DATE DUE			

PUBLIC DOCUMENT. No. 33.

SIXTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION,

AT

AMHERST, MASS.

1888.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
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Chemical Laboratory of the Massachusetts State Agricultural Experiment Station,

Amherst, Mass.

Wright & Potter Printing Co., State Printers.

Farm House of the Experiment Station.

WRIGHT & POTTER PRINTING CO. STATE PRINTERS.

Barn and Feeding Stalls of the Experiment Station.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

OFFICERS APPOINTED BY THE BOARD OF CONTROL.

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W. H. Beal, A.B., M.E.,	" " "
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R. B. Moore, B.S.,	" " "
E. E. Knapp, B.S.,	" " "
W. A. Parsons, B.S.,	*Field Experiments and Stock Feeding.*
David Wentzell,	*Farmer.*

* Left July 1, 1888. † Left Nov. 1, 1888. ‡ Left April 1, 1888.

BOSTON, Jan. 9, 1889.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Sixth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

SIXTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

Gentlemen: — The past year has been, for several reasons, an eventful one in the history of the Massachusetts State Agricultural Experiment Station. The State Legislature of 1888 has passed two acts affecting the organization and the work of the Station. The membership of the Board of Control has been increased, and the management of the new regulations for the trade in commercial fertilizers has been assigned to the director of the Station. The Board of Control has also assumed the responsibility of attending to all the chemical work called for in connection with investigations instituted in the various departments of the Hatch Experiment Station, reserved by the authorities of the Massachusetts Agricultural College. The terms agreed to by the Board of Trustees of the college and the Board of Control of the Massachusetts Experiment Station allow five thousand dollars of the Hatch fund for that work. The character of the additional work, as well as the increase in financial resources, has rendered some change in the working force of the Station advisable. To meet the growing demand for assistance in adopted lines of investigation, a department of vegetable physiology has been organized with a view to assist in particular in the investigation of diseases of plants by microscopic observations and otherwise. Prof. James Ellis Humphrey of North Weymouth, Mass., a graduate of Lawrence Scientific School, Harvard University, late professor of botany at the University of Indiana, Bloomington, Ind., was elected to the professorship of vegetable physiology, and entered upon his duties Nov. 1, 1888. A desirable increase of assistance in the chemical department of the Station for the coming year will be provided by some members of the senior class of the Agricultural College, who are already in training at the Station.

The work carried on during the past year has been in the main in three directions; namely: to determine the cost of food for the production of milk and pork, field experiments with different kinds of farm crops, and chemical examinations of a variety of substances of interest to farmers. The results of the season are, on the whole, quite satisfactory. Unfavorable weather during a considerable part of summer and autumn interfered at times, somewhat, with a more general success in field experiments, yet not in a sufficient degree to question seriously the previous statement.

The chemical laboratory has received a valuable addition of necessary apparatus. The library of the Station has been enriched by the addition of books and journals needed for reference in the special lines of investigations instituted. The stalls for feeding experiments have been enlarged in the direction pointed out in the preceding annual report. Most of the farm buildings are, as far as circumstances permit, in a good state of preservation; some of them, however, need a new coat of paint.

The chemical examinations in the laboratory have been in various directions, and exceptionally numerous. Fodder articles, fertilizers, products as well as refuse materials of various industries, have been tested with reference to their agricultural value. Much work has been done to determine the sanitary conditions of water supply in small towns and on farms. The resources of the chemical department have been engaged to their full capacity to meet the growing call for assistance on the part of our farming community.

The work for the improvement of the farm lands has been continued. Drill culture has been largely adopted for the renovation of the lands, and green manuring has extensively served to develop and economize inherent sources of plant food. The area prepared for future field experiments has been enlarged in various parts of the farm. From nine to ten acres of permanent grass land have been added to our fodder sources. Every field of the farm has been made to contribute, as far as practicable, to that end. A detailed description of the work carried on in the different parts of the farm will be found in the accompanying report.

The buildings for stock feeding have been considerably enlarged for the purpose of inaugurating experiments regarding the cost of feed for the production of mutton and beef. The general arrangement for serving the feed has been improved with a view to enter, whenever advisable, upon experiments to study the rate of digestibility of fodder plants peculiar to American farm industry. The live stock of the Station consists at present of two horses, six cows, two steers, six sheep and nine pigs. All, with the exception of the horses, serve at present in experiments to ascertain the cost of feed for the production of milk or meat.

The details of the work carried on in the barn, the field and the laboratory, during the past year, are recorded in the subsequent pages, under the following headings: –

Feeding Experiments.

I. Experiments with milch cows; English hay, corn stover, fodder corn, ensilage, corn and cob meal, wheat bran and gluten meal.

II. Experiments with milch cows; green fodder, vetch and oats, Southern cow-pea, corn meal, wheat bran and gluten meal.

III. Experiments with pigs; skim milk, corn meal, corn and cob meal, gluten meal and wheat bran.

IV. On fodder supply and analyses of fodder articles.

Field Experiments.

V. Fodder corn raised with single articles of plant food.

VI. Fodder crops raised with and without complete manure.

VII. Experiments with vetch and oats, serradella and Southern cow-pea.

VIII. Experiments with potatoes, roots and miscellaneous crops.

IX. "Potato Scab," by Prof. James Ellis Humphrey.

Work in the Chemical Department.

X. Fertilizer laws and fertilizer analyses; miscellaneous analyses.

XI. Water analyses.

XII. Compilation of analyses of fodder articles, with reference to food value.

XIII. Compilation of analyses of fodder articles, with reference to fertilizing ingredients.

XIV. Compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

XV. Meteorological observations.

The periodical publications of the Station have been continued at such intervals as circumstances advise. The public interest in the bulletins and annual reports is steadily increasing. The State authorities have authorized the publication of twenty-five thousand copies of the annual report; and the call for our bulletins has necessitated the printing of nine thousand copies, with a prospect of the need of ten thousand in the near future. The obligation imposed upon the director of the Station by the new laws for the regulation of the trade in commercial fertilizers, to issue, during a large part of the year, a monthly statement of analyses of fertilizers made under his direction, will materially increase the periodical publication. It appears advisable in the interest of economy to publish the analyses of fertilizers as far as practicable in the form of business circulars, and to reserve the discussion of experimental work to the periodical bulletins.

All parties engaged with me in the work of the Station have faithfully attended to the tasks assigned to them; and it is with particular pleasure that I publicly recognize that fact.

I cannot consider my whole duty on this occasion fulfilled without expressing my sincere thanks to you for your kind support during the past year.

Yours very respectfully,

C. A GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 9, 1889.

ON FEEDING EXPERIMENTS.

1888.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

II. Feeding Experiments with Milch Cows; Green Fodder, Vetch and Oats, Southern Cow-pea, Hay, Rowen, Corn Meal, Wheat Bran and Gluten Meal.

III. Feeding Experiments with Pigs; Skim Milk, Corn Meal, Corn and Cob Meal, Gluten Meal and Wheat Bran.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

During the year 1886 a series of feeding experiments with milch cows was inaugurated for the purpose of comparing the feeding effects of dry corn fodder, of corn ensilage and of corn stover, as a substitute in whole or in part for English hay; and that of corn ensilage, as compared with various kinds of roots, as far as practicable, under corresponding circumstances. The same variety of corn, if not otherwise specified, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same advanced state of maturity as the one which furnished the dry corn fodder, *i. e.*, at the beginning of the glazing over of the kernels.

The daily diet of the cows consisted, at the beginning of the experiment, of three and one-quarter pounds of corn meal, an equal amount of wheat bran, and all the hay they could eat. This combination of fodder articles was adopted as the basis of our investigation mainly for the reason that it had been used in some of our earlier feeding experiments, and not on the assumption of its being the best possible combination of fodder articles for milch cows. The actual amount of hay consumed in each case was ascertained by weighing out a liberal supply of it and deducting subsequently the hay left over. The statement made in our records in this connection refers to the average consumption of hay per day during the feeding period.

The temporary changes in the diet, whenever decided upon, were carried out gradually, as it is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates which accompany all detailed reports of our feeding experiments, past and present, furnish exact figures in that direction. This is in particular the case whenever such statements are of a special interest for an intelligent appreciation of the final conclusions presented. The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of the various fodder articles consumed was based on the average local market price per ton in Amherst, 1886–1887 : —

Good English hay, .	$15 00	Rye middlings, . .	$24 00
Corn meal, . . .	23 00	Dry corn fodder (stover),	5 00
Wheat bran, . . .	20 00	Corn ensilage, . . .	2 75
Gluten meal, . . .	23 00	Carrots, ...	7 00

To assist those not yet familiar with the various points which ought to be taken into consideration when deciding the relative agricultural value of fodder articles at our disposal, the following short discourse on this subject, from the preceding annual report, is here reprinted. The value of a fodder for dairy purposes may be stated from two distinctly different stand-points : namely, with reference to its influence on the temporary yield of milk and the general condition of the animals which consume it, and in regard to its cost, *i.e.*, its physiological and commercial value. The relative commercial value of a fodder article again depends on its first cost in the market, and on the value of the fertilizing constituents left in the manurial matter after it has served for food. The market value and actual feeding effect of one and the same article do not necessarily correspond with each other; in fact, they rarely coincide. The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, varies under different circumstances, and depends in a controlling degree on its judicial use in compounding diets.

1. *Physiological or Feeding Value.*

As no single plant or part of plant has been found to supply economically and efficiently, to any considerable extent, the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us, therefore, to study the value of fodder articles at our disposal from both standpoints.

To ascertain the chemical composition of a fodder ration, in connection with an otherwise carefully managed feeding experiment, enables us to recognize with more certainty the causes of the varying feeding effects of one and the same fodder article, when fed in different combinations. It furnishes also a most valuable guide in the selection of suitable commercial feed stuffs from known sources to supplement economically our home-raised fodder crops. Practical experience in feeding stock has so far advanced that it seems to need no further argument to accept it as a matter of fact that the efficiency of a fodder ration in the dairy does not depend, aside from its general or special adaptation, on the mere presence of more or less of certain prominent fodder articles, but on the presence of a proper quantity and a certain relative proportion of certain prominent constituents of plants which are known to be essential for a successful support of life and of the special functions of the dairy cow.

Investigations into the relations which the various prominent constituents of plants bear to the support of animal life have rendered it advisable to classify them, in this connection, into three groups, — mineral constituents, and nitrogenous and non-nitrogenous organic constituents. For details regarding this matter, I have to refer to previous publications of the Station. (See Fourth Annual Report, pages 31–37.)

Numerous and extensive practical feeding experiments with most of our prominent fodder articles in various conditions, and with all kinds of farm live stock, have introduced the practice of reporting, in connection with the analysis of the chemist, also the result of careful feeding experiments as far as the various fodder articles have proved digestible, and were thus qualified for the support of the life and the functions of the particular kind of animal on trial. In stating the amount of the digestible portion of the fodder consumed in a feeding experiment, it has proved useful for comparing different fodder rations, etc., to make known by a distinct record the relative proportions which has been noticed to exist between the amount of its digestible, nitrogenous and non-nitrogenous organic constituents. This relation is expressed by the name of " nutritive ratio." An examination of the description of our feeding experiments will show, for instance, that the corn meal fed (1888) contained one part of digestible nitrogenous to 9.66 parts of digestible non-nitrogenous organic matter, making the customary allowance for the higher physiological value of the fat as compared with that of starch, sugar, etc. (2.5 times higher).

The " nutritive ratios " of the articles of feed consumed in 1888 are subsequently stated as follows: —

Corn meal, . . .	1 : 9.66	English hay, . . .	1 : 10.52
Wheat bran, . . .	1 : 3.85	Dry corn fodder, . .	1 : 10.31
Gluten meal, . . .	1 : 2.11	Stover, ...	1 : 9.3
		Corn ensilage, . .	1 : 8.8

The results of our own analyses of these fodder articles are here turned to account for the calculation of the above-stated " nutritive ratios."

It has been noticed that, as a general rule, growing animals and milch cows require a richer food, — *i. e.*, a closer relation of digestible nitrogenous and non-nitrogenous organic constituents in their feed, — to do their best, than full-grown animals and moderately-worked horses and oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of nitrogenous organic constituents to 5.4 parts of digestible non-nitrogenous constituents.

2. *Commercial Value or Actual Cost of a Fodder Article.*

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and in particular nitrogen, a fodder ingredient contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm managements depends in a considerable degree on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder, and the value of the manure resulting, deserve the careful consideration of the farmer when devising an efficient and at the same time an economical diet for his live stock.

The question whether one or the other fodder mixture will prove ultimately, under otherwise corresponding circumstances, the cheapest one, can only be answered intelligently when both the original cost of the feed consumed and the value of the manurial residue subsequently obtained are duly considered.

An examination of the fodder articles used in connection with our investigations shows, for instance, the following relation between their first cost and the commercial value of their fertilizing constituents : —

	First cost.	Value of Fertilizing Constituents.
Corn meal,	$23 00	$7 19
Wheat bran,	23 00	12 31
Gluten meal,	27 00	17 49
English hay,	15 00	6 45
Corn ensilage,	2 75	1 31
Fodder corn,	5 00	4 77
Corn stover,	5 00	4 95
Carrots,	7 00	1 06
Lane's sugar beet,	5 00	1 60

A compilation of our own observations in this direction will be found at the close of our present report.

The close relation which quite necessarily exits in most farm managements between the system of cultivating the lands and the keeping of farm live stock for farm work, for the dairy and for the supply of food for the general market, imparts to the barn-yard manure a special if not a controlling importance as a valuable manurial resource. The barn-yard manure ought to remain, in a judicious system of mixed farming, not only the main reliance of the farmer for plant food, but also the cheapest manure at his disposal. The objections raised at times against a liberal use of barn-yard manure ought not to rest on its higher cost of production, when compared with other manurial substances in our market. The name, "barn-yard manure," is, however, too frequently used without any particular discrimination with reference to all kinds of manurial refuse obtained in connection with stock feeding and stock raising, which are frequently of widely differing composition. To approximate even fairly the comparative value of two samples obtained on different farms remains a hopeless task as long as a more definite information regarding the following points is wanting: —

(1.) The character of the fodder consumed.

