextro-rotatory and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid, not less than two (2) grams of solids, and not less than two-tenths (0.2) gram of ash. The water-soluble ash from one hundred (100) cubic centimeters of the vinegar requires not less than four (4) cubic centimeters of decinormal acid to neutralize its alkalinity and contains not less than nine (9) milligrams of phosphoric acid (P_2O_5).

4. *Sugar vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of a sugar, sirup, molasses, or refiners' sirup, and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

5. *Glucose vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of starch sugar, glucose, or glucose sirup, is dextro-rotatory, and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

6. *Spirit vinegar, distilled vinegar, grain vinegar* is the product made by the acetous fermentations of dilute distilled alcohol and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

INTERPRETATION OF THE LAW.

While there have been no court decisions in Maine, the executive officer will, until he is better informed, be guided by the following statements in the enforcement of the law concerning vinegar.

The standards above named, adopted under section 5 of the law, are part of the pure food law.

The word vinegar, as defined in section 1 of the standards, unless otherwise qualified, always means cider vinegar. To sell anything else than cider vinegar when vinegar is asked for, is prohibited by the law.

No vinegar whether cider or otherwise, carrying less than 4 per cent of acetic acid, can legally be sold unless the per cent of acid is stated on the package.

The use of the trade term "white wine vinegar" defined in section 2 of the standards is an adulteration unless the vinegar thus designated is made from grapes. The vinegars commonly called white wine vinegars should be labeled white vinegar, distilled; pickling vinegar, distilled; spirit vinegar; grain vinegar; or some such term that clearly states the nature of the goods.

Distilled vinegars colored so as to resemble cider vinegar must carry a statement showing that they are colored. In case caramel (burnt sugar) is the coloring matter, the exact nature of the coloring matter need not be stated. Thus "distilled vinegar, colored" would come within the requirements of the law.

In case a dealer furnishes a customer with vinegar other than cider vinegar, or one that carries less than 4 per cent acetic acid, he must so notify the purchaser. Failure to do so is a violation of the law, and bills therefor are uncollectable (section 8 of law).

RESULT OF THE INSPECTION.

Samples of vinegar were taken from the stock of retail dealers in several cities and large towns in the State in the months of May and August, 1905. These vinegars were examined for total acidity, volatile acids, total solids and ash. The nature of the solids and ash were not studied, except in a few special instances. For this reason it may be that an occasional sample of vinegar has been passed as a straight cider vinegar when it was adulterated. Ordinary adulterations would be detected by the methods employed by us. A skillful adulteration might have escaped detection.

It is gratifying to note that while there were low grade imitation vinegars on the market, no harmful ingredients were found. The fraud in every case was upon the pocket-book rather than upon the health of the consumer.

It is likewise gratifying that the makers and handlers of vinegar in the State are in apparent sympathy with the purpose of the law and desire to meet its requirements.

The results of the analyses are given in the table which follows.

Description and results of analyses of samples of different kinds of vinegars collected in Maine in the spring and fall of 1905.

Number.	Description*. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
	CIDER VINEGARS.	cts.	%	%	%	%
7059	A. H. Black, West Sidney. W. P. Stewart & Co., Waterville, April, 1905	25	5.86	5.74	1.76	.40
7289	A. H. Black, West Sidney. Edson Locke, Augusta, August, 1905	25	4.75	4.70	1.83	.38
7295	A. H. Black, West Sidney. G. E. Barrows, Waterville, August, 1905	25	4.53	4.37	1.85	.39
7261	Eastern Tea & Grocery Co., Bath, August, 1905. The barrel was labeled "pure cider vinegar" but did not carry the name of the maker. It appears to be a dilute cider vinegar, such as would result from adding a third or more water to a good vinegar	20	3.03	2.96	.82	.31
7046	John Cassidy Co., Bangor. S. H. Robinson & Son, Bangor, April, 1905	20	3.93	3.86	1.95	.30
7242	John Cassidy Co., Bangor. Robert Hickson & Son, Bangor, August, 1905	20	4.28	4.15	2.23	.43
7244	John Cassidy Co., Bangor. R. B. Blair, Brewer, August, 1905	25	4.35	4.20	2.28	.43
7271	E. Clifford & Co., Portland. Nealley & Miller, Lewiston, August, 1905	20	3.88	3.78	1.98	.34
7036	Chas. F. Dearth, Foxcroft. Fred T. Hall & Co., Bangor, April, 1905	30	6.05	5.82	2.74	.32
7042	Chas. F. Dearth, Foxcroft. J. C. Norton & Co., Bangor, April, 1905	25	5.88	5.73	2.80	.33
7053	Chas. F. Dearth, Foxcroft. W. S. Hamm, Foxcroft, April, 1905	20	5.67	5.52	2.68	.34
7247	Chas. F. Dearth, Foxcroft. Harlow Bros., Brewer, August, 1905	25	4.88	4.74	1.87	.32
7074	A. B. Donald. A. P. Conant & Co., Lewiston, April, 1905. Probably a pure cider vinegar, though rather poorly made	20	3.64	3.60	2.89	.48
7281	J. B. Donald, Portland. G. E. Whitehouse, Brunswick, August, 1905	20	4.43	4.16	3.18	.29
7047	Duffy Cider Co., Rochester, N. Y. F. H. Drummond, Bangor, May, 1905	25	4.10	4.00	2.21	.31
7293	Duffy Cider Co., Rochester, N. Y. Percival Bros., Augusta, August, 1905	25	4.00	3.94	2.30	.35
7055	E. G. Flanders, Sangerville. Warren & Dyer, Dover, May, 1905. Probably a poorly made straight cider vinegar	18	3.47	3.20	3.69	.35

* When two names are given, the first is that of the manufacturer. The date is that of taking the sample

Descriptions and analyses of vinegars collected in 1905.

Number.	Description. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
		cts.	%	%	%	%
7277	Fuller & Holmes Co., Augusta. Webber & Hewett, Augusta, August, 1905. Probably a rather poorly made cider vinegar........	25	3.39	3.36	1.71	.34
7041	"Gold Medal." Haynes-Piper Co., Boston. J. C. Norton & Co., Bangor, May, 1905..................	25	4.98	4.98	2.35	.36
7241	Holly Mills, Genesee Fruit Co., Holly, N. Y. Gallagher Bros., Bangor, August, 1905	25	4.22	4.04	3.41	.47
7037	H. J. Heinz Co., Pittsburg, Pa. James H. Snow & Co., Bangor, May, 1905.............	25	5.18	5.13	2.37	.3[illegible]
7256	H. J. Heinz Co., Pittsburg, Pa. J. H. Snow & Co., Bangor, August, 1905................	25	5.08	5.00	2.45	.42
7257	H. J. Heinz Co., Pittsburg, Pa. Walter S. Russell, Bath, August, 1905..................	25	5.40	5.38	2.35	.36
7282	H. J. Heinz Co., Pittsburg, Pa. H. T. Mason, Brunswick, August, 1905	25	4.60	4.44	2.40	.33
7286	H. J. Heinz Co., Pittsburg, Pa. H. E. Emmons, Brunswick, August, 1905.............	25	5.18	5.14	2.54	.41
7291	F. L. Hewins, East Winthrop. E. W. Church, Augusta, August, 1905. Probably an imperfectly fermented cider vinegar...	25	3.08	2.92	2.95	.45
7060	W. S. Hunnewell, China. Geo. A. Kennison, Waterville, May, 1905	25	5.77	5.60	2.46	.35
7297	W. S. Hunnewell, China. Geo. A. Kennison, Waterville, August, 1905	25	4.80	4.78	2.13	.33
7058	J. A. Jenkins, Lambs Corner. H. C. Haskell, Waterville, May, 1905	25	4.67	4.56	1.92	.37
7294	J. A. Jenkins, Lambs Corner. E. M. Jepson, Waterville, August, 1905.................	25	4.90	4.90	1.78	.35
7296	J. A. Jenkins, Lambs Corner. C. E. Mathews, Waterville, August, 1905...............	25	4.82	4.82	1.87	.37
7265	Pettingill, Limington. Wm. Milliken & Co., Portland, August, 1905...........	25	4.74	4.56	2.09	.44
7288	H. S. Melcher Co., Portland. E. M. Alexander, Brunswick, August, 1905.............	20	3.93	3.84	1.98	.34
7054	Daniel Page, Dover. Fred Palmer, Dover, May, 1905	20	6.12	4.76	7.26	.52
7068	E. D. Pettingill Bros., Portland. Morrill & Ross, Portland, May, 1905....................	25	4.63	4.38	2.83	.32
7270	E. L. Pettingill Sons Co., Portland. Scannell & Roche, Lewiston, August, 1905............	20	4.57	4.34	2.48	.27
7064	J. F. Pillsbury. Geo. C. Shaw Co., Portland, May, 1905..................	25	5.65	5.50	3.15	.48
7268	Steadman, Hawkes & Co., Portland. Ames & Merrill, Lewiston, August, 1905	20	4.23	4.22	1.68	.25

Descriptions and analyses of vinegars collected in 1905.

Number.	Description. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
		cts.	%	%	%	%
7075	Maker unknown. Bowker & Scott, Lewiston, May, 1905	20	4.85	4.78	1.29	.24
7069	Twitchell-Champlin Co., Portland. F. E. Plumer, Portland, May, 1905	25	4.73	4.68	1.80	.29
7262	"Hatchet brand." Twitchell-Champlin Co., Portland. A. F. Williams, Bath, August, 1905	20	5.03	4.96	1.82	.29
7287	"Hatchet brand." Twitchell-Champlin Co., Portland C. A. Pierce & Son, Brunswick, August, 1905	24	4.85	4.84	1.81	.29
7079	Fred Vickery, East Auburn. John Callahan, Auburn, May, 1905	20	3.97	3.82	2.52	.40
7273	J. P. Vickery, East Auburn. C. H. Libby & Co., Lewiston, August, 1905. If a cider vinegar it has apparently been reduced with water	20	3.70	3.64	1.23	.12
7063	"Domestic vinegar." Maker unknown. W. L. Wilson & Co., Portland, May, 1905	20	6.09	6.08	1.88	.36
7070	"Domestic vinegar." Maker unknown. A. M. Hanniford, Portland, May, 1905. Either a very poorly fermented or, what is more probable, a watered vinegar	18	2.30	2.20	1.79	.37
7266	"Domestic vinegar." Maker unknown. John W. Deering & Son, Portland, August, 1905. A rather poorly fermented cider vinegar	25	3.50	3.48	2.27	.25
7299	"Marvel brand." Maker's name illegible on barrel. Chas. Pomeleau, Waterville, August, 1905	25	4.47	4.44	1.65	.28
	MALT VINEGARS.					
7057	H. J. Heinz Co., Pittsburg, Pa. Warren & Dyer, Dover, May, 1905	25	5.10	4.76	1.89	.24
7066	H. J. Heinz Co., Pittsburg, Pa. Geo. C. Shaw Co., Portland, May, 1905	60	6.13	5.70	2.84	.31
7067	H. J. Heinz Co., Pittsburg, Pa. F. H. Verrill, Portland, May, 1905	25	4.73	4.28	2.24	.23
7245	H. J. Heinz Co., Pittsburg, Pa. Harlow Bros., Brewer, August, 1905	25	4.70	4.37	1.97	.22
7259	H. J. Heinz Co., Pittsburg, Pa. Walter S. Russell, Bath, August, 1905	25	4.87	4.52	2.10	.30
7264	H. J. Heinz Co., Pittsburg, Pa. Geo. C. Shaw & Co., Portland, August, 1905	60	5.38	5.04	2.65	.22
7274	H. J. Heinz Co., Pittsburg, Pa. Atwood Market Co., Lewiston, August, 1905	25	4.76	4.32	2.60	.43
7292	H. J. Heinz Co., Pittsburg, Pa. G. W. Wadleigh, Augusta, August, 1905	30	4.80	4.48	2.03	.29
	DISTILLED VINEGARS. NOT COLORED.					
7040	E. E. Clifford & Co., Portland. Brennen & Curran, Bangor, May, 1905. Branded and sold as white wine vinegar	25	3.79	3.31	.10	.03

Descriptions and analyses of vinegars collected in 1905.

Number.	Description. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
		cts.	%	%	%	%
7072	E. E. Clifford & Co., Portland. Spear & Webster, Lewiston, May, 1905. Branded and sold as white wine vinegar	20	3.58	3.56	.21	.13
7249	E. E. Clifford & Co., Portland. Brennan & Curran, Bangor, August, 1905. Branded and sold as white wine vinegar	25	3.78	3.70	.11	.03
7251	E. E. Clifford & Co., Portland. F. S. Jones, Bangor, August, 1905. Branded and sold as white wine vinegar	25	3.12	3.07	.36	.24
7290	Fleischmann's Superior White Wine Vinegar. Merrill Bros., Augusta, August, 1905. Branded and sold as white wine vinegar	25	3.30	3.28	.18	.04
7313	J. B. Donnell Co., Portland. Jensen & Blom, Portland, September, 1905. Branded and sold as white wine vinegar	....	3.10	3.10	.21	.08
7038	H. J. Heinz Co., Pittsburg, Pa. James H. Snow & Co., Bangor, May, 1905. This and all of Heinz' white vinegars are branded pickliug vinegars distilled	30	5.26	5.26	.19	.04
7048	H. J. Heinz Co., Pittsburg, Pa. F. H. Drummond, Bangor, May, 1905..................	30	6.50	6.50	.22	.04
7056	H. J. Heinz Co., Pittsburg, Pa. Warren & Dyer, Dover, May, 1905......................	20	5.28	5.28	.33	.06
7065	H. J. Heinz Co., Pittsburg, Pa. Geo. C. Shaw Co., Portland, May, 1905..................	30	5.50	5.48	.22	.05
7071	H. J. Heinz Co., Pittsburg, Pa. Spear & Webster, Lewiston, May, 1905	30	4.98	4.98	.25	.06
7253	H. J Heinz Co., Pittsburg, Pa. F. H. Drummond, Bangor, August, 1905...............	30	5.75	5.70	.24	.04
7258	H. J. Heinz Co., Pittsburg, Pa. Walter S. Russell, Bath, August, 1905	30	5.33	5.20	.16	.04
7272	H. J. Heinz Co., Pittsburg, Pa. Nealley and Miller, Lewiston, August, 1905. Branded white vinegar distilled. Sold for white wine vinegar	20	4.46	4.46	.18	.04
7278	H. J. Heinz Co., Pittsburg, Pa. Webber & Hewett, Augusta, August, 1905	25	5.22	5.18	.18	.04
7279	H. J. Heinz Co., Pittsburg, Pa. H. L. & W. E. Chase, Bath, August, 1905	35	5.18	5.16	.17	.04
7283	H. J. Heinz Co., Pittsburg, Pa. H. T. Nason, Brunswick, August, 1905..................	25	5.05	4.98	.31	.04
7285	H. J. Heinz Co., Pittsburg, Pa. "Howard White Vinegar." H. E. Emmons, Brunswick, August, 1905	25	4.00	4.00	.20	.05
7269	"White Wine." This is the only inscription on the barrel. The dealer obtained it from E. L. Pettingill Sons Co., Portland. Ames & Merrill, Lewiston, August, 1905..............	20	4.13	4.12	.16	.04

Descriptions and analyses of vinegars collected in 1905.

Number.	Description. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
		cts.	%	%	%	%
7051	Pine Hill Farm. Staples & Griffin, Bangor, May, 1905	20	2.85	2.84	.43	.08
7248	White vinegar "T. R. S. & Co., Bangor." Harlow Bros., Brewer, August, 1905	25	2.58	2.54	.19	.03
7076	Maker unknown. Bowker & Scott, Lewiston, May, 1905. It was branded as white wine vinegar	20	4.86	4.84	.23	.08
7044	Maker unknown. F. L. Frank & Co., Bangor, May, 1905	30	2.48	2.46	.28	.08
7275	Maker unknown. Bowker & Scott, Lewiston, August, 1905. Branded and sold as pure white wine vinegar	20	4.28	4.28	.19	.05
	DISTILLED VINEGARS COLORED IN IMITATION OF CIDER VINEGAR					
7043	John Cassidy Co., Bangor. A. E. Baker, Bangor, May, 1905	25	3.08	3.06	.20	.03
7039	E. E. Clifford & Co., Portland. Brennan & Curran, Bangor, May, 1905. Warranted pure cider vinegar	25	3.85	3.82	.20	.04
7052	E. E. Clifford & Co., Portland. W. J. Eldridge, Foxcroft. "Guaranteed Mass. standard." May, 1905	20	3.75	3.68	.31	.07
7061	E. E. Clifford & Co., Portland. Whitcomb & Cannon, Waterville, May, 1905. "Pure cider vinegar"	25	3.78	3.78	.27	.14
7073	E. E. Clifford & Co., Portland. Spear & Webster, Lewiston, May, 1905. "Pure cider vinegar"	18	3.81	3.80	.30	.05
7252	E. E. Clifford & Co., Portland. F. S. Jones, Bangor, August, 1905. "Pure cider vinegar, guaranteed Mass. standard"	20	4.25	4.19	.37	.25
7260	E. E. Clifford & Co., Portland. W. H. Swett, Bath, August, 1905. "Fine pure old XXXX vinegar"	25	3.55	3.50	.43	.09
7284	E. E. Clifford & Co., Portland. W. Hamilton, Brunswick, August, 1905. "Fine pure old XXX vinegar"	12	3.12	3.08	.28	.07
7250	E. E. Clifford & Co., Portland. Brennan & Curran, Bangor, August, 1905. "Pure Golden Russet vinegar"	25	3.88	3.80	.28	.03
7255	E. E. Clifford & Co., Portland. Staples & Griffin, Bangor, August, 1905. "Pure Golden Russet vinegar"	....	3.75	3.70	.18	.05
7314	E. E. Clifford & Co., Portland. Miss C. R. Garnet, Portland, by E. L. Cobb, Jr., milk inspector for Portland, September, 1905. "Golden Russet"	....	4.45	4.43	.22	.05

Descriptions and analyses of vinegars collected in 1905.

Number.	Description. Remarks.	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
		cts.	%	%	%	%
7300	Conant, Patrick & Co., Portland. Dumas & Vigue, Waterville, August, 1905. "Pure Perfection Vinegar." Sold for cider vinegar.	20	3.10	3.06	.38	.04
7276	F. G. Davis & Co., Lewiston. Bowker & Scott, Lewiston, August, 1905. "Fine Pure Old XXXX Vinegar"	20	3.20	3.16	.20	.16
7062	J. B. Donnell Co., Portland. John B. Johnson, Portland, May, 1905	25	2.93	2.92	.28	.13
7312	J. B. Donnell Co., Portland. C. A. Rounds, Portland, by E. L. Cobb, Jr., milk inspector for Portland, September, 1905. Labeled "Star brand vinegar."	....	2.43	2.42	.23	.03
7315	J. B. Donnell Co., Portland. C. S. Johnson, Portland, by E. L. Cobb, Jr., milk inspector for Portland, September, 1905. It was labeled "Star brand vinegar"	....	2.13	2.12	.19	.03
7316	J. B. Donnell Co., Portland. Chas. Mahoney, Portland, by E. L. Cobb, Jr., milk inspector for Portland, September, 1905	....	3.35	3.28	.20	.03
7045	Pine Hill Farm. F. L. Frank & Co., Bangor, May, 1905. A rather doubtful vinegar. It may be a cider vinegar watered	20	3.53	3.44	.96	.14
7050	Pine Hill Farm. Staples & Griffin, Bangor, May, 1905	20	3.20	3.18	.28	.04
7246	T. R. Savage & Co., Bangor. Harlow Bros., Brewer, August, 1905. "Pure vinegar"	15	3.46	3.42	.37	.05
7298	"S, Bangor." Toulouse & Soucier, Waterville, August, 1905	25	3.12	3.12	.32	.06
7078	Steadman & Hawks. Olfene & Holmes, Auburn, May, 1905. This was guaranteed to be pure cider vinegar	15	3.29	3.28	.37	.08
7243	Thurston & Kingsbury, Bangor. N. H. Hall, Brewer, August, 1905. "X L Pure pickling vinegar"	20	3.43	3.30	.46	.06
7254	Geo. I. Wescott & Son, Bangor. T. J. Daley & Co., Bangor, August, 1905. "XXX vinegar"	20	2.93	2.80	.39	.07
7317	C. A. Weston, Portland. S. F. Wood, Portland, by E. L. Cobb, Jr., milk inspector for Portland, September, 1905. "Solar brand"	....	2.05	2.02	.38	.09
7049	Maker unknown. Fisher & Crocker, Bangor, May, 1905. "Strictly pure vinegar"	20	2.95	2.90	.23	.03
7077	Maker unknown. E. B. Bray, Auburn, May, 1905	20	2.65	2.64	.19	

FERTILIZER INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of Fertilizer Analysis.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

The analyses of the manufacturers' samples for this year were published in March. A number of samples were received so late that the analyses could not be included in the bulletin then issued. The results of these analyses are given in the tables on page 168 beyond the analyses of the Station samples.

In the tables that immediately follow, the analyses of the samples of commercial fertilizers collected in the open market in the spring of 1905 by the Station representative are given.

The samples were drawn by an experienced chemist and every precaution was taken to make sure that they fairly represented the goods sampled. So far as posible the samples were taken in the large warehouses where a large amount of the goods were stored as received from the factory. They were taken in almost every instance from a large number of packages and in the presence of a representative of the manufacturers. The law requires that a duplicate sample be left with the dealer or agent for the use of the manufacturer in case the accuracy of the Station analysis is questioned. As this duplicate sample has been used only twice by the manufacturers in the past ten years they, with the understanding that they could have a portion of the Station sample if they should wish for it, waived their right to the reserve sample for the present year. This is a saving in

[Continued on page 166.]

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	THE AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK, N. Y.
20217	Bradley's Alkaline Bone with Potash
20218	Bradley's Complete Manure for Potatoes and Vegetables
20450	Bradley's Complete Manure for Potatoes and Vegetables
20219	Bradley's Complete Manure with 10% Potash
20451	Bradley's Complete Manure with 10% Potash
20220	Bradley's Corn Phosphate
20221	Bradley's Eureka Fertilizer
20222	Bradley's Niagara Phosphate
20223	Bradley's Potato Fertilizer
20224	Bradley's Potato Manure
20452	Bradley's Potato Manure
20225	Bradley's X. L. Superphosphate of Lime
20453	Bradley's X. L. Superphosphate of Lime
20226	Clark's Cove Bay State Fertilizer
20454	Clark's Cove Bay State Fertilizer
20227	Clark's Cove Bay State Fertilizer, G G
20455	Clark's Cove Bay State Fertilizer, G G
20228	Clark's Cove Bay State Fertilizer for Seeding Down
20456	Clark's Cove Bay State Fertilizer for Seeding Down
20229	Clark's Cove Defiance Complete Manure
20230	Clark's Cove Great Planet Manure, A. A
20231	Clark's Cove King Philip Alkaline Guano
20457	Clark's Cove King Philip Alkaline Guano
20232	Clark's Cove Potato Fertilizer
20458	Clark's Cove Potato Fertilizer
20233	Clark's Cove Potato Manure
20234	Cleveland Fertilizer for All Crops
20235	Cleveland High Grade Complete Manure
20236	Cleveland Potato Phosphate
20459	Cleveland Potato Phosphate
20237	Cleveland Seeding Down Fertilizer*
20238	Cleveland Superphosphate
20460	Cleveland Superphosphate
20239	Complete Manure with 10% Potash
20240	Crocker's Aroostook Potato Special
20461	Crocker's Aroostook Potato Special
20241	Crocker's Corn Phosphate
20462	Crocker's Corn Phosphate
20242	Crocker's Grass and Oats Fertilizer
20463	Crocker's Grass and Oats Fertilizer
20243	Crocker's New Rival Ammoniated Superphosphate
20464	Crocker's New Rival Ammoniated Superphosphate
20244	Crocker's Potato, Hop and Tobacco
20465	Crocker's Potato, Hop and Tobacco
20245	Crocker's Special Potato Manure

* Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
20217	......	......	......	......	6.17	4.52	1.72	10.69	11.00	12.41	12.00	1.95	2
20218	1.59	1.42	3.01	3.30	5.55	2.59	1.70	8.14	8.00	9.84	9.00	6.87	7
20450	0.94	2.16	3.10	3.30	4.26	3.22	4.08	7.47	8.00	11.55	9.00	6.97	7
20219	1.40	1.98	3.38	3.30	3.08	1.93	2.65	5.01	6.00	7.66	7.00	9.46	10
20451	1.70	1.56	3.26	3.30	4.27	1.85	1.63	6.12	6.00	7.75	7.00	9.86	10
20220	0.87	1.24	2.11	2.06	4.47	3.58	3.13	8.05	8.00	11.18	10.00	1.87	1.5
20221	0.54	0.56	1.10	1.03	4.80	3.62	2.51	8.42	8.00	10.93	10.00	2.36	2
20222	0.38	0.72	1.10	0.82	4.32	2.18	2.03	6.50	7.00	8.53	8.00	1.27	1
20223	0.98	0.98	1.96	2.06	3.92	3.88	2.83	7.74	8.00	10.57	10.00	3.41	3
20224	1.20	1.22	2.42	2.50	4.10	3.30	2.70	7.40	6.00	10.10	8.00	5.54	5
20452	1.40	1.30	2.70	2.50	3.29	2.99	2.73	6.28	6.00	9.01	8.00	4.98	5
20225	1.07	1.30	2.37	2.50	7.30	1.74	2.81	9.04	9.00	11.85	11.00	2.37	2
20453	0.92	1.38	2.30	2.50	5.45	2.89	3.96	8.34	9.00	12.30	11.00	2.08	2
20226	1.11	1.26	2.37	2.50	7.51	2.57	1.79	10.08	9.00	11.87	11.00	2.53	2
20454	1.00	1.28	2.28	2.50	5.93	2.78	2.90	8.71	9.00	11.61	11.00	2.14	2
20227	1.12	0.94	2.06	2.06	4.08	3.66	3.44	7.74	8.00	11.18	10.00	2.12	1.5
20455	0.88	0.94	1.82	2.06	6.03	2.61	2.48	8.64	8.00	11.12	10.00	1.72	1.5
20228	0.23	0.78	1.01	1.03	4.96	3.24	1.51	8.20	8.00	9.71	10.00	1.89	2
20456	0.32	0.80	1.12	1.03	5.55	2.43	1.38	8.08	8.00	9.46	10.00	1.72	2
20226	0.38	0.68	1.06	0.82	3.59	2.70	2.32	6.29	7.00	8.61	8.00	1.43	1
20230	1.88	1.36	3.24	3.30	5.49	1.56	3.13	7.05	8.00	10.18	9.00	6.64	7
20231	0.04	0.96	1.00	1.03	5.33	2.33	1.91	7.66	8.00	9.57	10.00	1.80	2
20457	0.32	0.86	1.18	1.03	5.47	2.66	1.61	8.13	8.00	9.74	10.00	1.76	2
20232	0.90	1.20	2.10	2.06	4.63	3.46	2.36	8.09	8.00	10.45	10.00	2.90	3
20458	0.92	1.04	1.96	2.06	5.68	2.48	2.93	8.16	8.00	11.09	10.00	3.09	3
20233	1.32	1.26	2.58	2.50	4.94	1.33	2.85	6.27	6.00	9.12	8.00	5.62	5
20234	0.68	0.32	1.00	1.03	4.86	4.90	0.45	9.76	8.00	10.21	10.00	2.18	2
20235	1.81	1.26	3.07	3.30	4.86	1.48	4.25	6.34	8.00	10.59	9.00	6.62	7
20236	0.81	1.14	1.95	2.06	6.30	1.72	1.99	9.02	8.00	11.01	10.00	2.99	3
20459	1.28	0.80	2.08	2.06	4.63	3.86	3.39	8.49	8.00	11.88	10.00	3.05	3
20237	......	......	1.03	......	......	......	......	8.00	......	......	10.00	......	2
20238	0.56	1.10	1.66	2.06	5.87	2.46	2.36	8.33	8.00	10.69	10.00	1.49	1.5
20460	1.04	0.72	1.76	2.06	4.13	3.80	2.72	7.93	8.00	10.65	10.00	1.87	1.5
20239	2.00	1.26	3.26	3.30	3.38	2.32	2.79	5.70	6.00	8.49	7.00	10.79	10
20240	1.06	0.96	2.02	2.06	3.83	3.37	3.57	7.20	8.00	10.77	......	6.06	6
20461	1.04	0.96	2.00	2.06	5.47	2.63	3.29	7.70	8.00	10.99	......	5.85	6
20241	1.02	0.96	1.98	2.06	5.94	2.30	3.06	8.04	8.00	11.10	......	1.71	1.5
20462	0.74	0.88	1.72	2.06	4.07	2.69	3.53	6.76	8.00	10.29	......	1.80	1.5
20242	......	......	......	......	4.26	6.50	2.13	10.76	11.00	12.89	......	2.18	2
20463	......	......	......	......	4.63	4.39	3.10	9.02	11.00	12.12	......	2.03	2
20243	0.54	0.46	1.00	1.03	5.25	2.46	2.42	7.71	8.00	10.13	......	2.25	2
20464	0.40	0.86	1.26	1.03	5.65	2.58	1.42	8.23	8.00	9.65	......	1.72	2
20244	0.52	1.34	1.86	2.06	4.59	3.49	3.23	8.08	8.00	11.31	......	3.02	3
20465	0.50	1.72	2.22	2.06	5.65	2.42	3.13	8.07	8.00	11.20	......	2.93	3
20245	1.50	1.86	3.36	3.29	4.66	2.81	1.70	7.47	6.00	9.17	......	7.30	10

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
20466	Crocker's Special Potato Manure
20246	Cumberland Guano for All Crops
20247	Cumberland Potato Fertilizer
20467	Cumberland Potato Fertilizer
20248	Cumberland Seeding Down Manure
20249	Cumberland Superphosphate
20468	Cumberland Superphosphate
20250	Darlings Blood, Bone and Potash
20251	Fine Ground Bone*
20252	Grass and Lawn Top Dressing
20253	Great Eastern General Fertilizer
20469	Great Eastern General Fertilizer
20254	Great Eastern Grass and Oats Fertilizer
20470	Great Eastern Grass and Oats Fertilizer
20255	Great Eastern High Grade Potato Manure
20471	Great Eastern High Grade Potato Manure
20256	Great Eastern Northern Corn Special
20472	Great Eastern Northern Corn Special
20257	Great Eastern Potato Manure
20473	Great Eastern Potato Manure
20258	High Grade Fertilizer with 10% Potash
20474	High Grade Sulphate of Potash
20259	High Grade Sulphate of Potash
20260	Lazaretto Aroostook Potato Guano
20261	Lazaretto Corn Guano
20262	Lazaretto Gigh Grade Potato Guano
20263	Lazaretto Propeller Potato Guano
20264	Lazaretto Wheat, Oats and Clover Fertilizer
20265	Muriate of Potash
20266	Nitrate of Soda
20267	Otis' Potato Fertilizer
20268	Otis' Seeding Down Fertilizer
20269	Otis' Superphosphate
20270	Pacific Dissolved Bone and Potash
20271	Pacific Grass and Grain Fertilizer
20272	Pacific High Grade General Fertilizer
20273	Pacific Nobsque Guano
20475	Pacific Nobsque Guano
20274	Pacific Potato Special
20476	Pacific Potato Special
20275	Packers Union Animal Corn Fertilizer
20276	Packers Union Economical Vegetable Guano
20477	Packers Union Economical Vegetable Guano
20277	Packers Union Gardeners Complete Manure
20278	Packers Union Potato Manure

* Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
20466	1.61	1.48	3.09	3.29	4.23	2.37	1.53	6.60	6.00	8.13	......	9.52	10
20246	0.70	0.70	1.40	1.03	3.91	3.99	2.93	7.90	8.00	10.83	10.00	2.05	2
20247	0.86	1.08	1.94	2.06	5.26	2.90	2.97	8.16	8.00	11.13	10.00	3.05	3
20467	0.78	1.38	2.16	2.06	4.85	3.02	3.02	7.87	8.00	10.89	10.00	3.18	3
20248	0.32	0.84	1.16	1.03	5.02	3.03	1.89	8.05	8.00	9.94	10.00	2.16	2
20249	0.66	1.10	1.76	2.06	6.32	0.94	2.39	7.26	8.00	10.65	10.00	1.47	1.5
20468	1.20	0.86	2.06	2.06	3.94	3.42	3.53	7.36	8.00	10.89	10.00	1.62	1.5
20250	1.67	2.10	3.77	4.10	3.73	2.22	3.32	5.95	7.00	9.27	8.00	6.70	7
20251	......	......	......	2.50	......	......	......	......	......	......	21.00	......	......
20252	4.80	0.00	4.80	3.91	1.04	3.82	1.79	4.86	5.00	6.65	6.00	3.32	2
20253	0.60	0.24	0.84	0.82	4.16	1.69	3.10	5.85	8.00	8.95	......	3.94	4
20469	0.63	0.16	0.79	0.82	4.26	2.42	3.29	6.68	8.00	9.97	......	3.92	4
20254	......	......	......	......	5.50	3.97	2.25	9.47	11.00	11.72	......	2.35	2
20470	......	......	......	......	4.27	6.38	2.00	10.65	11.00	12.65	......	2.03	2
20255	1.64	1.58	3.22	3.29	2.70	3.30	1.40	6.00	6.00	7.40	......	10.02	10
20471	1.64	1.56	3.20	3.29	4.59	2.28	1.44	6.87	6.00	8.31	......	9.42	10
20256	0.96	0.98	1.94	2.06	5.28	2.32	3.64	7.60	8.00	11.24	......	1.78	1.5
20472	1.12	1.04	2.16	2.06	4.86	2.88	3.11	7.74	8.00	10.85	......	1.85	1.5
20257	0.59	1.40	1.99	2.06	4.59	2.97	3.92	7.56	8.00	11.48	......	3.18	3
20473	0.80	1.42	2.22	2.06	5.25	2.39	2.97	7.64	8.00	10.61	......	3.18	3
20258	1.09	1.16	2.25	2.40	2.44	2.97	2.45	5.41	6.00	7.86	7.00	9.96	10
20474	1.24	1.48	2.72	2.40	3.14	2.69	1.94	5.83	6.00	7.77	7.00	9.40	10
20259	......	......	......	......	......	......	......	......	......	......	......	48.60	48
20260	0.56	0.28	0.84	0.82	4.39	2.64	2.48	7.03	8.00	9.51	......	4.11	4
20261	0.82	1.46	2.28	1.64	4.74	1.74	2.95	7.48	8.00	10.43	......	2.37	2
20262	1.76	1.26	3.02	3.29	2.55	2.45	2.58	5.00	6.00	7.58	......	10.13	10
20263	0.83	0.90	1.73	2.06	4.18	4.14	3.87	8.32	8.00	12.19	......	5.81	6
20264	......	......	......	......	5.47	2.61	2.18	8.08	11.00	11.26	......	2.03	2
20265	......	......	......	......	......	......	......	......	......	......	......	50.00	50
20266	......	......	15.80	15.60	......	......	......	......	......	......	......	......	......
20267	0.97	1.10	2.07	2.06	3.14	4.06	3.52	7.20	8.00	10.72	10.00	3.05	3
20268	0.46	0.64	1.10	1.03	3.43	4.03	2.54	7.46	8.00	10.00	10.00	2.14	2
20269	1.04	1.02	2.06	2.06	3.48	3.94	3.79	7.42	8.00	11.21	10.00	1.78	1.5
20270	......	......	......	......	5.28	3.65	2.95	8.93	10.00	11.88	11.00	2.00	2
20271	0.30	0.52	0.82	0.82	5.30	2.64	1.49	7.94	7.00	9.43	8.00	1.22	1
20272	1.83	1.26	3.09	3.30	4.53	6.70	3.23	7.23	8.00	10.46	9.00	7.33	7
20273	0.20	0.84	1.04	1.03	5.36	2.65	1.40	8.01	8.00	9.41	10.00	1.85	2
20475	0.38	0.78	1.16	1.03	3.48	3.50	2.72	6.98	8.00	9.70	10.00	2.07	2
20274	1.11	0.84	1.95	2.06	4.99	.64	2.42	7.63	8.00	10.05	10.00	3.28	3
20476	0.74	1.22	1.96	2.06	5.33	2.49	3.04	7.82	8.00	10.86	10.00	3.11	3
20275	1.16	1.20	2.36	2.47	7.10	1.84	2.30	8.94	9.00	11.24	......	2.35	2
20276	0.50	0.88	1.38	1.25	3.00	2.41	2.36	5.41	6.00	7.77	......	3.78	3
20477	0.62	0.52	1.14	1.25	4.31	2.46	2.93	6.77	6.00	9.70	......	3.82	3
20277	0.91	1.34	2.25	2.47	2.92	2.56	2.56	5.48	6.00	8.04	......	8.65	10
20278	0.76	1.16	1.92	0.82	6.17	2.04	2.22	8.21	8.00	10.43	......	5.44	4

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
20279	Packers Union Universal Fertilizer
20478	Packers Union Universal Fertilizer
20280	Packers Union Wheat, Oats and Clover Fertilizer
20479	Packers Union Wheat, Oats and Clover Fertilizer
20281	Plain Superphosphate
20282	Quinnipiac Climax Phosphate for All Crops
20480	Quinnipiac Climax Phosphate for All Crops
20283	Quinnipiac Corn Manure
20481	Quinnipiac Corn Manure
20284	Quinnipiac Market Garden Manure
20285	Quinnipiac Mohawk Fertilizer
20286	Quinnipiac Potato Manure
20287	Quinnipiac Potato Phosphate
20288	Read's Farmer's Friend
20289	Read's High Grade Farmer's Friend
20290	Read's Potato Manure
20291	Read's Practical Potato Special
20292	Read's Standard Superphosphate
20482	Read's Standard Superphosphate
20293	Read's Sure Catch Fertilizer
20294	Read's Vegetable and Vine Fertilizer
20483	Read's Vegetable and Vine Fertilizer
20295	Soluble Pacific Guano
20296	Standard A Brand
20297	Standard Bone and Potash
20298	Standard Complete Manure
20299	Standard Fertilizer
20484	Standard Fertilizer
20300	Standard Guano for All Crops
20485	Standard Guano for All Crops
20301	Standard Special for Potatoes
20486	Standard Special for Potatoes
20302	Williams and Clark's Americus Ammoniated Bone Superphosphate
20487	Williams and Clark's Americus Ammoniated Bone Superphosphate*
20303	Williams and Clark's Americus Corn Phosphate
20488	Williams and Clark's Americus Corn Phosphate
20304	Williams and Clark's Americus High Grade Special
20305	Williams and Clark's Americus Potato Manure
20489	Williams and Clark's Americus Potato Manure
20306	Williams and Clark's Royal Bone Phosphate for All Crops
	THE BOWKER FERTILIZER CO., BOSTON, MASS.
20312	Bowker's Bone, Blood and Potash
20313	Bowker's Bone and Potash Square Brand
20490	Bowker's Bone and Potash Square Brand
20314	Bowker's Corn Phosphate
20491	Bowker's Corn Phosphate
20315	Bowker's Early Potato Manure

* Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
%	%	%	%	%	%	%	%	%	%	%	%	%	%
20279	0.55	0.14	0.69	0.82	4.24	2.39	2.14	6.63	8.00	8.77	......	4.17	4
20478	......	......	......	......	4.35	2.38	2.90	6.73	8.00	9.63	......	3.98	4
20280	......	......	......	......	4.16	6.31	2.31	10.47	11.00	12.78	......	2.10	2
20479	......	......	......	......	6.59	3.90	1.43	10.49	11.00	12.22	......	1.80	2
20281	......	......	......	......	7.18	5.22	2.63	12.40	14.00	15.03	......	......	......
20282	0.24	0.92	1.16	1.03	1.71	4.42	3.60	6.13	8.00	11.02	10.00	2.10	2
20480	0.26	0.84	1.10	1.03	5.41	2.78	1.54	8.19	8.00	9.73	10.00	1.78	2
20283	0.71	1.04	1.75	2.06	5.93	2.45	2.54	8.48	8.00	11.02	10.00	1.83	1.5
20481	0.98	1.00	1.98	2.06	4.78	2.84	3.23	7.62	8.00	10.85	10.00	1.58	1.5
20284	2.99	1.18	3.17	3.30	4.63	4.55	1.62	9.18	8.00	10.80	9.00	6.48	7
20285	0.38	0.50	0.88	0.82	4.88	1.92	3.37	6.80	7.00	9.17	8.00	1.29	1
20286	0.96	1.60	2.56	2.50	4.64	1.49	3.28	6.13	6.00	9.41	8.00	5.25	5
20287	1.05	1.04	2.09	2.06	5.18	2.40	2.74	7.58	8.00	10.32	10.00	2.80	3
20288	0.86	1.24	2.10	2.06	6.01	2.04	3.27	8.05	8.00	11.32	10.00	3.03	3
20289	2.04	1.28	3.32	3.30	3.65	1.43	3.04	5.08	6.00	8.12	7.00	11.68	10
20290	1.06	1.36	2.42	2.40	2.84	2.54	2.08	5.38	6.00	7.46	7.00	9.48	10
20291	0.78	0.74	1.52	0.82	1.23	2.98	1.91	4.21	4.00	6.12	5.00	8.01	8
20292	0.62	0.64	1.26	0.82	3.96	2.83	3.56	6.79	8.00	10.35	10.00	4.17	4
20482	0.52	0.34	0.86	0.82	4.83	2.66	2.72	7.49	8.00	10.21	10.00	3.90	4
20293	......	......	......	......	4.26	6.20	2.27	10.46	10.00	12.73	11.00	2.08	2
20294	1.02	0.78	1.80	2.06	4.86	2.62	2.92	7.48	8.00	10.40	10.00	6.12	6
20483	1.07	0.86	1.93	2.06	4.63	2.63	3.51	7.26	8.00	10.77	10.00	6.00	6
20295	1.04	1.22	2.26	2.06	5.18	2.99	2.88	8.17	8.00	11.05	10.00	1.51	1.5
20296	0.60	0.80	1.40	0.82	4.58	1.76	2.03	6.34	7.00	8.37	8.00	2.20	1
20297	......	......	......	......	6.95	1.88	2.67	8.83	10.00	11.50	11.00	2.07	2
20298	1.80	1.40	3.20	3.30	6.33	1.57	1.62	7.90	8.00	9.52	9.00	6.45	7
20299	0.91	0.96	1.87	2.06	5.23	2.12	2.87	7.35	8.00	10.22	10.00	1.80	1.5
20484	0.76	1.12	1.88	2.06	6.57	2.22	2.74	8.79	8.00	11.53	10.00	1.66	1.5
20300	0.42	0.74	1.16	1.03	4.31	3.32	2.64	7.63	8.00	10.27	10.00	2.08	2
20485	0.26	0.80	1.06	1.03	5.45	2.81	1.31	8.26	8.00	9.57	10.00	1.72	2
20301	0.49	1.56	2.05	2.06	4.83	2.97	3.11	7.80	8.00	10.91	10.00	2.93	3
20486	0.76	1.18	1.94	2.06	5.65	2.24	3.37	7.89	8.00	11.26	10.00	2.95	3
20302	1.21	1.16	2.37	2.50	6.70	2.16	2.37	8.86	9.00	11.23	11.00	1.97	2
20487	......	......	......	2.50	......	......	......	......	9.00	......	11.00	......	2
20303	1.14	0.82	1.96	2.06	5.31	3.01	3.32	8.32	8.00	10.64	10.00	1.58	1.5
20488	1.00	0.82	1.82	2.06	4.71	4.31	2.70	9.02	8.00	11.72	10.00	1.62	1.5
20304	1.28	1.78	3.06	3.30	3.99	2.81	3.06	6.80	8.00	9.86	9.00	6.87	7
20305	0.98	1.10	2.08	2.06	4.58	3.03	3.04	7.61	8.00	10.65	10.00	2.93	3
20489	0.73	1.18	1.91	2.06	5.42	2.40	3.19	7.82	8.00	11.01	10.00	2.93	3
20306	0.28	0.88	1.16	1.03	4.74	3.14	1.79	7.88	8.00	9.67	10.00	2.34	2
20312	1.84	1.94	3.88	4.10	4.51	1.59	3.64	6.10	8.00	9.74	10.00	6.37	7
20313	0.74	0.80	1.54	1.65	4.88	1.92	2.83	6.80	6.00	9.63	7.00	2.07	2
20490	0.24	1.78	2.02	1.65	5.18	2.54	1.47	7.72	6.00	9.19	7.00	1.95	2
20314	1.10	0.84	1.94	1.65	2.92	3.88	2.90	6.80	8.00	9.70	9.00	2.45	2
20491	0.76	1.02	1.78	1.65	6.35	2.18	3.00	8.53	8.00	11.53	9.00	2.30	2
20315	1.79	1.26	3.05	3.29	5.23	2.07	2.49	7.30	7.00	9.79	8.00	6.72	7

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
20492	Bowker's Early Potato Manure
20316	Bowker's Farm and Garden Phosphate
20493	Bowker's Farm and Garden Phosphate
20317	Bowker's Fresh Ground Bone
20318	Bowker's Hill and Drill Phosphate
20494	Bowker's Hill and Drill Phosphate
20319	Bowker's Market Garden Fertilizer
20495	Bowker's Market Garden Fertilizer
20320	Bowker's Potash Bone
20321	Bowker's Potash or Staple Phosphate
20322	Bowker's Potato and Vegetable Fertilizer
20496	Bowker's Potato and Vegetable Fertilizer
20323	Bowker's Potato and Vegetable Phosphate
20497	Bowker's Potato and Vegetable Phosphate
20324	Bowker's Six Per Cent Potato Fertilizer
20325	Bowker's Superphosphate with Potash for Grass and Grain
20326	Bowker's Sure Crop Phosphate
20498	Bowker's Sure Crop Phosphate
20327	Bowker's Ten Per Cent Manure
20328	Monticello Grange Chemicals
20329	Special Potato Manure for the Grange
20330	Stockbridge Special Manures (for Corn, etc., Class D 107)
20331	Stockbridge Special Manures (for Grass, etc., Class F 56)*
20332	Stockbridge Special Manures (for Potatoes, etc., Class D 610)
20499	Stockbridge Special Manures (for Potatoes, etc., Class D 610)
20333	Stockbridge Special Manures (for Seeding Down, etc., Class C 610)
	E. FRANK COE CO., NEW YORK CITY, N. Y.
20337	E. Frank Coe's Celebrated Special Potato Fertilizer
20338	E. Frank Coe's Columbian Corn Fertilizer
20339	E. Frank Coe's Columbian Potato Fertilizer
20340	E. Frank Coe's Excelsior Potato Fertilizer
20341	E. Frank Coe's Grass and Grain Special
20342	E. Frank Coe's High Grade Ammoniated Bone Superphosphate
20343	E. Frank Coe's High Grade Potato Fertilizer
20344	E. Frank Coe's New Englander Corn Fertilizer
20345	E. Frank Coe's New Englander Special Potato Fertilizer
20346	E. Frank Coe's Prize Brand Grain and Grass Fertilizer
20347	E. Frank Coe's Red Brand Excelsior Guano
20348	E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate
	HUBBARD FERTILIZER CO., BALTIMORE, MD.
20352	Hubbard's Bone and Blood
20353	Hubbard's Farmer's I. X. L. Superphosphate
20354	Hubbard's Royal Ensign
20355	Hubbard's Soluble Bone and Potash
20356	Hubbard's Special Potato Compound
20357	Hubbard's Trucker's 5% Royal Seal Compound
20358	Hubbard's Wheat Growers Jewel

*Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
%	%	%	%	%	%	%	%	%	%	%	%	%	%
20492	1.54	1.44	2.98	3.29	5.17	2.24	1.35	8.41	7.00	9.76	8.00	6.58	7
20316	1.16	0.84	2.00	1.65	2.76	4.11	3.05	6.87	8.00	9.92	9.00	2.18	2
20493	0.76	0.94	1.70	1.65	5.95	2.41	2.55	8.36	8.00	10.91	9.00	2.35	2
20317	......	......	2.47	2.47	......	......	......	......	......	24.69	18.00	......	......
20318	1.24	1.34	2.58	2.47	6.41	2.41	3.01	8.82	9.00	11.83	10.00	2.30	2
20494	0.96	1.32	2.28	2.47	5.98	2.92	3.38	8.90	9.00	12.28	10.00	2.16	2
20319	1.05	1.16	2.21	2.47	4.55	1.64	2.23	6.29	6.00	8.52	7.00	9.38	10
20495	0.94	1.40	2.34	2.47	3.16	1.97	3.00	5.13	6.00	8.13	7.00	9.26	10
20320	0.20	0.82	1.02	0.82	5.74	2.33	1.48	8.17	6.00	9.65	7.00	1.72	2
20321	0.16	0.88	1.04	0.82	5.93	2.28	1.26	8.21	8.00	9.47	9.00	2.88	3
20322	0.75	1.40	2.15	2.47	6.38	1.31	2.96	7.69	8.00	10.65	10.00	3.76	4
20496	0.90	1.30	2.20	2.47	5.77	2.82	3.04	8.59	8.00	11.63	10 00	5.44	4
20323	1.10	0.88	1.98	1.65	3.56	3.19	3.36	6.75	9.00	10.11	10.00	2.05	2
20497	0.78	1.02	1.80	1.65	5.73	3.45	2.59	9.18	9.00	11.77	10.00	2.24	2
20324	0.64	0.18	0.82	0.82	4.32	1.95	3.04	6.27	6.00	9.31	7.00	5.67	6
20325	......	......	......	......	6.17	4.18	1.72	10.35	10.00	12.07	11.00	1.80	2
20326	0.64	0.56	1.20	0.82	5.25	2.05	2.67	7.30	9.00	9.97	10.00	2.08	2
20498	0.22	0.92	1.14	0.82	5.89	2.42	1.42	8.31	9.00	9.73	10.00	1.64	2
20327	0.42	0.40	0.82	0.82	2.52	3.01	1.65	5.53	5.00	7.18	6.00	10.75	10
20328	1.22	1.12	2.34	2.50	5.79	2.37	2.69	8.16	8.00	10.85	12.00	4.32	4
20329	0.86	0.58	1.44	1.50	4.56	4.52	1.75	9.08	9.00	10.83	12.00	11.02	12
20330	1.26	1.70	2.96	3.29	5.61	4.93	2.87	10.54	7.00	13.41	8.00	6.36	7
20331	......	......	......	4.94	......	......	......	......	4.00	......	6.00	......	6
20332	1.72	1.46	3.18	3.29	3.16	2.06	2.93	5.22	6.00	8.15	7.00	10.36	10
20499	1.20	2.02	3.22	3.29	3.32	1.52	2.93	4.84	6.00	7.77	7.00	9.84	10
20333	1.66	1.44	3.10	2.47	5.10	2.66	1.12	7.76	6.00	8.88	9.00	10.11	10
20337	0.96	1.08	2.04	1.65	7.24	0.08	2.12	7.32	8.00	9.44	10.00	4.11	4
20338	0.66	0.98	1.64	1.23	6.81	0.49	3.11	7.30	8.50	10.41	10.50	2.93	2.5
20339	0.70	1.10	1.80	1.23	6.75	1.87	2.19	8.6[illegible]	8.50	10.81	10.00	2.70	2.5
20340	1.88	0.80	2.68	2.47	5.89	0.95	1.15	6.84	7.00	7.99	9.00	8.53	8
20341	0.60	0.48	1.08	0.80	7.13	1.86	2.48	8.99	8.50	11.47	......	1.80	1.5
20342	1.46	0.96	2.42	1.85	7.40	1.12	2.36	8.52	9.00	10.88	11.00	2.59	2.25
20343	1.42	1.28	2.70	2.40	7.26	.79	1.65	8.05	8.00	9.70	10.00	6.02	6
20344	0.86	0.62	1.48	0.80	6.38	1.69	2.30	8.07	7.50	10.37	9.00	3.17	3
20345	0.88	0.64	1.52	0.80	4.67	2.29	2.64	6.96	7.50	9.60	9.00	3.24	3
20346	......	......	......	......	4.75	3.36	7.76	8.11	10.50	15.87	12.00	2.01	2
20347	1.95	1.18	3.13	3.36	7.37	1.03	2.40	8.40	9.00	10.80	10.00	5.94	6
20348	1.00	0.82	1.82	1.26	6.81	1.48	2.55	8.39	8.50	10.94	10.00	2.22	2
20352	1.82	1.08	2.91	3.29	6.08	1.89	1.65	7.97	8.00	9.62	9.00	7.51	7
20353	1.02	0.74	1.76	1.65	3.30	4.22	2.08	7.52	8.00	9.60	9.00	2.26	2
20354	1.28	0.82	2.10	2.47	6.22	1.50	1.82	7.72	8.00	9.54	9.50	4.81	4
20355	......	......	......	......	3.84	6.65	1.74	10.49	10.00	12.23	12.00	1.91	2
20356	1.58	1.12	2.70	3.29	5.84	2.16	1.84	8.00	6.00	9.84	7.00	7.22	10
20357	2.22	1.84	4.06	4.11	4.91	1.02	2.36	5.93	6.00	8.29	......	3.64	5
20358	0.33	0.68	1.01	1.23	4.48	3.92	2.92	8.40	9.00	11.32	......	3.44	2

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	JOHN WATSON COMPANY, HOULTON, ME.
20362	Watson's Improved High Grade Potato Manure
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
20363	Lister's Animal Bone and Potash
20500	Lister's Animal Bone and Potash
20364	Lister's High Grade Special for Spring Crops
20501	Lister's High Grade Special for Spring Crops
20365	Lister's Oneida Special
20502	Lister's Oneida Special
20366	Lister's Potato Manure
20503	Lister's Potato Manure
20367	Lister's Special Corn Fertilizer
20368	Lister's Special Potato Fertilizer
20504	Lister's Special Potato Fertilizer
20369	Lister's Success Fertilizer
20505	Lister's Success Fertilizer
	NATIONAL FERTILIZER CO., BRIDGEPORT, CONN.
20373	Chittenden's Complete Root
20374	Chittenden's Market Garden
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.
20376	New England Complete Manure
20377	New England Corn and Grain Fertilizer
20378	New England Corn Phosphate
20379	New England High Grade Potato Fertilizer
20380	New England High Grade Special (with 10% Potash)
20381	New England Potato Fertilizer
20382	New England Superphosphate
	OLDS AND WHIPPLE, HARTFORD, CONN.
20385	Eureka Fertilizer
20386	Excelsior Fertilizer
	THE PARMENTER & POLSEY FERTILIZER CO., PEABODY, MASS.
20389	A A Brand Fertilizer
20390	Aroostook Special Fertilizer
20391	Muriate of Potash*
20392	Nitrate of Soda*
20393	P. & P. Grain Grower*
20394	P. & P. Potato Fertilizer*
20395	Plymouth Rock Brand Fertilizer
20396	Pure Ground Bone
20397	Special Potato Fertilizer
20398	Star Brand Phosphate
	PORTLAND RENDERING CO., PORTLAND, ME.
20402	Bone Dust Tankage
	PROVINCIAL CHEMICAL FERTILIZER CO., LIMITED, ST. JOHN, N. B.
20404	Special Potato Phosphate
20405	10% Complete Aroostook Potato
	RUSSIA CEMENT CO., GLOUCESTER, MASS.
20408	Essex A 1 Superphosphate
20409	Essex Complete Manure for Corn, Grain and Grass
20410	Essex Complete Manure for Potatoes, Roots and Vegetables
20411	Essex Corn Fertilizer
20412	Essex Market Garden and Potato Manure
20413	Essex XXX Fish and Potash

*Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
%	%	%	%	%	%	%	%	%	%	%	%	%	%
20362	1.80	1.04	2.84	3.00	4.29	1.54	1.51	5.83	6.00	7.34	7.00	5.11	5
20363	......	......	......	......	5.53	4.64	1.94	10.17	11.00	12.11	11.00	2.01	2
20500	......	......	......	......	5.18	5.49	2.04	10.67	11.00	12.71	11.00	1.91	2
20364	0.58	1.00	1.58	1.65	5.65	1.80	3.32	7.45	8.00	10.77	......	9.46	10
20501	0.32	1.28	1.60	1.65	4.51	3.71	0.88	8.32	8.00	9.20	......	9.44	10
20365	0.42	0.54	0.96	0.83	2.62	3.09	2.68	5.71	7.00	8.39	8.00	1.45	1
20502	0.36	0.64	1.00	0.83	2.87	3.11	2.41	5.98	7.00	8.39	8.00	3.44	1
20366	1.23	1.88	3.11	3.30	4.39	3.13	2.35	7.52	8.00	9.87	9.00	7.04	7
20503	0.98	2.14	3.12	3.30	4.72	2.18	3.34	6.90	8.00	10.24	9.00	9.19	7
20367	0.42	1.22	1.64	1.65	4.31	3.19	1.80	7.50	8.00	9.30	9.00	3.03	3
20368	0.46	1.18	1.64	1.65	4.13	2.90	1.85	7.03	8.00	8.88	9.00	3.11	3
20504	0.38	1.12	1.50	1.65	4.98	3.30	1.66	8.28	8.00	9.94	9.00	2.78	3
20369	0.37	0.76	1.13	1.24	5.90	3.62	0.89	9.52	9.00	10.41	11.00	2.08	2
20505	0.40	1.04	1.44	1.24	3.80	3.95	2.25	7.75	9.00	10.00	11.00	1.81	2
20373	1.62	1.52	3.14	3.30	4.94	2.92	1.96	7.86	8.00	9.82	10.00	6.79	6
20374	1.36	1.12	2.48	2.40	5.09	1.63	1.54	6.72	6.00	8.26	8.00	5.50	5
20376	2.04	1.00	3.04	3.28	6.32	1.79	1.68	8.11	8.00	9.79	9.00	9.40	7
20377	0.58	0.76	1.34	1.22	5.69	1.63	1.47	7.32	7.00	8.79	8.00	2.34	2
20378	0.78	0.72	1.50	1.64	6.14	2.23	1.57	8.37	8.00	9.94	9.00	3.00	3
20379	0.86	1.42	2.38	2.46	5.97	1.63	2.97	7.60	8.00	10.57	9.00	6.12	6
20380	2.56	1.16	3.72	3.69	5.60	1.71	1.59	7.31	7.00	8.90	8.00	10.63	10
20381	0.75	0.82	1.57	1.64	5.12	2.06	1.85	7.18	7.00	9.03	8.00	4.27	4
20382	0.88	1.18	2.06	2.46	6.87	1.72	1.90	8.59	9.00	10.49	10.00	4.15	4
20385	1.28	1.98	3.26	2.50	7.26	1.65	1.19	8.91	8.00	10.10	8.00	7.03	6
20386	1.07	2.06	3.13	3.30	5.55	1.32	1.06	6.87	6.00	7.93	6.00	11.62	10
20389	2.70	1.44	4.14	4.10	4.82	2.44	1.91	7.26	7.00	9.17	8.00	7.82	8
20390	1.88	1.56	3.44	3.70	4.83	1.99	1.63	6.82	7.00	8.45	8.00	10.13	10
20391	......	......	......	......	......	......	......	......	......	......	......	......	5
20392	......	......	......	15.00	......	......	......	......	......	......	......	......	......
20393	......	......	......	0.82	......	......	......	......	7.00	......	8.00	......	2
20394	......	......	......	1.64	......	......	......	......	6.00	......	7.00	......	6
20395	1.42	0.92	2.34	2.47	5.34	2.71	2.19	8.05	8.00	10.24	9.00	4.32	4
......	......	......	......	......	......	......	......	......	......	......	......	......	......
20397	2.02	0.98	3.00	3.29	6.35	1.71	1.25	8.06	8.00	9.31	9.00	7.37	7
20398	0.70	0.96	1.66	1.64	4.26	2.37	2.08	6.63	7.00	8.71	8.00	3.32	2.5
20402	0.85	3.62	4.47	5.30	......	......	......	......	7.10	17.94	15.28	......	......
20404	1.06	1.02	2.08	2.05	6.94	1.10	4.59	8.04	8.00	12.63	......	5.10	6
20405	1.97	0.76	2.73	3.29	7.59	1.04	2.18	8.63	8.00	10.81	......	10.35	10
20408	0.10	0.96	1.06	1.00	1.04	4.02	6.93	5.06	7.00	12.04	9.00	2.34	2
20409	0.97	2.08	3.05	3.30	6.25	2.10	2.51	8.35	7.00	10.86	9.50	10.17	9.5
20410	1.02	2.68	3.70	3.70	3.46	2.57	7.30	6.03	7.00	13.33	9.00	8.84	8.5
20411	0.86	1.82	2.68	2.00	3.60	4.11	4.48	7.71	8.50	12.19	10.50	3.07	3
20412	0.80	1.12	2.00	2.00	1.98	5.13	4.26	7.11	8.00	11.37	10.00	5.56	5
20413	0.84	1.26	2.10	2.10	1.50	5.44	5.13	6.94	9.00	12.07	12.00	2.28	2.25

Descriptive List of Station Samples, 1905.

Station number.	Manufacturer, place of business and brand.
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, ME.
20416	Acid Phosphate
20417	Aroostook Potato Manure
20426	Bone Meal
20418	Dirigo Fertilizer
20419	Muriate of Potash
20420	Nitrate of Soda
20421	Sagadahoc High Grade Superphosphate
20422	Sagadahoc Special Potato Fertilizer
20423	Special Clover Fertilizer
20424	XX Chemical Fertilizer
20425	Yankee Fertilizer
	THE SCIENTIFIC FERTILIZER CO., PITTSBURG, PA.
20428	Scientific "Bone, Meat and Potash" Fertilizer *
20429	Scientific "Corn and Grain" Fertilizer
20506	Scientific "Corn and Grain" Fertilizer
20430	Scientific "Economy" Fertilizer
20431	Scientific Potato Fertilizer
20432	Scientific Potato and Vegetable Fertilizer
20507	Scientific Potato and Vegetable Fertilizer
	SWIFT'S LOWELL FERTILIZER CO., BOSTON, MASS.
20435	Swift's Lowell Acid Phosphate *
20436	Swift's Lowell Animal Brand
20437	Swift's Lowell Bone Fertilizer
20438	Swift's Lowell Cereal Fertilizer
20439	Swift's Lowell Dissolved Bone and Potash
20440	Swift's Lowell Empress Brand
20444	Swift's Lowell Potato Manure
20445	Swift's Lowell Potato Phosphate
20446	Swift's Lowell Special Vegetable Manure
20447	Swift's Superior Fertilizer with 10% Potash

* Not found by the inspector.