(2.) The kind, the age and the function of the animal which served for its production.

(3.) The nature and the quantity of the material which served for the absorption of the animal excretions.

(4.) The care bestowed upon collecting and preserving the entire liquid and solid excretions.

Assuming, for our present purpose, in both instances, identical conditions, as far as the kind of animal, the mode of collecting and the care of keeping the manure are concerned, it will be apparent that the relative values of the two kinds of barn-yard manure stand essentially in a direct relation to the amount of nitrogen, potash, phosphoric acid, etc., which was contained in the feed consumed.

The loss of fertilizing constituents contained in the fodder of milch cows, in consequence of the production of milk, varies quite naturally more or less in case of different cows, as well as of one and the same animal at its different stages of milk production. Whether the whole milk or only the cream is sold off from the farm deserves here not less serious consideration.

We have adopted thus far in our calculation a loss of twenty per cent., which may be considered quite a liberal allowance in case of a fair average production of milk, and where the whole milk is sold.

1886. — From the description of our earlier feeding experiments with milch cows (see Fourth Annual Report, page 11), it may be observed that the relations of the digestible nitrogenous and non-nitrogenous organic constituents in the different combinations of fodder articles which constituted, during the various feeding periods, the daily diet of the cows, varied on that occasion from 1 : 6.7 to 1 : 10.17. The closer relation was obtained by feeding, on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1 : 6.7.

and the wider ratio by feeding daily, on an average, —

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1 : 10.17.

1887. — As most well-conducted experiments with dairy cows endorse the use of a diet which has a closer relation between its digestible organic nitrogenous and non-nitrogenous constituents than either one of the above-stated two fodder rations used by us, it was decided to try fodder combinations which, in consequence of the addition of some concentrated commercial fodder article, would contain a larger amount of digestible nitrogenous substances. The gluten meal was selected for that purpose. The same coarse fodder articles — English hay, corn ensilage, corn stover and roots (carrots) — were used in most cases in different quantities and combinations with equal weights of corn meal, wheat bran and gluten meal. The relations between the two above-stated important groups of fodder constituents varied in the different diets used from 1 : 5 9 to 1 : 7.9. The closer relation was obtained by feeding daily, on an average, —

3¼ lbs. of corn meal,	Nutritive ratio, 1 : 5.9.
3¼ lbs. of wheat bran,	
3¼ lbs. of gluten meal,	
10 lbs. of hay,	
35 lbs. of carrots,	

and the wider ratio by feeding, on an average, —

3¼ lbs. of corn meal,	Nutritive ratio, 1 : 7.9.
3¼ lbs. of wheat bran,	
25 lbs. of hay,	

The entire feeding experiment (I) was subdivided into eight distinctly different feeding periods; the same number as on the preceding occasion, for the same length of time — seven months.

The dry corn fodder, the ensilage and the roots were cut before being offered as feed.

The yield of milk decreased, although at a different rate, in the case of different animals as time advanced. The shrinkage in the daily yield of milk amounted, at the end of the experiment, to from 3.2 quarts to 4.9 quarts in case of different cows. The gradual decline in the entire milk record of every cow is only once broken, namely, during the sixth feeding period, February 7 to February 21, when the yield of milk shows an increase of from .7 to 1.9 quarts per day, as compared with that of the preceding period. This change for the better was noticed when ten pounds of hay and thirty-four pounds of carrots were used, under otherwise corresponding circumstances, as a substitute for five pounds of hay and twenty-nine pounds of corn ensilage. The amount of dry vegetable matter contained in the hay fed with roots and in the hay fed with corn ensilage was practically the same in both instances. The feed of the sixth feeding period, containing carrots as an ingredient, is thus the most nutritive and also the most expensive.

The results of the experiment led us to the following conclusions: —

The nutritive value of our dry corn fodder (stover) compares well with that of an average quality of English hay; the same may be said of good corn ensilage in place of from one-half to two-thirds of the customary amount of hay.

The nutritive value of our dry corn fodder (stover) and of a good corn ensilage, taking into consideration pound for pound of the dry vegetable matter they contain, has proved in our case fully equal, if not superior, to that of the average English hay.

The nutritive feeding value of carrots, taking into consideration pound for pound of the dry vegetable matter they contain, exceeds that of the corn ensilage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed. The conclusions thus far stated are in full agreement with those pointed out in our earlier experiments

The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet.

The total cost of the feed for the production of milk is lowest whenever corn fodder or corn ensilage have replaced, in the whole or in part, English hay, under otherwise corresponding circumstances.

The net cost of feed consumed for the production of one quart of milk during the various feeding periods, varies as widely as from .34 cents to 1.6 cents in case of the same cow. The net cost of the feed is obtained by deducting eighty per cent. of the value of the fertilizing constituents it contains.

The manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed.

To avoid misconstruction regarding the statement of net cost of milk used in our description, I state once more that it does not include expenses of labor, housing, interest on investment, etc., but means merely net cost of feed after deducting eighty per cent. of its manurial value. (For details, see Fifth Annual Report, pages 11–34.)

1888. — To verify as far as practicable the above-stated conclusions, a new series of observations was decided upon. The course adopted was essentially the same as in the preceding year. English hay, fodder corn, corn ensilage and corn stover served as coarse fodder articles; and corn meal, corn and cob meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous and non-nitrogenous substances in the daily fodder rations. The repetition of a comparative test between roots and corn ensilage was left over for another season, when a larger supply of sugar beets and carrots would render the trial more decisive. The fodder corn, corn ensilage and corn stover were cut to an even length (1½–2 inches) before fed. The daily average amount of fodder corn left behind unconsumed was 5.55 pounds and that of corn stover and ensilage, 3 pounds.

Six cows, grades, served in the experiment, which was subdivided into seven feeding periods, extending over a period of four and one-half months. The same quantity of corn and cob meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily from the beginning to the close of the trial. Corn ensilage was fed in different proportions with one-half or one-fourth of English hay. Fodder corn and corn stover were fed most of the time by themselves.

The nutritive value of the different diets used has been quite close, varying from 1:5 5 to 1:6.1. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

Local Market Value of Feed used in our Calculations.

Corn meal,	$23 00	English hay,	$15 00
Corn and cob meal,	20 70	Fodder corn,	5 00
Wheat bran,	23 00	Corn ensilage,	2 75
Gluten meal,	27 00	Corn stover,	5 00

An examination of the subsequent tabular statement of the details of the late experiment cannot fail to show that the conclusions drawn from our preceding observation in this direction are in the main fully sustained.

The high nutritive value of fodder corn, good corn ensilage and corn stover, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animals on trial, as well as the quality of the milk, point in that direction.

The daily yield of milk decreased gradually, apparently at a normal rate, during the progress of the experiment. The shrinkage in the yield of milk amounted, at the close of the trial, in the case of different cows of different milking periods, to from 1.6 to 4 quarts per day. The weight of the cows had decreased in three cases, and had increased in three.

The first cost of feed for the production of one quart of milk in case of the same cow, is, as a rule, from one-half to one cent less per quart wherever fodder corn, corn ensilage or corn stover have replaced in part or in whole the English hay. The first cost of feed for the production of one quart of milk differs, for obvious reasons, quite seriously in case of the same diet as far as different animals are concerned. This difference stands in a direct relation to the daily yield of milk; the less the latter, the higher the cost of the feed. A few results taken from our subsequent records may convey some more definite idea regarding this important circumstance.

Fodder rations: Fodder corn, ... 18–19 lbs.
Corn and cob meal, ... $3\frac{1}{4}$ lbs.
Wheat bran, ... $3\frac{1}{4}$ lbs.
Gluten meal, ... $3\frac{1}{4}$ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy, . . .	17.5 qts.	1.01 cts. per qt.	.50 cts. per qt.
Melia, . . .	12.7 "	1.28 " "	.66 " "
Eva, ...	6.1 "	2.64 " "	1.39 " "

Fodder rations: English hay, ... 20 lbs.
Corn and cob meal, ... $3\frac{1}{4}$ lbs.
Wheat bran, ... $3\frac{1}{4}$ lbs.
Gluten meal, ... $3\frac{1}{4}$ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy, . . .	13.5 qts.	1.97 cts per qt.	1.28 cts. per qt.
Melia, . . .	10.9 "	2.44 " "	1.59 " "
Eva, ...	5.6 "	4.74 " "	3.09 " "

The net cost of feed is obtained by deducting eighty per cent. of the commercial value of the fertilizing constituents it contains from its first cost. The manurial value of the feed consumed during the feeding experiments, after deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is at current market prices in every instance more than one-third of the original cost of the feed.

For further details, consult the following record: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.89	–	–	–	25.49	10.8	2.36	1:6.1	845
Jan. 21 to Feb. 6, . .	–	3 25	3.25	3.25	20.00	–	–	–	26.46	12.3	2.15	1:5.9	862
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	20.41	–	–	23.95	11.0	2.18	1:6.2	825
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	11.6	1.94	1:5.6	848
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	36.78	–	21.45	10.6	2.02	1:5.5	828
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	13.98	19.93	10.1	1.97	1:5.5	820
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.6	2.50	1:5.9	862

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.86	–	–	–	25.47	12.0	2.12	1:6.1	993
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	12.7	2.08	1:5.9	993
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	17.71	–	–	21.93	11.3	1.94	1:5.9	960
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	12.1	1.86	1:5.6	955
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	29.45	–	19.78	10.9	1.81	1:5.4	949
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	11.20	17.68	10.2	1.73	1:5.2	870
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.5	2.52	1:5.9	862

FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.33	–	–	–	24.99	13.5	1.85	1 : 6.1	993
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	14.6	1.81	1 : 5.9	995
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.93	–	–	22.84	12.7	1.80	1 : 6.0	954
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.78	–	22.50	12.5	1.80	1 : 5.6	973
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	32.05	–	20.37	11.8	1.73	1 : 5.5	936
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	13.75	19.75	11.2	1.76	1 : 5.5	925
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.9	2.43	1 : 5.9	969

EVA: *Age, 8 years; Grade, Jersey; Last Calf, Jan. 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 6 to Jan. 16, . .	3.25	–	3.25	3.25	18.89	–	–	–	25.49	7.0	3.64	1 : 6.1	988
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.2	3.68	1 : 5.9	1,008
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.19	–	–	22.29	6.1	3.65	1 : 6.0	997
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	31.80	–	20.32	5.5	3.69	1 : 5.4	1,022
April 20 to April 30, . .	–	2.35	3.25	3.25	–	–	–	13.02	19.16	5.7	3.36	1 : 5.5	1,055
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	5.6	4.73	1 : 5.9	1,143

FEEDING RECORD — *Concluded.*

LIZZIE: *Age, 6 years; Native; Last Calf, Feb. 1, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.31	–	–	–	25.08	9.4	2.67	1:6.1	1,045
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10 6	2.50	1:5.9	1,055
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	20.18	–	–	23.74	8.2	2.90	1:6.1	1,037
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	18.92	–	21.85	9.2	2.38	1:5.5	1,040
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	26.42	–	19.09	8.6	2.22	1:5.3	1,073
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	12.70	18.90	8.7	2.17	1:5.4	1,055
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.9	3.35	1:5.9	1,091

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	19.2	1.38	1:5.9	1,148
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	25.00	–	–	27.40	17.5	1.56	1:6.5	1,102
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	34.46	–	25.38	17.0	1.49	1:5.8	1,068
March 20 to April 4,	–	3 25	3.25	3.25	5.00	–	47.36	–	23.86	14.3	1.67	1:5.8	1,084
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	15.32	21.02	13.6	1.55	1:5.7	1,100
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	13.5	1.96	1:5.9	1,102

TOTAL COST OF FEED PER QUART OF MILK.

May.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	97.2	10.8	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	2.41
Jan. 21 to Feb. 6, . .	209.1	12.3	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.16
Feb. 13 to Feb. 26, . .	154.0	11.0	–	45.50	45.50	45.50	–	285.74	–	–	2 33	1.51
March 1 to March 13, . .	162.4	11.6	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.77
March 20 to April 4, . .	169.6	10.6	–	52.00	52.00	52.00	80.00	–	588.48	–	3 26	1.93
April 20 to April 30, . .	111.1	10.1	–	35.75	35.75	35.75	–	–	–	143.22	1 65	1.59
May 9 to May 15, . .	74.2	10.6	–	22.75	22.75	22.75	140 00	–	–	–	1 86	2.51

Minnie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	108.0	12.0	29.25	–	29.25	29.25	169.74	–	–	–	$2 34	2.17
Jan. 21 to Feb. 6, . .	215.9	12.7	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.09
Feb. 13 to Feb. 26, . .	158 2	11.3	–	45.50	45.50	45.50	–	247.94	–	–	2 23	1.41
March 1 to March 13, . .	157.3	12.1	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.82
March 20 to April 4, . .	174.4	10.9	–	52.00	52.00	52.00	80.00	–	471.20	–	3 10	1.78
April 20 to April 30, . .	112.2	10.2	–	35.75	35.75	35.75	–	–	–	139.70	1 57	1.40
May 9 to May 15, . .	73.5	10.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.53

TOTAL COST OF FEED PER QUART OF MILK — Continued.

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	121.5	13.5	29.25	–	29.25	29.25	164.97	–	–	–	$2 30	1.89
Jan. 21 to Feb. 6, . .	248.2	14.6	–	55.25	55.25	55.25	310.00	–	–	–	4 51	1.82
Feb. 13 to Feb. 26, . .	177.8	12.7	–	45.50	45.50	45.50	–	265.02	–	–	2 27	1.28
March 1 to March 13, . .	162.5	12.5	–	42 25	42.25	42.25	130.00	–	283.14	–	2 87	1.77
March 20 to April 4, . .	188.8	11.8	–	52.00	52.00	52.00	80.00	–	512.80	–	3 16	1.67
April 20 to April 30, . .	123.2	11 2	–	35.75	35.75	35.75	–	–	–	168.52	1 74	1.33
May 9 to May 15, . .	76.3	10.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.44

Eva.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	63.0	7.0	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	3.71
Jan. 21 to Feb. 6, . .	122.4	7.2	–	55.25	55.25	55.25	340.00	–	–	–	4 51	3.68
Feb. 13 to Feb. 26, . .	85.1	6.1	–	45.50	45.50	45.50	–	254.66	–	–	2 25	2.64
March 20 to April 4, . .	88.0	5.5	–	52.00	52.00	52.00	80.00	–	508.80	–	3 15	3.58
April 20 to April 30, . .	62 7	5.7	–	35.75	35.75	35.75	–	–	–	153.78	1 62	2.58
May 9 to May 15, . .	39.2	5.6	–	22.75	22.75	22.75	140.00	–	–	–	1 86	4.74

TOTAL COST OF FEED PER QUART OF MILK — Concluded.

Lizzie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	84.6	9.4	29.25	–	29.25	29.25	164.79	–	–	–	$2 30	2.72
Jan. 21 to Feb. 6, . .	180.2	10.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.50
Feb. 13 to Feb. 26, . .	114 8	8.2	–	45.50	45.50	45.50	–	282.52	–	–	2 32	2.02
March 1 to March 13, . .	119.6	9.2	–	42.25	42.25	42.25	130.00	–	245.96	–	2 81	2.35
March 20 to April 4, . .	137.6	8.6	–	52.00	52.00	52.00	80.00	–	422.72	–	3 03	2.20
April 20 to April 30, . .	95.7	8.7	–	35.75	35 75	35.75	–	–	–	123.20	1 61	1.68
May 9 to May 15, . .	55.3	7.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	3.36

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 21 to Feb. 6, . .	326.4	19.2	–	55.25	55.25	55.25	340.00	–	–	–	$4 51	1.38
Feb. 13 to Feb. 26, . .	245.0	17.5	–	45.50	45.50	45.50	–	350.00	–	–	2 49	1.01
March 1 to March 13, . .	221.0	17.0	–	42.25	42.25	42.25	130.00	–	447.98	–	3 10	1.40
March 20 to April 4, . .	228.8	14.3	–	52.00	52.00	52.00	80.00	–	757.76	–	3 50	1.53
April 20 to April 30, . .	149.6	13.6	–	35.75	35.75	35.75	–	–	–	151.25	1 69	1.13
May 9 to May 15, . .	94.5	13.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	1.97

Summary of Net Cost of Feed for Each Cow during Succeeding Periods

PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
1. May, . .	$2 34	$1 03	$0 82	$1 52	1.56	860
Minnie, . .	2 34	1 03	82	1 52	1.41	985
Melia, . .	2 30	1 02	82	1 48	1.22	985
Eva, . .	2 34	1 03	82	1 52	2.41	985
Lizzie, . .	2 30	1 02	82	1 48	1.75	1,025
2. May, . .	4 51	1 98	1 58	2 93	1.40	880
Minnie, . .	4 51	1 98	1 58	2 93	1.36	1,005
Melia, . .	4 51	1 98	1 58	2 93	1.19	1,005
Eva, . .	4 51	1 98	1 58	2 93	2.39	1,030
Lizzie, .	4 51	1 98	1 58	2 93	1.63	1,060
Daisy, . .	4 51	1 98	1 58	2 93	.90	1,145
3. May, . .	2 33	1 42	1 14	1 19	.77	820
Minnie, . .	2 23	1 33	1 06	1 17	.74	965
Melia, . .	2 27	1 37	1 10	1 17	.66	965
Eva, . .	2 25	1 34	1 07	1 18	1.39	1,010
Lizzie, . .	2 32	1 41	1 13	1 19	1.04	1,060
Daisy, . .	2 49	1 57	1 26	1 23	.50	1,105
4. May, . .	2 87	1 29	1 03	1 84	1.13	840
Minnie, . .	2 87	1 29	1 03	1 84	1.17	950
Melia, . .	2 87	1 29	1 03	1 84	1.13	975
Lizzie, . .	2 81	1 27	1 02	1 79	1.50	1,050
Daisy, . .	3 10	1 41	1 13	1 97	.89	1,060
5. May, . .	3 26	1 50	1 20	2 06	1.21	825
Minnie, . .	3 10	1 42	1 14	1 96	1.12	942
Melia, . .	3 16	1 45	1 16	2 00	1.06	897
Eva, . .	3 15	1 45	1 16	1 99	2.26	1,000
Lizzie, . .	3 03	1 39	1 11	1 92	1.40	1,045
Daisy, . .	3 50	1 62	1 30	2 20	.96	1,091
6. May, . .	1 65	93	74	91	.82	804
Minnie, . .	1 57	92	74	83	.74	922
Melia, . .	1 74	1 00	80	94	.76	935
Eva, . .	1 62	96	77	85	1.35	1,153
Lizzie, . .	1 61	88	70	91	.95	1,043
Daisy, . .	1 69	95	76	93	.62	1,046
7. May, . .	1 86	81	65	1 21	1.63	860
Minnie, . .	1 86	81	65	1 21	1.65	945
Melia, . .	1 86	81	65	1 21	1.59	972
Eva, . .	1 86	81	65	1 21	3.09	1,105
Lizzie, . .	1 86	81	65	1 21	2.19	1,087
Daisy, . .	1 86	81	65	1 21	1.28	1,103

Summary.

May.

Total amount of milk produced during the above records (87 days),	977.6 qts.
Total cost of feed per quart of milk produced,	1.93 cts.
Manurial value left behind per quart of milk produced,	.73 cts.
Net cost per quart of milk produced,	1.20 cts.

Minnie.

Total amount of milk produced during the above records (87 days),	999.5 qts.
Total cost of feed per quart of milk produced,	1.85 cts.
Manurial value left behind per quart of milk produced,	.70 cts.
Net cost per quart of milk produced,	1.15 cts.

Melia.

Total amount of milk produced during the above records (87 days),	1,098.3 qts.
Total cost of feed per quart of milk produced,	1.70 cts.
Manurial value left behind per quart of milk produced,	.65 cts.
Net cost per quart of milk produced,	1.05 cts.

Eva.

Total amount of milk produced during the above records (74 days),	460.4 qts.
Total cost of feed per quart of milk produced,	3.42 cts.
Manurial value left behind per quart of milk produced,	1.31 cts.
Net cost per quart of milk produced,	2.11 cts.

Lizzie.

Total amount of milk produced during the above records (87 days),	787.8 qts.
Total cost of feed per quart of milk produced,	2.34 cts.
Manurial value left behind per quart of milk produced,	.90 cts.
Net cost per quart of milk produced,	1.44 cts.

Daisy.

Total amount of milk produced during the above records (78 days),	1,265.3 qts.
Total cost of feed per quart of milk produced,	1.36 cts.
Manurial value left behind per quart of milk produced,	.53 cts.
Net cost per quart of milk produced,	.83 cts.

Manurial Value of Feed.

May.

Feeding Periods.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.56	860
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.40	880
Feb. 13 to Feb. 26,	2 33	1 42	1 14	1 19	.77	820
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	840
Mar. 20 to Apr. 4,	3 26	1 50	1 20	2 06	1.21	825
Apr. 20 to Apr. 30,	1 65	93	74	91	.82	804
May 9 to May 15,	1 86	81	65	1 21	1.63	860
Total, . . .	$18 82	$8 96	$7 16	$11 66	–	–

Minnie.

Feeding Periods.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.						
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.36	1,005
Feb. 13 to Feb. 26,	2 23	1 33	1 06	1 17	.74	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.17	950
Mar. 20 to Apr. 4,	3 10	1 42	1 14	1 96	1.12	942
Apr. 20 to Apr. 30,	1 57	92	74	83	.74	922
May 9 to May 15,	1 86	81	65	1 21	1.65	945
Total, . . .	$18 48	$8 78	$7 02	$11 46	–	–

Melia.

Feeding Periods.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.22	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.19	1,005
Feb. 13 to Feb. 26,	2 27	1 37	1 10	1 17	.66	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	975
Mar. 20 to Apr. 4,	3 16	1 45	1 16	2 00	1.06	897
Apr. 20 to Apr. 30,	1 74	1 00	80	94	.76	935
May 9 to May 15,	1 86	81	65	1 21	1.59	972
Total, . . .	$18 71	$8 92	$7 14	$11 57	–	–

MANURIAL VALUE OF FEED — Concluded.

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	2.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	2.39	1,030
Feb. 13 to Feb. 26,	2 25	1 34	1 07	1 18	1.39	1,010
Mar. 20 to Apr. 4,	3 15	1 45	1 16	1 99	2.26	1,000
Apr. 20 to Apr. 30,	1 62	96	77	85	1.35	1,153
May 9 to May 15,	1 86	81	65	1 21	3.09	1,105
Total, . . .	$15 73	$7 57	$6 05	$9 68	–	–

Lizzie.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.75	1,025
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.63	1,060
Feb. 13 to Feb. 26,	2 32	1 41	1 13	1 19	1.04	1,060
Mar. 1 to Mar. 13,	2 81	1 27	1 02	1 79	1.50	1,050
Mar. 20 to Apr. 4,	3 03	1 39	1 11	1 92	1.40	1,045
Apr. 20 to Apr. 30,	1 61	88	70	91	.95	1,043
May 9 to May 15,	1 86	81	65	1 21	2.19	1,087
Total, . . .	$18 44	$8 76	$7 01	$11 43	–	–

Daisy.

1888.						
Jan. 21 to Feb. 6,	$4 51	$1 98	$1 58	$2 93	0.90	1,145
Feb. 13 to Feb. 26,	2 49	1 57	1 26	1 23	.50	1,105
Mar. 1 to Mar. 13,	3 10	1 41	1 13	1 97	.89	1,060
Mar. 20 to Apr. 4,	3 50	1 62	1 30	2 20	.96	1,091
Apr. 20 to Apr. 30,	1 69	95	76	93	.62	1,046
May 9 to May 15,	1 86	81	65	1 21	1.28	1,103
Total, . . .	$17 15	$8 34	$6 68	$10 47	–	–

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents per pound; potassium oxide, 4¼ cents per pound.

[Per cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Fodder Corn.	Hay.	Ensilage.	Corn Stover.
Nitrogen, . . .	1.796	1.453	2.780	5.120	.995	1.250	.289	1.119
Phosphoric acid, . .	.744	.688	1.857	.297	.201	.464	.112	.354
Potassium oxide, . .	.435	.548	1 071	.030	1.465	2.085	.264	.975
Valuation per 2,000 lbs.,	$7 19	$6 09	$12 31	$17 28	$4 77	$6 45	$1 31	$4 95

ANALYSES OF MILK.

[Per cent.]

1888.	Jan. 17.	Jan. 31.	Feb. 24.	Mar. 9.	Mar. 29.	April 11.	April 24.	May 3.
May.								
Solids, . .	14.04	13.64	14.30	14.18	14.05	13.76	13 91	14.36
Fat, . . .	4.13	3.64	3.91	3.55	3.95	2.64	4.18	4.71
Solids not fat, .	9.91	10.00	10.39	10.63	10.10	11.12	9.73	9.65
Minnie.								
Solids, . .	13.61	13.86	14.55	13.76	13.36	13.84	13.28	13.90
Fat, . . .	3.68	4.21	3.90	3.65	3.54	3.43	4.33	4.62
Solids not fat, .	9.93	9.65	10.65	10.11	9.82	10.41	8.95	9.28
Melia.								
Solids, . .	12.79	13.19	13.26	12.43	12.15	13.26	13.90	13.12
Fat, . . .	3.30	3.57	3.13	2.48	3.21	3.19	4.47	3.79
Solids not fat, .	9.49	9.62	10.13	9.95	8.94	10.07	9.43	9.33
Eva.								
Solids, . .	16.38	16.60	15.97	16.04	15.79	16.44	16.28	16.70
Fat, . . .	5.45	6.00	5.17	4.84	5.54	4.77	6.30	6.46
Solids not fat, .	10.93	10.60	10.80	11.20	10.25	11.67	9.89	10.24
Lizzie.								
Solids, . .	13.39	13.77	13.20	13.27	14.02	12.89	13 35	13.76
Fat, . . .	3.68	4.46	3.15	3.21	4.32	2.87	4.71	4.61
Solids not fat, .	9.71	9.31	10.05	10.06	9.70	10.02	8.64	9.15
Daisy.								
Solids, . .	13.34	11.96	12.63	13.22	12.94	12.95	12.09	12.43
Fat, . .	4.23	3.09	2.73	3.55	3.54	3.18	3.86	3.78
Solids not fat, .	9.11	8.87	9.90	9.67	9.40	9.77	8.23	8.65

Corn Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	–	

Corn and Cob Meal (Average).

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00
Analysis of dry matter.	
Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 8.8.

Wheat Bran (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

Hay.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.78	215.60	–	–	1 : 10.52
Dry matter, ...	89.22	1,784.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash, ...	7.11	142.20	–	–	
" cellulose, . . .	35.55	711.00	412.38	58	
" fat, ...	2.63	52.60	24.20	46	
" protein (nitrogenous matter), . .	8.75	175.00	99.75	57	
Non-nitrogenous extract matter, ...	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.43	–	

Fodder Corn (dry).