Analyses of Station Samples, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
20416	......	......	......	......	14.36	2.27	0.52	16.63	16.00	17.15	......	......	......
20417	0.92	0.16	1.08	1.05	2.84	2.40	2.67	5.24	6.00	7.91	7.00	5.56	4
......	......	......	......	......	......	......	......	......	......	......	......	......	......
20418	0.21	0.36	0.57	0.85	4.56	2.53	4.30	7.09	6.00	11.39	9.00	2.41	3
20419	......	......	......	......	......	......	......	......	......	......	......	50.80	50
20420	15.12	......	15.12	14.00	......	......	......	......	......	......	......	......	......
20421	1.36	0.32	1.68	1.85	6.33	2.18	2.81	8.51	7.00	11.32	8.00	4.71	3
20422	1.60	0.46	2.06	2.00	4.18	2.50	3.64	6.68	7.00	10.32	8.00	8.22	8
20423	0.29	0.38	0.67	0.85	3.19	4.37	3.96	7.56	5.00	11.52	8.00	......	......
20424	6.30	1.14	7.44	6.00	......	......	3.74	4.54	3.00	8.28	7.00	8.26	8
20425	0.60	......	0.60	0.40	5.42	2.83	0.89	8.25	7.00	9.14	8.00	2.01	2
20428	......	......	......	3.33	......	......	......	......	8.00	......	10.00	......	8
20429	0.48	1.02	1.50	1.66	5.18	2.15	2.30	7.33	8.00	9.63	9.00	2.01	2
20506	0.42	1.04	1.46	1.66	6.41	2.03	1.85	8.44	8.00	10.29	9.00	2.55	2
20430	0.42	1.68	2.10	1.66	5.04	2.16	3.13	7.20	9.00	10.33	10.00	5.25	4
20431	0.62	1.92	2.54	2.50	4.43	2.36	3.70	6.79	8.00	10.49	10.00	5.73	6
20432	0.82	2.32	3.14	3.33	6.25	2.20	3.96	8.45	7.00	12.41	8.00	6.10	10
20507	1.08	2.38	3.46	3.33	3.64	2.12	4.54	5.76	7.00	10.30	8.00	6.81	10
20435	......	......	......	......	......	......	......	......	12.00	......	......	......	......
20436	0.98	1.20	2.18	2.46	7.16	2.21	1.56	9.37	9.00	10.93	10.00	4.03	4
20437	0.85	0.82	1.67	1.64	6.35	2.45	1.66	8.80	8.00	10.46	9.00	2.97	3
20438	0.38	0.44	0.82	0.82	3.73	2.71	1.47	6.44	7.00	7.91	8.00	0.95	1
20439	0.65	0.94	1.59	1.64	6.49	1.61	2.11	8.10	9.00	10.21	10.00	2.24	2
20440	0.52	0.72	1.24	1.23	5.02	2.35	0.38	7.37	7.00	7.75	8.00	2.16	2
20444	0.81	0.83	1.64	1.64	4.93	2.38	1.72	7.31	7.00	9.03	8.00	3.90	4
20445	0.78	1.52	2.30	2.46	5.76	1.79	3.36	7.55	8.00	10.91	9.00	6.00	6
20446	2.14	1.02	3.16	3.28	6.25	1.80	1.62	8.05	8.00	9.67	9.00	7.30	7
20447	2.57	1.12	3.69	3.69	5.41	1.73	1.54	7.14	7.00	8.68	8.00	11.99	10

[Continued from page 153.]

the time of the inspector and in the number of sampling jars that he needs to take with him. As far as possible two samples of each brand were taken, an effort being made to obtain the duplicate from a distinct lot of the same brand in a different part of the State. In case the analysis of the first sample of a brand did not conform closely to the guaranteed composition, the duplicate sample of that brand was analyzed. Thus it happens in many instances that two analyses of the same brand are given in the tables. A few brands that were licensed were not actually shipped into the State and in two or three instances the inspector failed to find the brands in the hands of the dealers or agents. Hence it happens that a few brands appear in the tables without an accompanying analysis.

During the years immediately following 1895 there was a tendency to the multiplication of brands. At present it is only rarely that a company that has been doing business in the State for years offers a new brand. With the growth of the sale of fertilizers in the State, companies that formerly did no business in Maine are now sending their goods to the State. This of course results in an increase in the number of brands. While it is unfortunate that so many farmers buy fertilizers from a name rather than from the amount of plant food contained in the fertilizer, it is gratifying that brands are not being unnecessarily multiplied. There has been a constant increase from the 20 brands licensed in 1885 to the 180 brands of complete manures and 20 single ingredient chemicals licensed in 1905.

When the manufacturers first put their goods upon the market, recognizing the difficulty of accurate mixing, they placed a somewhat elastic guarantee upon them. For instance, potash might be guaranteed 4 to 5 per cent and for the most part the goods would carry 4.5 per cent of potash. As competition became closer and the process of manufacture became somewhat more trustworthy, the manufacturers worked closer and closer to the minimum guarantee so that at present it rarely happens that fertilizers carry much above the minimum percentages of nitrogen and potash, the more costly constituents of a fertilizer. If this were the whole story there would be nothing to complain of, but there has been an increasing tendency to fail to maintain the goods up to their minimum guarantee. Over 80 per cent of the samples collected this year are below the guarantee in at least one constitutent. For the most part these deficiencies are slight but they should not occur.

It is to be remembered, however, that it has been many years since a fraudulent fertilizer has been offered in Maine and there is probably no class of goods that come nearer to making good their claims that commercial fertilizers, and there are very few staples that are so largely sold on their merits.

Descriptive List of Manufacturers' Samples Licensed After March 1, 1905.

Station number.	Manufacturer, place of business and brand.
	HUBBARD FERTILIZER CO., BALTIMORE, MD.
20197	Hubbard's Bone and Blood Complete Fertilizer
20198	Hubbard's Farmer's I X L Superphosphate
20196	Hubbard's Royal Ensign
20199	Hubbard's Soluble Bone and Potash
20200	Hubbard's Special Potato Compound
	LISTER AGRICULTURAL CHEMICAL CO., NEWARK, N. J.
20201	Lister's Dissolved Bone Black
20202	Lister's High Grade Sulphate of Potash
20203	Lister's Nitrate of Soda
	OLDS AND WHIPPLE, HARTFORD, CONN.
20204	Eureka Fertilizer
20205	Excelsior Fertilizer
	SAGADAHOC FERTILIZER CO., BOWDOINHAM.
20206	Bone Meal
	WHITMAN AND PRATT RENDERING CO., LOWELL, MASS.
20207	Whitman and Pratt's Corn Success
20208	Whitman and Pratt's Potash Special
20209	Whitman and Pratt's Vegetable Grower

Analyses of Manufacturers' Samples Licensed After March 1, 1905.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
20197	1.60	2.12	3.72	3.29	9.14	0.48	0.76	9.62	8.00	10.38	9.00	9.09	7
20198	1.06	0.90	1.96	1.65	7.35	1.43	0.96	8.78	8.00	9.74	9.00	2.53	2
20196	1.58	1.36	2.94	2.47	8.80	1.08	0.55	9.88	8.00	10.43	9.50	4.55	4
20199	......	......	......	......	5.98	5.86	0.78	11.84	10.00	12.62	12.00	2.24	2
20200	1.76	2.00	3.76	3.29	7.38	0.34	0.92	7.72	6.00	8.64	7.00	10.60	10
20201	......	......	......	......	11.16	3.54	1.20	14.70	16.00	15.90	......	......	......
20202	......	......	......	......	......	......	......	......	......	......	......	48.6	48
20203	16.00	......	16.00	15.6	......	......	......	......	......	......	......	......	......
20204	1.22	1.48	2.70	2.50	7.86	1.76	1.05	9.62	8.00	10.67	8.00	6.18	6
20205	1.24	2.16	3.40	3.30	5.02	1.26	0.91	6.28	6.00	7.19	6.00	11.14	10
20206	0.68	3.00	3.68	......	......	......	......	......	......	21.52	......	......	......
20207	0.76	1.14	1.90	1.64	4.99	2.85	6.34	7.84	8.00	14.18	10.00	3.07	3
20208	0.70	1.56	2.26	2.88	3.41	2.87	5.79	6.28	6.00	12.07	8.00	10.36	10
20209	1.16	2.56	3.72	3.29	5.42	3.20	5.54	8.62	8.00	14.16	10.00	8.84	7

THE COTTONY GRASS SCALE.

Eriopeltis festucæ (Fonsc.).

Edith M. Patch.

Economic Significance.—Until recently the cottony grass scale has not seemed to merit treatment from the economic standpoint, for the experience of this insect since it was first observed in America had led to the conclusion that it would be an intermittent thing very quickly brought under control by natural agencies.

During the summer of 1904, however, considerable consternation was caused in several localities in Maine by the presence of the egg sacs of this scale in enormous numbers. From Sedgwick and all along the Eggemoggin Reach; from the vicinity of Portland, especially at Gorham and Stroudwater; from Dresden and from Manchester, came persistent and alarmed reports. " My mowing lands look as though scattered with swollen rice grains," "A strange fungus has destroyed large plots in my grass lands," "The hay fields look as if a slight shower of snow pellets had fallen over them," were among the descriptive comments.

This infestation doubtless was not so sudden as it seemed. The scale is inconspicuous until the egg sac is secreted, thus for most of its life only a careful search would reveal its presence. The egg sacs themselves are only about one-fourth of an inch in length and these could be scattered along fence and road ways, over uncut grass near streams, unnoticed for years, and in view of the fact that comparatively few people are keen observers of little things not in their special line of interest, the statements that "we have never seen anything like this before," do not necessarily signify that the creatures have not been breeding within stone's throw for 40 years. However, the cottony grass scale is admirably fitted for rapid increase as the enormous number of eggs in a sac (600 to 700), the lively disposition of the young scales and their ability to travel, and the fact that there are at least two broods a season, all indicate.

The insidious approach of this insect may be illustrated by this experience. During the late summer and early fall of 1904 in the vicinity of Orono, careful searches were made for egg sacs over large areas, some of which appeared to be entirely free from the scale and others attacked in an exceedingly scattering manner. This fall, 1905, the increase in the places of scattering infestation is very marked, and even over some areas apparently free last season the egg sacs are a common though not yet a conspicuous occurrence. In one Orono meadow which contained an infested plot last fall, the egg sacs have increased certainly one hundred fold in a year's time.

NATURAL CHECKS.

Whether such increases are occasions for real alarm is a question involving a consideration of natural agencies as checks.

Weather.—While the eggs within the sacs are safe in ordinary climatic conditions, the young larvæ, minute, delicate, and unprotected, must be largely dependent upon favorable conditions between the time of leaving the sac and settling upon a promising blade. A heavy rain at this time must undoubtedly beat down and destroy myriads of the little creatures.

Rust.—In a meadow near Portland thickly infested with the scales, areas half a mile in length were observed to be attacked heavily by rust. This was the 25th of August, 1904, when many of the scales were from one to three weeks old. The situation of the rust spots along the leaf resembled so closely the position selected by the scales that it suggested the possibility of some relation between the rust and the scales. In view of the fact that fungi are predisposed to attack parts of plants wounded by insects or in other ways, it seems legitimate to conclude that the grass rusts in scale infested meadows would be most likely to settle at places punctured by the scales. The development of rust could not but interfere with the scales upon the same leaf, and death of the scales result indirectly from the presence of the rust. It was an interesting, if not a significant circumstance, that in the Portland meadow the rust was much more conspicuous in the places where there were most egg sacs of the grass scale and where the blades must have been freely punctured by the young scales. Yet on the blades most attacked by the rust no living scales remained. There seemed to be no practical way of obtaining reliable data in this case, but there would be nothing extraordinary in a reduction of scales through the weakening of the host plant by fungus agencies. Such a remedy, however, would prove a severe one for the hay crop.

Predaceous Insects.—Large numbers of fresh egg sacs were frequently observed (1904 and 1905) to be torn open near the end or at the side, and a considerable portion of the eggs in such cases would be missing. This seemed to be the work of some predaceous insects, but none were observed in the act.

Overcrowding.—Sometimes more young scales than one leaf could possibly support are found crowded upon a single blade. In such cases death of some of the scales must result, or a drying of the blade which would cause the death of all the scales upon it.

Parasites.—Nor are parasites lacking. For one test lot nearly two quarts of egg sacs were collected August 1, 1904, in a meadow near Portland. On August 3, such numbers of the minute larvæ hatched and swarmed over the jars that it seemed improbable that parasites were present to any appreciable extent. Two days later, however, parasitic hymenoptera began to emerge. There were more than 100 of these, among which a new species of *Eunotus* and a species of a new genus were about evenly represented, and there were a few of a new species of *Microterys.* About 30 parasitic dipterons, *Leucopis nigricornis* Egger., a European species, also emerged from this lot. Less than 150 parasites from many thousand sacs, however, would not mean an extended diminution of the scales for that generation.

The following year, 1905, about the middle of August, egg sacs were collected near Orono for greenhouse observations. These were too extensively parasited to yield a sufficient number of larvæ for the experiments planned. From 262 sacs collected about the same time from the Isle of Springs, 98 hymenopterous parasites emerged. No dipterous parasites appeared in this collection.

This will suffice to show that among the natural agencies that tend to check the increase of cottony grass scale, parasites are especially efficient. A list of the parasites reared during two years' observation of Maine material is given on a subsequent page.

NATURE OF INJURY.

Like plant-lice and other hemipterous insects, scales weaken their host plant by piercing the tissues with their sharp pointed beaks and sucking the sap. Sometimes as many as 10 or 12 egg sacs are found attached to one blade, which means that for weeks, 10 or 12 scales have been draining sap from that blade. Where the infestation is excessive the result is dead grass and brown plots here and there through the field. Where the infestation is less serious, it still means a shrinkage in the hay crop corresponding to the amount of grass which has been impoverished through the loss of sap. During 1904 and 1905 the places of worst infestation in certain Portland meadows were revealed by irregular brown areas of dead grass.

REMEDIAL MEASURES.

The point in regard to the life history of this insect which is most significant in view of remedial measures is that the scale passes the winter in the egg stage within the white egg sacs attached to the grass blades, well up above the ground. Thus a spring burning of the infested grass land will destroy the whole generation unhatched, without injury to the grass. In some instances this will mean a burning over of more than 50 acres, but in some the infestation is as yet restricted to spots a few rods square here and there in the meadows. It is advisable in districts where the scale has been especially conspicuous to burn the grass along roadsides and in neglected corners, either in the early spring or in the fall, so that such places will not serve as breeding places for the scale.

It is not improbable that if the fields should be left to themselves the parasites, or other natural agencies, would in time master the scales and the grass lands contain only scattered scales which would do practically no harm. As it is quite impossible to predict whether such an adjustment, were it to come about, would take 2 years or 20, it is certainly much safer to relieve the parasites of the responsibility and burn over the badly infested grass lands. Owners of grass lands can with comparative ease control the situation, and failure to destroy the pest is likely to place a heavy tax upon the hay crop in the infested districts.

A practical demonstration of the worth of this remedial measure was given on Deer Isle last spring (1905). The meadows there had been seriously attacked by the grass scale for several years. During the summer of 1904 the hay crop was reckoned at a third less than the usual amount and the hay was reported to be inferior in quality. Several of the fields were burned over the following spring. Concerning this, one of the meadow owners writes about October twentieth, "We have hardly seen a scale since burning the land last spring. The hay crop was unusually large and we think it did the land good to burn it over."

LIFE HISTORY NOTES.

Description and Habits.—The white egg sacs, appearing like "a strange fungus" attached to grass blades, are what have attracted attention to the cottony grass scale. This is not a stage of progressive injury, but of quiescence. The eggs deposited by the fall brood of scales winter in the protective oval cases. The active larvæ emerge during the warm spring days and seek a suitable grass blade. That they are able to travel for a considerable distance at this time was proven by the sprightly journeys of these microscopic creatures in the laboratory. In confinement as many as 50 have been observed to settle upon one grass blade. (Figures 2 and 3). In the field a single blade with 12 full sized egg sacs is sometimes found, though the number is usually much less. Probably more than 12 could scarcely mature upon one leaf, but 20 to 30 young scales to the blade were not at all an unfrequent occurrence in Portland meadows. Once accepting a favorable location, the young scale must abide by its decision, for after piercing the blade with its minute beak the insect becomes stationary, the legs atrophy and a little clear delicate scale rests flat upon the blade, continuously draining the plant of sap. The scales invariably settle head down the blade, sometimes on the under side but more frequently on the upper surface. What the physiological effect would be of imbibing constantly for 6 to 11 weeks in this position might seem a trifle uncertain as a matter of conjecture, but it certainly works all right as a practical demonstration and when the time finally comes to secrete the egg sac, the advantages of this peculiar habit become evident. During July when the scale has attained full size, a snow white felty covering of curly filament is secreted, fitting closely over the entire body. If the secretion is removed before the female has begun to deposit eggs a plump, smooth, oval, slightly pink, object is found to be quite filling the closed sac. When it begins to deposit eggs, the female scale pushes the anterior end of its body through the sac in front, breaking open the end pointed downward. Then slowly contracting as the eggs are laid, the scale becomes, by the time the sac is filled with eggs, a shrivelled helpless object already nearly dead. Sometimes it remains in the opening forming a plug for the sac, but more often it drops to the ground.

The oval sac is usually slightly more than quarter of an inch in length. One fair sized sac contained 740 pinkish yellow eggs. The closed end being directed uppermost, the eggs are more thoroughly protected than otherwise would be the case. Enough filaments of the sac are scattered among the eggs to hold them in place.

The eggs of this summer generation hatch in July and August, and the scales mature in the fall, secreting before winter (in October and early November for Maine) sacs in which the eggs remain until spring.

The Male Scales.—No adult males were captured during the two seasons. Three male pupæ were found among 136 mounted scales taken from grass blades in Portland, August 17, 1904. The wing pads, antennæ and legs were distinct in all. One was more nearly mature than the others and seemed about to emerge. Most of the female scales mounted at this time range from 1½ to 3 millimeters. The male pupæ are less than 1½ millimeters long, while a full grown female scale often measures a little over 6 millimeters. The male scales would naturally be expected to appear before the females begin to secrete the cottony covering.

Number of Generations.—From the middle of July to August 4, 1904, freshly formed egg sacs as well as egg sacs from which larvæ were emerging were collected in great numbers at Gorham, Portland, Dresden, and along the Eggemoggin Reach. From the middle of October to November 3, 1904, the females were observed to be secreting egg sacs and depositing eggs in fields near Orono, Portland, and Sedgwick, and unhatched egg sacs were gathered in Portland, November 22, 1904.

Field data, and material sent to this station during 1904 were sufficient proofs of two generations, the first maturing and secreting egg sacs in July and the first of August, and the second depositing eggs (in sacs as before) during late October and early November. In this egg stage the insect winters, the young scales emerging in the spring.

Life Cycle.—On several occasions, from sacs gathered from different parts of large fields on the same day and kept in jars in the laboratory, all the larvæ emerged within a few days of each other. Thus it seemed probable that the life cycle was passed with considerable evenness and regularity. But this conclusion was contradicted by the circumstance that on August 1-4, 1904, there were found, within a few feet of each other, sacs in which the eggs were not yet hatched, others from which larvæ were emerging and scales of various sizes ranging apparently from one to three weeks in age.

There was no way to tell from field observations as to the exact length of the scale life, so April 12, 1905, egg sacs were gathered for laboratory observations. Many of these were hatched April 28 and the larvæ were liberated upon transplanted June grass sod in the greenhouse. They settled upon the grass readily, over 50 placing themselves upon single blades in some cases. In about two weeks when the scales were well established the sod was again transplanted to cold frames where the conditions were much as they would be in the open field. They were exposed to much cold weather and considerable rain. On July 12 nine plump sacs newly filled with eggs were picked. It had been 11 weeks from the hatching of the scale to the deposition of eggs within the sac. Some of the scales in this lot were not so far advanced and had not begun to deposit eggs, although the scales were covered with a thin cottony secretion.

An interesting check to these observations was found in a second lot which had developed in the greenhouse upon redtop. The newly hatched larvæ were liberated on June 16. On July

19, they were secreting the white sacs and were as far advanced as the slower portion of the cold frame lot, which were 11 weeks old.

As the foregoing observations show, the time required for development depends much upon the temperature, and it seems fair to conclude that a long hot season might give opportunity for 3 broods where the scales are favorably situated. A cold wet summer would probably preclude the development of more than two broods. This seems to be the usual number for Maine, but with such circumstances as scales within a few feet of each other ranging from one day to at least a month in age it would be difficult to be sure that 3 generations were not a frequent occurrence in warm sunny fields.

A simple test was made with 3 lots of eggs as to their power to withstand cold under unnatural conditions.

On April 28, two sealed jars containing egg sacs from which the larvæ were beginning to emerge were placed in a refrigerator. These were labeled No. 1 and No. 2. A third jar, No. 3, was filled the same day with egg sacs newly gathered which had not begun to hatch. These jars remained in the refrigerator until June 6 when they were placed in the greenhouse. June 16 the eggs in jar No. 3 began to hatch. The larvæ were liberated among red-top upon which they settled. These developed, secreting egg sacs from the 19th to the last of July. Seven weeks retardation by cold did not injure these eggs. The eggs in jars No. 1 and No. 2 subjected to the same treatment did not hatch. These, however, were just on the point of hatching when they were placed in the refrigerator and were taken at an unfair advantage.

KINDS OF GRASSES INFESTED.

The egg sacs collected in Maine have been upon June grass, *Poa pratensis,* and red-top, *Agrostis alba.* Where specimens have been sent in on broken bits of grass, as is frequently the case, identification of the host was of course impossible; but so far as the observations of the past two seasons have gone, these are apparently the only two infested grasses yet reported for Maine.

PARASITES.

A large number of egg sacs was collected from June grass in a meadow near Portland the first of August, 1904. For the most part the material was cut close to the sacs, with only a bit of the grass blade left attached. There was included, however, a little infested grass, cut stalk and all, a circumstance which will doubtless account for the presence (in the list appended) of *Lasioptera* and *Isosoma,* insects of grain, or grass-stalk inhabiting proclivities. The single specimen of *Eupelmus* may not necessarily, therefore, have been parasitic upon the grass scale itself. Considering the fact that some species of *Oscinis* are stem maggots and that the larvæ of many species of the same genus are reported as preying upon Coccidae,* the economic position of the two specimens of this insect may also be open to question at present. The remaining species, however, are bred from egg sacs of *Eriopeltis festucæ.* No. 11 and No. 12 were reared from material collected on Isle of Springs, August 9, 1905.

These insects were submitted to Dr. L. O. Howard, chief of Bureau of Entomology, U. S. Department of Agriculture, whose kindness in examining them makes this report possible. All of the Hymenoptera were examined by Dr. W. H. Ashmead, U. S. National Museum, to whom thanks is also due. The following insects are listed as Dr. Howard reported them, except for the addition of the number of specimens reared in each case.

No. 1. *Leucopis nigricornis* Egger. 30 specimens.
2. *Eunotus* n. sp. 36 specimens.
3. New genus near *Phaenodiscus* in Mirini. 32 specimens.
4. *Microterys* n. sp. 4 specimens.
5. Probably males of No. 3. 18 specimens.
6. *Lasioptera* sp. 1 specimen.
7. *Eupelmus* sp. 1 specimen.
8. *Isosoma* sp. 1 specimen.
9. *Lasioptera* sp. 1 specimen.
10. *Oscinis* sp. 2 specimens.
11. *Eunotus* n. sp. How. Many specimens.
12. *Eunotus* n. sp. How. Many specimens.

* U. S. Dept. Agr., Div. of Ent., Bul. 32, p. 35.

BIBLIOGRAPHY.

The published accounts of this insect are meagre, as little attention has been paid to it.

An interesting popular description of *Eriopeltis festucæ* given by Mr. E. A. Butler in Knowledge, July 2, 1894, p. 148, reads as follows:

"This forms little compact oval tufts, like pieces of cotton wool, attached to the stems and blades of certain grasses, and there is certainly nothing whatever in their external appearance to suggest any connection with insects, unless, indeed, they might be cocoons of small ichneumon flies. But a close examination, revealing a number of separate threads standing out in all directions, would soon dispel this idea, and would leave their real nature as problematic as ever. Though apparently not uncommon, they have not long been generally known in this country (England) having previously, no doubt, been overlooked, partly because of the little attention that was until recently paid to the Coccidæ, and partly because of the completeness of their disguise. They seem to have been first noticed in this country in 1856, when there is a reference to them in the *Proceedings of the Entomological Society of London;* but that was soon forgotten, and they passed out of knowledge till 1885, when Mr. Q. C. Bignell again called attention to them."

Dr. James Fletcher, in his report of the Canadian Experimental Farms for 1895, (Ottawa, 1896) pp. 145-147, gives an account of an outbreak of the cottony grass scale with references to literature.

Following are references to the Genus Eriopeltis as corrected by Mrs. C. H. Fernald from her catalogue * of the Coccidæ of the World.

GENUS ERIOPELTIS Sign. Type, *lichtensteinii.*

Eriopeltis, Sign., Ann. Soc. Ent. Fr., (5), i. p. 429 (1871): Ckll., Can. Ent. xxxi, p. 332 (1899).

1. ERIOPELTIS BRACHYPODII Giard.

Eriopeltis brachypodii Giard, Bull. Soc. Ent. Fr., (7), iii, p. cxcix (1893).

* Mass. Experiment Station, Bulletin No. 88.

Eriopeltis brachypodii Butler, "Knowledge," p. 148 (1894).

Eriopeltis brachypodii Fletcher, Rep. Can. Exp. Farms, p. 146 (1896).

Habitat.—France.

On Brachypodium pinnatum.

2. ERIOPELTIS FESTUCÆ (Fonsc.).

Coccus festucæ Fonsc., Ann. Soc. Ent. Fr., iv. p. 216 (1834).

Coccus fectucæ Kalt., De Pflanz., p. 747 (1874).

Eriopeltis festucæ Sign., Ann. Soc. Ent. Fr., (5), ix, p. 46 (1879).

Eriopeltis festucæ King, Can. Ent., xxxiii, p. 197 (1901).

Eriopeltis festucæ Butler, " Knowledge," p. 148 (1894).

Eriopeltis festucæ Fletcher, Rep. Can. Exp. Farms, p. 146 (1896).

Habitat.—Europe; Nova Scotia; Canada; Illinois; Indiana; Dakota.

On Festuca cæpitosa; F. phœnicioides.

3. ERIOPELTIS LICHTENSTEINII Sign.

Eriopeltis festucæ Sign. (non Fonsc.) Ann. Soc. Ent. Fr., (5), i, p. 430 (1871).

Eriopeltis lichtensteinii Sign., Ann. Soc. Ent. Fr., (5), vi, p. 607 (1876).

Eriopeltis lichtensteinii Sign., Bull. Soc. Ent. Fr., (5), vii, p. xxxvi (1877).

Eriopeltis festucæ Sign., Bull. Soc. Ent. Fr., (5), vii, p. xxxvi (1877).

Eriopeltis festucæ Bignell, The Entom., xviii, p. 286 (1885).

Eriopeltis lichtensteinii Dougl., Ent. Mon. Mag., xxiv, p. 166 (1887).

Eriopeltis lichtensteinii Newst., Ent. Mon. Mag., xxvii, p. 165 (1891).

Habitat.—France; Holland; England; Scotland.

On Festuca spp. and other grasses.

EXPLANATION OF PLATES.

Cottony Grass Scale. *Eriopeltis festucæ* (Fonsc.).

Figure 1. Egg sacs on Red-top.

" 2. Upper surface of June-grass blade. Enlarged. Showing the number and position of young scales on May 10, 1905, twelve days after the active larvæ were liberated in greenhouse.

" 3. Under surface of same blade on same date.

" 4. Active larva x 120. Ventral view. Showing normal insect appendages.

" 5. Young scale x 44. Ventral view. Scale taken August 17, 1904. Showing atrophied condition of antennæ and legs.

" 6. Egg x 80.

" 7. Full grown female scale. Natural size. Removed from sac before any eggs were deposited.

" 8. Pupa of male scale x 55. Taken August 17, 1904.

Fig. 1.

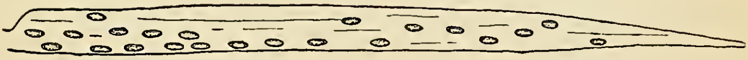


Fig. 2.

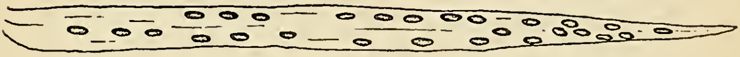


Fig. 3.

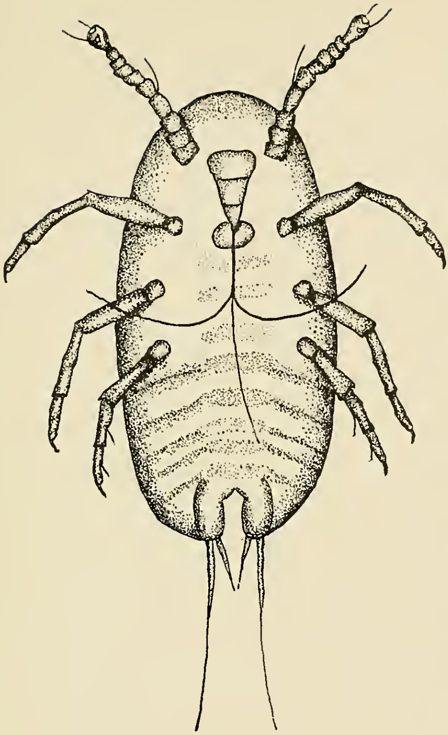


Fig. 4.

Fig. 5.

Fig. 7.

Fig. 6.

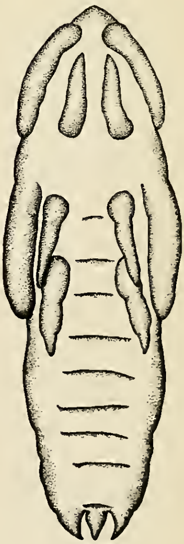


Fig. 8.

EXPERIMENTS IN ORCHARD CULTURE.

SECOND REPORT.*

W. M. MUNSON.

It has been estimated that the average value of the fertilizing elements taken from an acre of soil by apple trees during the period of 20 years, counting in ten crops of fruit, is approximately $377. Of this amount $147, or a little less than 39 per cent, is in the fruit; $160, or about 42 per cent, in the leaves; and $70, or about 19 per cent, in wood for the growth of the tree. The total amount of nitrogen, exclusive of that used in the growth of the trees, is about 1,300 pounds, of phosphoric acid 310 pounds, of potash 1,900 pounds per acre.

"To restore the potash alone as above, and that used by the growth of the tree, it would require 21.7 tons of high grade ashes containing 5 per cent potash. To restore the nitrogen would require 16.2 tons of a commercial fertilizer containing 5 per cent nitrogen." † In view of these facts, and also of the large amounts of fertilizing elements removed by crops of hay or grain, or by pasturing the orchard without giving extra feed to the animals, it is not strange that many of the orchards of Maine are deteriorating.

Of course, the fact should be taken into account that a portion of the material above referred to is returned to the soil in the way of fallen fruit and leaves and in the excrement of the animals, but with a liberal allowance for these returns the value of fertilizing elements actually removed from the soil during the period named will probably not fall short of $200, or $10 per acre per year.‡

As often urged in the publications of this Station, thorough tillage is one of the surest ways of rendering available the plant

* First Report see Bulletin 89, 1903.

† Roberts, Bul. 103, Cornell Exp. Sta.

‡ A recent valuable contribution to the literature of this subject is Bul. 265, N. Y Agr. Exp. Sta. (Geneva).

food which is naturally contained in the soil. It may be added that apple trees are well suited to abstract this natural store of fertility; but there is a limit beyond which the tree cannot go without help.

In studying the methods of fertilizing orchards, the same general principles will apply as in the management of other farm crops. The essential constituents must be the same; but unlike ordinary farm crops, orchard crops do not give an opportunity for rotation. A certain amount of nitrogen is essential to the vigorous foliage upon which depends the life of the tree. Potash also is important, not only because it constitutes a large part of the ash of fruit trees and more than half of the ash of the fruit itself, but also, as suggested by Voorhees, because it forms salts with the well known acids. Lime, as also pointed out by Voorhees, "seems to strengthen the stems and woody portion of the tree, to shorten the period of growth and to hasten the time of ripening. Fruit trees growing on soils rich in lime show a stocky, sturdy, vigorous growth, and fruit ripens well; while those on soils which contain but little lime, particularly the clays, appear to have an extended period of growth, the result of which is that wood does not mature and the fruit does not ripen properly." *

Culture and Fertilization.

In Bulletin 89, February, 1903, was published an outline of certain experiments relative to the culture and fertilization of orchards, together with such results as had been obtained. The work in question was conducted upon the farm of Mr. Chas. S. Pope, Manchester, Kennebec county, Maine. The interest evoked by these experiments, and the practical value of the demonstration of approved methods of treatment, have led to a considerable increase in the scope of the work and to the extension of operations with other growers. As in the past, much credit should be given to Mr. Pope for his faithful and hearty coöperation. The present report extends and supplements the report in Bulletin 89, and as little repetition is made as is consistent with clearness.

The comparative study of cultivation and mulch as treatment for a young bearing orchard is continued along the lines origin-

* Trans. Mass. Hort. Soc'y, 1896.

DIAGRAM OF THE ORCHARD.

Explanation of Diagram: The significance of the figures in the above diagram s as follows: ● = trees bearing in 1902; • = trees not bearing in 1902; × = vacancy: * = Bellflower tree; R = Roxbury Russet; B = Ben Davis.

ally planned. Forty trees are kept in cultivation and forty mulched; a part of each lot receiving complete fertilizer, part stable manure, and part no fertilizer of any kind.

HISTORY OF THE ORCHARD SINCE 1902.*

In 1902 no fertilizers were applied to any of the trees. The season was moist and the growth was satisfactory.

In 1903 and 1904 the treatment was the same as in preceding years except that the fertilizer used carried 3 per cent nitrogen, 6 per cent phosphoric acid, and 8 per cent potash, and was applied broadcast at the rate of 750 pounds per acre. No stable manure was used in 1904.

In 1905 two-thirds the usual amount of fertilizer was used; that is, 500 pounds was applied broadcast and a good application of stable manure was made to the trees usually receiving this material.

A good crop of fruit has been taken from the orchard every year as shown by the tables included in this report, although there is a marked individuality in the trees as to amount and character of fruit.

The weakness of seedling stocks, mentioned in Bulletin 89, has continued to manifest itself and several of the best trees have died, not because of injury to the Gravenstein or Tolman tops, but because of the inherently weak seedling trunks. This is a striking illustration of the advantage of using some well known, hardy, vigorous sort as the foundation of an orchard, rather than miscellaneous seedlings even though they be home grown.

GROWTH AND CONDITION OF TREES.

The accompanying table, compiled from field notes taken each year, will convey an exact account of the growth of the trees from year to year. Numbers 1-12 and 41-52 inclusive have received no fertilizer of any kind. But the first mentioned trees were cultivated, while the second were mulched, as shown in the diagram. Numbers 13-24 and 53-64 respectively are Tolman. The remainder are Gravenstein, with the exceptions noted in the column of "Remarks," and numbers 42, 46, 50, 66, 70, 74 and 78, which are Tolman.

* For a history of the orchard up to the close of 1902, see Bulletin 89.

Annual Growth of Trees in Cultivated Area.

Number of tree.	Growth in inches.* 1902.	1903.	1904.	1905.	Average growth in inches for four years.	Remarks.
1	6- 8	4- 6	4-6	3- 4	4 - 6	Hurt by cold, 1904-5.
2	6- 8	3- 5	1-2	0	3 - 4	Hurt by cold, 1904-5—nearly dead.
3	8-10	5- 7	2-3	2- 4	4 - 6	In excellent condition.
4	6- 8	5- 7	3-5	3- 6	4 - 6½	In excellent condition.
5	8-10	6- 8	4-6	6- 8	6 - 8	Top partly killed by cold, 1904-5.
6	4- 6	1- 2	0	0	1 - 2	Nearly dead.
7	8-10	3- 4	3-4	1- 3	4 - 5	Defective stock.
8	10-14	10-12	5-6	8-10	8 -10½	Injured a little in center of top.
9	8-10	4- 6	3-6	3- 6	4½- 7	Injured a little in center of top.
10	10-12	6- 8	6-8	8-10	8½- 9½	Vigorous; a good tree.
11	6- 8	4- 6	2-4	2- 4	3½- 5½	Defective stock.
12	10-12	7- 9	5-7	5- 7	8 - 9	Vigorous, healthy; a fine tree.
					5 - 6½	*Average annual growth for the twelve trees.*
13	8-10	4- 6	4-6	3- 4	5 - 6½	Vigorous.
14	8-10	8-10	5-6	7- 9	7 - 9	A very fine tree.
15	8-10	5- 7	1-2	6- 8	5 - 7	Doing well.
16	4- 5	8-10	7-9	7- 9	6½- 8	Doing well.
17	8-10	6- 8	4-6	6- 8	6 - 8	Doing well.
18	6- 8	10-12	7	9-10	8 - 9	Extra good tree.
19	6- 8	4- 6	2-3	0	3 - 4	Defective stock.
20	8-10	10-12	3-4	5- 8	6½- 8½	Good tree.
21	10-12	6- 8	6-7	8-12	7½- 9½	Extra good--both tree and fruit.
22	0	......	......	......	......	Dead. (Defective stock; died in 1903.)
23	10-12	10-12	4-6	8-10	8 -10	Extra fine tree.
24	6	10-12	2-3	4- 6	5½- 7	Good tree.
					6 - 8	*Average annual growth; eleven trees.*
25	6- 7	4- 6	6-8	8-10	6 - 8	Doing well.
26	6- 8	5- 7	4-5	6- 8	5 - 7	Doing well.
27	12	7- 9	4-5	1- 3	6 - 7	Half of tree dying.
28	4- 6	6- 8	2-4	1- 3	3 - 5	Dying.
29	6- 8	4- 6	3-6	4- 6	4 - 6	Doing well.
30	6- 8	3- 5	......	0	3 - 4	Nearly dead.
31	10	8-10	3-6	4- 6	6 - 8	Injured in 1904; may be saved.
32	12	6- 8	4-6	5- 7	7 - 8	Good tree.
33	8	3- 5	5-7	1- 3	4 - 6	Good tree.
34	10	8-10	3-6	1- 3	5½- 7	Half of tree dying; trunk defective.
35	6- 8	5- 7	3	6- 8	5 - 6½	Half of tree dying; trunk defective.
36	8	5- 7	4-6	8-10	6 - 8	Doing well.
37	6- 8	6- 8	6	6- 8	6 - 7½	Doing well.
38	7- 8	4- 6	4-6	3- 5	4½- 6	One-third of tree Roxbury Russet. Doing well.
39	8	6- 8	5-7	6- 8	6 - 8	Good tree.
40	......	......	......	......	......	Vacant.
					5 - 7	*Average annual growth; fifteen trees.*

* Fractions less than ½ are disregarded.

Annual Growth of Trees in Mulched Area.

Number of tree.	GROWTH IN INCHES.*				Average growth in inches for four years.	Remarks.
	1902.	1903.	1904.	1805.		
41	8-10	8-10	4-6	8-10	7 - 9	*Ben Davis.* Doing well.
42	4- 6	5- 7	5-7	2- 4	4 - 6	
43	4- 6	3- 5	3-5	2- 4	3 - 5	
44	6- 8	6- 8	4-6	5- 7	5 - 7	
45	8-10	5- 7	3-5	1- 3	4 - 6	Center of top dying; defective trunk.
46	2- 4	4- 6	3-5	2- 4	3 - 5	
47	4- 6	4- 6	3-5	2- 4	3 - 5	
48	3- 6	3- 5	4-5	1- 3	3 - 5	
49	8-10	5- 7	5-6	4- 6	5½- 7	
50	2- 3	1- 3	2-3	1- 3	1½- 3	A weak tree.
51	6- 8	5- 7	4-7	2- 3	4 - 6	
52	2- 3	1- 3	3-5	1- 3	2 - 3	Half of top dying.
					3¾- 5½	*Average annual growth; twelve trees.*
53	6- 8	6- 8	1-3	4- 6	4 - 6	Doing well.
54	3- 5	4- 6	2-3	1- 3	2½- 4	Defective at base.
55	4- 6	6- 8	3-4	4- 6	4 - 6	
56	8-10	8-10	4-6	6- 8	6½- 8½	
57	10-12	7- 9	3-5	6- 8	6½- 8½	*Bellflower.* Fine tree. Excellent fruit in 1904; none 1905.
58	5- 6	7- 9	5-7	3- 5	5 - 7	Doing well.
59	4- 6	8-10	6-8	3- 5	5 - 7	Doing well.
60	5- 6	5- 7	3-5	4- 6	4 - 6	
61	6- 8	7- 9	4-6	3- 5	5 - 7	
62	4- 6	6- 8	3-5	4- 6	4 - 6	
63	8-10	8-10	4-6	4- 6	6 - 8	Particularly good tree.
64	10-12	10-12	5-7	4- 6	7 - 9	Particularly good tree.
					5 - 7	*Average annual growth; twelve trees.*
65	10-12	3- 5	3-5	3- 6	5 - 7	
66	2- 4	4- 6	1-3	1- 3	2 - 4	
67	10-12	8-10	4-6	6- 8	7 - 9	*Roxbury Russet.* Good tree.
68	8-10	8-10	6-8	5- 7	7 - 9	
69	12-14	8-10	4-6	6- 8	7½- 9½	*Bellflower.* Good crop of good fruit, both 1904 and 1905.
70	8	7- 9	3-5	8-10	6½- 8	
71	5- 7	5- 7	1-2	5- 7	4 - 6	*Roxbury Russet.*
72	6- 8	6- 8	5-7	6- 8	6 - 8	Doing well.
73	......	......	......	......	......	Vacant.
74	1- 3	5- 7	1-2	1- 3	2 - 4	Good tree; 4½ bushels (Tolman), 1905.
75	6	6- 8	5-7	8-10	7 - 8	Fine tree; 9 bushels (Gravenstein), 1905.
76	6- 8	6- 8	6-8	6- 8	6 - 8	Doing very well.
77	10-12	6- 8	2-3	4- 6	5½- 7	Two-thirds of tree dead.
78	4- 6	5- 7	3-5	6- 8	4½- 6½	Doing well.
79	8-10	7- 9	5-7	8-10	7 - 9	Fine tree; 8½ bushels, 1905.
80	8-10	7- 9	6-8	8-10	7 - 9	Fine tree; 8¾ bushels, 1905.
					5½- 7½	*Average annual growth; fifteen trees.*

* Fractions less than ½ are disregarded.

Taking the orchard as a whole, there was an average annual growth of from three and one-half to eight inches. The unfertilized trees, in general, made less growth than did the fertilized trees, and the uncultivated than the cultivated. It is noticeable, however, that the Gravensteins which were mulched and fertilized averaged slightly better than those which were cultivated and fertilized. This is, no doubt, due to the partial killing of several of the trees on the cultivated ground. In nearly every case, however, it was the seedling stock which suffered and not the top, though of course the top soon followed. It is also true that the difference in elevation, if any, was in favor of the mulched trees; these being slightly lower, and possibly more moist. Such difference is very slight, however.

In Bulletin 89 the following table was published with the note that: " With a single exception, in which two trees had particularly good advantages, the growth on the mulched areas was less than on corresponding cultivated plats. On cultivated soil there was little increase in growth from the use of either manure or commercial fertilizer; while on the mulched land the growth was noticeably—two to five inches—greater as a result of adding plant food. These facts would indicate that there is enough plant food in the soil to produce a fairly satisfactory growth, if mechanical treatment is such as to render it available, and other plants are not allowed to rob the trees."

Variety.	Treatment.	Growth in inches; unfertilized.	Growth in inches; stable manure.	Growth in inches; commercial fertilizer.
Gravenstein ...	Cultivated	$7\frac{1}{2}$—$9\frac{2}{3}$ (12 trees)	7 —8 (8 trees)	$8\frac{1}{2}$—9 (7 trees)
	Mulched	$5\frac{1}{2}$—$7\frac{1}{2}$ (9 trees)	7 —$8\frac{1}{2}$ (6 trees)	10-12 (2 trees)*
Tolman	Cultivated	....	$6\frac{2}{3}$—$8\frac{1}{3}$ (6 trees)	7 —$8\frac{1}{2}$ (6 trees)
	Mulched	$2\frac{2}{3}$–$4\frac{1}{3}$ (3 trees)	$6\frac{1}{2}$–$8\frac{1}{3}$ (6 trees)	5 —$6\frac{1}{2}$ (5 trees)

* These trees were in a slight depression and next to the cultivated area.

The record of succeeding years has justified the statement there made. For several years the unfertilized trees held their places both as to growth and as to yield, but during recent years the need of additional plant food has been manifest, even on the cultivated areas. The average growth of the same trees for the past two years has been as follows:

Variety.	Treatment.	Growth in inches; unfertilized.		Growth in inches; stable manure.		Growth in inches; commercial fertilizer.	
		1904.	1905.	1904.	1905.	1904.	1905.
Gravenstein ...	Cultivated	3 —4¾	3½—5	4 —5½	4 —6	3⅔—5⅓	4½—6½
	Mulched	3⅔—5½	2¼—4	5½—7½	7 —9	2½—4	3½—6
Tolman	Cultivated	....	....	5¼—6¼	6½—8¼	3 —4½	5 —7
	Mulched	3⅓—5	2 —4	4¼—6	4¼—6¼	3 —5	3 —5

These figures, when compared with the preceding table, indicate a decided falling off in the growth of the unfertilized trees, especially in the uncultivated plat. On the fertilized plats a part of this falling off in wood growth is of course due to the fact of the annual crops of fruit which have been produced. This reason is less applicable to the unfertilized trees, as they have borne less regularly. The low average growth of Gravenstein on the cultivated area as compared with the mulched trees, is due to the injury to some of the trees, as before mentioned. In the absence of injury, which was an individual matter, the cultivated trees made a larger growth than the others, as may be seen by referring to the tables on pages 185 and 186.

THE QUESTION OF YIELDS.

In 1902, the first bearing year of this young orchard, the following results—irrespective of fertilizers—were obtained:

Gravenstein—Cultivated, 19 bearing trees, averaging .72 bbl. per tree; mulched, 14 bearing trees, averaging .59 bbl. per tree.

Tolman—Cultivated, 9 bearing trees, averaging .44 bbl. per tree; mulched, 6 bearing trees, averaging .50 bbl. per tree.

In case of the Gravenstein, there was a decided difference both in number of bearing trees and in average yield per tree in favor of cultivation. With the Tolman the difference was less marked.

It is planned to keep an exact record of the yield of each tree in the orchard every year. By accident, however, the records of the Gravensteins were unsatisfactory for a part of the time, and there is given below only the record of the Tolmans.

Cultivation vs. Mulch—Annual Yields.

Number of tree.	1902.	1903.*	1904.	1905.	Remarks.
			CULTIVATED.		
			Bush.	Bush.	
13	Good	....	3.0	2.0	
14	Good	....	2.8	6.5	
15	Small..........	....	1.0	2.4	
16	....	....	0.5	1.9	
17	Medium	....	1.8	4.0	
18	Medium	....	2.0	7.0	
19	Small..........	....	1.2	2.5	
20	Small..........	....	.5	4.8	
21	Full	....	4.0	5.0	Extra; both tree and fruit.
22	Full	....	....	....	Dead.
23	Small..........	....	1.3	7.6	
24	Small..........	....	.3	.0	
	Total	....	18.4	43.7	
			MULCHED.		
53	Small..........	....	.8	4.5	
54	....	....	.0	0.0	
55	....	....	1.2	2.5	
56	....	....	3.0	4.2	
57	Small..........	....	Full ...	Medium	Bellflower.
58	....	....	5.0	2.5	
59	....	....	1.8	1.7	
60	Medium	....	1.8	3.0	
61	Medium	....	2.6	2.2	
62	....	....	1.0	3.2	
63	Small..........	....	3.5	3.2	
64	Small..........	....	1.3	4.0	
	Total	....	22.0	31.0	

* By an accident the records of 1903 were rendered useless and are omitted. There was a fair crop on most of the trees.

With the exception noted, the above trees are now all in prime bearing condition and yield satisfactory annual crops. In Bulletin 89 the statement was made that, " With Tolman the number of bearing trees is greater by one-half on the cultivated area, but the average yield is slightly less. Most of the fruit on the cultivated area came from four trees; the remaining trees, in most cases, not having half a peck each." The same general ratio existed for the next two years. In 1904 the total yield from eleven trees on the cultivated plat, as shown by the table, was 18.4 bushels, or an average of 1.7 bushels per tree; while on the mulched area, for the same number of trees, the total yield was 22 bushels, or an average of 2 bushels per tree.

In 1905, however, the relative advantage of cultivation becomes evident when it appears that there is a total of 43.7

bushels, or an average of 4 bushels per tree on the cultivated trees, as compared with 31 bushels, or an average of 2.8 bushels per tree where mulching was used.

By reference to the diagram of the orchard, page 183, it may be seen that much better returns have, as a rule, been obtained from those trees upon which stable manure has been used. For example, trees 13, 14, 17, 18, 21 and 22, on the cultivated plat, received stable manure and produced an average of 2.7 bushels per tree in 1904, and 4.9 bushels in 1905; while the others, receiving commercial fertilizers, gave an average of .8 and 3.4 bushels for the two years respectively. On the mulched area similar results followed. Trees 55, 56, 59, 60, 63 and 64, received stable manure and gave an average of 2.1 and 3.1 bushels for the two years; while the other trees, receiving commercial fertilizer, yielded an average of 1.9 and 2.5 for the two years. These facts are given without further comment. Future management of the orchard will of course be governed by the lessons learned.

The Potash Orchard.

The study of the specific influence of different potash salts upon the apple is continued as in former years. The treatment is as detailed in Bulletin 89; but the need of additional nitrogen being evidenced by the growth of the trees, an application of 350 pounds per acre of nitrate of soda, and of about 650 pounds per acre of acid phosphate was made in 1904, besides the usual excessive application of potash salts. The season being very dry, the trees did not profit much by this application and it was repeated in 1905, with marked advantage.

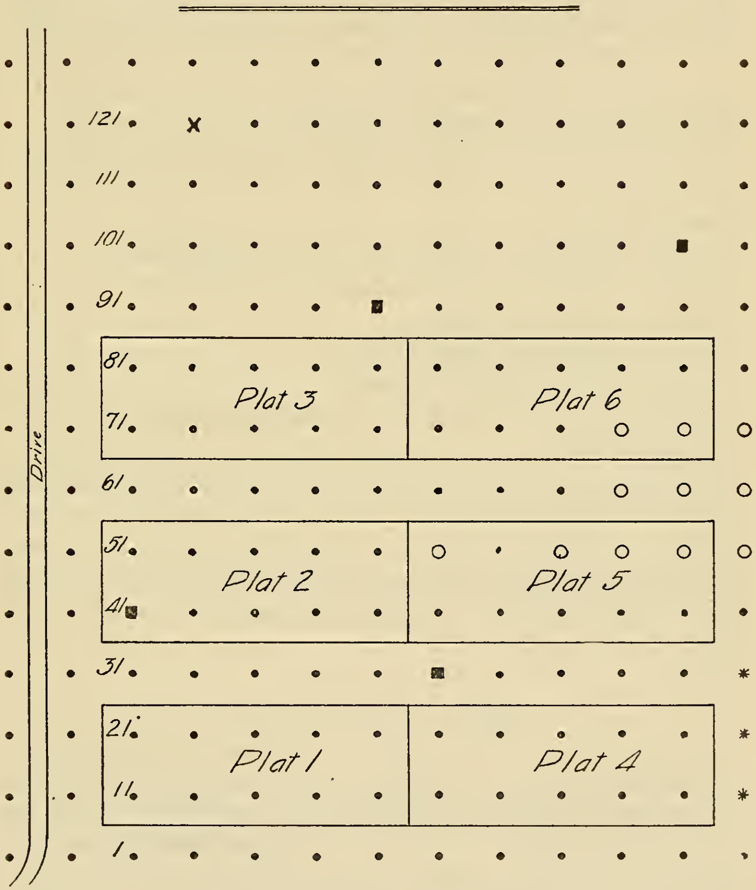
The severe winter of 1904-5 worked serious injury to some of the trees but as a result of the fertilizing and the cultivation given, most of them have started a vigorous new growth, and fruit buds are well developed for next year.

Without going into details at this time, it may be said that there is no noticeable difference in the character of fruit or of the behaviour of the trees as a result of the form of potash used. The work will be continued further, however.

Orchard Renovation.

In 1902, because of the manifestly favorable results following the treatment given the orchards above referred to, one hundred trees were set apart for specific experiments in the renovation of an old orchard. The trees in question were about thirty-five years old, planted on the western slope of a dry gravelly hillside. They were divided into six groups, with appropriate check trees, as indicated in the accompanying diagram.

ORCHARD RENOVATION.—DIAGRAM OF THE ORCHARD.



TREATMENT OF THE ORCHARD.

The history of the orchard, as given in Bulletin 89, is as follows: "The soil is a light sandy loam, 6-8 inches deep, with gravelly or sandy subsoil. The trees were set in 1866-70 in a cultivated field which had previously produced corn, wheat, and general farm crops; but after a very few years the orchard was used as a sheep pasture, the trees being frequently mulched while young. No further attention was given the trees, save an occasional slight pruning, until May, 1892, when the whole orchard received an application of bone and muriate of potash. The same summer hogs were turned in, and they thoroughly stirred the soil and started the trees into vigorous growth. A very large crop of fruit was produced in 1893 and again in 1896, but since that date the trees have done practically nothing. Since 1892 the orchard has received no treatment except spraying, until the present year when a portion of it, as indicated in the diagram, was thoroughly tilled and variously fertilized."

The fertilizers used in 1902, 1903 and 1904 were as follows:

Plat 1—Muriate of potash 75 lbs; acid rock 75 lbs; nitrate of soda 50 lbs.

Plat 2—Muriate of potash 75 lbs; acid rock 75 lbs.

Plat 3—Nitrate of soda 50 lbs; acid rock 75 lbs.

Plat 4—Acid rock 75 lbs.

Plat 5—Muriate of potash 75 lbs.

Plat 6—Nitrate of soda 50 lbs.

In 1905 the same materials were used, but only two-thirds the amount of each.

The orchard has been plowed every spring and harrowed at intervals during the summer. The effects of the culture and feeding are evident as far as the orchard can be seen from surrounding hilltops; and the satisfactory annual crops of fruit more than illustrate the practical importance of systematic orchard management.

RESULTS OF TREATMENT.

At the close of the first season's treatment it was stated (see Bulletin 89, p. 19): "As might be expected, the plat receiving a complete fertilizer presented the best appearance at the end of the growing season. The use of nitrogen alone increased the growth to a marked degree (though less than the complete fertilizer) but there was a noticeable lack of color in the fruit. Trees on the plat receiving acid rock alone, in general, seemed no better than the check trees which were cultivated but not fertilized. Potash alone, on the other hand, produced a distinct improvement."

These impressions have been confirmed by the work of succeeding years, particularly as to the effect of the complete fertilizer and the nitrogen. The lack of color upon the fruit from trees receiving an excess of nitrogen is specially noticeable.

In 1904 a very serious injury to both tree and fruit was apparently the result of a too free use of nitrogen, either alone or in the absence of potash. The foliage dropped, the fruit cracked, and much of it dropped, while the remainder was as soft and mealy in October as it should have been the following May. This is referred to in another connection.

YIELD OF FRUIT—RENOVATED ORCHARD.

Since the first year of treatment, this orchard has made a good growth and has yielded annual returns of fruit. Not every tree has borne every year, for there is a decided individuality among trees given precisely the same treatment; but from the record of fruiting given below it is evident that the so-called "off year" in case of the Baldwin is an unnecessary condition,—a condition which the up-to-date orchardist will not permit to exist.

Without attempting to draw conclusions, at present, there are certain interesting facts brought out by the tables on pages 194 and 195. The best general results are seen to follow on plat 1, complete fertilizer; but there are notably good individual trees upon the other plats (see figure 10) and among the check trees. Taking at random some of the trees in the orchard, it will be seen that tree 11 in 1903 produced 4.5 barrels of fruit; in 1904, 1 barrel; in 1905, 2.8 barrels. Tree 25 produced 8.5, 4, and 5.8 barrels for the three years respectively. Tree 53 gave 5, 2.7 and 3.3 barrels, and so on. On the other hand, tree 43 has a record for the three years of 0, .7 and 0. Tree 75 is gradually improving, the record for the three years being 0, .8 and 1 barrel, respectively.

The check trees adjoining plats III and VI are noticeably productive; which fact may be due to sending their roots across into the adjacent plats.

Certain of the trees have been indicated as being of specially good type; these are watched from year to year to see if the character is permanent. If so, these trees become specially valuable as a source from which to obtain cions in top-working a young orchard.

These notes are to be regarded more as a report of progress than as data from which to draw definite conclusions.

Orchard Renovation—Annual Yield.

Plat and number of tree.	Yield per Tree, in Barrels. 1903.	1904.	1905.	Remarks.
Plat I. Tree No.				
11	4.5	1.0	2.8	
12	3.5	0.0	2.6	
13	3.5	3.3	2.4	
14	2.0	3.0	3.4	
15	6.5	1.7	3.0	
21	3.0	2.8	1.9	
22	3.0	6.0	1.0	
23	4.0	1.6	3.2*	*Extra good fruit, 1905.
24	.5	3.0	.6	
25	8.5	4.0*	4.8*	*Extra good fruit.
Check Row Tree No.				
31	3.5	6.1	.1	
32	5.0	3.9	2.1	
33	1.5	2.0*	2.1	* Extra good type.
34	1.5	4.2	0.0	
35	1.5	1.7*	1.5	* Extra good type.
Plat II. Tree No.				
41	....	....	....	Vacant.
42	3.0	8.7	0.0	
43	0.0	2.5	0.0	
44	3.5	4.1	0.0	
45	1.0	5.4	1.2	
51	4.5	5.9*	2.4*	* Extra good type of frui
52	1.0	3.4	0.0	
53	5.0	2.7*	3.3	* Extra good type
54	.5	4.7	0.0	
55	.5	3.7	.1	
Check Row Tree No.				
61	....	1.5	0.0	
62	2.5	3.8	0.0	
63	1.0	4.5	.1	
64	1.0	6.4	0.0	
65	2.0	4.0	0.0	
Plat III. Tree No.				
71	5.5	.4	2.1	
72	6.5	.0	3.4	
73	1.5	.4	1.7	
74	1.0	1.5	.5	
75	0.0	.8 †	1.0	
81	6.0	2.9	1.5	† Nearly all the fruit on this plat dropped early, in 1904, remainder was soft and worthless as in April or May.
82	2.5	1.0	3.2	
83	3.5	1.5	2.6	
84	4.0	.9	4.8	
85	4.0	1.1	4.1	
Check Row Tree No.				
91	....	3.5	.6	
92	....	1.8	.5	
93	....	3.0	2.3	
94	....	5.4	3.6	
95	....	4.1	....	

Orchard Renovation—Annual Yield—Concluded.

Plat and number of tree.	Yield per Tree, in Barrels.			Remarks.
	1903.	1904.	1905.	
Plat IV. Tree No.				
16	1.5	1.3	1.0	
17	2.0	6.5*	.5	* Extra good type.
18	.0	.4	.9	
19	0.0	2.5	.7	
20	7.0	5.8*	1.3	* Extra good type.
26	.0	2.5	.1	
27	1.5	5.0	1.9	
28	.0	3.7	.4	
29	.0	5.1	2.3	
30	4.0	2.4	3.4	
Check Row Tree No.				
36	....	....	....	Vacant.
37	.0	5.0	.2	
38	.0	2.4	1.0	
39	.0	5.8	.3	
40	.0	.4	.1	Almost dead.
Plat V. Tree No.				
46	2.0	4.2	.0	
47	5.0	5.8	3.4	
48	.0	2.2	1.6	
49	.0	2.5	1.2	
50	.0	1.8	1.0	
56	....	....	....	Gravenstein.
57	.0	.0	.9	Tree broken; only one limb, extra fine fruit.
58	....	....	....	Gravenstein.
59	....	....	....	Gravenstein.
60	....	....	....	Gravenstein.
Check Row Tree No.				
66	1.5	2.4	1.6	
67	2.0	2.3	.8	
68	2.5	1.3	.2	
69	....	....	....	Gravenstein.
70	....	....	....	Gravenstein.
Plat VI. Tree No.				
76	3.0	1.0	1.0	
77	6.5	0.0	1.3	
78	.0	.0	.1	
79	....	....	....	Gravenstein.
80	....	....	....	Gravenstein.
86	3.0	.7 †	1.6*	* Also .8 bbl. Starkey on portion of tree.
87	4.0	.0 †	2.8	
88	3.5	2.8 †	3.5	† Condition of this fruit similar to that of plat
89	.0	1.1 †	.5	
90	1.0	3.2 †	.9	
Check Row Tree No.				
96	....	7.0	.0	
97	....	2.6	1.0	
98	....	3.4*	2.0	*Extra good fruit.
99	....	.5	1.0	
100	....	4.2	1.1	

The Fisher Formula.

In response to a demand for definite information as to the merits of a highly nitrogenous fertilizer made after what is known as the "Fisher formula," and used quite extensively in some parts of the State, a comparison of this fertilizer with one commonly recommended by the writer for orchard purposes has been undertaken.

Briefly stated, the Fisher formula—so called because first suggested by Dr. Fisher of Massachusetts—is composed of about 8.6 per cent nitrogen, 3.3 per cent phosphoric acid and 11.9 per cent of potash, being made up as follows: Nitrate of soda, 350 lbs; sulphate of ammonia, 150 lbs; sulphate of potash, 230 lbs; acid phosphate, 200 lbs; kieserite, 50 lb. "All to be thoroughly mixed and sown on the surface under the tree out a little further than the limbs extend, at the rate of ten pounds to a medium sized tree, from the first to the tenth of May, or as soon as the blossom buds begin to open."

Unquestionably this fertilizer produces a most vigorous growth, resulting in large, though not always well colored fruit, and on uncultivated land it is regarded with favor by many growers. For use in connection with the thorough cultivation now recommended, however, the percentage of nitrogen is too high for the best results.

The Station formula contains about 3 per cent nitrogen, 5½ per cent phosphoric acid and 8 per cent potash, being made up as follows: 200 lbs nitrate of soda; 75 lbs sulphate of ammonia; 225 lbs muriate of potash; 500 lbs acid phosphate.

The cost of this fertilizer is about $16 per 1,000 pounds; that of Fisher fertilizer about $21 per 1,000 pounds for the materials alone.

Twenty Baldwin and five Tolman trees are being used for the specific test of each of these formulas. The Baldwins are kept under cultivation; the Tolmans are in sod. The work has been in progress for two seasons, which time is of course not sufficient to warrant conclusions. It may be said, however, that both lots of trees have responded freely to the treatment, and yielded a good crop of fruit this year. The Baldwins were in an exhausted condition when the work was commenced, but all are now making a remarkably strong, vigorous growth, and promise well. It should be said, however, that as in the experiments first mentioned, the stirring of the soil, and the decay of the turf in case of the cultivated trees, obscures any specific difference in the relative merits of the two formulas up to the present time.

The following diagrams represent the orchards now under observation:

FISHER FORMULA—DIAGRAM OF BALDWIN ORCHARD.

1 □	2 □	3 □	4 □	5 □	6 □	7 □	8 □
9 □	10 □	11 □	12 □	13 □	14 □	15 □	16 □
17 •	18 •	19 •	20 •	21 •	22 •	23 •	24 •
25 ⊙	26 ⊙	27 ⊙	28 ⊙	29 ⊙	30 ⊙	31 ⊙	32 ⊙
33 ⊙	34 ⊙	35 ⊙	36 ⊙	37 ⊙	38 ⊙	39 ⊙	40 ⊙

FISHER FORMULA—DIAGRAM OF TOLMAN ORCHARD.

1 •	2 •	3 •	4 □	5 □	6 ⊙	7 •
8 •	9 •	10 •	11 ⊙	12 □	13 ⊙	14 •
15 ×	16 •	17 •	18 •	19 □	20 ⊙	21 •

EXPLANATION OF DIAGRAM. □—Station formula; ⊙—Fisher formula; •—untreated tree; ×—vacancy.

The Top-Working of Orchards.

The experiments here noted include the relative value of cions from bearing trees of known value as compared with cions from miscellaneous sources; the actual commercial advantage, if any, of changing vigorous trees from Ben Davis to Baldwin, Sutton, Spitzenburg, or Jonathan; and incidentally the question as to the value of Ben Davis as a stock for top-working.

PLAN OF WORK.