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	24 87	497.40	–	–	1 : 10.31
Dry matter, ...	75 13	1,502.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash, ...	5.14	102.80	–	–	
" cellulose, . . .	22 26	445.20	320.60	72	
" fat, ...	2 62	52 40	39.30	75	
" protein (nitrogenous matter), . .	8.28	165.60	120.89	73	
Non-nitrogenous extract matter, ...	61.70	1,234.00	826.78	67	
	100.00	2,000.00	1,307.57	–	

Corn Ensilage.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	77.24	1,544.80	–	–	1:8.8
Dry matter,	22.76	455.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4.94	98.80	–	–	
" cellulose,	20.66	413.20	297.50	72	
" fat,	3.15	63.00	47.25	75	
" protein (nitrogenous matter),	9.67	193.40	141.19	73	
Non-nitrogenous extract matter,	61.58	1,231 60	825.17	67	
	100.00	2,000.00	1,311.11	–	

Corn Stover.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.07	381.40	–	–	1:9.3
Dry matter,	80.93	1,618.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4 22	84.40	–	–	
" cellulose,	20.93	418.60	301.39	72	
" fat,	2.63	52.60	39.45	75	
" protein (nitrogenous matter),	9.17	183.40	133.88	73	
Non-nitrogenous extract matter,	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

II. Feeding Experiments with Milch Cows: Green Crops *v.* English Hay.

The preceding annual report contains a record of feeding experiments with milch cows, in which some noted green crops were used in place of English hay.

1887. — A mixed crop of green oats and vetch, of Southern cow-pea and of serradella, served in that connection.

Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 25 pounds.

The excess of hay left over was weighed back, and subsequently deducted from the original quantity. Three cows received periodically the above-stated daily rations and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-peas, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the Fifth Annual Report of the Station.

1888. — The experiment has been repeated with some modifications during the past season. A mixed crop of vetch and oats and one of Southern cow-pea were raised for that purpose. (See record of field C. in this report.)

The quantity of green fodder fed at stated times is somewhat less in pounds than in last year's trial, on account of the addition of gluten meal to our last year's fodder ration.

The daily green fodder ration consisted of corn meal, 3¼ pounds; wheat barn, 3¼ pounds; gluten meal, 3¼ pounds; English hay, 5 pounds; and as much of vetch and oats or cow-pea as the animal would consume, which amounted in the case of green vetch and oats to from 54 to 68 pounds, and in that of green Southern cow-peas from 70 to 80 pounds.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned.

Five cows, grades, were turned to account in the trial. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15.00 per ton, allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre.

This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Articles of Fodder used.

Corn meal,	$24 00	English hay,	$15 00
Corn and cob meal,	20 70	Vetch and oats,	2 75
Wheat bran,	22 50	Cow-pea,	3 14
Gluten meal,	22 50	Rowen,	15 00

The following pages contain the details of the experiment: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.08	2.39	1 : 6.12	905
July 10 to July 22,	3.25	–	3 25	3.25	5.00	62 42	–	–	29.12	11.65	2.50	1 : 5.51	890
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.57	–	–	–	29.10	10.64	2.73	1 : 6.11	893
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.63	28.36	11.83	2.40	1 : 5.00	925
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.43	–	28.63	12.59	2.27	1 : 4.50	903
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	19.43	–	–	–	25.97	11.25	2.31	1 : 6.09	916

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.42	2.32	1 : 6.12	1,012
July 10 to July 22,	3.25	–	3.25	3.25	5.00	54.39	–	–	27.23	10.92	2.49	1 : 5.43	1,005
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.25	–	–	–	25.81	10.46	2.47	1 : 6.08	1,008
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	20.66	27.47	10.48	2.62	1 : 4.97	1,028
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.16	–	28.57	10.78	2.65	1 : 4 50	1,001
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	18.86	–	–	–	25.46	8.82	2.89	1 : 6.05	1,007

FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.79	2.24	1 : 6.12	1,016
July 10 to July 22,	3.25	–	3.25	3.25	5.00	64.33	–	–	29.81	11.62	2.57	1 : 5.53	1,044
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.11	–	–	–	25.69	10.71	2.40	1 : 6.07	1,029
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.27	28.05	11.43	2.45	1 : 4.99	1,055
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	75.34	–	27.83	11.59	2.40	1 : 4.50	1,035
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.11	–	–	–	23.90	10.39	2.30	1 : 5.90	1,035

ANNIE: *Age, 5 years; Grade, Jersey; Last Calf, June 19, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	16.67	1.59	1 : 6.12	766
July 10 to July 22,	3.25	–	3.25	3.25	5.00	53.48	–	–	26.99	16.38	1.65	1 : 5.42	773
July 26 to Aug. 1,	3.25	–	3.25	3.25	16.43	–	–	–	23.30	14.36	1.71	1 : 5.84	764
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	19.67	26.67	14.70	1.81	1 : 4.94	763
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	71.00	–	26.98	15.13	1.78	1 : 4.50	774
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.18	–	–	–	23.97	12.64	1.90	1 : 5.91	768

FEEDING RECORD — *Concluded.*

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	14.25	1.86	1 : 6 12	1,084
July 10 to July 22,	3.25	–	3.25	3.25	5.00	67.71	–	–	30.69	14 31	2.14	1 : 5.56	1,127
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.89	–	–	–	26.38	13.36	1.97	1 : 6.13	1,106
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.87	28 57	13.68	2.08	1 : 5.01	1,113
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	80.00	–	28.74	13.88	2.07	1 : 4 50	1,105
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	21.00	–	–	–	27.37	9.82	2.79	1 : 6.22	1,084

Total Cost of Feed per Quart of Milk.

May.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6,	66.5	11.08	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.34
July 10 to July 22,	151.1	11.65	42.25	–	42.25	42.25	65.00	811.50	–	–	3 07	2.03
July 26 to Aug. 1,	74 5	10.64	22.75	–	22.75	22.75	137.00	–	–	–	1 82	2.45
Aug. 11 to Aug. 25,	177.5	11.83	48.75	–	48.75	48·75	–	–	–	324.50	4 13	2.33
Sept. 7 to Sept. 14,	100.8	12.59	26.00	–	26 00	26.00	40.00	–	635.75	–	2 20	2.18
Sept. 19 to Sept. 25,	78.8	14.25	22.75	–	22.75	22.75	136.00	–	–	–	1 81	2.30

Minnie.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6,	68.50	11.42	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.27
July 10 to July 22,	142.00	10.92	42.25	–	42 25	42 25	65.00	707.00	–	–	2 93	2.08
July 26 to Aug. 1,	73.25	10.46	22.75	–	22.75	22 75	134.75	–	–	–	1 80	2.46
Aug. 11 to Aug. 25,	157.25	10.48	48.75	–	48.75	48.75	–	–	–	310.00	4 02	2.56
Sept. 7 to Sept. 14,	86.25	10.78	26 00	–	26.00	26.00	40.00	–	633.25	–	2 20	2.55
Sept. 19 to Sept. 25,	61.75	8.82	22.75	–	22 75	22.75	132 00	–	–	–	1 78	2.88

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6,	70.75	11 79	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.20
July 10 to July 22,	151.00	11.62	42.25	–	42.25	42.25	65.00	836.25	–	–	3 11	2.05
July 26 to Aug. 1,	75.00	10.71	22.75	–	22.75	22.75	133.75	–	–	–	1 79	2.39
Aug. 11 to Aug. 25,	171.50	11.43	48 75	–	48.75	48.75	–	–	–	319.00	4 09	2.38
Sept. 7 to Sept. 14,	92.75	11.59	26.00	–	26.00	26.00	40.00	–	602.75	–	2 15	2.32
Sept. 19 to Sept. 25,	72.75	10.39	22.75	–	22.75	22.75	119.75	–	–	–	1 69	2.32

Annie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6,	100.00	16.67	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.56
July 10 to July 22,	213.00	16.38	42.25	–	42.25	42 25	65.00	695.25	–	–	2 91	1.37
July 26 to Aug. 1,	100.50	14.36	22.75	–	22.75	22.75	115.00	–	–	–	1 65	1.64
Aug. 11 to Aug. 25,	220.50	14.70	48.75	–	48.75	48.75	–	–	–	295.00	3 91	1.77
Sept. 7 to Sept. 14,	121.00	15.13	26.00	–	26 00	26.00	40.00	–	568.00	–	2 10	1.44
Sept. 19 to Sept. 25,	88.50	12.64	22.75	–	22.75	22.74	120.25	–	–	–	1 69	1.91

Total Cost of Feed per Quart of Milk — *Concluded.*

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, . . .	85.50	14.25	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.82
July 10 to July 22, . . .	186.00	14.31	42.25	–	42.25	42.25	65.00	880.25	–	–	3 17	1.65
July 26 to Aug. 1, . . .	93.50	13.36	22.75	–	22.75	22.75	139.25	–	–	–	1 83	1.96
Aug. 11 to Aug. 25, . . .	205.25	13.68	48.75	–	48.75	48.75	–	–	–	328.00	4 15	2.02
Sept. 7 to Sept. 14, . . .	111.00	13.88	26.00	–	26.00	26.00	40.00	–	640.00	–	2 21	1.99
Sept. 19 to Sept. 25, . . .	68.75	9.82	22.75	–	22.75	22.75	147.00	–	–	–	1 89	2.75

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.
[Per Cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen,
Moisture,	12.78	13.69	10.87	10.59	10.78	74.02	.	8.84
Nitrogen,	1.635	1.45	2.415	5.30	1.25	.447		1.93
Phosphoric acid,	.746	.688	2.88	4.41	.464	.176	.09	.364
Potassium oxide,	.436	.548	1.64	.551	2.085	1.475	.239	2.86
Valuation per 2,000 lbs.,	$6 67	$6 09	$12 82	$18 49	$6 45	$2 94	$2 15	$9 24

Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	.95	770
July 10 to July 22,	2 91	2 03	1 62	1 29	.61	768
July 26 to Aug. 1,	1 65	0 80	0 64	1 01	1.00	763
Aug. 11 to Aug. 25,	3 91	2 29	1 83	2 08	.94	777
Sept. 7 to Sept. 14,	2 10	1 24	0 99	1 11	.92	766
Sept. 19 to Sept. 25,	1 69	0 82	0 66	1 03	1.16	781
Total,	$13 82	$7 94	$6 35	$7 47	–	–

Daisy.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.11	1,095
July 10 to July 22,	3 17	2 31	1 85	1 33	.71	1,125
July 26 to Aug. 1,	1 83	0 88	0 70	1 13	1.21	1,108
Aug. 11 to Aug. 25,	4 15	2 44	1 95	2 20	1.07	1,112
Sept. 7 to Sept. 14,	2 21	1 31	1 05	1 16	1.05	1,090
Sept. 19 to Sept. 25,	1 89	0 91	0 73	1 16	1.69	1,100
Total,	$14 81	$8 61	$6 89	$7 92	–	–

MANURIAL VALUE OF FEED — *Concluded.*

May.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.43	895
July 10 to July 22,	3 07	2 20	1 76	1 31	0 86	880
July 26 to Aug. 1,	1 82	0 88	0 70	1 12	1.50	896
Aug. 11 to Aug. 25,	4 13	2 43	1 94	2 19	1.23	916
Sept 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.15	902
Sept. 19 to Sept. 25,	1 81	0 87	0 70	1 11	1.40	931
Total, . . .	$14 59	$8 44	$6 75	$7 84	–	–

Minnie.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.39	1,010
July 10 to July 22,	2 93	2 05	1 64	1 29	.91	990
July 26 to Aug. 1,	1 80	0 86	0 69	1 11	1.52	1,007
Aug. 11 to Aug. 25,	4 02	2 36	1 89	2 13	1.35	1,022
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.34	992
Sept. 19 to Sept. 25,	1 78	0 85	0 68	1 10	1.78	1,035
Total, . . .	$14 29	$8 18	$6 55	$7 74	–	–

Melia.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.34	1,019
July 10 to July 22,	3 11	2 24	1 79	1 32	.87	1,048
July 26 to Aug. 1,	1 79	0 86	0 69	1 10	1.47	1,032
Aug. 11 to Aug. 25,	4 09	2 40	1 92	2 17	1.27	1,045
Sept. 7 to Sept. 14,	2 15	1 27	1 01	1 14	1.23	1,028
Sept. 19 to Sept. 25,	1 69	0 81	0 65	1 04	1.43	1,052
Total, . . .	$14 39	$8 34	$6 67	$7 72	–	–

ANALYSES OF MILK.

[Per Cent.]

May.

	July 3.	July 17.	July 24.	Aug. 7.	Aug. 21.	Sept. 4.	Sept. 15.	Sept. 25.
Water, . .	86.91	85.95	85.72	85.88	86.60	86.12	85.85	85.95
Solids, . .	13.09	14.05	14.28	14.12	13.40	13.88	14.15	14.05
Fat (in solids),	2.44	2.85	4.04	4.40	4.28	3.79	4.54	4.29

Minnie.

Water, . .	86.95	86.48	85.37	85.63	87.10	86.64	86.03	86.00
Solids, . .	13.05	13.52	14.63	14.37	12.90	13.36	13.97	14.00
Fat (in solids),	2.57	3.22	4.08	4.83	4.11	3.91	4.65	4.66

Melia.

Water, . .	86.90	86.63	86.92	86.94	87.73	86.82	87.56	85.98
Solids, . .	13.10	13.37	13.08	13.06	12.27	13.18	12.44	14.02
Fat (in solids),	3.73	3.42	3.61	3.65	3.42	3.37	3.04	4.30

Annie.

Water, . .	88.71	88.51	88.15	87.73	88.51	88.86	87.47	87.22
Solids, . .	11.29	11.49	11.85	12.27	11.49	11.14	12.53	12.78
Fat (in solids),	2.08	1.72	2.99	3.60	3.25	2.30	3.29	3.87

Daisy.

Water, . .	86.39	–	86.84	87.46	87.76	87.39	87.49	85.77
Solids, . .	13.61	–	13.16	12.54	12.24	12.61	12.51	14.23
Fat (in solids),	2.66	–	4.08	3.50	3.54	3.46	3.46	3.98

CORN MEAL (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.78	255.60	–	–	
Dry matter,	87.22	1,744.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.58	31.60	–	–	
" cellulose,	1.69	33.80	11.49	34	1 : 8.95
" fat,	3.96	79.20	60 19	76	
" protein (nitrogenous matter),	11.15	223.00	189.55	85	
Non-nitrogenous extract matter,	81.62	1,632.40	1,534.46	94	
	100.00	2,000.00	1,795.69	–	

The analyses of corn and cob meal and of English hay are the same as used in the preceding experiment.

WHEAT BRAN (AVERAGE ANALYSIS).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40	–	–	
Dry matter,	89.13	1,782.60	–	–	
	100.00	2,000,00			
Analysis of dry matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	10.38	207.60	41.52	20	1 : 4.05
" fat,	5.11	102.20	81.76	80	
" protein (nitrogenous matter),	16.96	339.20	298.50	88	
Non-nitrogenous extract matter,	60.20	1,204.00	963.20	80	
	100.00	2,000.00	1,384.98	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10 59	211.80	–	–	1 : 2.01
Dry matter,	89.41	1,788.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.53	10.60	–	–	
" cellulose,	.89	17.80	6.05	34	
" fat,	5.49	109.80	83.45	76	
" protein (nitrogenous matter),	37.04	740.80	629.68	85	
Non-nitrogenous extract matter,	56 05	1,121.00	1,053.74	94	
	100.00	2,000.00	1,772.92	–	

Vetch and Oats.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.02	1,480.40	–	–	–
Dry matter,	25.98	519.60	–	–	–
	100.00	2,000.00	–	–	–
Analysis of dry matter.					
Crude ash,	7.39	147.80	–	–	–
" cellulose,	35.81	716.20	–	–	–
" fat,	2.29	45.80	–	–	–
" protein (nitrogenous matter),	10.76	215.20	–	–	–
Non-nitrogenous extract matter,	43.75	875.00	–	–	–
	100.00	2,000.00	–	–	–

Cow-Pea.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.45	1,609.00	–	–	1 : 4.44
Dry matter,	19.55	391.00	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.44	148.80	–	–	
" cellulose,	25.88	517.60	243.27	47	
" fat,	2.62	52.40	30.92	59	
" protein (nitrogenous matter),	17.93	358.60	215.16	60	
Non-nitrogenous extract matter,	46.13	922.60	636.59	69	
	100.00	2,000.00	1,125.94	–	

Rowen.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.84	176.80	–	–	1 : 6.4
Dry matter,	91.16	1,823.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	10.50	210.00	–	–	
" cellulose,	29.46	589.20	341.74	58	
" fat,	3.05	61.00	28.06	46	
" protein (nitrogenous matter),	13.20	264.00	150.48	57	
Non-nitrogenous extract matter,	43.79	875.80	551.75	63	
	100.00	2,000.00	1,072.03	–	

EXPERIMENT STATION FARM.

Milk and Creamery Record from Nov. 1, 1887, to Oct. 31, 1888.

	Quarts of Milk produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount received from Creamery.
1887.				
Nov. 1 to Nov. 30, .	1,692½	756	3.75 cents.	$28 35
Dec. 1 to Dec. 31, .	1,667	872	3.875 "	33 79
1888.				
Jan. 1 to Jan 31, .	1,979¼	1,105	4.00 "	44 20
Feb. 1 to Feb. 29, .	2,108¾	1,067	4.00 "	42 68
March 1 to March 31, .	1,965	1,013	3.90 "	39 50
April 1 to April 30, .	1,864¼	951	3.65 "	34 71
May 1 to May 31, .	1,798¾	941	3.50 "	32 94
June 1 to June 30, .	1,701½	848	3.25 "	27 56
July 1 to July 31, .	1,966½	920	3.25 "	29 90
Aug. 1 to Aug. 31, .	1,858	894	3.50 "	31 29
Sept. 1 to Sept. 30, .	1,730¼	822	3.75 "	30 82
Oct. 1 to Oct. 31, .	1,759½	897	3.85 "	34 53
Total, ...	22,091¼	11,086	–	$410 27

1887.

Nov., 6.62 spaces of cream make 1 pound of butter, equal to 24 85 cents per pound.

Dec., 6.69 spaces of cream make 1 pound of butter, equal to 25.94 cents per pound.

1888.

Jan., 6.63 spaces of cream make 1 pound of butter, equal to 25.54 cents per pound.

Feb., 6.60 spaces of cream make 1 pound of butter, equal to 26.40 cents per pound.

March, 6.60 spaces of cream make 1 pound of butter, equal to 25 74 cents per pound.

April, 6.65 spaces of cream make 1 pound of butter, equal to 24.27 cents per pound.

May, 6.46 spaces of cream make 1 pound of butter, equal to 22.58 cents per pound.

June, 6.35 spaces of cream make 1 pound of butter, equal to 20.63 cents per pound.

July, 6.45 spaces of cream make 1 pound of butter, equal to 20.96 cents per pound.

Aug., 6.34 spaces of cream make 1 pound of butter, equal to 22.19 cents per pound.

Sept., 6.45 spaces of cream make 1 pound of butter, equal to 24 32 cents per pound.

Oct., 6.39 spaces of cream make 1 pound of butter, equal to 24 61 cents per pound.

III. Feeding Experiments with Pigs: Skim Milk, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

Our annual report for 1887 contains a description of seven successive feeding experiments with growing pigs, which were instituted mainly for the purpose of ascertaining the cost of the feed required for the production of a definite weight of dressed pork.

In the first and second cases, creamery buttermilk and home-made skim milk with corn meal had furnished the sole ingredients of the daily diet of the animals on trial; whilst, during the five succeeding ones, wheat bran and gluten meal had been added as fodder constituents. (For details, see Fifth Annual Report, pages 55 to 83.)

In comparing the final results of the different experiments from a financial stand-point, adopting in all cases, for obvious reasons, a corresponding local market value of the fodder articles used, it was found that feeding skim milk or creamery buttermilk and corn meal in connection with wheat bran and gluten meal, as described in the Fifth Annual Report, experiments III., IV., V., VI., VII., had lessened the net cost of production of dressed pork.

This reduction appeared, however, to be due in the majority of experiments (III., IV., V. and VI.,) rather to a higher commercial value of the manurial refuse resulting, than to a higher nutritive effect of the stated change in the character of the diet. The results obtained in the seventh experiment alone furnished an exception to this circumstance; for, in this case, the smallest quantity of the total weight of the dry feed consumed showed not only a high commercial value of the manurial refuse resulting, but also the highest nutritive effect. The subsequent reprinted summary of the seven experiments may serve as a further illustration of the previous discussion.

SUMMARY OF EXPERIMENTS.

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II., ...	3.31	5.51	2.30	3.90
III., IV., V., ...	3.86	5.92	2.91	3.88
VI., ...	3.56	5.69	2.78	3 74
VII., ...	3.07	5.15	2.52	3.39

From the above summary it is apparent that the course of feeding adopted in the seventh experiment has given the most satisfactory pecuniary results; for the net cost of feed consumed amounted to 3.39 cents per pound of dressed pork produced, after allowing a loss of thirty per cent. of the manurial value of the feed, in consequence of the growth of the animal. As we sold our dressed pork for from $5\frac{1}{2}$ to $7\frac{1}{2}$ cents per pound, we received from 1.5 to 3.5 cents for labor, housing, etc.

The statement that an addition of gluten meal or of wheat bran or of both, to a diet which previously consisted only of skim milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

First. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

Second. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potash, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that particular diet, as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources.

It has been stated that, during our III., IV., V., VI. and VII. experiments, the same fodder articles, skim milk, corn meal, wheat bran and gluten meal, had been used to compound the daily diet; and that the seventh feeding experiment had yielded the highest profits on the same basis of selling price. As the daily fodder rations thus in all of these trials had consisted of the same kind of fodder ingredients, and as at all periods of the experiments the call for food had been attended to with care, it became evident that the particular mode of combining at different times the same fodder ingredients to make up the daily diet had to be considered the principal cause of the difference in our results.

To test the correctness of this conclusion it was decided to constitute a new experiment. The same mode of compounding the daily fodder ration for different periods of growth, which had been adopted during the seventh experiment, was to be carried out with a new lot of pigs. (See experiments VIII. and IX. further on.)

The following short abstract, taken from a more detailed description of the seventh feeding experiment in our last annual report, cannot fail to assist in a desirable understanding of the question involved : —

Seven animals, crosses between White Chester and Black Berkshire, served in this experiment (VII.). Their live weights were from twenty-two to twenty-six pounds in case of different animals. The same fodder articles were used as in the third, fourth, fifth and sixth experiments; they were, however, fed in different proportions. The daily ration of corn meal was gradually increased during the progress of the experiment, for the purpose of altering the relative proportion between the nitrogenous and non-nitrogenous matter in the feed. The relative proportion of one part of digestible nitrogenous matter to two and nine-tenths parts of digestible non-nitrogenous matter was changed at stated periods until it reached 1 : 4.28 ; practically, three feeding periods.

AVERAGE OF DAILY RATIONS (EXPERIMENT VII.).

	Corn Meal (Ounces).	Skim Milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
June 23 to July 11,	8.00	4	-	-	I.	1:2.91
July 12 to July 25,	12.00	6	-	-		
July 26 to July 28,	12.00	6	1.34	2.66	II.	1:2.85
July 29 to Aug. 8,	12.00	6	2.00	4.00		
Aug. 9 to Aug. 15,	14.67	6	2.66	2.66	III.	1:3.34
Aug. 16 to Aug. 23,	17.34	6	5.33	5.33		
Aug. 24 to Aug. 29,	20.00	6	8.00	8.00		
Aug. 30 to Sept. 12,	23.34	6	11.35	11.35		
Sept. 13 to Sept. 26,	29.00	6	17.00	17.00		
Sept. 27 to Oct. 11,	47.00	6	12.00	12.00	IV.	1:4.28
Oct. 12 to Oct. 27.	62.66	6	15.66	15.66		

SUMMARY OF EXPERIMENT VII.

MARK OF PIG.	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment (in lbs.).	Dressed Weight gained during Experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
N, . . .	202.93	176.0	60.04	61.66	163.75	129.36	5.39
O, . . .	203.09	176.0	60.21	61.83	161.00	127.19	5.49
P, . . .	203.00	176.0	60.21	61.83	174.00	139.20	5.02
Q, . . .	194.09	173.0	57.71	59.93	164.50	128.31	5.27
R, . . .	194.43	173.0	58.04	59.66	177.50	138.45	4.89
S, . . .	194.43	173.0	58.04	59.66	162.50	128.38	5.26
T, . . .	194.43	173.0	58.04	59.66	178.25	140.85	4.80
	1,386.40	1,220.0	412.29	424.23	1,181.50	931.74	-

Total Cost of Feed consumed during the Above-stated Experiment (1887).

1,386.40 lbs. corn meal, at $24.00 per ton, ...	$16 64
1,220.00 gals. skim milk, at 1.8 cents per gallon, . . .	21 96
412.29 lbs. wheat bran, at $22.50 per ton, ...	4 64
424.23 lbs. gluten meal, at $22.50 per ton, ...	5 77
	$48 01

Average cost of feed for production of one pound of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Total.
$5 52	$11 32	$2 97	$3 71	$23 52

Manurial value of feed for production of one pound of dressed pork, 2.52 cents.

The cost of feed consumed varied, in case of different animals, from 4.80 to 5.49 cents per pound of dressed pork produced.

Taking the entire lot of animals into consideration, it amounts to 5.15 cents per pound of dressed pork obtained. The amount of dry matter contained in the feed required for the production of one pound of dressed pork varied from 2.83 to 3.24 pounds.

Basis of Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used (1887).

	Per Cent.			
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.
Moisture,	10.00	90.00	10.80	8.80
Nitrogen (17 cents per lb.),	1.96	0.55	2.80	5.03
Phosphoric acid (6 cents per lb.),	0.77	0.17	2.36	0.30
Potassium oxide (4¼ cents per lb.),	0.45	0.20	1.36	0.03
Valuation per 2,000 lbs.,	$7.97	$2.25	$13.51	$17.49

Eighth Feeding Experiment.

Six animals of a mixed breed, weighing from twenty-three to twenty-nine pounds, served in the experiment. The latter began Nov. 8, 1887, and lasted until March 12, 1888, or 124 days; the average of the individual live weight had reached 185 pounds. Skim milk, corn meal or corn and cob meal, wheat bran and gluten meal, furnished the fodder ingredients of the daily diet. The corn and cob meal took the place of the clear corn meal on the 8th of January. The daily ration of skim milk reached, within the first week, six quarts per head. This amount, being the limit of our home supply, was fed daily until the close of the experiment. Skim milk and corn meal, two ounces of the latter to one quart of the former, constituted the diet for about three weeks, when the steadily increasing demand for food was supplied by a gradually increasing quantity of a mixture consisting of two weight parts of gluten meal and one weight part of wheat bran. On the 3d of January, at the beginning of the third month, the daily diet was changed; the latter consisted thereafter of six quarts of skim milk and a mixture prepared of four weight parts of corn and cob meal, one weight part of wheat bran, and one weight part of gluten meal. The quantity required of the latter to meet the daily wants of the animals began with forty-eight ounces per head, and rose gradually to seventy-two ounces. (See, for details, subsequent tabular statement.)