Adjacent trees (three of each) were top-grafted April 8, 1904, with cions from nursery trees and from bearing trees, as shown by the map on page 199. The "nursery cions" were obtained from H. S. Wiley, Cayuga, N. Y.; the "fruiting tree cions," from Geo. T. Powell, Ghent, N. Y. (except Baldwin which were from Mr. Pope's orchard). As a check upon this work, and to see if it really pays to top-work a young orchard of this kind, four of the original Ben Davis trees are left (Nos. 7, 8, 26 and 27). These are to be pruned and cared for the same as the top-worked trees.

HISTORY AND CONDITIONS OF THE ORCHARD.

The orchard was set (two-year-old trees) in May, 1890. The trees were cultivated the first year. After that, however, they were left in sod and hay was cut every year until 1902 when hogs were turned in for one season. No treatment of any kind was given in 1903, and a good crop of fruit was produced. Trees made an excellent growth in 1902 and 1903, and the north half of the orchard is in good condition. About the middle of the plat the water has stood some in winter and trees have suffered.

With the exception of tree No. 14, the trees which were top-worked in 1904 were in good vigorous condition.

1904. Orchard plowed and cultivated during summer. Five hundred pounds of fertilizer analyzing about 3 per cent nitrogen, 6 per cent phosphoric acid, and 8 per cent potash. Photographs made at time of grafting.

1905. Treatment of previous year repeated. Superb growth,—15 to 24 inches. Photographs made October 23.

Naturally conclusions are not yet drawn from this work.

DIAGRAM OF TOP-WORKED ORCHARD.

39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
●	●	●	●	O	O	O	●	●	●	●	●	●	●	●	●	●	●	●
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
●	●	●	⊙	⊙	⊙	●	●	□	□	□	*	*	*	●	●	●	●	●
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
●	●	⊙	⊙	*	⊙	●	●	□	□	□	*	*	*	●	×	●	●	●

EXPLANATION OF DIAGRAM: The significance of the characters in the above diagram is as follows: ●—Ben Davis, original trees; ⊙—Baldwin; ■—Sutton; *—Jonathan; O—Spitzenburg; ×—vacancy.

All cions used in the first row were from nursery trees; all cions in the second row from bearing trees. The Spitzenburg cions in third row, from bearing trees

KEEPING QUALITIES AS AFFECTED BY CULTURE.

The influence of cultivation in an orchard, as affecting the keeping quality of the fruit, is a question of perennial interest. The Station has no facilities for conducting a satisfactory inquiry in this direction, but as bearing upon the subject several barrels of fruit were set aside in the winter of 1904-5 in Mr. Pope's cellar, and were left until some time after the usual season for marketing. While conclusions can not be drawn from this test, certain indications may be suggestive.

For the trial three barrels of Tolmans and four barrels of Baldwins were set aside. Of the Tolmans, one barrel each from sod and from cultivated land were taken, and one barrel was divided between the two. Of the Baldwins, two barrels were from trees in sod and two from adjacent cultivated trees. The fruit was sorted as for commercial purposes and the barrels were headed up and set in a very cool cellar, in a temperature of 35 to 40 degrees Fahrenheit.

On April 7 the Tolmans were examined and showed signs of breaking down. They were accordingly assorted and a record made of their condition. At this time the Baldwins showed no sign of breaking down, and they were left until May 10 before assorting. In each case the fruit was divided into three classes: (1) that which was perfectly sound; (2) slightly decayed, or "specked," including that form of breaking down commonly called "scalding;" (3) decayed or worthless fruit. The following table represents the exact condition of the fruit at the times indicated:

Variety.	Number fruits sound.	Number fruits specked.	Number fruits decayed.	Total number fruits.	Per cent sound.	Remarks.
Tolman						
No. 1 (sod)........	344	102	48	494	69.6	Free from scald and of better color than cultivated fruit—often with blush.
No. 2 (sod)........	164	27	21	212	77.4	
No. 3 (cultivated)	314	140	27	481	65.3	A little scald.
No. 4 (cultivated)	222	45	15	282	78.7	Much scald.
Baldwin						
No. 1 (sod)........	655	83	14	752	87.1	Sod grown fruit scalded worse than the other but was of better color.
No. 2 (sod)........	507	196	25	758	66.9	
No. 3 (cultivated)	438	125	120	683	64.1	
No. 4 (cultivated)	361	183	51	595	60.7	

These figures seem to contradict, or at least to cast doubt upon the statement frequently made by some of the best writers upon fruit growing, viz.: "Apples grown in sod attain a higher color and keep longer than those grown under clean culture."

There is no uniformity in the results shown. For instance, of the Tolmans the barrel from sod land gave 69.6 per cent of sound fruit at the end of six months; while the corresponding barrel from cultivated land gave 65.3 per cent—a difference of only 20 apples in the barrel, and the actual number of worthless fruits was nearly double from the sod grown tree. Where the fruit was in the same barrel (numbers 2 and 4 of Tolman), the difference was 1.3 per cent in favor of the cultivated fruit. Of the Baldwins, one barrel was decidedly better than all of the others, and both barrels from sod land gave a higher percentage than did those from cultivated land; but the difference between number 2 and numbers 3 and 4 was not greater than might be expected from fruit grown under the same conditions. Indeed not so great as the difference between numbers 1 and 2.

The color of the fruit grown on sod was usually better than that from the cultivated trees; but the size of the other fruit was greater. In order to be of permanent value these tests should be made under the best conditions for a series of years, and with a wide range of varieties.

Cover Crops.

While no data are to be reported at this time, the importance of a winter cover for orchard lands that are given clean culture during the summer should not be overlooked. In brief, the practice followed by the writer is to plow the orchard in May, cultivate freely and frequently until about the first to the tenth of August and at the last cultivation seed the ground with some crop which shall make an effective cover through the winter and during the period of freezing and thawing, the following spring.

ADVANTAGES OF A COVER CROP.

The advantages following the use of a cover crop may be summarized as follows:

(1) The cover crop utilizes soluble fertilizers which would otherwise be wasted, and prevents washing of the land.

(2) Adds humus to the soil.

(3) Protects roots during winter, and holds the snow.

(4) Helps to dry out the soil in spring, thus permitting earlier working of the land.

(5) In some cases adds directly to the store of nitrogen in the soil,—as when leguminous crops are used.

(6) Growth of trees late in the season is checked.

KIND OF COVER CROP.

What to sow for a cover crop depends largely upon soil and location. On good strong land, which is not specially in need of additional nitrogen, winter rye has proved the most satisfactory of anything tried at the Station. It germinates quickly, and even in cold seasons, when frosts come early, will form a very satisfactory mat before winter. On "thin" soils, however, rye does not stool freely and fails to make a good cover. Such soils also are usually in need of more nitrogen and will be benefited by the use of some leguminous crop like the vetches or mammoth clover. The ideal cover crop on such soils is winter vetch (*Vicia villosa*), sown as early as July 15. Within six weeks this plant develops nitrogen accumulating nodules and contributes directly to the fertility of the land. It is hardy and usually makes a good growth the following spring before time for plowing.

Spring vetch (*Vicia sativa*), is another nitrogen gathering cover crop which makes a very vigorous growth in the fall, often forming a perfect mat a foot thick, when sown August 1. It is apparently even more efficient than the winter vetch as a nitrogen gatherer, but it does not survive the winter; hence is not as valuable in preventing washing by the spring rains, and does not help dry out the land in spring.

Mammoth clover must be sown as early as July 15 to produce sufficient growth to be of much value. As a rule the vetches are to be preferred.

Other crops used at the Station for this purpose are peas, oats, and these two combined. All things considered, however, the first three mentioned are the most satisfactory.

A WORD OF CAUTION.

While in general the use of a cover crop in cultivated orchards is advantageous, there are cases where, if used injudiciously, it may be actually detrimental. One such case is the use of rye upon a soil naturally dry and gravelly; especially if the crop is left late in spring before plowing under. This treatment may result in so drying the soil as to seriously interfere with the growth of the trees. On soils of the nature indicated, spring vetch or oats are always to be preferred unless the land is to be plowed promptly in the spring.

Orchard Work at New Gloucester.

For the purpose of emphasizing the importance of rational treatment of orchard lands in other sections of the State, arrangements have been made with Mr. John W. True and Mr. Fred H. Chandler of New Gloucester to carry on certain coöperative experiments in the planting and management of orchards.

The work in Mr. True's orchard includes the use of cover crops and a comparison of the Fisher formula with the Station formula and with stable manure. For the latter work an orchard of Baldwins, set about 20 years and sadly in need of pruning, was selected. The orchard was pruned and plowed, and fertilizers were applied as follows: 4 rows were given stable manure; 5 rows Station fertilizer; 4 rows Fisher fertilizer; with a check row between each two plats. For the study of cover crops, a two-acre orchard of Ben Davis and a one-acre orchard of Sutton, both just coming into bearing, are available. The crops thus far used are rye and winter vetch, but of course only a report of progress can as yet be made concerning either line of work indicated.

The work in Mr. Chandler's orchard contemplates a study of different methods of orchard treatment and some of the problems connected with the top-grafting of orchards. About eight acres of rolling land, in plain sight from the Maine Central Railroad station at New Gloucester, were fitted and planted to various trees in the spring of 1905. The land is mostly a strong loam, with heavier subsoil, and had been in hay for several years. The ground was plowed the first week in May and, after harrowing, the trees were set two rods apart each way. Between the first five rows, and alternating with the trees in those rows, (thus making a "quincunx" planting) "fillers" of Wealthy were planted. In 1906 the planting of "fillers" will be extended.

Strong two-year old trees of the following varieties were used: Northern Spy, Ben Davis, Tolman, and Wealthy. Most of these, except the Wealthy "fillers," will eventually be top-grafted to Baldwin.

Careful maps and records have been made and reports of progress will be made later. During the past season the orchard between the trees was planted to corn, peas and potatoes. It is designed to keep the greater part of the orchard under cultivation each year.

FIG. 9. In need of renovation—one-half barrel of fruit.

FIG. 10. The result of renovation—eight barrels of fruit. (See page 193.)

STRAWBERRY CROWN GIRDLER. *Otiorhynchus ovatus,* Linn.

EDITH M. PATCH.

More than a little annoyance has been caused in the State by the strawberry crown girdler, a small, black, snout beetle, noticed in some localities especially for its habit of crowding into the house.

It was the protests of tried housekeepers that drew attention to the beetle last season. "We have been overrun with these hateful pests." "I killed more than 400 one evening in the front room." "They travel all over the house and crawl from baseboard to ceiling only to drop to the carpet and try it over and over again. They hide under any protection, carpet, clothing, bedding, and are a general nuisance." Such reports came from Maysville Center, Houlton, Monson, North Wayne and Caribou during September, June and August. They seemed worthy of some attention and this season observations of the strawberry crown girdler were made with reference to the habit of crowding into houses, habits of larva and adult, and remedial or protective measures.

The beetles in the house with reference to their out-of- door habits. The troublesome habit this beetle has of crowding into the house and getting into the way makes it an objectionable insect, although it does no real harm indoors. It feeds upon plants and is therefore, unlike the larder and carpet beetles, interested neither in the food supply of the household nor in clothing and carpets. For the past two years the beetles have occurred in great numbers about the first of June, lasting through that month, and have appeared again in August and September. The house which seems to be troubled most at North Wayne was built in 1822, and as might be expected had crevices near the foundation which offer attractions for insects in search of a hiding place. The beetles were most numerous in the front room into which they crept through cracks near the base boards, though they entered the house also at the doorway under the screen. If they were content to be quiet after once finding a hiding place, their presence would be less objectionable, often unsuspected indeed, but their exasperating persistence in "climbing over everything only to drop into everything else" as one housekeeper complained, entitles them to the rank of household pests.

The house at North Wayne was not visited until June 27, 1905, and at this time the beetles were not numerous enough to give sufficient data as to the relation of their house infesting habits to their out-of-door movements. Farther north, however, near Houlton July 5, ample opportunity for observation was afforded. A day's search was made for the adult beetles out of doors. They were not found hiding under planks, stones or other objects in damp places, but in dry soil they were frequently dug up from among the roots of plants. Some of these were newly transformed from the pupal condition and would naturally be found under the surface where the larval period was passed, but others were well hardened specimens which seemed to have sought the roots from above ground, very likely for the deposition of eggs.

Toward the top of a hill along a hot, dusty road more of the beetles were found during the day than elsewhere. The road was bordered by white clover, which may have been significant, for larvæ of the beetles were found at the roots of this plant. The puzzling thing about the beetles here was the fact that they (ordinarily more active during the evening) were wandering restlessly across the road at mid day, under a scorching sun which they were evidently glad to avoid, for every time a leaf or chip was placed near these wanderers they crept underneath and remained there. The question why, if they wanted shelter, they had not apparently found it before mid day, was unsolved until a horse and carriage passed, scattering dry layers of clay with which the road was well supplied at this place. Then disturbed beetles were seen everywhere poking out from crumbled clay bits and walking off in search of another nook in which to finish their nap. More than 200 beetles were captured easily after this disturbance before they had found satisfactory hiding places. Except when the beetles were moving it was difficult to see them, for though they are black they were too thoroughly dust covered to be detected readily in the roadway.

Toward dusk the hill top road was again visited and this time the beetles were more numerous and more interested in their journey, for they had voluntarily quitted shelter, and were out for purposes of their own. Before dark, beetles were seen everywhere along places where they had been sought in vain during the day; fence rails, piles of sun heated stones, tree trunks, sides of sheds, came in for their share of the active beetles as well as doorway and window sill by which the creatures were entering the house.

These out-of-door observations lead logically enough, it seems, to the conclusion that the house seeking habit of the strawberry crown girdler is merely an incident in the general trend of the movements of this beetle,—perhaps accident would be a more appropriate term from the beetle's standpoint for the house proves a gigantic trap from which the beetles, in spite of restless and persistent climbing, find no means of egress. Like the old fashioned wire fly traps, the house is easier to enter from the foundation than to get out of at the ceiling. The beetles desire a dry shelter and find a building as acceptable as a clump of clay,—until they try to get out.

The restless wanderings of these beetles in and out of the house is probably a necessary impulse for the spread of the species for, unlike many insects, they are incapable of flight and are doomed to walk the earth if the succeeding generations are to find new feeding grounds.

It may not be entirely without interest to question whether the presence of these beetles in houses is augmented by lights as is frequently the case with insects most active at night. At North Wayne the room most troubled was the closed front room where no lights were taken during the evening except for a little while to collect the beetles. Yet in one evening over 400 were killed in this room.

The foregoing discussion has a bearing upon two characteristics commonly accredited this beetle. It is spoken of as "gregarious," and its entrance into houses has been explained as "hibernating."

Certainly these beetles were not observed to show gregarious instincts in the sense of seeking the companionship of others of their kind, but wander about quite indifferent to the direction or destination of their kindred. Of course in places of concentrated local infestation many beetles independently happen upon the same shelter.

If the beetles were found in houses only in the fall their presence might seem a hibernation, but in Maine there are two times when they appear most abundantly,—during June and in August and September, and the June lot are as troublesome in the house as the fall beetles. These two marked periods might seem to indicate two annual broods, but it is difficult to obtain dependable evidence with an insect which is to be found as adults, pupæ and larvæ of various sizes, from early June until fall, as is the case with this beetle in Maine.

Feeding habits of larvæ. At North Wayne, late in June, a day was spent in search of larvæ of the strawberry crown girdler. Close to the foundation of the house near the room most troubled by the adults, the roots of a grass, *Poa cerotine,* were found to be freely infested by nearly grown larvæ, and this grass had doubtless supplied a fair proportion of the troublesome beetles. A few pupæ and some newly developed adults, still brown in color, were found among the roots with the larvæ. The main seat of action, however, seemed to be the strawberry bed. The weather had been wet and cold for some time, but in spite of that there were conspicuous wilty places in the bed, here and there. The strawberry plants in these spots could be lifted from the ground with the slightest pull, for their roots were eaten through at a distance of two or three inches from the crown. The appropriateness of the popular name of this beetle was thus approved for the strawberry crowns in this bed were certainly "girdled."

A space containing three square feet was selected at random from one of the wilted places in the bed. More than 200 nearly grown grubs, pupæ, and freshly developed adults of the girdler were found about the strawberry roots in this space, besides which there were one young cut worm and four Lachnosterna grubs under half size. How many more there would have been if eight fat predaceous ground beetles had not been skirmishing through these three square feet of infested soil is a question, depending for its solution upon the capacity of the beetles. It was not surprising to learn, one month later (July 28) that this strawberry bed was more than half dead.

Near Houlton on the place where the beetles were most annoying there was no strawberry bed, and a day was spent examining the roots of meadow plants, July 6, 1905. Larvæ and pupæ of the girdler were found at the roots of wild strawberry, Timothy grass, June grass and white clover. Large potato fields were close at hand, but no signs of the crown girdler were found about potato vines which were dug up in various places in the field.

Feeding experiments with adult beetles. Several hundred beetles taken near Houlton early in July were brought to the laboratory for the purpose of testing the range of their food plants. These were confined for three days at a time in bottles containing perfect leaves. The following list records such leaves (or flowers as indicated) as were found to be eaten to a greater or less extent during this time: Apple, cauliflower, red clover (blossom), red clover, woodbine, Tartarian honeysuckle, turnip, radish, white clover (blossom), white clover, rose (petal), oak, dandelion, lettuce, maple leaf, lawn grass, sorrel, timothy grass, basswood, raspberry, mulberry, spirea, currant, strawberry, rose, plantain, celery, mountain ash, Roman wormwood, rhubarb, bean, nasturtium, wolf weed, nightshade, box elder, thistle, cottonwood, elm, geranium, flowering currant, dahlia, syringa, peony, blackberry, fall dandelion, asparagus, horse radish, pea, chickweed, wild cherry, gooseberry, birch, iris, willow, "self heal."

While it is probable that beetles placed in confinement would eat some leaves which in the open they would avoid for other food, still the foregoing test bears out the reputation of this insect as a general feeder.

REMEDIAL MEASURES.

Arsenate of lead. Two experiments were made with elm leaves (a favorite diet of the girdler) dipped in arsenate of lead, mixed at the rate of 4 pounds to 50 gallons of water. For the first, 42 well fed beetles were confined with a few poisoned leaves for two days, when 18 were dead and 24 still alive. For the second test 40 beetles were kept without food for 7 days and then confined for 36 hours with poisoned elm leaves. At the end of this time 32 beetles were dead and 8 alive. These tests, especially the second, were arbitrary and unfair with respect to normal out-of-doors conditions because ordinarily the beetles would not be so hungry and there would be unsprayed food within traveling distance. The only significant fact concerned is if they eat sprayed plants they die. In this connection the experience in Montana * with new strawberry plants dipped in arsenate of lead is exceedingly interesting. It was found in that instance that the beetles avoided the sprayed leaves and began to feed upon the roots of the strawberry.

In view of the great range of food plants accepted by the adult beetles there seems little help to be expected from the application of poison except as it might serve to a certain extent as a protection of valuable plants by causing the beetles to shun them. Mr. R. A. Cooley * concluded that where adult beetles attacked the leaves badly, spraying was better than no treatment and was worth the cost and trouble incurred. The injury to strawberry beds in Maine, however, has been (so far as known) by the grubs alone, working at the roots, and thus spraying, here, would be of no avail.

Cultural means. The fact that grubs (larvæ) of the crown girdler were found during the past season at the roots of grasses, white clover, and wild strawberry merely confirms the evidence of other observers that the larva of this insect finds its natural food in roots of grasses and other meadow plants. Young strawberries set out on newly broken ground already infested with these grubs would of necessity be seriously attacked.

Mr. R. A. Cooley says * in this connection, "The remedial measure that seems to promise most is so managing the soil that when it is desired to set out the field to strawberries the beetles will have been previously starved out." He also cites the case of a Montana fruit grower who was so troubled by this insect that he abandoned strawberry growing entirely some years ago, using the land for other crops. Strawberry plants were started on this same place in the summer of 1904 and were not troubled at all by these beetles.

* Montana Agr. Exp. Sta., Bul. 55.

This method is in accordance with preventive means commonly accepted as the only practical way of combating other underground enemies, such as the white grub and the wire worm.

No extended tests have been made in Maine as to what crops would be best adapted for this purpose. At Houlton, however, favorable opportunities for an observation were offered. Potato fields were at hand on newly broken ground adjoining meadows freely infested with grubs of the crown girdler. In two of these fields, the roots of potato vines variously situated were examined and in no case were larvæ of the crown girdler found. This, of course, is no positive indication that potato vines are never attacked by this insect, but the situation of the potato field was exactly such as would have proven the worst possible condition for a strawberry bed; and the apparent freedom of the field from the grubs certainly seems significant.

In localities where the strawberry crown girdler is present to any marked extent, it would be unsafe to set strawberry plants in newly broken land. Some less susceptible crop (the potato would probably serve) should be used first, and the soil so thoroughly cultivated that grass or other weeds cannot remain as a bait for the beetles, or food for such larvæ as chance to be already in the ground.

Repellents. As most of the complaints against this beetle in Maine were concerned with its entrance to houses, a few tests were made to see if camphor gum could be used successfully as a repellent to be placed at cracks about baseboards or windows. Between 30 and 40 beetles were placed in a space 6 inches in diameter surrounded by a circle of powdered camphor gum piled about an inch high. The beetles seemed neither stunned nor excited, but walked about in the space and climbed over the camphor apparently indifferently for quarter of an hour when the beetles were taken and buried under a mound of the camphor gum and left for nearly two hours. Shortly after the camphor was removed, the beetles, deliberately stalked off, to all appearances as well as ever. The experiment was repeated with flowers of sulphur with precisely the same results.

At Maysville Center where the beetles in troublesome numbers were entering a house under the baseboard, a liberal application of fresh pyrethrum powder was recommended. The report came "They do not seem affected one bit by insects powder. They walk right through it and do not mind it at all."

Probably all that can be done to guard against an invasion of the house is to stop the cracks with putty as far as possible and then philosophically to regard these beetles that get in as really harmless. It may be, too, that the beetles will not occur for many years in successsion in such large numbers in the places of worst infestation. At North Wayne about 18 years ago there was an outbreak of the same pest which overrun the house for two or three seasons, after which the trouble disappeared, not to come again in conspicuous numbers until the last few years. What natural agencies controlled the situation are quite a matter for surmise.

SUMMARY.

Out of doors. The strawberry crown girdler in the larval or grub stage feeds upon the roots of grasses and some other plants. Strawberries are especially susceptible to attack and should not be set in, or very near, soil infested by these grubs. The only known practical remedy is clean cultivation. The adult beetles feed upon the leaves of the strawberry and many other plants, and when they are numerous enough to cause much injury, arsenate of lead should be used as a spray.

In the house. The presence of great numbers of the beetles in the house is annoying but need cause no real alarm, for they are bent upon no mischief either to persons, clothing or food supplies. Ordinary repellents seem to be or no avail, and probably all that can be done to guard against them is to make the house as tight and beetle proof as possible. With this precaution such beetles as can not be conveniently swept or gathered up, can be tolerated as harmless and transient guests.

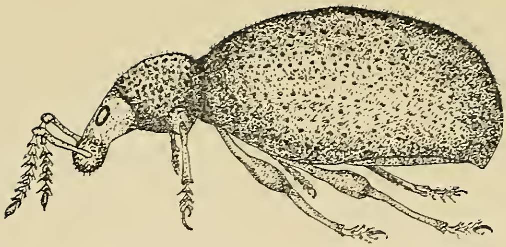


FIG. 11. Strawberry crown girdler. Adult x 8.

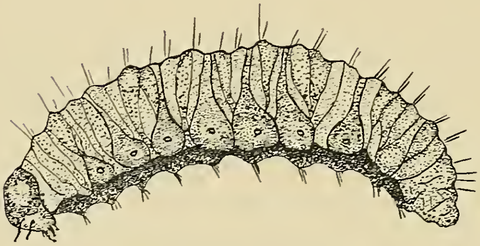


FIG. 12. Strawberry crown girdler. Larva x 8.

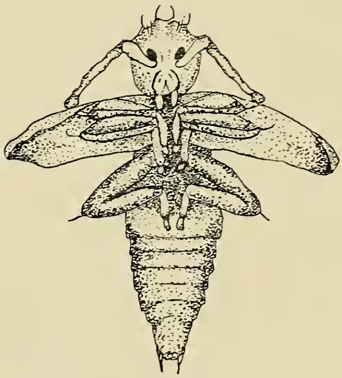


FIG. 13. Strawberry crown girdler. Pupa x 8.

INSECTS OF THE YEAR.

EDITH M. PATCH.

Tussock moth. Cocoons of two species of tussock moth, *Notolophus leucostigma* and *N. antiqua,* were received in such numbers during the present year that it is simpler to give them single mention than to list each specimen sent for identification. Most of these cocoons were accompanied by the question "Is this the nest of the brown-tail moth?" In order that further confusion may be avoided to some extent at least, figures 14 and 15 are presented with this comment: The winter nests of the brown-tail moth contain many tiny caterpillars, while the cocoons of the tussock moth are empty during the winter and those from which the females have emerged are covered by a mass of whitish eggs. These egg clusters should be collected and burned.

Red-humped catapillars. There were talso too many of the red-humped caterpillars, *Œdemasia concinna,* to list in the accompanying table. Between July 29 and October 28, 1905, 81 lots of these caterpillars were received for identification. As only 11 came last year, these insects seem to be on the increase at present. They undoubtedly did great damage in the State this season. Many orchardists reported that entire orchards of young trees were stripped of their foliage, except for the mid ribs of the leaves, before the presence of the pest had been discovered. They are not especially difficult to combat as the broods are gregarious and if found while the caterpillars are young the whole colony can usually be removed with ease. The fact that they come late in the season makes their attacks a surprise oftentimes. Arsenical sprays will kill them, but the presence of ripe fruit sometimes debars the use of poison. There is no difficulty in recognizing this peculiar caterpillar by its red head and conspicuous red band about the body a short distance behind the head. See figure 16.

The yellow-necked caterpillar, *Datana ministra,* seems also to be increasing in this State. During August this species vied with the preceding in troubling orchardists. Means of combating these two species are identical. See figure 19.

Tent caterpillars. The unsightly webs of the tent caterpillar, *Clisiocampa americana,* which had not been numerous for several seasons, were present to a troublesome extent all over the State this spring.

Stalk borer. In July and August the stalk borer, *Papaipema nitella,* caused complaint from several localities. The destruction of a crop of sweet corn for two seasons was charged to its account near Gardiner. From Westbrook five specimens of this caterpillar were received with the report: "This pest is destroying my raspberry, blackberry, currant, and gooseberry bushes, corn and dahlia stalks, potato vines and many other kinds of plants, by boring a hole into the plant, usually near the ground but sometimes as many as 30 inches above the surface of the ground, and then eating its way, usually up but sometimes down, until the plant is destroyed."

Cherry tortrix. An interesting communication from North Newry late in June gave a description of a "yellowish worm one and a quarter inches long, present by thousands in the grass in the meadow." The owner of the meadow feared a "new grass pest." When specimens were asked for, a mass of grass was sent which was webbed solidly together, and writhing with larvæ of the cherry tortrix, *Cacœcia cerasivorana.* They were not eating the grass and further inquiry elicited the information that they had stripped some wild cherry bushes on the meadow border and then had webbed the grass far into the meadow. About 9 cubic inches of the web was saved and the larvæ pupated, packing it full of pupal cells. On July 10, 119 fresh looking pupæ were counted in this section. During the next few days many moths and a few ichneumons emerged. Brown egg masses were deposited in thin, well varnished layers on the sides of the glass jars and upon leaves, by the imprisoned moths.

Mourning cloak. Larvæ of the mourning cloak butterfly, *Euvanessa antiopa,* were reported in destructive numbers from several localities upon elm, willow and apple. Fully half of the caterpillars received at the Station (about 200) were parasited by tachina flies. See figure 20.

Dotted geometer. Late in the summer larvæ of the chain dotted geometer, *Cingilia catenaria*, were plentiful upon sweet fern, and large swarms of these beautiful, smoky winged moths were common during the cool autumn days and evenings near Orono and Alfred. See figure 17.

Snout beetle. At North Wayne in June an interesting looking bronze gray snout beetle was found in and about a house frequented by the strawberry crown girdler. More of this species were reported from North Wayne during September and one of the specimens was sent Dr. L. O. Howard, chief of the Bureau of Entomology, United States Department of Agriculture, for identification. Dr. Howard kindly replied that the specimen "was identified by Mr. E. A. Schwarz as *Sciaphilus muricatus*, Fab. This species is now referred to *asperatus*. A brief note on its occurrence in Maine with reference to other occurrences in this country is given on p. 272 of vol. VII of Insect Life. It is an introduced species, and some doubt has been expressed by Mr. Schwarz as to its permanent location in this country."

The reference to Insect Life reads as follows:

"During September of the present year a correspondent at Bangor, Me., sent to this office a small lot of a European snout beetle, *Sciaphilus asperatus* Bonsd. (*muricatus* Fab.), which has attracted some little attention in that city. Our correspondent informs us that the beetles gather on the fences, and 'getting on the top rail just cluster and keeping still seem to enjoy life.' They have a singular habit of 'piling up on each other in a straight line, many at once and in many small groups.' They were not, however, observed to be copulating. This unusual gathering took place during the first of September and was preparatory to hibernation.

"The first notice of the occurrence of this insect in North America is by Mr. Samuel Henshaw, published in 1888 in Psyche (vol. V, p. 137). The insect was collected at Brookline, Mass., by Mr. F. C. Bowditch, on *Populus balsamifera*. In the Canadian Entomologist (vol. XXIII, pp. 23, 114, 1891) Mr. W. H. Harrington reports this species at Sydney, Cape Breton, Nova Scotia. It was found in 1884 and 1890 and was not uncommon. In the National Museum collection there are also specimens from Malden and one other locality in Massachusetts, and Mr. M. L. Linell informs me that he has taken a specimen near Brooklyn, L. I.

"It will be noticed that although the species was known to have been introduced at least ten years ago, that it is still limited to districts near the seashore. Like other allied wingless species that have been introduced from Europe it will probably not extend its range much farther south, but will move gradually westward from the points where it has now established itself. It is a common European species and is known to feed on a great variety of deciduous trees and shrubs, and though it is impossible to forecast the future it is not probable that it will ever be particularly injurious to cultivated plants in this country.—F. H. C."

As the foregoing account was written some ten years ago, data concerning this season's collection in Maine may be of interest.

On June 20, 1905, a correspondent wrote a vigorous protest against beetles in her house and stated "there are two kinds of bugs, but more of the black than the gray ones." Both kinds were reported to have been very numerous for two years in June and again in the fall. Specimens accompanied the letter and the black ones proved to be the strawberry crown girdler, while the gray ones were the species recently identified by Mr. Schwarz as *Sciaphilus asperatus* Bonsd. (*muricatus* Fab.)

At North Wayne on June 27 seven of this species were collected at dusk climbing the foundation of the house and a few more were taken inside the dwelling.

Between 20 and 30 of these beetles were collected by the North Wayne correspondent September 11, and sent to the Station with the information: "I found all I send on my dahlia blossoms. There are none in the house now but I find them out of doors on 'most everything though not very thick."

It would seem that this imported snout beetle has not yet lost its hold. No other specimens of *Sciaphilus asperatus* are recorded at the Station this season, except a single specimen collected at Orono, August 8, 1905.

Rose chafer. On June 28, the vicinity of North Wayne and Kent's Hill was observed to be invaded by the rose chafer, *Macrodactylus subspinosus.* Willows and alders had been eaten to the greatest extent, though wild blackberry bushes were

FIG. 14. Nest of brown-tail moth, containing no eggs but many small caterpillars.