AVERAGE OF DAILY RATIONS (EXPERIMENT VIII.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1887.							
Nov. 8 to Nov. 15, . .	10	5	-	-	-	I.	1:2.92
Nov. 16 to Nov. 29, . .	12	6	-	-	-		
Nov. 30 to Dec. 13, . .	12	6	2.38	4.76	-	II.	1:2.30
Dec. 14 to Dec. 20, . .	12	6	5.35	11.06	-		
1888.							
Dec. 21 to Jan. 3, . .	12	6	9.43	18.86	-		
Jan. 4 to Jan. 7, . .	32	6	8.00	8.00	-	III.	1:3.80
Jan. 8 to Jan. 16, . .	-	6	8.87	8.87	35.48		
Jan. 17 to Jan. 30, . .	-	6	9.81	9.81	39.24		
Jan. 31 to Feb. 20, . .	-	6	8.00	8.00	48.00	IV.	1:4.17
Feb. 21 to March 11, . .	-	6	8.81	8.81	52.86		

The entire experiment was managed, as far as practicable, to serve as a repetition of our seventh feeding experiment. The substitution of the corn and cob meal of our own production from a superior home-raised corn, for the clear corn meal of our general market, may well be considered of but little consequence. This view is fully supported by a careful analysis of both.

The financial results of the eighth experiment, like those of the seventh, are superior to those obtained in the preceding five feeding experiments. This fact becomes still more worthy of notice when considering that the seventh experiment was carried on during a warmer period of the year, and thus under more favorable circumstances than the eighth experiment. Our late results seem to confirm the conclusions arrived at in our previous experiments, namely: —

First. A gradual periodical change, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed, is recommendable in the interest of good economy.

Second. The feeding effect of one and the same diet changes with the advancing growth of the animal on trial.

Third. The power of assimilating food and of converting it into live weight decreases with the progress in age.

Fourth. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from 175 to 180 pounds is only advisable when exceptionally high market prices for dressed pork can be secured.

In addition to what has been said on this particular point in previous communications, I insert here, in a tabular form, the estimated cost of feed used for the production of one pound of live weight during the succeeding stages of growth of the entire lot of pigs which served in the eighth experiment.

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live weight of animals at close of feeding period (in lbs.).	Gain in live weight during period (in lbs.).	One hundred lbs. of dry matter in feed produced live weight (in lbs.).	Cost of feed for production of one lb. of live weight (in cts.).
U. I. Feeding period,	48.50	22.50	63.4	3.24
II. " "	96.50	48.00	51.2	3.58
III. " "	134.00	37.50	33.2	4.80
IV. " "	189.00	55.00	27.3	5.40
V. I. Feeding period,	43.00	20.00	56.3	3.65
II. " "	91.00	48.00	51.2	3.58
III. " "	132.00	41.00	35.8	4.44
IV. " "	198.00	66.00	32.8	4.50
W. I. Feeding period,	44.00	21.50	60.5	3.40
II. " "	96.00	52.00	55.5	3.31
III. " "	130.00	34.00	30.1	5.29
IV. " "	187.00	57.00	28.3	5.21
X. I. Feeding period,	46.00	21.00	59.1	3.48
II. " "	93.00	47.00	50.1	3.66
III. " "	128.00	35.00	30.6	5.20
IV. " "	178.50	50.50	25.0	5.88
Y. I. Feeding period,	46.00	21.00	59.1	3.48
II. " "	93.50	47.50	50.7	3.62
III. " "	133.00	39.50	34.5	4.61
IV. " "	181.50	48.50	23.8	6.12
Z. I. Feeding period,	52.00	22.50	63.4	3.24
II. " "	97.00	45.00	48.0	3.82
III. " "	132.50	35.50	31.1	5.13
IV. " "	184.50	52.00	25.8	5.71

[U.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1 : 2.92	26.00	48.50	1 1
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1 : 2.30	48.50	96.50	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1 : 3.80	96.50	134 00	1 5
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1 : 4.17	134.00	189.00	1 5

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.68 lbs. wheat bran, equal to dry matter,	44.15 "
62.10 lbs. gluten meal, equal to dry matter,	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter,	157.59 "
Total amount of dry matter,	434.84 lbs.

Live weight of animal at beginning of experiment,	26.00 lbs.
Live weight at time of killing,	189.00 "
Live weight gained during experiment,	163.00 "
Dressed weight at time of killing,	154.00 "
Loss in weight by dressing,	35 lbs., or 18.52 per cent.
Dressed weight gained during experiment,	132.82 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 per ton,	.58
49.68 lbs. wheat bran, at $23.00 per ton,	.57
62.10 lbs. gluten meal, at $27.00 per ton,	.84
182.59 lbs. corn and cob meal, at $20.70 per ton,	1.90
	$7.22

2.69 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.28 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	22.50 lbs. live weight gained; cost per lb.,	3.24 cts.
	18.33 lbs. dressed weight gained; cost per lb.,	3.98 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	48.00 lbs. live weight gained; cost per lb.,	3.58 cts.
	39.11 lbs. dressed weight gained; cost per lb.,	4 40 cts.
PERIOD III.	Cost of feed consumed during period,	$1.80
	37.50 lbs. live weight gained; cost per lb.,	4.80 cts.
	30.55 lbs. dressed weight gained; cost per lb.,	5.89 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	55.00 lbs. live weight gained; cost per lb.,	5.40 cts.
	44.81 lbs. dressed weight gained; cost per lb.,	6.63 cts.

[V.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1 : 2.92	23.00	43.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1 : 2.30	43.00	91.00	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1 : 3.80	91.00	132.00	1 7
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1 : 4.17	132.00	198.00	1 10

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49 85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
Total amount of dry matter,	435.74 lbs.

Live weight at beginning of experiment,	23.00 lbs.
Live weight at time of killing,	198.00 "
Live weight gained during experiment,	175.00 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	38 lbs., or 19.19 per cent.
Dressed weight gained during experiment,	141.41 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal at $23.00 per ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.49 lbs. dry matter yielded 1 lb. of live weight, and 3.08 lbs. dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.11 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	20.00 lbs. live weight gained; cost per lb.,	3.65 cts.
	16.16 lbs. dressed weight gained; cost per lb.,	4.52 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	48.00 lbs. live weight gained; cost per lb.,	3.58 cts.
	38.79 lbs. dressed weight gained; cost per lb.,	4.43 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	41.00 lbs. live weight gained; cost per lb.,	4.44 cts.
	33.13 lbs. dressed weight gained; cost per lb.,	5.49 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	66.00 lbs. live weight gained; cost per lb.,	4.50 cts.
	53.33 lbs. dressed weight gained; cost per lb.,	5.57 cts.

[W.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	22.50	44.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	44.00	96.00	1 8
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1:3.80	96 00	130.00	1 2
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	130.00	187.00	1 6

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.68 lbs. wheat bran, equal to dry matter,	44.15 "
62.10 lbs. gluten meal, equal to dry matter,	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter,	157.59 "
Total amount of dry matter,	434.84 lbs.

Live weight of animal at beginning of experiment, . .	22.50 lbs.
Live weight at time of killing, ...	187.00 "
Live weight gained during experiment, ...	164.50 "
Dressed weight at time of killing, ...	151.00 "
Loss in weight by dressing, . . .	36 lbs., or 19.25 per cent.
Dressed weight gained during experiment, . . .	132.83 "

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.68 lbs. wheat bran, at $23.00 per ton, ...	.57
62.10 lbs. gluten meal at $27.00 per ton, ...	.84
182.59 lbs. corn and cob meal at $20.70 per ton, . . .	1.90
	$7.22

2.64 lbs. dry matter yielded 1 lb. live weight, and 3.27 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	21.50 lbs. live weight gained; cost per lb., . .	3.40 cts.
	17.36 lbs. dressed weight gained; cost per lb., .	4.20 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	52.00 lbs. live weight gained; cost per lb., . .	3.31 cts.
	41.99 lbs. dressed weight gained; cost per lb., .	4.10 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.80
	34.00 lbs. live weight gained; cost per lb., . .	5.29 cts.
	27.45 lbs. dressed weight gained; cost per lb., .	6.56 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	57.00 lbs. live weight gained; cost per lb., . .	5.21 cts.
	46.03 lbs. dressed weight gained; cost per lb., .	6.45 cts.

[X.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	46.00	93.00	1 5
Jan. 4 to Jan. 30,	162.00	9 00	16.17	16.17	55.68	1:3.81	93.00	128.00	1 3
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	128.00	178.50	1 3

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
	435.74 lbs.

Live weight of animal at beginning of experiment,	25.00 lbs.
Live weight at time of killing,	178.50 "
Live weight gained during experiment,	153.50 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	18.50 lbs., or 10.38 per cent.
Dressed weight gained during experiment,	137.59 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 a ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.84 lbs. of dry matter yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.33 cts.

Period I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	18.82 lbs. dressed weight gained; cost per lb.,	3.88 cts.
Period II.	Cost of feed consumed during period,	$1.72
	47.00 lbs. live weight gained; cost per lb.,	3.66 cts.
	42.12 lbs. dressed weight gained; cost per lb.,	4.08 cts.
Period III.	Cost of feed consumed during period,	$1.82
	35.00 lbs. live weight gained; cost per lb.,	5.20 cts.
	31.37 lbs. dressed weight gained; cost per lb.,	5.80 cts.
Period IV.	Cost of feed consumed during period,	$2.97
	50.50 lbs. live weight gained; cost per lb.,	5.88 cts.
	45.26 lbs. dressed weight gained; cost per lb.,	6.56 cts.

[Y.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25 88	12.41	24.83	–	1:2.30	46.00	93.50	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	93.50	133.00	1 6
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	133.00	181.50	1 2

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
Total amount of dry matter,	435.74 lbs.

Live weight of animal at beginning of experiment,	25.00 lbs.
Live weight at time of killing,	181.50 "
Live weight gained during experiment,	156.50 "
Dressed weight at time of killing,	150.00 "
Loss in weight by dressing,	31.00 lbs., or 17.08 per cent.
Dressed weight gained during experiment,	129.27 lbs

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal at $23.00 per ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.78 lbs. of dry matter yielded 1 lb. of live weight, and 3.37 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.59 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	17.83 lbs. dressed weight gained; cost per lb.,	4.09 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	47.50 lbs. live weight gained; cost per lb.,	3.62 cts.
	39.39 lbs. dressed weight gained; cost per lb.,	4.37 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	39.50 lbs. live weight gained; cost per lb.,	4.61 cts.
	32.75 lbs. dressed weight gained; cost per lb.,	5.56 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	48.50 lbs. live weight gained; cost per lb.,	6.12 cts.
	40.22 lbs. dressed weight gained; cost per lb.,	7.38 cts.

[Z.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	29.50	52.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1:2.30	52.00	97.00	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	97.00	132.50	1 4
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	132.50	184.50	1 4

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
Total amount of dry matter,	435.74 lbs.

Live weight of animal at beginning of experiment,	29.50 lbs.
Live weight at time of killing,	184.50 "
Live weight gained during experiment,	155.00 "
Dressed weight at time of killing,	150.00 "
Loss in weight by dressing,	34.50 lbs., or 18.70 per cent.
Dressed weight gained during experiment,	126.02 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.85 lbs. wheat bran, at $23.00 per ton, ...	.57
62.27 lbs. gluten meal, at $27.00 per ton, ...	.84
183.27 lbs. corn and cob meal, at $20.70 per ton, . . .	1.91
	$7.23

2.81 lbs. of dry matter yielded 1 lb. live weight, and 3.46 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.74 cts.

PERIOD I.	Cost of food consumed during period, . .	$0.73
	22.50 lbs. live weight gained; cost per lb., .	3.24 cts.
	18.29 lbs. dressed weight gained; cost per lb., .	3.99 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	45.00 lbs. live weight gained; cost per lb., .	3.82 cts.
	36.58 lbs. dressed weight gained; cost per lb., .	4.70 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	35.50 lbs. live weight gained; cost per lb., . .	5.13 cts.
	28.86 lbs. dressed weight gained; cost per lb., .	6.31 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	52.00 lbs. live weight gained; cost per lb., .	5.71 cts.
	42.28 lbs. dressed weight gained; cost per lb., .	7.02 cts.

SUMMARY OF EXPERIMENT VIII.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs).	Corn and Cob Meal (in lbs.).	Live weight gained during experiment (in lbs.).	Dressed weight gained during experiment (in lbs.).	Cost per lb. of Dressed Pork (cts.).
U, ...	50.26	185 25	49.68	62.10	182.59	163.00	132.82	5.44
V, ...	50.26	185.25	49.85	62.27	183.27	175.00	141.41	5.11
W, ...	50.26	185.25	49.68	62.10	182.59	164.50	132.83	5.44
X, ...	50.26	185.25	49.85	62.27	183.27	153.50	137.59	5.33
Y, ...	50 26	185.25	49.85	62.27	183.27	156.50	129.27	5.59
Z, ...	50.26	185.25	49.85	62.27	183.27	155.00	126.02	5.74
Total, . . .	301.56	1,111.50	298.76	373.28	1,098.26	967.50	799.94	-

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon, ...	$20.01
301.56 lbs. corn meal, at $23 00 per ton, ...	3.47
298.76 lbs. wheat bran, at $23.00 per ton, ...	3.44
373.28 lbs. gluten meal at $27.00 per ton, ...	5.04
1098.26 lbs. corn and cob meal, at $20.70 per ton, . . .	11.42
	$43.38

Average cost of feed for production of 1 lb. dressed pork, 5.42 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$8.85
Corn meal,	1.09
Wheat bran,	1.99
Gluten meal,	2.88
Corn and cob meal,	3.33
	$18.14

Manurial value of feed for production of 1 lb. of dressed pork, 2.27 cts.

Basis of Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used (1888).

	Per Cent.				
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Corn and Cob Meal.
Moisture,	13.08	91.00	11.14	9.77	13.69
Nitrogen (16½ cents per lb.),	1.80	.47	2.78	4.57	1.45
Phosphoric acid (6 cents per lb.),	.74	.22	1.86	.30	.69
Potassium oxide (4¼ cents per lb.),	.43	.21	1.07	.03	.55
Valuation per 2,000 lbs.,	$7.20	$1.99	$12.35	$15.46	$6.06

The net cost of feed consumed for the production of one pound of dressed pork, making a deduction of thirty per cent. of the fertilizing constituents contained in the feed, varies in the case of different animals from 3.52 cents to 4.00 cents per pound. In the case of the entire lot of pigs, it amounts to 3.83 cents per pound. As we sold our dressed pork at 7¾ cents per pound, we secured 3.92 cents per pound sold for investment, labor and profit.

It will be noticed that our estimates above are based on the ruling local market prices of the time when our late experiments were carried on. These prices differ from those adopted on earlier occasions. An intelligent comparison of our late financial results with those obtained in previous experiments can only be made by using corresponding values. The subsequent page contains a re-valuation of our late results, on the basis of market value used in all previous feeding experiments.

SUMMARY OF EXPERIMENT BASED ON THE SAME COST OF FEED AND OF MANURIAL VALUE OF FEED CONSUMED AS USED IN PRECEDING EXPERIMENTS.

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $24.00 per ton,	3.62
298.76 lbs. wheat bran, at $22.50 per ton,	3.36
373.28 lbs. gluten meal, at $22.50 per ton,	4.20
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$42.61

Average cost of feed for production of 1 lb. dressed pork, 5.32 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$10.00
Corn meal,	1.20
Wheat bran,	2.02
Gluten meal,	3.26
Corn and cob meal,	3.33
	$19.81

Manurial value of feed for production of 1 lb. dressed pork, 2.48 cts.

The net cost of feed for the production of one pound of dressed pork, taking the entire lot of pigs into consideration, amounts to 3.69 cents. This result is the second best in our whole series of experiments. This fact becomes more significant when it is duly considered that the experiment (VIII.) was carried out during the winter season. The task of maintaining a desirable moderate temperature in the piggery during the entire trial becomes more difficult in winter than during any other season of the year. Low temperature requires more food for the support of respiration; the normal condition of the animal system is apt to be more seriously affected in various directions, and the gain in live weight suffers usually correspondingly in case of the same diet.

To confirm, if possible, our previously advanced conclusions still more, it was decided to repeat our mode of feeding with another lot of pigs during the latter part of spring and the summer season. An examination of our ninth experiment, which is described in a few subsequent pages, cannot fail to show that they are fully sustained.

Analyses of Fodder Articles used in Experiment VIII.

Skim Milk (Average).

	Per Cent.
Moisture at 100° C.,	91.00
Dry matter,	9.00
	100.00

Analysis of Dry Matter.

Crude ash,	6.67
" fat,	2.78
" protein (nitrogenous matter),	34.00
Non-nitrogenous extract matter,	56.55
	100.00

Nutritive ratio, 1 : 1.86.

Corn Meal (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41		

Wheat Bran (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

Gluten Meal (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00

Analysis of Dry Matter.

Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 1 : 8.8.

Ninth Experiment.

Six pigs of a mixed breed, weighing from seventeen to twenty-two pounds each, served in the experiment. The feeding began April 12, and closed August 8. The live weights of the animals at the time of killing varied from 185 to 203.5 pounds. Skim milk, corn meal, gluten meal and wheat bran furnished the ingredients of the diet. The mode of feeding was practically divided into three periods, with reference to the nutritive character of the feed, as follows : —

	Live Weight of Animal.	Nutritive Ratio.
I. Period,	20 to 90 lbs.,	1 digestible nitrogenous; 2.66 digestible non-nitrogenous constituents.
II. Period,	90 to 130 lbs.,	1 digestible nitrogenous; 3.62 digestible non-nitrogenous constituents.
III. Period,	130 to 200 lbs.,	1 digestible nitrogenous; 4.35 digestible non-nitrogenous constituents.

AVERAGE OF DAILY RATIONS (EXPERIMENT IX.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, . .	–	3	–	–	6.	I.	1 : 2.80
April 24 to May 1, . .	–	6	–	–	12.		
May 2 to May 14, . .	–	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, . .	–	6	9.89	19.78	12.		
May 29 to June 4, . .	–	6	10.67	21.34	12.		
June 5 to June 22, . .	–	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, . .	–	6	9.86	9.86	39.44		
July 4 to July 9, . .	–	6	7.70	7.70	46.20	IV.	1 : 4.35
July 10 to July 25, . .	56.10	6	9.35	9.35	–		
July 26 to Aug. 8, . .	63.00	6	10.50	10.50	–		

[1.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	21.50	50.00	1 7
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	50.00	95.00	1 5
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	95.00	140.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	140.25	200.75	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	200.75 "
Live weight gained during experiment,	179.25 "
Dressed weight at time of killing,	162.00 "
Loss in weight by dressing,	38.75 lbs., or 19.3 per cent.
Dressed weight gained during experiment,	144.65 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
268.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $27.00 per ton,	84
	$6 99

2.40 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.97 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.83 cents.

[2.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	20.00	45.00	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	45.00	88.00	1 5
June 5 to July 3,	-	174.00	65.09	16.60	16.93	1 : 3.63	88.00	128.25	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	128.25	185.75	1 95

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
117.66 lbs. corn and cob meal, equal to dry matter,	101.55 "
53.38 lbs. wheat bran, equal to dry matter,	46.71 "
69.32 lbs. gluten meal, equal to dry matter,	62.33 "
Total amount of dry matter,	427.12 lbs.

Live weight of animal at beginning of experiment,	20.00 lbs.
Live weight of animal at time of killing,	185.75 "
Live weight gained during experiment,	165.75 "
Dressed weight at time of killing,	152.00 "
Loss in weight by dressing,	33.75 lbs., or 18.17 per cent.
Dressed weight gained during experiment,	135.63 lbs.

Cost of Feed consumed during Experiment.

189.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
117.66 lbs. corn and cob meal, at $20.70 per ton,	1 22
53.38 lbs. wheat bran, at $23.00 per ton,	61
69.32 lbs. gluten meal, at $24.00 per ton,	83
	$6 96

2.58 lbs. dry matter fed yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.13 cents.

[3.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1:2.80	19.00	44.50	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1:2.53	44.50	91.25	1 6
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1:3.62	91.25	132.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1:4.35	132.00	196.25	1 11.5

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	19.00 lbs.
Live weight of animal at time of killing,	196.25 "
Live weight gained during experiment,	177.25 "
Dressed weight at time of killing,	159.00 "
Loss in weight by dressing,	37.25 lbs., or 18.98 per cent.
Dressed weight gained during experiment,	143.61 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton, ...	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon, ...	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton, . . .	1 23
53.65 lbs. wheat bran, at $23.00 per ton, ...	62
70.38 lbs. gluten meal, at $24.00 per ton, ...	84
	$6 99

2.42 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.00 lbs of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.86 cents.

[4.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	17.00	42.00	1 4
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	42.00	85.25	1 4
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	85.25	126.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	126.00	188.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment, . .	17.00 lbs.
Live weight of animal at time of killing, ...	188.75 "
Live weight gained during experiment, ...	171.75 "
Dressed weight at time of killing, ...	154.25 "
Loss in weight by dressing, ...	34.50 lbs., or 18.27 per cent.
Dressed weight gained during experiment, ...	140.36 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23 00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.50 lbs. dry matter fed yielded 1 lb. of live weight, and 3.06 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.98 cents.

[5.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	21.50	45.00	1 3
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	45.00	86.75	1 4
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	86.75	129.50	1 7.5
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	129.50	193.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.96 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	193.75 "
Live weight gained during experiment,	172.25 "
Dressed weight at time of killing,	158.00 "
Loss in weight by dressing,	35.75 lbs., or 18.45 per cent.
Dressed weight gained during experiment,	140.47 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton, ...	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon, ...	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton, . . .	1 23
53.65 lbs. wheat bran, at $23.00 per ton, ...	62
70.38 lbs. gluten meal, at $24.00 per ton, ...	84
	$6 99

2.49 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.07 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.97 cents.

[6.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.)	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1:2.80	18.25	47.00	1 7
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1:2.53	47.00	95.00	1 7
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1:3.62	95.00	142.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1:4.35	142.25	203.50	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment, . .	18.25 lbs.
Live weight of animal at time of killing, ...	203.50 "
Live weight gained during experiment, ...	185.25 "
Dressed weight at time of killing, ...	165.50 "
Loss in weight by dressing, ...	35 lbs., or 17.2 per cent.
Dressed weight gained during experiment, ...	153.39 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.32 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.81 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.56 cents.

Summary of Experiment IX.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Corn and Cob Meal (in lbs.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during experiment (in lbs.).	Dressed Weight gained during experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
1,	109.97	168.75	118.69	53.65	70.38	179.25	144.65	4.83
2,	109.97	168.75	117.66	53.38	69.32	165.75	135.63	5.13
3,	109.97	168.75	118.69	53.65	70.38	177.25	143.61	4.86
4,	109.97	168.75	118.69	53.65	70.38	171.75	140.36	4.98
5,	109.97	168.75	118.69	53.65	70.38	172.25	140.47	4.97
6,	109.97	168.75	118.69	53.65	70.38	185.25	153.39	4.56
	659.82	1,012.50	711.11	321.63	421.22	1,051.50	858.11	–

Total Cost of Feed consumed during the Above-stated Experiment.

659.82 lbs. corn meal, at $23.00 per ton,	$7 59
1,012.50 gals. skim milk, at 1.8 cents per gallon,	18 23
711.11 lbs. corn and cob meal, at $20.70 per ton,	7 36
321 63 lbs. wheat bran, at $23.00 per ton,	3 70
421.22 lbs. gluten meal, at $24.00 per ton,	5 05
	$41 93

Average cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Total.
$2 11	$8 29	$2 16	$2 01	$4 05	$18 62

Manurial value of feed for production of 1 lb. of dressed pork, 2.17 cents.

Summary of Experiments (II. to IX. inclusive).

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39
VIII.,	3.27	5.32	2.48	3.58
IX.,	3.00	4.89	2.30	3.27

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live Weight of Animal at close of feeding period (in lbs.).	Gain in Live Weight during period (in lbs.).	Cost of Feed for production of one pound of Live Weight (in cents).
1. I. Feeding Period,	50.00	28.50	1.72
II. " "	95.00	45.00	3.87
III. " "	140.25	45.25	4.13
IV. " "	200.75	60.50	4.78
2. I. Feeding Period,	45.00	25.00	1.96
II. " "	88.00	43.00	4.05
III. " "	128.25	40.25	4.57
IV. " "	185.75	57.50	5.03
3. I. Feeding Period,	44.50	25.50	1.92
II. " "	91.25	46.75	3.72
III. " "	132.00	40.75	4.59
IV. " "	196.25	64.25	4.50
4. I. Feeding Period,	42.00	25.00	1.96
II. " "	85.25	43.25	4.02
III. " "	126.00	40.75	4.59
IV. " "	188.75	62.75	4.61
5. I. Feeding Period,	45.00	23.50	2.09
II. " "	86.75	41.75	4.17
III. " "	129.50	42.75	4.38
IV. " "	193.75	64.25	4.50
6. I. Feeding Period,	47.00	28.75	1.70
II. " "	95.00	48.00	3.63
III. " "	142.25	47.25	3.96
IV. " "	203.50	61.25	4.72

Analyses of Fodder Articles used in Experiment IX.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.59	271.80	–	–	1 : 9.56
Dry matter, ...	86.41	1,728.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.68	33.60	–	–	
" cellulose, . . .	1.56	31.20	10.61	34	
" fat, ...	3.10	62.00	47.12	76	
" protein (nitrogenous matter), . .	10.42	208.40	177.14	85	
Non-nitrogenous extract matter, ...	83.24	1,664.80	1,564.91	94	
	100.00	2,000.00	1,799.78	–	

The analyses of corn and cob meal and of skim milk are the same as used in the preceding experiment.

WHEAT BRAN.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.50	250.00	–	–	1 : 3.86
Dry matter, ...	87.50	1,750.00	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude ash, ...	6.80	136.00	–	–	
" cellulose, . . .	10.70	214.00	42.80	20	
" fat, ...	5.49	109.80	87.84	80	
" protein (nitrogenous matter), . .	17.79	355.80	313.10	88	
Non-nitrogenous extract matter, ...	59.22	1,184.40	947.52	80	
	100.00	2,000.00	1,391.26	–	

GLUTEN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.09	201.80	–	–	1 : 1.82
Dry matter,	89.91	1,798.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.51	10.20	–	–	
" cellulose,	.86	17.20	5.85	34	
" fat,	4.86	97.20	73.87	76	
" protein (nitrogenous matter),	39.28	785.60	667.76	85	
Non-nitrogenous extract matter,	54.49	1,089.80	1,024.41	94	
	100.00	2,000.00	1,771.89	–	

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

	PER CENT.				
	Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.
Moisture,	13.59	–	13.69	12.50	10.09
Nitrogen,	1.60	.48	1.45	2.49	5.65
Phosphoric acid,	.662	.22	.688	2.54	.455
Potassium oxide,	.387	.21	.548	1.45	.059
Valuation per 2,000 lbs.,	$6 40	$2 02	$6 09	$12 50	$19 25

ANALYSES OF FODDER ARTICLES.

Corn Fodder (Pride of the North).

	Per cent.
Moisture at 100° C.,	24.87
Dry matter,	75.13
	100.00

Analysis of Dry Matter.

Crude ash,	5.14
" cellulose,	22.26
" fat,	2.62
" protein (nitrogenous matter),	8.28
Non-nitrogenous extract matter,	61.70
	100.00

Fertilizing Constituents in Corn Fodder.