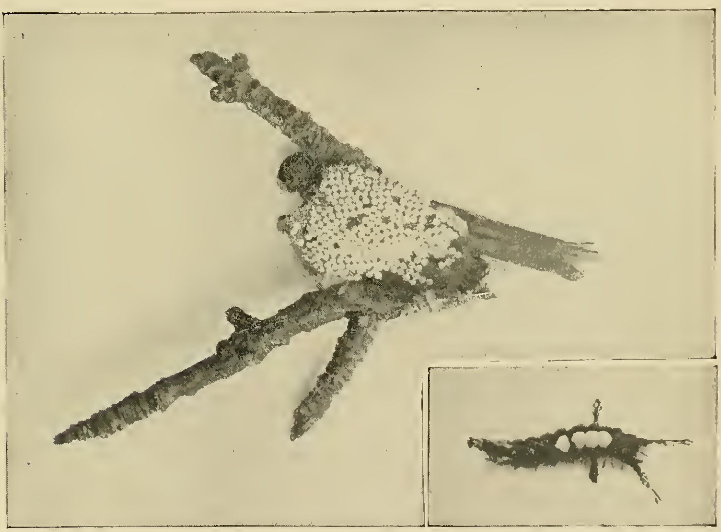


FIG. 15. Cocoon, eggs and caterpillar of tussock moth.

FIG. 16. Red-humped caterpillar.

stripped here and there. The rose bushes did not happen to be attacked badly at that date. One alder clump composed of five stems none of which was six feet high presented a peculiar appearance with every leaf skeletonized and dangling with pairing beetles. From this single clump 1,315 chafers were collected and then the task of clearing the bush was abandoned as hopeless. Twenty leaves were then picked at random and from one to three pairs of chafers were still clinging to each.

About this time specimens of the rose chafer were received from Mt. Vernon with the complaint that some of the orchard trees were covered with them. Several apples about one inch in diameter, accompanying this communication, were tunnelled to the core by the chafers which were gorged and sticky with the repast. See figure 21.

A report from West Peru stated that a whole orchard had been stripped. Early in July from East Sumner a correspondent wrote that for three years the rose chafer had done great damage to orchards, berry bushes and gardens, " about ruining everything they touch."

Carpet beetle. Early in June carpet beetles, *Anthrenus scrophularius,* were seen commonly upon rhubarb and horse radish blossoms at Orono. June 9, they seemed especially numerous and a half day's collection was made from one rhubarb bed during which time 156 of these beetles were taken. As they were also on polliniferous flowers which are gathered for house decoration, it is advisable to be on the watch for these beetles in picking flowers in order to make sure that none are carried into the house in this way. The adult beetles are pollen eaters but the young, as is known well enough, are among the most troublesome of household pests.

Flea beetle. About June 6, several species of flea beetles were much in evidence at Orono. The cucumber flea beetle, *Epitrix cucumeris,* had riddled the leaves of potato vines. A striped flea beetle, *Phyllotreta vittata,* was present especially on horse radish, and bronze flea beetles were conspicuous upon rhubarb and other plants.

Wire worms. As the present season brought an unusual number of complaints against wire worms, the following statements in regard to these insects were published as a newspaper bulletin.

Wireworms are slender grubs of yellowish white color and very hard bodies. They are the young (larvæ) of click-beetles, or snapping beetles, so called from the fact that when placed upon their backs they will suddenly bend the body and, with a sharp clicking sound, throw themselves a considerable distance into the air. They are among the most troublesome of crop pests and as they live underground it is difficult to combat them.

At the New York, Cornell, Agricultural Experiment Station, exhaustive experiments covering a period of three years were made for the purpose of testing remedial measures. The statements here made are based largely upon the results of those experiments. Many methods that had previously been recommended for the destruction of these pests were found to be inefficient. To cite but one example: It was found that the wire worms were still alive in soil to which salt enough had been applied to kill the vegetation.

One method, especially approved, was fall plowing. The explanation of the beneficial results that follow fall plowing is believed to be found in the following facts. Wire worms live for at least three years in the worm or larval state. When the worms are full grown they change to soft white pupæ during July. The pupal stage lasts only about three weeks, the insect assuming the adult form in August. But, strange to say, although the adult state is reached at this time, the insect remains in the cell in the ground till the following April or May, nearly a year. This period of quiescence is apparently necessary to the life of the beetle, for in every case where the soil was disturbed after the insects had transformed, the beetles perished. By fall plowing we can destroy the beetles in the soil and thus prevent their depositing eggs the following season. After plowing (at least six inches deep) the soil should be well pulverized and kept stirred so that the earthen cells of the pupæ and adults may be destroyed. It will usually require at least three years to render the soil comparatively free from wire worms, as only the pupæ and adults are killed, the young larvæ remaining uninjured.

Nematode worm. Late in November specimens of diseased gardenia from one of the nurseries in the State were received at this Station. The trouble seemed to be caused neither by insect or fungus attack and the material was sent to the United States

Department of Agriculture, Bureau of Plant Industry, for examination. Mr. C. O. Townsend, acting pathologist and physiologist of that bureau, stated the trouble to be due to nematode worms.

Although worms are not insects, the nature of their attack and the remedies applied bring them into a closer relation with work pertaining to insects than any other department of the Station, and a record of this case is included with notes on insects.

As Mr. Townsend's letter is of interest and as the preventative means he recommended apply with equal force to millipedes, concerning which complaints from greenhouses frequently reach the station, the letter is quoted in full:

"The swellings on the roots were caused by the root-knot nematode, *Heterodera radicicola*. These swellings, after the nematodes have reached maturity and laid their eggs, decay and bring about thus the death of the plant. They also reduce the vigor of the plant before the period of decay is reached by checking the water supply and diminishing the root growth.

"There is no certain method known by which the nematodes can be killed in the roots of this plant without injury to the plant itself. Experiments were conducted at Washington some years ago with roses badly infested with nematodes, using a 1-per cent solution of formalin. This proved effective in destroying the pests and, although it caused the shedding of the leaves, did not kill the rose plants. Whether similar treatment would be destructive to the gardenia plants or not can be determined only by experiment. The plants should be hardened off somewhat for a week or two before the experiment is made.

"The trouble can be avoided by sterilizing the soil in which the plants are to grow and then using only such plants as are absolutely free from any signs of root-knot. This sterilization can best be effected, as described in bulletin No. 55 of the Hatch Experiment Station, by the use of live steam from a boiler with a pressure of 40 to 60 pounds. This is conducted through perforated pipes laid in the bottoms of the benches, the steam being passed into the soil until it has all been heated to the temperature of boiling water. This suffices to kill not only the nematodes but also various destructive fungi."

Tarnished plant bug. The tarnished plant bug was present in the usual numbers this season and during the spring caused considerable injury to opening leaf and flower buds by puncturing the buds, which resulted in deformed growth.

Plant lice. Serious injuries were caused by plant lice in different parts of the State. Perhaps the most important of these this season were injuries to cucumber vines, several beds being entirely ruined. Where the plants were small enough, however, to cover, bisulphide of carbon was recommended and this treatment met with entire success. It is not a difficult remedy to apply and the gardeners who used it were pleased with the results.

For the past two seasons enormous numbers of plant lice have appeared upon the potato vines near Houlton, working both on the stalks and on the under side of the flower leaves.

As usual where plant lice are numerous, complaints against ants and lady beetles are frequent. "Ants have attacked our woodbine and caused the leaves to wilt," and specimens of lady beetles sent in with the report " these are completely devastating cucumber patches," or " ruining a small ash tree," are examples of this all too common mistake. When ants are seen running over plants it is usually for the purpose of sipping a sweet fluid exuded by the plant lice and not to injure the plant. It is especially unfortunate that larval lady beetles are not more generally recognized, because they are among the most active of the natural checks upon plant lice, devouring great numbers of them.

Nearly 80 collections of plant lice were made during the summer, most of them near Orono. It was interesting to notice that though this family of insects was everywhere abundant the past two seasons the species most common in 1904 were not so much in evidence in 1905 as different species. A fuller and more definite record of this material is reserved for future discussion.

The natural checks which seemed to be most effective in connection with the observed species of plant lice, were Syrphus flies, lady beetles, predaceous Capsidæ, and parasites of the genus *Aphidius.*

Garden flea. At the time garden plants were just starting, about the first of June, garden fleas, *Smynthurus albamaculata* Harvey, were to all appearances guilty of real havoc in Orono gardens. Myriads of the tiny creatures occurred on the tender

Fig. 17. Chain-dotted geometer.

Fig. 18. Hickory tiger moth.

Fig. 19. Moth of yellow-necked caterpillar.

young leaves of lettuce, beans, cucumbers and squash and other plants which were at the time quite free from other insect guests. They worked round cavities in the soft leaves (usually from the under side, but not infrequently from the upper) reaching into the soft tissues, but not piercing quite through both surfaces of the leaf. The plants attacked were much damaged.

Apple maggot. There seems little to be said about the apple maggot for 1905 except that there is no apparent change in the general situation. It is at least not increasing in extent of injury in Maine.

Brown-tail moth. By far the most serious insect problem for Maine at present is the brown-tail moth. An account of this destructive and distressing pest was published last year.* A discussion of the moth and a history of the campaign against it has recently been ably presented in Bulletin of the Department of Agriculture of Maine, Vol. IV, No. 4, as a report of Hon. A. W. Gilman, Commissioner of Agriculture, and Mr. E. F. Hitchings, Entomologist. It hardly seems necessary here, therefore, to do more than touch upon the work of this Experiment Station in connection with the situation. Previous to the State appropriation for protection against insect ravages, the State Pomological Society expressed a helpful interest in the matter, and the Experiment Station worked in co-operation with the Commissioner of Agriculture in ascertaining the extent of infestation. This co-operation was continued during the spring of 1905, the Station locating infested areas in the counties of York, Cumberland, Androscoggin, Sagadahoc, Kennebec, Lincoln, Knox, Waldo, and Hancock. Station bulletins and other printed matter concerning the brown-tail moth and the danger involved were scattered broadcast over the State.

Whenever the infestation was discovered, the town or local authorities earnestly used every means within their power to inform the people of the danger and incite them to the destruction of the nests. So thoroughly was the work done that for the season just over, no appreciable loss has been experienced in Maine from the brown-tail moth and only a few cases of poisoning have been reported. It is not to be understood, however, that anything approaching an extermination has taken place. Scattered nests in wild growths remained to form new centers

* Me. Exp Sta., Bul. 108.

of infestation and alarming invasions of the winged moths from neighboring states occurred during the past summer. This year, no less than last, Maine is confronted with a serious menace to the orchard and woodlands, to the attraction of summer resorts, and to the health and comfort of the people; and the neglect of the situation now means a gigantic financial problem for later years to meet.

Insect legislation. Until 1905 no state appropriations had been made in Maine to provide for the protection of trees and shrubs from the introduction and ravages of dangerous insects and diseases. The alarming invasion of the brown-tail moth during 1903 and 1904 emphasized the need of legislation relating to such matters, and on February 28, 1905, a protection act was passed. This act provides for the inspection of nurseries in the State and of nursery stock shipped into the State, by a competent entomologist to be employed by the Commissioner of Agriculture; and places with the Commissioner of Agriculture the duty of making full investigations of any locality when the presence of the brown-tail or gypsy moths or other injurious insects or plant diseases may be suspected.

A copy of this act may be procured by applying to the Commissioner of Agriculture, Augusta, Me., in whose hands the matter rests.

LIST OF INSECTS RECEIVED.

A partial list of the insects received at this Station for identification from January 1 to December 1, 1905, is given on the following pages.

INSECTS RECEIVED FOR IDENTIFICATION.

Name.	Date.	Host.	Locality.	Remarks.
Fuller's rose beetle, *Aramiges fulleri*	Jan. 17	Tuberous begonia	Ellsworth	Larvæ troublesome in greenhouse.
———, *Chrysomēla multiguttata*	May 25	Linden	Portland	Adults numerous.
———, *Scrica sericea*	June 8	Strawberry	Indian River	Adults devouring the leaves, numerous.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 22		Wayne	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Caribou	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Maysville Centre	Great numbers in house.
Strawberry crown girdler, *Otiorhynchus ovatus*	June 29		Monson	Great numbers in house.
Rose chafer, *Macrodactylus subspinosus*	July 1	Apple plum	West Peru	Stripped the orchard.
Rose chafer, *Macrodactylus subspinosus*	July 3	Blackberry, elm and others	East Sumner	Very troublesome.
Rose chafer, *Macrodactylus subspinosus*	June 29	Apples	Mt. Vernon	Apples eaten to the core.
Lady beetles, ———	July 14		Belfast	Larvæ numerous on ash, feeding on plant lice.
Lady beetle, ———	Aug. 23		Portland	Larvæ feeding on plant lice on poppy.
Lady beetle, *Coccinella 5-notata*	Aug. 3		Lewiston	Numerous on cucumber vines.
Saw-toothed grain beetle, *Silvanus surinamensis*	July 14	Flour and starch	Richmond.	
Tortoise beetle, *Chelymorpha argus*	July 17		Lisbon Falls	Larvæ.
Tortoise beetle, *Chelymorpha argus*	Aug. 3	Raspberry	Stroudwater	Pupæ and adults numerous.
———, *Chrysochus auratus*	July 22	Dogbane	Bethel.	
Bean weevil, *Bruchus obtectus*	Aug. 28		Searsport.	
———, *Monohammus titillator*	Aug. 30		Winnegance	Adult.
White pine weevil, *Pissoides strobi*	Sept. 6	Pine	Bar Harbor	Destroying leading shoot.
Round-headed apple tree borer, *Saperda candida*	Sept. 23	Apple	Solon	Adult reported to be feeding on apple leaves.
Bumble flower-beetle, *Euphoria inda*	Oct. 9	Apple	South Bridgton	Adults destroyed about 100 grafts in apple trees.
Wire worms, ———	Nov. 8	Potato	Newport	Larvæ very troublesome.
Wire worms, ———	Oct. 24	Potato	Clinton	Larvæ very troublesome.
Wire worms, ———	May 18	Onion	Lee	Larvæ very troublesome.
Eyed elater, *Alaus oculatus*	June 29		Corinna	Adult.
Leaf-rolling weevil, *Attelabus sp.*	Aug. 8	Alder	Gardiner	Packets on leaf.
———, *Sciaphilus asperatus*	June 20		North Wayne	Adults in house.
———, *Sciaphilus asperatus*	Sept. 11	Dahlia	North Wayne	Adults in blossoms.
Brown-tail moth, *Euproctis chrysorrhœa*	Feb. 23		South Berwick	Nests numerous.
Br wn-tail moth, *Euproctis chrysorrhœa*	Feb. 27		Bowdoin	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	Feb. 28	Apple	Portland	Nests.
Brown-tail moth, *Euproctis chrysorrhœa*	March 4		Lincolnville	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	March 17		Kittery Point	Nests numerous.
Brown-tail moth, *Euproctis chrysorrhœa*	March 20		West Scarboro	Nest.
Browh-tail moth, *Euproctis chrysorrhœa*	April 3	Apple, plum, birch	Vinalhaven	Nests in great numbers.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.		Host.	Locality.	Remarks.
Brown-tail moth, *Euproctis chrysorrhœa*	May	19	Plum	Maxfield	Nest containing 183 living caterpillars.
Brown-tail moth, *Euproctis chrysorrhœa*	June	1		East Jefferson	Nest.
Brown-tail moth, *Euproctis chrysorrhœa*	July	29		Bar Harbor	Egg mass.
Cherry tree tortrix, *Cacœcia cerasivorana*	June	26	Wild cherry	North Newry	Larvæ webbing grass.
Cherry tree tortrix, *Cacœcia cerasivorana*	July	1	Wild cherry	Palmyra	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July	3	Wild cherry	North Monmouth	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July	10	Wild cherry	Greenville	Larvæ.
Cherry tree tortrix, *Cacœcia cerasivorana*	July	17		Gardiner	Larvæ.
Stalk borer, *Papaipema nitela*	July	7	Corn	Gardiner	Larvæ ruining corn stalks.
Stalk borer, *Papaipema nitela*	July	7	Strawberry	Sanford	Larvæ buried in fruit. Troublesome.
Stalk borer, *Papaipema nitela*	July	15	Sweet corn	Gardiner	Spoiled sweet corn for two seasons.
Stalk borer, *Papaipema nitela*	July	27	Corn, potato, dahlia.	Westbrook	Devastating garden.
Stalk borer, *Papaipema nitela*	Aug.	10	Potato	Portland	Working havoc in stalks.
Thysbe clearwing, *Hemaris thysbe*	July	1		Vinalhaven	Adult.
Galium sphinx, *Deilephila chamænerii*	July	3		Athens	Adult.
Virginian tiger moth, *Spilosoma virginica*	July	3		Abbot	Adult.
Salt-marsh caterpillar, *Estigmene acraea*	July	3		Winterport	Adult.
Unicorn prominent, *Schizura unicornis*	Sept.	6	Apple	Lisbon Falls	Larvæ.
———, *Sabulodes transversata*	Sept.	12	Apple	Lewiston	Larvæ.
Scallop-shell geometer, *Calocalpe undulata*	Sept.	18		Kezar Falls	Larvæ.
Codling moth, *Carpocapsa pomonella*	March	17		Brooklin	Adult.
Oblique-banded leaf roller, *Cacœcia rosana*	June	13	Apple	Newport	Larvæ in great numbers.
Gray comma, *Grapta progne*	June	16	Currant	Lowell	Larvæ plentiful.
Gray comma, *Grapta progne*	July	15	Gooseberry	Ashland	Parasited larva.
Laurel sphinx, *Sphinx kalmiæ*	June	16		Solon	Adult.
Laurel sphinx, *Sphinx kalmiæ*	June	29		Skowhegan	Adult.
Laurel sphinx, *Sphinx kalmiæ*	July	8		Skowhegan	Adult.
Green apple leaf-tier, *Terus minuta*	June	21	Apple	Houlton	Larvæ.
Canker worm, *Anisopteryx pometaria*	June	21	Apple	Houlton	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa.*	June	24	Elm	Portland	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July	1		Berwick	Larva.
Mourning cloak butterfly, *Euvanessa antiopa*	July	24	Elm	North Monmouth	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July	24		Greenville	Parasited larva.
Mourning cloak butterfly, *Euvanessa antiopa*	July	26	Elm	Harrison	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	July	29	Elm	Lee	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Aug.	3	Balm gilead	Wells	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Aug.	7	Poplar	North Monmouth	Larvæ.
Mourning cloak butterfly, *Euvanessa antiopa*	Sept.	16		Auburn	Larvæ.

FIG. 20. Mourning cloak butterfly.

FIG. 21. Work of rose-chafer in apples.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.		Host.	Locality.	Remarks.
Apple sphinx, *Sphinx gordius*	Aug.	23	Apple	Lewiston	Larva full grown.
Achemon sphinx, *Philampelus achemon*	Aug.	23	Woodbine	Waterville	Larva.
Promethea moth, *Callosamia promethea*	Feb.	18		Kennebunkport	Cocoons, common
Cecropia moth, *Samia cecropia*	March	17		South Paris	Cocoon.
Cecropia moth, *Samia cecropia*	April	10		Greene	Cocoons.
Cecropia moth, *Samia cecropia*	April	17	Apple	Jay	Cocoon.
Cecropia moth, *Samia cecropia*	April	18	Pear	Wiscasset	Cocoon.
Cecropia moth, *Samia cecropia*	May	1		Ripley	Cocoon.
Cecropia moth, *Samia cecropia*	May	6		Skowhegan	Cocoon.
Cecropia moth, *Samia cecropia*	May	19		Abbot	Cocoon.
Cecropia moth, *Samia cecropia*	June	21		North Anson	Cocoon.
Cecropia moth, *Samia cecropia*	July	3		Detroit	Male.
Cecropia moth, *Samia cecropia*	July	26	Apple	Harrison	Cocoon.
Cecropia moth, *Samia cecropia*	Aug.	16		Har Harbor	Larva full grown.
Cecropia moth, *Samia cecropia*	Aug.	25		Newport	Larva full grown.
Cecropia moth, *Samia cecropia*	Oct.	16		Dryden	Cocoon.
Cecropia moth, *Samia cecropia*	Oct.	19		Buckfield	Cocoon.
Swallow-tail butterfly, *Papilio polyxenes*	March	3		South Paris	Chrysalis.
Swallow-tail butterfly, *Papilio polyxenes*	July	7	Parsnip	Brunswick	Larva.
Tiger swallow-tail, *Papilio turnus*	Aug.	18	Apple	Belgrade Lakes	Larva.
Tiger swallow-tail, *Papilio turnus*	Sept.	1		Hutchins	Larva.
Tiger swallow-tail, *Papilio turnus*	Aug.	15	Apple	Dover	Larvæ.
Polyphemus moth, *Telea polyphemus*	May	1		South Paris	Cocoon.
Polyphemus moth, *Telea polyphemus*	July	3		Gardiner	Male.
Polyphemus moth, *Telea polyphemus*	July	13		Olamon	Male.
Polyphemus moth, *Telea polyphemus*	Sept.	13		Gorham	Cocoon.
Tent caterpillar, *Clisiocampa americana*	May	19		North Penobscot	Eggs.
Tent caterpillar, *Clisiocampa americana*	May	31	Apple	Bar Harbor	Nest and larvæ.
Tent caterpillar, *Clisiocampa americana*	June	2	Apple	Mechanic Falls	Old cocoon.
Tent caterpillar, *Clisiocampa americana*	July	24		North Monmouth	Male.
Tent caterpillar, *Clisiocampa americana*	Aug.	21		Foxcroft	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Aug.	22		East Lowell	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Aug.	29		East Holden	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept.	1		West Troy	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept.	1		Skowhegnn	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Sept.	13		Unity	Egg cluster.
Tent caterpillar, *Clisiocampa americana*	Oct.	4		Monmouth	Egg cluster.
Hickory tiger moth, *Halisidota caryii*	July	17	Apple	Springvale	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Hickory tiger moth, *Halisidota caryii*	July 29	Apple	Greene	Larvæ.
Hickory tiger moth, *Halisidota caryii*	Aug. 4	Apple	Charleston	Larvæ.
Hickory tiger moth, *Halisidota caryii*	Aug. 15		Dexter	Larvæ.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 8	Sweet fern	Dayton	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 15	Sweet fern	Lyman	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Aug. 19	Sweet fern	Alfred	Larvæ very numerous.
Chain-dotted geometer, *Cingilia catenaria*	Oct. 4		Alfred	Moths flying about sweet fern.
Fall web worm, *Hyphantria cunea*	Aug. 8	Apple	Kent's Hill	Larvæ.
Fall web worm, *Hyphantria cunea*	Aug. 15		Kennebunk	Larvæ.
Dagger moth, *Apatela lepusculina*	Aug. 11	Poplar	Dexter	Larvæ.
Skiff slug caterpillar, *Eulimacodes scapha*	Aug. 21	Apple	Foxcroft	Larvæ.
Io moth, *Automeris io*	Aug. 8		West Buxton	Larvæ.
Io moth, *Automeris io*	Sept. 6		Westbrook	Larvæ, "Pest on delicate garden plants."
Mediterranean flour moth, *Ephestia kuehniella*	Oct. 13		Gardiner	Reared in laboratory.
Thistle butterfly, *Pyrameis cardui*	July 27	Echinops	Bar Harbor	Larvæ troublesome in nursery.
Chersis sphinx, *Hyloicus chersis*	Aug. 7	Ash	Fort Fairfield	Larvæ.
American lappet moth, *Phyllodesma americana*	July 24	Birch	North Monmouth	Larva.
———, *Argynnis cybele.*	July 24		North Monmouth	Adult.
Velleda lappet moth, *Tolype velleda*	July 25		Gerry	Larva.
Walnut caterpillar, *Datana angusii*	Aug. 23	Black walnut	South Berwick	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	July 26	Apple	Harrison	Larvæ.
Yellow necked caterpillar, *Datana ministra*	Aug. 4	Apple	Eliot	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 4	Apple	Litchfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 8	Hazel	Gardiner	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	Mechanic Falls	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	Fairfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 11	Apple	South Paris	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 15		Wales	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 21		Litchfield	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 21		Foxcroft	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 22		East Lowell	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 23		Sabattus	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 25		Vassalboro	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 28		Springvale	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 28		Ross Corner	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Aug. 30		North Anson	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		Lee	Larvæ.

INSECTS RECEIVED FOR IDENTIFICATION—CONTINUED.

Name.	Date.	Host.	Locality.	Remarks.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		North Jay	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 1		Skowhegan	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 4		East Waterford	Larvæ.
Yellow-necked caterpillar, *Datana ministra*	Sept. 6		Sumner	Larvæ.
Scalloped owlet moth, *Scoliopteryx libatrix*	April 5		Augusta	Adult.
White marked tussock moth, *Notolophus leucostigma**				
Old tussock moth, *Notolophus antiqua*				
Red-humped caterpillars, *Œdemasia concinna**				
Elm leaf curl, *Schizoneura americana*	Feb. 16	Elm	Presque Isle.	
Elm leaf curl, *Schizoneura americana*	March 4	Elm	Alfred.	
Elm leaf curl, *Schizoneura americana*	April 1	Elm	Norridgewock.	
Elm leaf curl, *Schizoneura americana*	June 23	Elm	Gardiner.	
Plant lice, ———	March 20	Asters	Gardiner	On roots; very destructive.
Plant lice, ———	July 1	Cucumbers	West Bath	Vines ruined for two years.
Plant lice, ———	Aug. 18	Cucumber	Portland	Ruining the bed.
Plant lice, ———	Aug. 18	Poppy	Portland.	
Plant lice, ———	Aug. 18	Rhubarb	Portland	Especially troublesome.
Plant lice, ———	Aug. 19	Apple	Newport.	
Plant lice, *Pemphigus rhois*	Sept. 12	Sumach	East Holden	Galls numerous.
Plant lice, *Pemphigus*	Sept. 14		Castine	Numerous on the wing.
Alder blight, *Pemphigus tesselata*	Aug. 21	Alder	South Orrington	Conspicuous infestation.
Apple aphis, *Aphis mali*	Oct. 24	Apple	Kezar Falls	Adults and eggs.
Woolly louse of the apple, *Schizoneura lanigera*	Oct. 13	Apple	South Thomaston.	
———, *Pemphigus acerifolii*	July 13		Alfred	Winged forms, "present by thousands."
———, *Pemphigus acerifolii*	July 14	Maple	Kennebunk	Several localities infested.
———, *Pemphigus acerifolii*	July 27	Maple	Bar Harbor.	
Oyster shell scale, *Mytilaspis pomorum*	April 29	Cornus	Winter Harbor	Killing big branches.
Scale, *Aspidiotus*	June 13	Bay laurel	Bar Harbor.	
Scale, *Lecanium*	June 20	Apple	Lincoln.	
Morga's scale, *Chrysomphalus dictyospermi*	Aug. 14		Bar Harbor.	
Cottony maple scale, *Pseudococcus aceris*	July 8	Maple	Sanford Mills	Great numbers.
Garden flea hopper, *Halticus uhleri*	July 27	Clematis virginiani and Clematis vitalba	Bar Harbor.	

* See discussion under "Insects of the Year" in this bulletin.

INSECTS RECEIVED FOR IDENTIFICATION—CONCLUDED.

Name.	Date.		Host.	Locality.	Remarks.
Tarnished plant-bug, *Lygus pratensis*	May	2	Pear	Harrison	On buds of young pear tree. Numerous.
———, *Dog-day cicada*	July	17		Vanceboro	Pupa.
———, *Cercopids*	Aug.	12	Garden plants	Portland	On flower and leaves in garden. Caused buds to drop.
Giant water bug, *Belostoma americana*	Oct.	7		Pittsfield.	
Horntail, *Urocerus albicornis*	Aug.	30		Lewiston	Female.
Giant saw-fly, *Cimbex americana*	Aug.	8		Ellsworth	Larva.
Giant saw-fly, *Cimbex americana*	Aug.	11	Elm	Cornish	Cocoon.
Oak fig gall, *Biorhiza forticornis*	Aug.	21	White oak	Woodfords	Galls common.
Pear slug, *Eriocampoides limacina*	Sept.	15	Cherry Quince	Lewiston	Larvæ.
Mossy rose gall, *Rhodites rosæ*	Oct.	10	Rose	Castine	Galls with larvæ.
Maple spot gall, *Sciara ocellata*	June	29	Maple	Hancock Point	Numerous.
Comb-horned fish-fly, *Chauloides pectinicornis*	July	13		Gardiner	Adult.

METEOROLOGICAL OBSERVATIONS.

Lat. 44° 54′ 2″ N. Lon. 68° 40′ 11″ W. Elevation 150 feet.

The instruments used at this Station are the same as those used in preceding years, and include: Wet and dry bulb thermometers; maximum and minimum thermometers; rain-gauge; self-recording anemometer, vane, and barometer. The observations at Orono now form an almost unbroken record of thirty-seven years.

The winter of 1904-5 was one of unusual severity, December being 4½°, January 3°, and February 4° below the average for these months. Lower temperatures for both January and February have been recorded at this Station, but in only one instance, the winter of 1874-5, has the combined record for the three months fallen so low. During this same period the thermometer registered zero or below, as the minimum temperature, on no less than 50 days.

For three successive years the total precipitation has been very low, the deficit for the past year amounting to about 12 inches, or over one-fourth of the whole. The shortage was especially noticeable in March and October, in which months the precipitation was about one-fifth the average. In but one month of the year, November, did the precipitation equal the average amount. That these conditions were not confined to this particular locality is shown by the table on page 231.

METEOROLOGICAL SUMMARY FOR 1905.

Observations Made at the Maine Experiment Station.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	Total.
Highest barometer	30.57	30.42	30.66	29.97	30.23	30.09	30.87	30.43	30.30	30.43	30.31	30.66	30.41	......
Lowest barometer	29.22	29.06	29.59	29.19	29.35	29.01	29.50	29.47	29.55	29.45	29.26	29.08	29.31	......
Mean barometer	29.91	29.88	29.96	29.61	29.80	29.68	29.84	29.89	29.90	29.92	29.80	29.90	29.84	......
Highest temperature	48°.0	45°.0	60°.0	74°.0	79°.0	87°.0	89°.0	89°.0	83°.0	78°.0	60°.0	48°.0	....	......
Lowest temperature	-30°.0	-19°.0	-14°.0	21°.0	31°.0	32°.0	71°.0	35°.0	29°.0	15°.0	2°.0	-17.0	....	......
Mean temperature	12°.8	14°.8	27°.1	42°.7	52°.9	60°.6	68°.6	63°.9	57°.6	46°.7	35°.0	22°.9	42°.13	......
Mean temperature for 37 years	15°.8	18°.9	28°.1	40°.7	52°.5	61°.8	66°.9	64°.9	57°.3	44°.8	34°.2	20°.4	42.°20	......
Total precipitation in inches	4.28	2.20	0.83	2.22	3.47	3.13	2.19	2.13	3.19	0.78	4.08	3.51	....	32.01
Mean precipitation for 37 years	4.29	3.89	4.34	2.85	3.48	3.53	3.30	3.56	3.41	3.82	3.73	3.78	....	43.98
No. of days with precip. of .01 in. or more	9	6	6	6	12	12	6	7	11	4	10	9	....	98
Snow fall in inches	25.5	22.0	2.2	....	....	....	....	....	....	....	2.3	18.5	....	70.5
Average snow fall for 37 years	23.1	21.4	15.8	5.1	0.3	....	....	....	....	0.8	8.0	17.1	....	91.6
Number of clear days	17	14	18	8	9	10	10	12	13	18	8	13	....	150
Number of fair days	1	6	8	16	10	3	15	12	2	7	9	5	....	94
Number of cloudy days	13	8	5	6	12	17	6	7	15	6	13	13	....	121
Total movement of wind in miles	4458	5263	4928	7147	5940	3971	4759	3614	3762	4036	5552	4295	....	......

Monthly and Annual Precipitation (as rain) for the Year 1905.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Bar Harbor	5.20	3.20	1.05	0.95	3.20	4.54	3.35	2.56	7.79	2.10	7.22	7.61	48.77
Chesuncook	2.67	0.69	1.32	0.71	2.42	1.65	1.52	1.38	1.18	0.77	3.15	2.22	19.68
Cornish	5.53	1.51	2.65	1.97	2.15	4.12	9.12	4.26	7.48	1.38	4.48	4.21	48.83
Debsconeag	....	....	....	....	....	....	4.80	1.10	2.92	1.31	4.28	....	....
Eastport	4.13	2.77	1.10	0.83	2.64	3.03	2.62	1.76	4.32	0.47	4.29	3.91	31.87
Fairfield	3.78	0.99	0.88	2.15	2.22	3.49	3.65	1.43	2.45	0.38	3.80	3.19	28.41
Farmington	3.79	0.70	1.41	2.12	2.65	3.60	4.07	3.10	5.27	1.24	2.58	2.69	33.22
Fort Fairfield	2.12	1.21	0.92	....	....	2.09	2.44	0.72	1.69	1.40	3.03	2.34	....
Gardiner	4.85	1.32	0.94	2.10	2.17	4.83	4.52	2.03	4.09	0.78	3.95	3.12	34.70
Houlton	2.83	1.60	0.70	1.25	2.00	1.50	1.45	0.12	1.80	1.00	2.25	2.40	18.90
Lewiston	4.42	1.80	1.48	1.54	2.04	4.12	4.58	1.79	5.51	1.01	3.70	3.65	35.64
Madison	4.08	1.61	2.13	2.59	3.73	4.65	5.75	2.23	5.61	1.13	4.60	3.45	41.56
Mayfield	4.25	....	1.00	2.17	3.29	3.39	4.39	1.86	4.40	0.90	2.87	2.69	....
Millinocket	5.45	1.25	0.77	2.05	2.91	2.41	2.92	2.08	3.47	1.49	4.29	3.57	32.66
North Bridgton	4.67	1.60	2.06	1.65	2.16	5.50	5.97	2.53	7.02	1.56	3.16	2.95	40.89
Oquossoc	3.33	1.03	1.53	1.91	3.63	3.06	3.78	2.49	2.95	1.67	1.55	1.47	28.40
Orono	4.28	2.20	0.83	2.22	3.47	3.13	2.19	2.13	3.19	0.78	4.08	3.51	32.01
Patten	4.20	0.90	0.90	2.50	2.15	5.25	2.00	0.06	3.96	1.38	3.30	2.00	28.60
Portland	5.16	1.78	1.97	1.43	2.58	3.08	3.65	2.78	5.35	0.95	4.45	5.44	38.62
Rumford Falls	3.90	1.11	2.08	2.11	2.33	4.15	4.61	2.85	4.21	1.51	2.92	2.98	34.76
South Lagrange	3.76	1.22	....	....	....	....	....	....	....	....	....	....	....
Thomaston	....	....	....	1.50	2.43	3.64	4.93	2.37	5.82	1.45	5.02	....	....
Van Buren	1.42	1.61	0.78	1.08	3.26	3.27	2.54	0.15	2.20	1.14	1.60	2.60	21.65
Winslow	3.66	0.93	0.83	2.20	2.53	3 39	4.26	2.03	3.20	0.62	4.00	2.82	30.47

With the exception of readings from the Orono station, the above table is compiled from the monthly bulletins of the U. S. Weather Bureau.

REPORT OF THE TREASURER.

Maine Agricultural Experiment Station in account with the United State appropriation, 1904-5:

DR.

To receipts from the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1905, as per act of Congress approved March 2, 1887		$15,000 00

CR.

By salaries:		
(a) Director and administration officers	$2,500 00	
(b) Scientific staff	4,600 00	
(c) Assistants to scientific staff	1,200 00	
Total		$8,300 00
Labor:		
(a) Monthly employees	$1,084 34	
(b) Daily employees	705 22	
Total		1,789 56
Publications		259 36
Postage and stationery		356 07
Freight and express		211 46
Heat, light and water		535 03
Chemical supplies		247 55
Seeds, plants and sundry supplies:		
(a) Agricultural	$119 67	
(b) Horticultural	115 58	
(c) Botanical	6 32	
(d) Entomological	71 58	
(e) Miscellaneous	107 39	
Total		420 54
Fertilizers		120 29
Feeding stuffs		743 29
Library		329 85
Tools, implements and machinery		190 27
Furniture and fixtures		142 46
Scientific apparatus		178 64
Live stock		70 65
Contingent expenses		29 40
Traveling expenses		489 41
Building and repairs		586 17
Total		$15,000 00

ISAIAH K. STETSON, *Treasurer.*

I, the undersigned, duly appointed Auditor of the Corporation, do hereby certify that I have examined the books of the Maine Agricultural Experiment Station for the fiscal year ending June 30, 1905, that I have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements, $15,000.00; for all of which proper vouchers are on file and have been examined by me and found correct.

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

GEORGE E. FELLOWS, *Auditor.*

Maine Agricultural Experiment Station in account with "General Account" for the year ending June 30, 1905.

DR.

To balance from 1903-1904	$54 07	
Sales of produce, inspections, fees, etc	8,015 52	$8,069 59

CR.

By salaries	$3,141 46	
Labor	619 85	
Chemical suppiies	129 47	
Feeding stuffs	2,000 00	
Traveling expenses	270 01	
Buildings	800 00	
Balance to 1905-1906 account	1,108 80	$8,069 59

INDEX.

	PAGE
Achemon sphinx	225
Adulterated mixed feed	66
Alaus oculatus	223
Alder blight	227
Alum baking powders	141
Anisopteryx pometaria	224
Announcements	v
Anthrenus scrophularius	217
Apatela lepusculina	226
Aphis mali	227
Apple aphis	227
maggot	221
orchards, culture and fertilization	181
sphinx	225
tree borer, round-headed	223
trees, annual growth	185
Apples, affected by potash salts	190
keeping qualities affected by culture	200
Aramiges fulleri	223
Argynnis cybele	226
Aspidiotus	227
Attelabus sp	223
Automeris io	226
Baking powders, available carbonic acid gas	137
three classes	138
Bean weevil	223
Belostoma americana	228
Biorhiza forticornis	228
Blueberry	27
Bordeaux, dry, experiments	6
soluble, field experiments	10
for potato blight	8
preparation	9
Brown-tail moth	221, 223
Bruchus obtectus	223
Bumble flower beetle	223

PAGE
Cabbage, experiments with 22
Cacœcia cerasivorana 214, 224
rosana 224
Callosamia promethea 225
Calocalpe undulata 224
Candy, food standards 86
Canker worm 224
Carpet beetles 217
Carpocapsa pomonella 224
Cauliflower, experiments with 22
Cecropia moth 225
Celery, experiments with 24
Cercopids 228
Cereal foods 117
claims of manufacturers 130
classification 119
composition 120
cooking 134
cost 132
dextrin content 126
digestibility 124
relative economy 133
Chain-dotted geometer 226
Chauloides pectinicornis 228
Chelymorpha argus 223
Cherry tortrix 214
Chersis sphinx 226
Chickens, manner of feeding 113
Chocolate, food standards 90
Chrysochus auratus 223
Chrysomela multiguttata 223
Chrysomphalus dictiospermi 227
Cider vinegar, analyses 147
Cimbex americana 228
Cingilia catenaria 215, 226
Clisiocampa americana 214, 225
Clover, red. germination tests 28
from various sources 28
yield with seed from different localities 31
Cocoa and cocoa plants, food standards 89
Coccinella 5-notata 223
Codling moth 224
Comb-horned fish-fly 228
Condimental foods 69
Condiments, food standards 86
Corn meal 67
average composition 121

PAGE
Cottonseed meal 60
as a feed.................................... 71
composition 74
different grades 73
digestibility 75
digestible nutrients 76
effect on health of animals.................................... 72
fertilizing value 72
high and low grades.................................... 71
Cottony grass scale (see Grass scale).................................... 169
maple scale 227
Cover crops for orchards.................................... 201
Cream of tartar baking powder.................................... 139
Culture and fertilization of orchards.................................... 181
Dagger moth 226
Datana angusii 226
ministra 214, 226
Deilephila chamænerii 224
Dextrin in cereal foods.................................... 126
Digestibility of cereal foods.................................... 124
Distilled vinegars, analyses.................................... 149
Distiller's grains 63
Dog-day cicada 228
Dotted geometer 215
Egg plant, experiments with.................................... 23
production 94
Elm leaf curl 227
Ephestia kuehniella 226
Epitrix cucumeris 217
Eriocampoides limacina 228
Eriopeltis brachypodii 178
festucæ 169
festucæ, bibliography 178
lichtensteinii 179
Estigmene acraea 224
Eulimacodes scapha 226
Eunotus, parasitic on grass scale.................................... 171, 177
Eupelmus 177
Euphoria inda 223
Euproctis chrysorrhœa 221, 223
Euvanessa antiopa 214, 224
Experiments in orchard culture 181
Eyed elator 223
Fall web worm.................................... 226
Feeding stuffs, analyses.................................... 55
inspection 53
Fertilization of orchards.................................... 182

PAGE
Fertilizer analyses 155
brands, multiplication 166
constituents 39
inspection 37, 153
Fertilizers, analyses of manufacturers samples.......... 45
guarantees and composition.......... 166
home mixed, for potatoes.......... 13
valuation 41
Fertilizing ingredients, trade values.......... 42
Fisher formula for orchards.......... 196
Flea beetle 217
Flours, average composition.......... 121
food standards 83
Food and seed legislation inspection.......... 77, 137
law 77
products, analysis 91
standards 80
animal products 81
beverages 89
condiments 86
lard 82
meats 81
spices 86
sugar and related substances.......... 84
vegetable products 82
vinegar 90
Fruit growing 25
Fuller's rose beetle.......... 223
Galium sphinx 224
Garden flea 220
hopper 227
Gee's extra fancy sharps middlings.......... 65
Giant saw-fly 228
water bug 228
Glucose products, food standards.......... 85
Gluten meals and feeds.......... 61
Graham flour 122
Grain products, food standards.......... 82
Grapta progne 224
Grass scale, cottony, bibliography.......... 178
description and habits.......... 173
economic significance 169
kinds of grass infested.......... 176
life cycle 175
life history notes.......... 173
number of generations.......... 175

	PAGE
Grass scale, cottony, natural checks	170
nature of injury	172
parasites	171, 177
relation to rust	170
remedial measures	172
Gray comma	224
Green apple leaf-tier	224
Halisodota caryii	225
Halticus uhleri	227
Heating foods	123
Hemaris thysbe	224
Hens. See poultry.	
Heterodera radicicola	219
Hickory tiger moth	225
Honey, food standards	86
Horntail	228
Horticulture, practical, experiments in	21
Hyloicus chersis	226
Hyphantria cunea	226
Incubator house	vii
Insect legislation	222
Insects of the year, 1905	213
Inspection, feeding stuff	53
fertilizer	37, 153
foods	77, 137
seeds	vii
Io moth	226
Isosoma	177
Lady beetles	223
Lard, food standards	82
Lasioptera	177
Laurel sphinx	224
Law, food inspection	77
Leaf-rolling weevil	223
Leucanium	227
Leucopis nigricornis, parasitic on grass scale	171, 177
Linseed meal	62
Lygus pratensis	228
Macrodactylus subspinosus	216, 223
Malt vinegar, analyses	149
Maple spot gall	228
Mediterranean flour moth	226
Meals, food standards	83
Meat meals and ground scraps	64
Meats, food standards	81
Meteorological observations	229
Microterys, parasitic on grass scale	171, 177

PAGE
Molasses, food standards........ 84
Monohammus titillator 223
Morga's scale 227
Mossy rose gall 228
Mourning cloak butterfly........ 214, 224
Mulching vs. cultivation of orchards........ 187
Mytilaspis pomonorum 227
Nematode worm 218
Notolophus antiqua 213, 227
leucostigma 213, 227
Oak fig-gall 228
rolled, average composition........ 121
Oblique banded leaf roller........ 224
Oedemasia concinna 213, 227
Old tussock moth........ 227
Orchard cover crops........ 201
culture, experiments in........ 181
fertilization 182
renovation 190
work in New Gloucester........ 203
Orchards, annual growth of trees........ 185
cultivated vs. mulch........ 187
Fisher formula 196
top-working 198
Ornamental gardening 24
Oscinis 177
Otiorhynchus ovatus 205, 223
Oyster shell scale 227
Papaipema nitella 214, 224
Papilio polyxenes 225
turnus 225
Pear slug 228
Pedigree charts, poultry........ 100
Pemphigus acerifolii 227
rhois 227
tesselata 227
Philampelus achemon 225
Phosphate-alum baking powders........ 141
baking powders 141
Phyllodesma americana 226
Phyllotreta vittata 217
Phytophthora infestans 1
Pissoides strobi 223
Plant breeding 27
lice 220, 227
Polyphemus moth 225

PAGE

Potash salts, effect upon apples.......... 190
Potato blight, soluble Bordeaux for.......... 8
experiments in 1904.......... 1
late blight fungus.......... 1
yields with home mixed fertilizers.......... 18
rot, conditions favorable to development.......... 5
development in cellar.......... 1
effect of time of digging.......... 2
transmission after harvesting.......... 2
Potatoes, Bordeaux treatment.......... 6
home mixed fertilizers for.......... 13
Poultry, amounts of food eaten.......... 110
bulletins, list of.......... 93
dry feeding 111
egg production 94
experiments 93
experiments in egg production.......... 94
houses, details 105
floor space 105
ventilation 107
manner of feeding.......... 108
pedigree charts 100
registered 100
registered males 103
selection of breeding stock.......... 98
size of flocks.......... 105
Promethea moth 225
Protena dairy feed.......... 65
Pseudococcus aceris 227
Pyrameis cardui 226
Radish, experiments 23
Rainfall, annual 231
Red clover from various sources.......... 28
Red-humped caterpillars 213, 227
Renovation of orchards.......... 190
Rhodites rosæ 228
Root-knot nematode 219
Rose chafer 216, 223
Sabulodes transversata 224
Salt marsh caterpillar.......... 224
Samia cecropia 225
Saperda candida 223
Saw-toothed grain beetle.......... 223
Scalloped owlet moth.......... 227
Scallop shell geometer.......... 224
Schizoneura americana 227
lanigera 227

	PAGE
Schizura unicornis	224
Sciaphilus asperatus	215, 223
muricatus	215
Sciara ocellata	228
Scolcopteryx libatrix	227
Seed and food legislation	vii
Serica sericea	223
Silvanus surinamensis	223
Sirups, food standards	84
Skiff slug caterpillar	226
Snout beetle	215
Sphinx gordius	225
kalmiæ	224
Spices, food standards	86
Spilosoma virginica	224
Spraying	26
Stalk borer	214, 224
Staff, changes	vii
Standards, food	80
Strawberry crown girdler	205, 223
feeding habits	208
remedial measures	209
repellents	211
Sucrate of lime, preparation	9
Sugars, food standards	84
Swallow-tail butterfly	225
Tarnished plant bug	219, 228
Tartaric acid baking powders	139
Tartrate-alum-acid-phosphate powder	143
Tartrate-phosphate baking powder	143
Telea polyphemus	225
Tent caterpillar	214, 225
Teras minuta	224
Thistle butterfly	226
Thysbe clearwing	224
Tiger swallow-tail	225
Tolype velleda	226
Tomato, experiments with	21
Topworking of orchards	198
Tortoise beetle	223
Treasurer's report	232
Tussock moth	213, 227
Unicorn prominent	224
Union grains	64
Urocerus albicornis	228
Vegetable gardening	21
Velleda lappet moth	226

	PAGE
Vetch as a cover crop	202
Vinegar, food standards	90
standards for Maine	144
Vinegars	143
cider, analyses	147
distilled, analyses	147
interpretation of the law	145
malt, analyses	149
result of the inspection	147
Virginian tiger moth	224
Viscid oil meal	62
Walnut caterpillar	226
Weather report	229
Wheat bran and middlings	66
malted, average composition	121
rolled, average composition	121
White marked tussock moth	227
pine weevil	223
Winter gardening	24
Wire worms	217, 223
Woolly louse of the apple	227
Yellow-necked caterpillar	214, 226

INDEX TO REPORTS FOR THE YEARS 1901 TO 1905, AND TO BULLETINS 70 TO 124 INCLUSIVE.

A general index to the reports for 1885 to 1896 inclusive will be found in the report for 1896; and for the reports for 1897 to 1900 inclusive in the report for 1900.

In each reference the first two figures indicate the year. Thus, '04, 183 indicates page 183 of the report for 1904.

Achemon sphinx .... '04, 183; '05, 225
Acknowledgments .... '01, 185
Acorns, analyses .... '01, 108
Acorn bread, analysis .... '01, 108
Adatia bipunctata .... '04, 184
Adulterated brans .... '01, 38
mixed feed .... '05, 66
Alaus oculatus .... '05, 223
Alder blight .... '04, 183; '05, 227
Aleurone layer .... '04, 62
Aleyrodes chelidonii .... '03, 125
plant-house .... '03, 125
anatomy .... '03, 134
embryology .... '03, 126
remedies .... '03, 137
Aleyrodes vaporariorum .... '03, 125
Alfalfa .... '04, 127
Alligator pear, analysis .... '01, 111
Alum baking powders .... '05, 141
Alsophila pometaria .... '03, 122
American apples, good varieties .... '02, 88
Ammonia salts in fertilizers .... '03, 27
Anaphothrips striata. See Grass thrips .... '02, 97
Angora goats .... '02, 214
notes on .... '03, 193
Animal meal, analyses .... '01, 31; '03, 60; '04, 47
Anisopteryx pometaria .... '05, 224
Announcements .... '01, 7; '04, vii; '05, v
Anthrenus scrophularius .... '05, 217
Apatela lepusculina .... '05, 226

Aphids .... '04, 179
Aphis mali .... '04, 183; '05, 227
Apple aphis .... '05, 227
maggot .... '04 169; '05, 221
life history .... '04, 171
preventive measures .... '04, 172
varieties of apple infested...................... '04, 177
orchards, culture .... '03, 1
culture and fertilization......................... '05, 181
scab and potash fertilizers............................. '03, 16
sphinx .... '05, 225
tree borer, round-headed................................ '05, 223
trees, annual growth...................................... '05, 185
mulching .... '04, 210
Apples, affected by potash salts.......................... '05, 190
catalogue of hardiest varieties........................ '02, 83
effect of potash fertilizers............................ '03, 12
good American varieties................................ '02, 88
Arctic .... '02, 89
Boiken .... '02, 89
Doctor .... '02, 89
Hurlbut .... '02, 89
Milding .... '02, 89
Munson Sweet .... '02, 89
Northwestern Greening .... '02, 90
Rolfe .... '02, 90
Shiawassee .... '02, 90
Wealthy .... '02, 90
Westfield .... '02, 90
York Imperial .... '02, 91
infested by apple maggot............................... '04, 177
keeping qualities .... '02, 94
affected by culture................................ '05, 200
Maine seedlings .... '02, 91
Aroostook .... '02, 91
Dudley .... '02, 91
Rolfe .... '02, 92
Stowe .... '02, 92
valuable Russian varieties.............................. '02, 85
Alexander .... '02, 86
Anisim .... '02, 86
Arabka .... '02, 86
Borsdorf .... '02, 86
Cross .... '02, 87
Green Crimean .... '02, 87
Hibernal .... '02, 87
Longfield .... '02, 87
Pink Anis .... '02, 87

Apples, valuable, Prolific Sweeting .... '02, 22
Russian Gravenstein .... '02, 88
Yellow Transparent .... '02, 88
varieties for Central Maine .... '02, 216
hardy in Maine .... '02, 82
Aramiges fulleri .... '05, 223
Arctia caia .... '04, 182
Argynnis cybele .... '05, 226
Army rations .... '01, 100
Aroostook county wheats and flours .... '03, 145
Arsenate of lead .... '01, 178; '02, 198
Arsenic, soluble, in Paris green .... '02, 198
Arsenical insecticides .... '02, 199; '03, 208
Arsenite of copper .... '01, 178
Ashes, leached, analyses .... '01, 68
manurial value .... '01, 66
mechanical effect on soils .... '01, 70
of various woods, analyses .... '01, 67
unleached, analyses .... '01, 68
Asilidæ .... '04, 179, 184
Asparagus beetle .... '04, 184
Aspidiotus .... '05, 227
Attelabus sp .... '05, 223
Automatic sprayers for potatoes .... '01, 62
Automeris io .... '05, 226
Available phosphoric acid .... '03, 28
Avocado, analysis of fruit .... '01, 111
Babcock test, law regulating use .... '03, 104
Baking powders, available carbonic acid gas .... '05, 137
three classes .... '05, 138
tests of Aroostook milled flours .... '03, 149
of flours from milling experiments .... '03, 175
Balance, income and outgo of nitrogen .... '04, 208
Barley .... '02, 130
Bean weevil .... '05, 223
Beef scrap, analyses .... '03, 60; '04, 47
tea, analysis .... '01, 101
Beets, fertilizers, formula .... '04, 150
Belostoma americana .... '05, 228
Bibliography, reciprocal crosses .... '04, 98
Biles Fourex .... '03, 63
Ready Rations, feeding experiments .... '04, 124
Biorhiza forticornis .... '05, 228
Birds, insect-eating .... '04, 166
Blackberries, management .... '02, 215
Black damsel bug .... '04, 184
Black Death .... '02, 199
Blatchford's Calf Meal .... '04, 56

18

Blatta germanica .... '04, 184
Blight, potato, resistance to .... '03, 181
Blind eyed sphinx .... '04, 183
Blissus leucopteris .... '03, 41
Blueberry barrens .... '01, 125
culture .... '05, 27
financial importance .... '01, 129
industry .... '01, 124
picking the fruit .... '01, 127
propagation .... '01, 120
rake .... '01, 127
seedlings, method of starting .... '01, 121
Blue stem wheat .... '03, 158, 169, 170
effect of change of climate .... '03, 158
Bone as manure .... '01, 84
composition .... '01, 87
meal .... '01, 85
meal and wood ashes .... '01, 87
steamed .... '01, 86
Bordeaux, dry, experiments .... '05, 6
soluble, field experiments .... '05, 10
for potato blight .... '05, 8
preparation .... '05, 9
mixture and Paris green .... '01, 177
boxal and Lion Brand .... '01, 56
cost .... '01, 57
for potato blight .... '03, 181
preparation .... '01, 49, 62
ready made vs. freshly prepared .... '01, 56
Boxal .... '01, 56
Bran, wheat .... '04, 68
composition .... '04, 79, 188
structure .... '04, 63
Brans, adulterated .... '01, 38
analyses .... '02, 49, 51
Breads, digestibility .... '04, 73
Breeding for egg production .... '02, 26; '03, 69
Brooder lamps .... '04, 6
Brooders, portable .... '04, 5
Brown-tail moth .... '04, 153, 182; '05, 221, 223
caterpillars, poisonous qualities .... '04, 156
description and habits .... '04, 155
history .... '04, 154
manner of distribution .... '04, 157
remedial measures .... '04, 158
winter nests .... '04, 156
Bruchus obtectus .... '05, 223
Bug Death .... '02, 201
vs. Paris green .... '03, 189

Building, description ... '04, ix
Bulletins, newspaper ... '01, 177
published in 1902 ... '02, 213
Bumble flower beetle ... '05, 223
By-products of the oat ... '02, 59; '03, 65
Cabbage butterfly ... '04, 180
experiments with ... '05, 22
Cacœcia cerasivorana ... '05, 214, 224
rosana ... '05, 224
Callosamia promethea ... '04, 165; '05, 225
Calocalpe undulata ... '05, 224
Candy, food standards ... '05, 86
Canker-worm, how to fight ... '03, 123
fall ... '03, 122; '05, 224
spring ... '03, 121
Carpet beetles ... '05, 217
Carpocapsa pomonella ... '05, 224
Carrion beetles ... '04, 180
Cauliflower, experiments with ... '05, 22
Cecidomyia strobiloides ... '04, 180
Cecropia moth ... '04, 165; '05, 225
Celery, experiments with ... '05, 24
Cercopids ... '05, 228
Cereal foods ... '02, 129; '05, 117
claims of manufacturers ... '05, 130
classification ... '05, 119
composition ... '05, 120
cooking ... '05, 134
cost ... '05, 132
dextrin content ... '05, 126
digestibility ... '05, 124
relative economy ... '05, 133
grains ... '02, 129
Cereals, prepared ... '02, 139
Chain-dotted geometer ... '05, 226
Chain-streak moth ... '04, 182
Chauloides pectinicornis ... '05, 228
Chelymorpha argus ... '05, 223
Chemicals, fertilizing, how to mix ... '04, 139
Chermes pinicorticis ... '04, 179
Cherry, surinam, analysis ... '01, 110
tortrix ... '05, 214
Chersis sphinx ... '05, 226
Chestnuts, Italian, analyses ... '01, 109
Chicago gluten meal ... '01, 36
Chickens, fattening with meat meal ... '02, 16
feeding for growth ... '02, 9
feeding with skim-milk ... '02, 15

Chickens, manner of feeding ... '05, 113
raising by artificial processes ... '04, 4
raising by natural processes ... '04, 2
relation of age to fattening ... '02, 14
Chicks, methods of feeding ... '04, 8
treatment ... '04, 7
Chinch bug, description ... '01, 182; '03, 41
enemies and checks ... '03, 43
habits ... '03, 42
in Maine ... '03, 44
remedies ... '01, 183; '03, 45
resistant powers ... '03, 48
Chocolate, food standards ... '05, 90
Chrysochus auratus ... '05, 223
Chrysomela multiguttata ... '05, 223
Chrysomphalus dictiospermi ... '05, 227
Chrysopa ... '04, 184
Chrysopidæ ... '04, 179
Cider vinegar, analyses ... '05, 147
Cimbex americana ... '05, 228
Cingilia catenaria ... '05, 215, 226
Clear-wing moth ... '04, 183
Cleft-grafting ... '03, 21
Clisiocampa americana ... '04, 162; '05, 214, 225
disstria ... '04, 162
Clover experiments ... '02, 216
hay, composition ... '04, 188
making ... '04, 213
red, germination tests ... '05, 28
from various sources ... '05, 28
yield with seed from different localities ... '05, 31
silage, composition ... '04, 188
Cockerels, feeding for market ... '04, 9
feeding tests ... '02, 10
Cockoo fly ... '04, 184
Cocoa and cocoa plants, food standards ... '05, 89
Coccinella 5-notata ... '05, 223
Codling moth ... '05, 224
Coefficients, digestion, with sheep ... '04, 193, 196
with steers ... '04, 195, 197
Colorado potato beetle ... '01, 177
Comb-horned fish-fly ... '05, 228
Concentrated feeding stuffs ... '04, 59
feeds, weights ... '04, 60
Condensed foods, analyses ... '01, 101
Condimental foods ... '02, 62; '05, 69
Condiments, food standards ... '05, 86
Coops vs. house and yard ... '02, 9

Coriscus subcoleoptratus .... '04, 184
Corn .... '02, 130
and oat feed, analyses .... '01, 31
breakfast foods, average composition .... '02, 151
average cost .... '02, 151
chops .... '01, 38
fertilizer formula .... '04, 144
fodder, composition .... '04, 118, 188, 190
meal, composition .... '04, 188; '05, 121, 67
preparations .... '02, 140
silage, composition .... '04, 118, 188
digestibility .... '04, 119
for cows .... '04, 122
Cotton seed meal .... '01, 36; '02, 56; '03, 54; '04, 51; '05, 60
meal, analyses '01, 27, 29; '02, 43; '03, 54; '04, 39, 188; '05, 74
as a feed .... '05, 71
composition .... '05, 74
different grades .... '05, 73
digestibility .... '05, 75
digestible nutrients .... '05, 76
effect on health of animals .... '05, 72
fertilizing value .... '05, 72
high grade .... '03, 60
low grade .... '01, 180; '02, 217; '03, 60, 209; '05, 71
Cottony grass scale (see Grass scale) .... '04, 183; '05, 169
maple scale .... '05, 227
Cover crops for orchards .... '05, 201
Cows, feeding experiments .... '04, 122
Cream gluten .... '01, 37
Cream of tartar baking powder .... '05, 139
Crioceris asparagi .... '04, 184
Cross-fertilization of tomatoes and squashes .... '04, 81
Crosses, reciprocal, bibliography .... '04, 98
Croton bugs .... '04, 184
Ctenucha virginica .... '04, 182
Cultivation, effect on growth of apple trees .... '03, 8
Culture and fertilization of orchards .... '05, 181
Curtain front house for hens .... '04, 14
Cut worm .... '04, 182
Dagger moth .... '05, 226
Dairymen, act for protection of .... '03, 104
Dandelion, fall .... '03, 109
cultivated .... '03, 112
Datana angusii .... '05, 226
ministra .... '04, 182; '05, 214, 226
Decorticated wheat flour .... '04, 67
Deilephila chamænerii .... '05, 224
Dermestes lardarius .... '04, 184

Dextrin in cereal foods.......... '05, 126
Diet, adequate.......... '01, 105
Dietaries, American and European.......... '01, 105
Digestibility of cereal foods.......... '05, 124
different breads.......... '04, 74
oat products.......... '01, 23
Digestible nutrients of oat products.......... '01, 24
protein in flours.......... '04, 74
Digestion coefficients with sheep.......... '04, 193, 196
with steers.......... '04, 195, 197
experiments with sheep and steers.......... '04, 185
Distilled vinegars, analyses.......... '05, 149
Distiller's grains.......... '04, 56; '05, 63
Dog-day cicada.......... '05, 228
Doryphora clivicollis.......... '04, 184
Dotted geometer.......... '05, 215
Dried eggs.......... '01, 93
Drone fly.......... '04, 180
Duck eggs, analyses.......... '01, 91
Early blight of potatoes.......... '01, 59
Eel grass, analyses.......... '01, 81
Egg cases, light and dark.......... '02, 18
plant, experiments with.......... '05, 23
production.......... '05, 94
breeding for.......... '02, 26; '03, 69
records.......... '02, 27, 33, 37
records of foundation stock.......... '03, 74
of pullets, 1901-1902.......... '03, 71
substitutes.......... '01, 93
Eggs, analyses.......... '01, 91
continuance of fertility.......... '02, 24
effects of temperature.......... '02, 20
fertility in.......... '02, 22; '03, 82
for incubation, effects of light and air.......... '02, 18
preparation for analysis.......... '01, 92
resting after transit.......... '02, 21
relation of shape to fertility.......... '02, 25
treatment before incubation.......... '02, 18
weight.......... '01, 90
Elm leaf curl.......... '05, 227
Embryology of Aleyrodes.......... '03, 126
Emergency rations.......... '01, 100
English Bug Compound.......... '02, 199
Entire wheat compared with straight and patent flour.......... '04, 69
flour.......... '04, 61, 66
bread, digestibility.......... '04, 73
composition.......... '04, 79
cost.......... '04, 75
milling experiment.......... '04, 77

Ephestia kuehniella .... '05, 226
Epilachna borealis .... '04, 184
Epitrix cucumeris .... '05, 217
Eriocampoides limacina .... '05, 228
Eriopeltis brachypodii .... '05, 178
festucæ .... '04, 183; '05, 169
festucæ, bibliography .... '05, 178
lichtensteinii .... '05, 179
Eristalis tenax .... '04, 180, 184
Estigmene acraea .... '05, 224
Eugenia Michelii, analysis of fruit..................................... '01, 110
Eulimacodes scapha .... '05, 226
Eunotus, parasitic on grass scale..................................... '05, 171, 177
Eupelmus .... '05, 177
Euphoria inda .... '05, 223
Euproctis chrysorrhœa .... '04, 154, 179, 182; '05, 221, 223
Euvanessa antiopa .... '04, 183; '05, 214, 224
Experiments in orchard culture..................................... '05, 181
Eyed elator .... '05, 223
Fall dandelion .... '03, 109
web worm .... '04, 163, 182; '05, 226
Feces, sheep, composition..................................... '04, 188, 189
steers, composition .... '04, 190, 191
Feed flour .... '04, 190
Feeding chickens for growth..................................... '02, 9
experiments with cows .... '04, 122
stuffs, analyses .... '01, 27; '02, 43; '04, 39; '05, 55
inspection .... '01, 25; '02, 41; '04, 37; '05, 53
law .... '01, 25, 180
requirements of .... '02, 41; '03, 53
test with Union Grains..................................... '04, 124
Feeds low in protein..................................... '02, 56
Feltia subgothica .... '04, 182
Fence, wire, for goats..................................... '02, 214
Fertility of eggs..................................... '02, 22; '03, 82
relation to shape..................................... '02, 25
continuance .... '02, 24
Fertilization of orchards..................................... '05, 182
abnormal .... '04, 84
Fertilizer analyses ......'01, 43, 163; '02, 72, 162; '03, 33, 95,; '04, 29, 101; '05, 45, 155
brands multiplication .... '05, 166
constituents .... '02, 67; '03, 27; '04, 23; '05, 39
formulas .... '04, 139
corn .... '04, 144
grass .... '04, 145
legumes .... '04, 148
orchards .... '03, 19

Fertilizer formulas, potatoes .... '04, 140
mangolds .... '03, 205
guarantees and analyses ....'02, 162, 168; '05, 166
compared .... '01, 170
home mixed .... '04, 129
for potatoes .... '05, 13
manufacturer's view .... '04, 131
why used .... '04, 130
practicability .... '04, 132
ingredients .... '04, 134
inspection .....'01, 42, 161; '02, 65, 153; '03, 25, 93; '04, 21, 101; '05, 37, 153
law, chief provisions...........'01, 48; '02, 80; '03, 40; '04, 36
rotation .... '04, 151
terms used .... '03, 27
trade valuation .... '03, 102
valuation ....'02, 69; '03, 29; '04, 25; '05, 41
Fertilizing chemicals, how to mix.............................. '04, 139
ingredients, trade value ......'02, 70; '03, 30; '04, 26; '05, 42
materials, composition .... '04, 135
in roots and stubble.................... '04, 138
required by crops........................ '04, 137
where purchasable .... '04, 136
Fife wheat .... '03, 167
effect of change of climate......................... '03, 157
Fish as manure.................................. '02, 213
Fisher formula for orchards.................................. '05, 196
Flea beetle .... '05, 217
Flour, amounts produced from wheat......................... '03, 173
chemical composition .... '04, 71
consumption in the United States..................... '03, 146
entire wheat .... '04, 61
grades .... '04, 66
graham .... '04, 64
mills of Aroostook county.............................. '03, 145
standards .... '03, 150
Flours, average composition .... '05, 121
composition ....'03, 147, 165
comparison of Maine and western grown.............. '03, 146
food standards .... '05, 83
of Aroostook county.................................. '03, 145
baking tests .... '03, 149
prepared, analyses .... '01, 96
Food and seed legislation inspection.........................'05, 77, 137
frauds and humbugs.................................. '02, 61
law .... '05, 77
man's daily needs .... '01, 104
materials, analyses .... '01, 89

Food nutrients and their uses .... '02, 55
products, analysis .... '05, 91
standards .... '05, 80
animal products .... '05, 81
beverages .... '05, 89
condiments .... '05, 86
lard .... '05, 82
meats .... '05, 81
spices .... '05, 86
sugar and related substances .... '05, 84
vegetable products .... '05, 82
vinegar .... '05, 90
Foods, cereal breakfast .... '02, 129
condensed .... '01, 100
condimental .... '02, 62
Forage crops .... '03, 207
Forest tent caterpillar .... '04, 162
Fruit growing .... '05, 25
Fucus evanescens .... '01, 79
vesiculosis .... '01, 79
Fuller's rose beetle .... '05, 223
Fungicides, commercial .... '01, 50
cost .... '01, 57
for potatoes, application .... '01, 50
experiments .... '01, 49; '02, 197
field notes .... '01, 52; '02, 203
ready made vs. freshly prepared .... '01, 56
Fungus diseases of the potato .... '01, 59
Galium sphinx .... '05, 224
Garden flea .... '05, 220
hopper .... '05, 227
Gee's extra fancy sharps middlings .... '05, 65
Germ oil cake .... '01, 37
meal, analyses .... '01, 29
Giant saw-fly .... '05, 228
water bug .... '05, 228
Ginseng .... '03, 117
Glassware for Babcock test .... '03, 104
Glassy cut worm .... '04, 183
Glucose products, food standards .... '05, 85
Gluten feed, analyses .... '03, 57; '04, 45, 191
foods, analyses .... '01, 99
in flour, determination .... '03, 150
layer of wheat .... '04, 62
meal, analyses .... '01, 29; '03, 57; '04, 45
meals and feeds .... '01, 36; '02, 45, 57; '03, 63; '04, 54; '05, 61
preparations, analyses .... '02, 133
Goats, Angora .... '02, 214; '03, 193

Gooseberries, mulching .... '04, 210
Goose eggs, analyses .... '01, 91
Grafting apple orchards........ '03, 21
wax, how to make........ '03, 23
Graham bread, digestibility........ '04, 73
flour .... '04, 64; '05, 122
composition .... '04, 73
Grain products, food standards........ '05, 82
Grapta progne .... '05, 224
fauna .... '04, 183
Grass land, top dressing with chemicals........ '03, 107
Grass scale, bibliography .... '05, 178
cottony .... '05, 169
description and habits........ '05, 173
economic significance .... '05, 169
kinds of grass infested........ '05, 176
life cycle .... '05, 175
life history notes........ '05, 173
natural checks .... '05, 170
nature of injury........ '05, 172
number of generations........ '05, 175
parasites .... '05, 171, 177
relation to rust........ '05, 170
remedial measures .... '05, 172
Grass, seeding, formula for fertilizer........ '04, 145
thrips, circulatory system .... '02, 111
description .... '02, 97
digestive system .... '02, 103
excretory system .... '02, 104
eyes .... '02, 109
larva .... '02, 101
habits .... '02, 112
life history .... '02, 100
mouth parts .... '02, 101
muscular system .... '02, 105
nervous system .... '02, 108
pupa .... '02, 101
reproductive system .... '02, 110
respiratory system .... '02, 111
salivary glands .... '02, 104
treatment .... '02, 128
Gravenstein, types of tree........ '03, 7
Gray comma .... '05, 224
Great tiger moth........ '04, 182
Green apple leaf-tier........ '05, 224
aphis .... '04, 183
Greens, dandelion, effects of digging........ '03, 111
Guinea fowl eggs, analyses........ '01, 91

Gypsy moth .... '04, 161
Hadena devastatrix .... '04, 183
Hair lice .... '04, 184
Halisodota caryii .... '04, 164; '05, 225
Halticus uhleri .... '05, 227
Hammond's Slug Shot .... '02, 201
Handmaid moth .... '04, 182
Hawkweed, orange .... '03, 114
Hay, composition .... '04, 188, 190
Haynes blue stem wheat .... '03, 166
Heating foods .... '05, 123
Hemaris thysbe .... '05, 224
Hens. See poultry.
Hen houses, curtain front .... '04, 14
pioneer .... '04, 12
warmed .... '04, 11
manure, amount per hen .... '03, 202
composition .... '03, 200
preservation .... '03, 199
Hens, breeding for egg production .... '02, 26
feeding .... '04, 19
first and second years' laying .... '03, 74
housing experiments .... '03, 77
management .... '04, 1
Herbivorous lady beetle .... '04, 184
Heterodera radicicola .... '05, 219
Hibiscus Sabdariffa, analysis of fruit .... '01, 112
Hickory tiger-moth .... '04, 164; '05, 225
High grade cotton seed meal .... '03, 60
Hieracium aurantiacum .... '03, 114
prealtum .... '03, 115
Historical sketch of station .... '04 ix
Holmes, Ezekiel .... '04, xii
Hall .... '04, xii
Home mixed fertilizers .... '04, 129
Hominy, analyses .... '02, 133, 137
Honey, food standards .... '05, 86
Horntail .... '05, 228
Horticulture, practical, experiments in .... '05, 21
Housing experiments with hens .... '03, 77
Hyloicus chersis .... '05, 226
Hyphantria cunea .... '04, 163, 182; '05, 226
Ichneumon fly .... '04, 184
Improvement of wheat .... '03, 179
Income and outgo of nitrogen .... '04, 205
Incubation, experiments in .... '02, 18; '03, 80
Incubator house .... '05, vii
Incubators .... '04, 4
treatment of eggs .... '02, 18

Insect enemies of the potato.................................. '01. 58
legislation .... '05. 222
Insects of the year, 1904..................................... '04, 179
1905 .... '05, 213
Insecticides .... '03, 208
effect on quality of potatoes................................. '02, 207
field notes .... '02, 205
for potatoes ....'01, 177; '02, 197
Inspections .... '01, 7
Inspection of feeding stuffs.......'01, 25; '02, 41; '03, 53; '04, 37; '05, 53
fertilizers ......'01, 41, 161; '02, 65, 153; '03, 25, 93; '04, 21, 101; '05, 37, 153
foods ....'05, 77, 137
seeds .... '05, vii
Insectivorous birds .... '04, 166
Io moth .... '05, 226
Ips fasciatus .... '04, 184
Isabella tiger moth... '04, 182
Isosoma .... '05, 177
Italian chestnuts, analyses .... '01, 109
Jamaica sorrel, analyses .... '01, 112
Kainite and apple scab.. '03, 17
Kelp, analyses .... '01, 81
King-Devil weed .... '03, 115
King gluten meal .... '01, 37
Kno-bug .... '02, 199
Lace-winged fly .... '04, 184
Lachnus .... '04, 179
abietis .... '04, 183
Lady beetles ....'04,184; '05, 223
Lamona wheat, effect of change of climate..................... '03, 157
Lampyridæ .... '04, 179
Larder beetle .... '04, 184
Lard, food standards.. '05, 82
Lasioptera .... '05, 177
Laurel sphinx .... '05, 224
Late blight of potatoes....................................... '01, 59
Law, feeding stuff.. '03, 66
chief requirements ....'03, 53; '04, 37
fertilizer, chief provisions.................................. '03, 40
food inspection .... '05, 77
regulating use of Babcock test................................ '03, 104
Leaf hoppers .... '04, 183
Leaf-rolling weevil .... '05, 223
Leaming corn silage, composition.............................. '04, 188
Leg bands for hens.. '04, 19
Legumes, fertilizer formulas.................................. '04, 148
Leontodon autumnale .... '03, 109

Lesser apple leaf folder .... '04, 182
Leucanium .... '05, 227
Leucopis nigricornis, parasitic on grass scale .... '05, 171, 177
Light Brahma hens, egg production .... '02, 28, 35
Lime used with insecticides .... '01, 178
Linseed meal .... '01, 29; '02, 58; '03, 56, 62; '04, 44, 189; '05, 62
Lion Brand Bordeaux mixture .... '01, 56
Low grade cottom seed meal .... '03, 60
Lycomorpha pholus .... '04, 182
Lygus pratensis .... '04, 184; '05, 228
Macrodactylus subspinosus .... '05, 216, 223
Malted foods, analyses .... '02, 137
discussion .... '02, 147
nuts, analysis .... '01, 107
Malt vinegar, analyses .... '05, 149
Mangel wurzels, fertilizers for .... '03, 205
Mangolds, fertilizers for .... '03, 205
Manure, hen, preservation .... '03, 199
influence on oats .... '01, 9
Maple borer .... '04, 181, 184
spot gall .... '05, 228
Meals, food standards .... '05, 83
Meat meal, analyses .... '01, 31; '03, 60
and ground scraps .... '04, 57
in chicken fattening .... '02, 16
meals and scraps .... '02, 58; '03, 65; '05, 64
Meats, food standards .... '05, 81
Mediterranean flour moth .... '05, 226
Meteorological observations .. '01, 189; '02, 218; '03, 210; '04, 215; '05, 229
Microterys, parasitic on grass scale .... '05, 171, 177
Middlings, composition .... '04, 189
loss of flour in .... '03, 174
Milk yield in feeding experiments .... '04, 123, 126
Millet for a forage crop .... '03, 207
Milling experiment with entire wheat flour .... '04, 77
with wheat .... '03, 164; '04, 64
Mixed feeds .... '01, 38; '02, 59; '03, 59; '04, 58; '05, 66
Molasses, food standards .... '05, 84
grains .... '04, 57
Monohammus titillator .... '05, 223
Morga's scale .... '05, 227
Mossy rose gall .... '05, 228
Mourning cloak butterfly .... '04, 183; '05, 214, 224
Muck .... '01, 71
analyses .... '01, 73
ash, analyses .... '01, 75
organic matter .... '01, 75

Mulching, effect on growth of apple trees .... '03, 8
for apple trees and gooseberries .... '04, 210
vs. cultivation of orchards .... '05, 187
Muriate of potash, top dressing for grass .... '03, 107
Mussel mud, analyses .... '01, 74
Mytilaspis pomonorum .... '04, 183; '05, 227
Nematode worm .... '05, 218
in fish .... '04, 181
Nests, trap .... '04, 17
Newspaper bulletins .... '01, 177; '02, 213; '03, 205; '04, 209
Newspapers received by the Station .... '01, 186
Nitrates in fertilizers .... '03, 28
Nitrate of soda, top dressing for grass land .... '03, 107
Nitrogen balance with sheep and steers .... '04, 205
forms used in fertilizers .... '04, 23
income and outgo, sheep and steers .... '04, 205
in fertilizers .... '03, 27
in urine, sheep and steers .... '04, 206
loss in hen manure .... '03, 200
organic .... '03, 27
Notolophus antiqua .... '04, 164, 182; '05, 213, 227
definita .... '04, 164
leucostigma .... '04, 164, 179, 182; '05, 213, 227
Nuclei, non-fusion .... '04, 87
Nutrients of food and their uses .... '02, 55
Oak fig-gall .... '05, 228
Oat and pea hay .... '01, 18
pea hay, analyses .... '01, 21
vetch hay, analysis .... '01, 21
breakfast foods, average composition and cost .... '02, 151
by products .... '01, 19
feeds .... '01, 38
hay, analyses .... '01, 21
meals .... '02, 141
meal, analyses .... '02, 133
products, analyses .... '01, 21
digestibility .... '01, 23
digestible nutrients .... '01, 24
smut and its prevention .... '02, 210; '04, 212
straw, analysis .... '01, 21
Oats .... '02, 131
analyses .... '01, 15
as grain and fodder .... '01, 9
as hay .... '01, 16
as silage .... '01, 18
by-products .... '02, 59; '03, 65
influenced by manure .... '01, 9
Maine grown .... '01, 12

Oats malted, average composition.......... '05, 121
rolled, average composition.......... '05, 121
treatment of seed.......... '02, 212
yield per acre.......... '01, 14
Oblique banded leaf roller.......... '05, 224
Œdemasia concinna ....'04, 164, 179; '05, 213, 227
Old tussock moth..........'04, 164; '05, 227
Open front poultry house.......... '03, 77
Orange hawkweed .... '03, 114
Orchard caterpillars in wild cherry.......... '04, 162
cover crops .... '05, 201
culture, experiments ....'03, 1; '05, 181
fertilization .... '05, 182
growth and condition of trees.......... '03, 5
insects .... '04, 153
methods of dressing.......... '03, 2
notes .... '02, 81
renovation ....'03, 18; '05, 190
tent caterpillar .... '04, 162
yield of fruit.......... '03, 11
work in New Gloucester.......... '05, 203
Orchards, annual growth of trees.......... '05, 185
cultivated vs. mulch.......... '05, 187
effects of potash salts.......... '03, 13
effect of stable manure.......... '03, 8
Fisher formula .... '05, 196
for experiment, history .... '03, 1, 13
top-working ....'03, 20; '05, 198
Organic nitrogen in fertilizers.......... '03, 27
Ornamental gardening .... '05, 24
Oscinis .... '05, 177
Otiorhynchus ovatus ....'04, 184; '05, 205, 223
Oyster shell scale..........'04, 183; '05, 227
Paleacrita vernata .... '03, 121
Pancake flours, analyses.......... '01, 96
Paonias excæcatus .... '04, 183
Papaipema nitella ....'05, 214, 224
Papilio polyxenes .... '05, 225
turnus .... '05, 225
Paris green and Bordeaux mixture.......... '01, 177
for potatoes .... '02, 197
purity .... '02, 197
vs. Bug Death .... '03, 189
Pea and oat hay.......... '01, 18
flour, analysis .... '01, 98
Pear slug .... '05, 228
Peat .... '01, 71
analyses .... '01, 73

Pedigree charts, poultry ... '05, 100
Pelecinus ... '04, 180
polyturator ... '04, 184
Pemphigus acerifolii ... '05, 227
rhois ... '05, 227
tesselata ... '05, 227
Persea gratissima, analysis of fruit ... '01, 111
Philampelus achemon ... '04, 183; '05, 225
Phosphate-alum baking powders ... '05, 141
baking powders ... '05, 141
Phosphates, various forms ... '03, 28
Phosphoric acid in fertilizers ... '03, 28
acids, forms used in fertilizers ... '04, 24
Phyllodesma americana ... '05, 226
Phyllotreta vittata ... '05, 217
Phytophthora infestans ... '05, 1
Pieris rapæ ... '04, 180
Pioneer roosting closet house ... '04, 12
Pissoides strobi ... '05, 223
Pine Cone lime for Bordeaux mixture ... '03, 189
Plaginotus speciosus ... '04, 180, 184
Plant breeding ... '05, 27
lice ... '04, 183; '05, 220, 227
food in soil and sod ... '04, 137
removed by crops ... '04, 136
Plant-house Aleyrodes ... '03, 125
Plymouth Rock hens, egg production ... '02, 27, 33, 37; '03, 72
Plums, varieties for central Maine ... '02, 216
Pollen, impotent ... '04, 85
tubes, incomplete development ... '04, 85
Pollination process ... '04, 82
Polyphemus moth ... '05, 225
Porthetria dispar ... '04, 161
Potash fertilizers and apple scab ... '03, 16
effect on apples ... '03, 12
in commercial fertilizers ... '03, 28; '04, 24
muriate, top dressing for grass ... '03, 107
salts, effect upon apples ... '05, 190
Potato aphis ... '04, 183
beetle, poisons for ... '01, 177
blight or rot ... '01, 59
resistance to ... '03, 181
soluble Bordeaux for ... '05, 8
enemies, how to fight ... '01, 58
experiments in 1903 ... '03, 181
in 1904 ... '05, 1
fertilizer formulas ... '04, 140
home mixed, composition ... '04, 133

Potato insecticides and fungicides .... '02, 197
late blight fungus .... '05, 1
leaf diseases .... '01, 60
rot, conditions favorable to development .... '05, 5
development in cellar .... '05, 1
effect of time of digging .... '05, 2
transmission after harvesting .... '05, 2
scale .... '01, 59
yields with home mixed fertilizers .... '05, 18
Potatoes, application of fungicides .... '01, 52
Bordeaux treatment .... '05, 6
experiments with fungicides .... '01, 49
home mixed fertilizers for .... '05, 13
methods of spraying .... '01, 61
quality affected by spraying .... '02, 207
sprayed, yield .... '01, 55
variety test .... '03, 181
when and how to spray .... '01, 64
yield of experiment plots .... '02, 207, 208
Poultry, amounts of food eaten .... '05, 110
bulletins, list of .... '05, 93
dry feeding .... '05, 111
egg production .... '05, 94
experiments .... '05, 93
in 1900 and 1901 .... '02, 9
in 1902 .... '03, 69
in egg production .... '05, 94
feeding .... '04, 19
house, details of construction .... '03, 77; '05, 105
houses, construction .... '04, 11, 13, 14
floor space .... '05, 105
ventilation .... '05, 107
housing and egg records .... '03, 77
management .... '04, 1
manner of feeding .... '05, 108
pedigree charts .... '05, 100
registered .... '05, 100
registered males .... '05, 103
selection of breeding stock .... '05, 98
size of flocks .... '05, 105
yards .... '04, 16
Prepared flours, analyses .... '01, 96
Promethea moth .... '04, 165, 182; '05, 225
Protein, cost in feeding stuffs .... '04, 59
in American wheats .... '03, 153
Protena dairy feed .... '05, 65
Pseudococcus aceris .... '05, 227

Publications of Station.................................'01, 8; '04, vii
received by the Station.......................... '01, 186
Pullets, egg records ....'02, 31, 36; '03, 71
Pyrameis cardui .... '05, 226
Pyrrharctia isabella .... '04, 182
Quercus Emoryi, analysis of acorn............................. '01, 108
lobata, analysis of acorn.................................. '01, 108
Quick death .... '02, 199
Radish, experiments .... '05, 23
Rain fall, annual............'01, 191; '02, 220; '03, 212; '04, 217; '05, 231
Ration cartridges .... '01, 101
Raspberries, management .... '02, 215
Rat-tailed larva .... '04, 184
Reciprocal crosses, bibliography .... '04, 98
study of .... '04, 81
Red albumen .... '02, 62
clover from various sources.................................. '05, 28
currant tomato, crosses...................................... '04, 88
humped caterpillar ....'04, 164, 182; '05, 213, 227
Refuses from oats and corn..................................... '04, 57
Renovation of orchards..................................'03, 18; '05, 190
Retopping sweet apple trees................................... '04, 209
Reverted phosphoric acid....................................... '03, 28
Rhagoletis pomonella .... '04, 169
Rhodites rosæ .... '05, 228
Ribbon weed, analyses .... '01, 81
Rice .... '02, 131
Robber flies ....'04, 179; '04, 184
Rockweed, analyses .... '01, 80
as cattle food... '01, 79
Rolled oats, analyses..'02, 133, 137
Roller mills .... '04, 65
flour mills of Aroostook county.......................... '03, 145
Roosting closets, close .... '03, 79
Root-knot nematode .... '05, 219
Rose chafer ....'05, 216, 223
Roselle, analysis .... '01, 112
Rotation, fertilizers .... '04, 151
Rove beetle .... '04, 184
Royal Oat Feed, analysis....................................... '01, 21
Russian apples, most valuable varieties (See Apples).......... '02, 85
Sabulodes transversata .... '05, 224
Salt marsh caterpillar .... '05, 224
Samia cecropia ....'04, 165, 182; '05, 225
Sanford corn silage... '04, 190
Saperda candida .... '05, 223
Saw-toothed grain beetle....................................... '05, 223
Scalloped owlet moth .... '05, 227
Scallop shell geometer .... '05, 224

Schizoneura americana ....'04, 183; '05, 227
lanigera ....'04, 183; '05, 227
tessellata ....'04, 179, 183
Schizura unicornis .... '05, 224
Sciaphilus asperatus ....'05, 215, 223
muricatus .... '05, 215
Sciara ocellata .... '05, 228
Scientific fertilizer .... '03, 103
Scolcopteryx libatrix .... '05, 227
Sea lettuce, analysis .... '01, 80
Seaweed, analyses .... '01, 80
as cattle food.................................... '01, 79
manurial value .... '01, 78
Seed and food legislation.................................... '05, vii
Seed, formation .... '04, 82
Seeds, test of vitality.................................... '04, 211
Self-raising flours, analyses.................................... '01, 96
Serica sericea .... '05, 223
Sesiidae .... '04, 183
Sheep and seaweed.................................... '01, 79
Sheep, digestion experiments.................................... '04, 185
Silage, clover, composition.................................... '04, 188
Leaming corn, composition.................................... '04, 188
oat .... '01, 18
pea and oat.................................... '01, 19
Sanford corn .... '04, 190
Silpha .... '04, 180
americana .... '04, 184
Silvanus surinamensis ....'04, 184; '05, 223
Sirups, food standards.................................... '05, 84
Skiff slug caterpillar.................................... '05, 226
Skim-milk as chicken food.................................... '02, 15
Smuts of cereals.................................... '02, 210
Snout beetle .... '05, 215
Soils, treatment for orchards.................................... '03, 9
Soluble phosphoric acid .... '03, 28
Soy bean and corn silage, composition.................................... '04, 189
digestibility .... '04, 119
hay, composition .... '04, 118
silage composition .... '04, 118
digestibility .... '04, 119
for cows .... '04, 122
Soy beans compared with corn fodder.................................... '04, 120
composition .... '04, 118
conditions of growth.................................... '04, 114
description .... '04, 113
digestibility .... '04, 119
fertilizing and culture.................................... '04, 115

Soy beans for a forage crop .... '03, 207
harvesting .... '04, 116
in Maine .... '04, 113
nutritive value .... '04, 117
varieties .... '04, 114
yield .... '04, 117
yield of protein .... '04, 120
Sphagnum, decomposed, analysis .... '01, 74
Sphinx gordius .... '05, 225
kalmiæ .... '05, 224
Spices, food standards .... '05, 86
Spilosoma virginica .... '05, 224
Sprayed potatoes, yield .... '01, 55
Spraying .... '05, 26
formulas for potatoes .... '01, 62
for potato blight .... '03, 181
potatoes, apparatus .... '01, 61
cost .... '01, 57
methods .... '01, 61
when and how to do it .... '01, 64
with fungicides .... '01, 49
Spring wheat bran, composition .... '04, 190
Spruce gall aphis .... '04, 183
Squashes, cross-fertilization .... '04, 81, 91
Staff, changes .... '05, vii
Stalk borer .... '05, 214, 224
Staphylinidæ .... '04, 184
Star Brand cotton seed meal .... '03, 209
Standards, food .... '05, 80
Starch content of sprayed potatoes .... '02, 207
Station, aim of .... '01, 7
historical sketch .... '04, ix
publications .... '01, 8
Steers, digestion experiments .... '04, 185
Strawberry crown girdler .... '04, 18; '05, 205, 223
feeding habits .... '05, 208
remedial measures .... '05, 209
repellents .... '05, 211
Sucrate of lime, preparation .... '05, 9
Sugars, food standards .... '05, 84
Surinam cherry, analysis .... '01, 110
Swallow-tail butterfly .... '05, 225
Syrphus fly .... '04, 184
Tankage .... '02, 214
Taraxicum officinale .... '03, 111
Tarnished plant bug .... '04, 184; '05, 219, 228
Tartaric acid baking powders .... '05, 139
Tartrate-alum-acid-phosphate powder .... '05, 143

Tartrate-phosphate baking powder .... '05, 143
Telea polyphemus .... '05, 225
Tent caterpillar .... '05, 214, 225
Teras minuta .... '04, 182; '05, 224
Thalessa lunata .... '04, 184
Three-spotted doryphora .... '04, 184
Thrips, grass (See Grass thrips) .... '02, 97
striata .... '02, 97
Thistle butterfly .... '05, 226
Thysbe clearwing .... '05, 224
Tiger swallow-tail .... '05, 225
Timothy hay, composition .... '04, 188, 189
Tolman apple trees, culture and growth .... '03, 8
Tolype velleda .... '05, 226
Tomato, experiments with .... '05, 21
Tomatoes, cross-fertilization .... '04, 81
Top dressing for grass lands .... '03, 107
Top-working of orchards .... '03, 20; '05, 198
Tortoise beetle .... '05, 223
Trade values of fertilizing ingredients .... '02, 70
Trap nests .... '04, 17
Treasurer's report .... '01, 192; '02, 221; '03, 213; '04, 218; '05, 232
Tremex columba .... '04, 184
Trichodectes .... '04, 184
Trillium grandiflorum, variation in .... '02, 169
Tropical fruit .... '01, 109
Trypeta pomonella .... '04, 169
Turkey eggs, analyses .... '01, 91
Tussock moth .... '04, 164, 182; '05, 213, 227
Two-spotted lady beetle .... '04, 184
Unicorn prominent .... '05, 224
Union Grains .... '04, 56; '05, 64
feeding experiments .... '04, 124
Urine, sheep and steers, nitrogen contained in .... '04, 206
Urocerus albicornis .... '05, 228
Vaccinium, albino forms .... '01, 130
American species .... '01, 115, 154
bibliography .... '01, 155
botanical notes .... '01, 132
classification, horticultural .... '01, 135
natural .... '01, 133
characters of the genus .... '01, 132
common names .... '01, 113
cultivation, history of .... '01, 122
distribution of species .... '01, 114
historical notes .... '01, 115
important species .... '01, 137
key to the natural groups .... '01, 133

Vaccinium, names, common ... '01, 113
natural groups of species ... '01, 133
species description of ... '01, 137, 154
arboreum ... '01, 152
atrococcum ... '01, 150
caespitosum ... '01, 142
Canadense ... '01, 145
corymbosum ... '01, 149
crassifolium ... '01, 151
erythrinum ... '01, 152
erythrocarpon ... '01, 140
hirsutum ... '01, 146
macrocarpon ... '01, 138
Myrsinites ... '01, 141
myrtilloides ... '01, 147
Myrtillus ... '01, 142
nigrum ... '01, 144
nitidum ... '01, 140
ovalifolium ... '01, 147
ovatum ... '01, 152
Oxycoccus ... '01, 137
parvifolium ... '01, 139
Pennsylvanicum ... '01, 143
stamineum ... '01, 153
uliginosum ... '01, 151
vacillans ... '01, 141
virgatum ... '01, 148
Vitis-Idaea ... '01, 138
use for ornamental planting ... '01, 119
uses of the fruit ... '01, 116
Valuation of fertilizers ... '02, 69; '03, 29, 102; '04, 25; '05, 41
Vegetable gardening ... '05, 21
Velleda lappet moth ... '05, 226
Vetch and oat hay, analysis ... '01, 21
Vetch as a cover crop ... '05, 202
Vinegar, food standards ... '05, 90
standards for Maine ... '05, 144
Vinegars ... '05, 143
cider, analyses ... '05, 147
distilled, analyses ... '05, 147
interpretation of the law ... '05, 145
malt, analyses ... '05, 149
result of the inspection ... '05, 147
Virginian tiger moth ... '05, 224
Viscid oil meal ... '05, 62
Vitality of seeds ... '04, 211
Walnut caterpillar ... '05, 226
Warmed house for hens ... '04, 11

Wax for grafting .... '03, 23
Weather report .... '01, 189; '02, 218; '03, 210; '04, 215; '05, 229
Weights of concentrated feeds .... '04, 60
Wellman's Fife wheat .... '03, 157, 165
Well-marked tussock moth .... '04, 164
Wheat .... '02, 131
American, composition .... '03, 153
blue stem .... '03, 158, 169, 170
bran .... '04, 68
bran and middlings .... '01, 39; '02, 59; '03, 65; '04, 58; '05, 66
breakfast foods .... '02, 133, 137
breakfast foods, average cost .... '02, 151
composition .... '04, 79, 188
effect of climate .... '03, 152
effect of change of climate .... '03, 157
endosperm .... '04, 62
fife .... '03, 167
flour, entire .... '04, 61
germ .... '04, 62
hard, composition .... '04, 68
Haynes blue stem .... '03, 166
improvement .... '03, 179
kernel, anatomy .... '04, 61
Lamona .... '03, 157
Maine grown, composition .... '03, 152
malted, average composition .... '05, 121
middlings, composition .... '04, 191
milling .... '04, 64
milling experiments .... '03, 164
offals .... '01, 39
preparations, discussion .... '02, 142
products, distribution of nitrogen and ash .... '04, 80
rolled, average composition .... '05, 121
structure .... '04, 63
Wellman's fife .... '03, 157, 165
white Russian .... '03, 168
yields in flour .... '03, 173
and offals .... '04, 67
Wheats, composition of seed and progeny .... '03, 161
Maine and western compared .... '03, 159
Maine, from western seed .... '03, 159
northwestern grown in Maine .... '03, 160
of Aroostook county .... '03, 145
of Maine and the Northwest, composition .... '03, 155
of the Northwest grown in Maine .... '03, 156
variation in protein content .... '03, 153
White marked tussock moth .... '04, 164, 182; '05, 227
pine weevil .... '05, 223

White Russian wheat .... '03, 168
Wyandotte hens, egg production...................'02, 28, 34, 38
Willow cone gall.. '04, 180
Winter gardening .... '05, 24
wheat mixed feed, composition...................... '04, 188
Wire worms ....'05, 217, 223
Wood ashes .... '01, 66
Woolly elm aphis.. '04, 183
louse of the apple...........................'04, 183; '05, 227
Wyandottes, white, egg record............................ '03, 73
Yards for poultry.. '04, 16
Yellow-necked caterpillar ....'05, 214, 226
Yellow plum tomato, crosses................................ '04, 88