Moisture at 100° C.,	24.87
Nitrogen (16½ cts. per lb.),	.995
Phosphoric acid (6 cts. per lb.),	.201
Calcium oxide,	.310
Magnesium oxide,	.093
Potassium oxide (4¼ cts. per lb.),	1.465
Sodium oxide,	.794
Ferric oxide,	.026
Insoluble matter,	1.318
Valuation per 2,000 lbs.,	$4 77

Weight of stalk and ear (average),	8 oz.
" stalk (average),	3 oz.
" ear (average),	5 oz.

The above material was cut when the kernels began to glaze. Part of the crop was put into a silo. Both products have been used of late in our feeding experiments with milch cows.

Corn Cob (Pride of the North).

[Experiment Station, 1887.]

	Per cent.
Moisture at 100° C.,	24.76
Dry matter,	75.24
	100.00

Analysis of Dry Matter.

	Per cent.
Crude ash,	1.75
" cellulose,	33.77
" fat,	.53
" protein (nitrogenous matter),	3.00
Non-nitrogenous extract matter,	60.95
	100.00

Fertilizing Constituents in Corn Cob.

Moisture at 100° C.,	24.76
Nitrogen (16½ cts. per lb.),	.36
Phosphoric acid (6 cts. per lb.),	.069
Calcium oxide,	.005
Magnesium oxide,	.008
Potassium oxide (4¼ cts. per lb.),	.512
Sodium oxide,	.265
Ferric oxide,	.006
Insoluble matter,	.267
Valuation per 2,000 lbs.,	$1 71

Corn and Cob Meal (Pride of the North).

[Experiment Station, 1887.]

	Per Cent.	
	I.	II.
Passed sieve, 144 meshes to square inch,	75.36	73 85
Moisture at 100° C.,	26.34	13.69
Dry matter,	73.66	86.31
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.64	1.68
" cellulose,	6.31	7.75
" fat,	3 36	3.67
" protein (nitrogenous matter),	7.82	9.13
Non-nitrogenous extract matter,	80.87	77.77
	100.00	100.00

Fertilizing Constituents in Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	26.34
Nitrogen (16½ cts. per lb.),	1.24
Phosphoric acid (6 cts. per lb.),	.587
Calcium oxide,	.095
Magnesium oxide,	.131
Potassium oxide (4¼ cts. per lb.),	.468
Sodium oxide,	.200
Ferric oxide,	.004
Insoluble matter,	.130
Valuation per 2,000 lbs.,	$5 19

CORN ENSILAGE.

[Sent on from Marblehead, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	78.88	83.48
Dry matter,	21.12	16.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.32	4.30
" cellulose,	25.77	35.25
" fat,	3.27	3.33
" protein (nitrogenous matter),	8.94	6.91
Non-nitrogenous extract matter,	55.70	50.21
	100.00	100.00

Both samples of ensilage, it is stated, were planted and harvested at the same time; both had their kernels fully developed, just past the milky state, when they were put into a silo, Sept. 20 to 30, 1887. No. I. is from "Stowell's Evergreen Sweet," and No. II. from common "Southern White" corn.

Ensilage No. I. shows a larger percentage of nitrogenous and non-nitrogenous matter than No. II., yet it was of a decidedly inferior general state of preservation when received at our office. Whether this circumstance applies to the entire contents of each silo, or is merely of an accidental nature, we are unable to decide.

CORN MEAL.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.97	239.40	–	–	1 : 8.41
Dry matter,	88.03	1,760.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.48	29.60	–	–	
" cellulose,	1.83	36.60	12.44	34	
" fat,	4.81	96.20	73.11	76	
" protein (nitrogenous matter),	11.88	237.60	201.96	85	
Non-nitrogenous extract matter,	80.00	1,600.00	1,504.00	94	
	100.00	2,000.00	1,791.51	–	

WHEAT BRAN.

[Sent on from North Amherst, Mass.]

68.97 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.43	188.60	–	–	1 : 4.00
Dry matter,	90.57	1,811.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.27	125.40	–	–	
" cellulose,	12.98	259.60	51.92	20	
" fat,	4.36	87.20	69.76	80	
" protein (nitrogenous matter),	16.76	335.20	294.98	88	
Non-nitrogenous extract matter,	59.63	1,192.60	954.08	80	
	100.00	2,000.00	1,370.74	–	

The material is of a fair average composition.

Fertilizing Constituents in Wheat Bran.

	Per cent.
Moisture at 100° C.,	9.43
Phosphoric acid (6 cts. per lb.),	2.67
Magnesium oxide,	.83
Calcium oxide,	.18
Potassium oxide (4¼ cts. per lb.),	1.51
Sodium oxide,	.15
Nitrogen (16½ cts. per lb.),	2.43
Insoluble matter,	.24
Valuation per 2,000 lbs.,	$12 50

WHEAT BRAN.
[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	–	–	1 : 4.26
Dry matter,	90.75	1,815.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.90	158.00	–	–	
" cellulose,	10.05	201.00	40.20	20	
" fat,	4.73	94.60	75.68	80	
" protein (nitrogenous matter),	16.12	322.40	283.71	88	
Non-nitrogenous extract matter,	61.20	1,224.00	979.20	80	
	100.00	2,000.00	1,378.79	–	

Wheat Bran.

[Amherst Mills.]

67.50 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.89	197.80	–	–	1 : 3.57
Dry matter,	90.11	1,802.22	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.26	145.20	–	–	
" cellulose,	14.80	296.00	59.20	20	
" fat,	5.22	104.40	83.52	80	
" protein (nitrogenous matter),	18.17	363.40	319.79	88	
Non-nitrogenous extract matter,	54.55	1,091.00	872.80	80	
	100.00	2,000.00	1,335.31	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.50	190.00	–	–	1 : 1.95
Dry matter,	90.50	1,810.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.08	21.60	–	–	
" cellulose,	4.74	94.80	32.23	34	
" fat,	3.92	78.40	59.58	76	
" protein (nitrogenous matter),	36.19	723.80	615.23	85	
Non-nitrogenous extract matter,	54.07	1,081.40	1,016.52	94	
	100.00	2,000.00	1,723.56	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.10	222.00	–	–	1 : 2.24
Dry matter,	88.90	1,778.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.55	11.00	–	–	
" cellulose,	.91	18.20	6.19	34	
" fat,	6.13	122.60	93.18	76	
" protein (nitrogenous matter),	34.79	695.80	591.43	85	
Non-nitrogenous extract matter,	57.62	1,152.40	1,083.26	94	
	100.00	2,000.00	1,774.06	–	

Rowen.

[Grown at the Experiment Station, 1887. Contained a liberal admixture of clover.]

	Per cent.
Moisture at 100° C.,	8.84
Dry matter,	91.16
	100.00

Analysis of Dry Matter.

Crude ash,	10.50
" cellulose,	29.46
" fat,	3.05
" protein (nitrogenous matter),	13.20
Non-nitrogenous extract matter,	13.79
	100.00

Fertilizing Constituents of the above Rowen.

Moisture at 100° C.,	8.840
Nitrogen (16½ cts. per lb.),	1.930
Phosphoric acid (6 cts. per lb.),	.364
Potassium oxide (4¼ cts. per lb.),	2.860
Calcium oxide,	.853
Magnesium oxide,	.197
Sodium oxide,	.122
Ferric oxide,	.057
Insoluble matter,	2.178
Valuation per 2,000 lbs.,	$9 24

Provender.

[From Amherst Mill.]

	Per cent.
Moisture at 100° C.,	9.40
Dry matter,	90.60
	100.00

Analysis of Dry Matter.

Crude ash,	3.42
" cellulose,	11.52
" fat,	5.76
" protein (nitrogenous matter),	14.35
Non-nitrogenous extract matter,	64.95
	100.00

Nutritive ratio, 1 : 7.56.

This article is, according to statement, a mixture of 450 pounds of corn, 125 pounds of oats, and 100 pounds of wheat bran.

Ground Oat Feed.

[Sent on from Salem, Mass.]

	Per cent.
Moisture at 100° C.,	8.92
Dry matter,	91.08
	100.00

Analysis of Dry Matter.

Crude ash,	3.52
" cellulose,	8.78
" fat,	8.34
" protein (nitrogenous matter),	18.66
Non-nitrogenous extract matter,	60.69
	100.00

The article is evidently a compound containing admixtures which are richer in nitrogenous matter and fat than oats. A mere analysis of a compound commercial fodder article is only of interest to the practical farmer when the amount and kind of ingredients which serve in its preparation are well known. It is not safe, as a rule, to invest to any extent in a compound commercial fodder article without feeling well satisfied concerning the character of its various ingredients.

Spent Brewer's Grain.

72.63 per cent. passed through mesh 144 to square inch.

	Per cent.
Moisture at 100° C.,	6.98
Dry matter,	93.02
	100.00

Analysis of Dry Matter.

Crude ash,	6.15
" cellulose,	15.90
" fat,	1.95
" protein (nitrogenous matter),	20.49
Non-nitrogenous extract matter,	55.51
	100.00

Fertilizing Constituents of Spent Brewer's Grain.

Moisture at 100° C.,	6.98
Nitrogen (16½ cts. per lb.),	3.05
Phosphoric acid (6 cts. per lb.),	1.26
Potassium oxide (4¼ cts. per lb.),	1.552
Calcium oxide,	.296
Magnesium oxide,	.286
Sodium oxide,	.347
Ferric oxide,	.159
Insoluble matter,	1.770
Valuation per 2,000 lbs.,	$12 88

The material is of a fair quality as far as composition is concerned.

Cotton Hulls.

[I. and II. sent on from Boston, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.17	11.45
Dry matter,	89.83	88.85
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	2.75	3.38
" cellulose,	51.40	40.24
" fat,	2.36	4.27
" protein (nitrogenous matter),	4.90	5.36
Non-nitrogenous extract matter,	38.59	46.75
	100.00	100.00

Fertilizing Constituents of Cotton Hulls.

[I. and II. sent on from Boston (same as above); III. sent on from Memphis, Tenn.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.17	11.45	8.76
Phosphoric acid,	.14	.28	.18
Magnesium oxide,	.23	.29	.25
Calcium oxide,	.13	.20	.22
Potassium oxide,	1.12	1.06	1.07
Nitrogen,	.77	.76	.74
Insoluble matter,	.06	.003	.11
Valuation per 2,000 lbs.,	$3 66	$3 75	$3 57

Cotton-seed Meal.

[Sent on from North Amherst, Mass.]

68.34 per cent. passed sieve 144 mesh to square inch.

	Per cent.
Moisture at 100° C.,	6.84
Dry matter,	93.16
	100.00

Analysis of Dry Matter.

Crude ash,	7.06
" cellulose,	10.83
" fat,	13.02
" protein (nitrogenous matter),	40.13
Non-nitrogenous extract matter,	28.96
	100.00

A fair sample of its kind.

FIELD EXPERIMENTS.

I. Field A. Fodder Corn raised with Single Articles of Plant Food.

II. Field B. Fodder Crops raised with and without Complete Manure.

III. Field C. Experiments with Fodder Crops for Green Fodder.

IV. Experiments with Potatoes; and Paper on Potato Scab, by Prof. James E. Humphrey.

V. Experiments with Root Crops.

VI. Notes on Miscellaneous Field Work.

FIELD EXPERIMENTS.

[Field A.]

I. Fodder Corn raised upon Worn-out Meadow Lands partly fertilized with One or Two Special Articles of Plant Food, partly without the Use of any Manurial Matter.

The observations recorded below extend already over a period of five years.* The field selected for the experiment was utilized for a series of years previous to 1882 as a meadow for the production of hay. The annual yield of that crop had suffered at that time a serious decline in quantity and quality. During the spring of 1883 it was planted with corn for the production of fodder corn, without the use of any manurial matter.

The same course of planting and of general treatment was carried out during the year 1884. The corn fodder raised in that year left no doubt about the serious exhaustion of the soil, as far as its fitness for a further successful cultivation of corn fodder was concerned, for the entire yield of that crop amounted only to 5,040 pounds per acre, with a moisture of thirty per cent. The soil had evidently reached a condition which promised to prove favorable for a special investigation, as far as the extent and the particular character of its exhaustion on plant food was concerned, whether the failure of the crop was due to a general exhaustion of

* For details, see preceding reports, 1883, 1884, 1885, 1886, 1887.

essential articles of plant food, or to that of any particular one of them.

As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it seemed but natural that a soil which originally did not contain much more of available potash than of available phosphoric acid must become unproductive, as far as these crops are concerned, before the latter is exhausted. It is not less evident that a system of manuring, devised with reference to this circumstance alone, can prevent an early decline of remunerative crops in the majority of cases.

The recognized importance of both — grasses and fodder corn — in our present system of general farm management has served as the principal inducement to begin our field experiments at the Experiment Station with a practical illustration of the particular serious changes which a close rotation of these crops produces in the existing soil resources of plant food, wherever the adopted system of manuring does not provide for a periodical return of fertilizing substances, with reference to the kind and to the amount of each of them carried off by the crop.

The land set apart for the experiment consists of ten adjoining plats, one-tenth of an acre each in size. The plats are five feet apart; the grounds between them are kept free from any growth, and receive no fertilizing ingredients of any description. The entire field is surrounded by a tile drain, and each plat has a separate one through its centre. This terminates at its east end in a well, which is connected with the surrounding drain.

The systematic treatment of the various plats began in May, 1885. All were ploughed, year after year, at the same time and in the same manner, — in autumn after harvesting and in spring before manuring and planting. Plats 1, 3, 5, 7, 9 and 10 received annually for three succeeding years, 1885, 1886 and 1887, an addition of a definite amount of either phosphoric acid or of a nitrogen compound or of a potash compound; while plats 2, 4, 6 and 8 received no manurial matter during that period. All, except plat 6, were planted during the above-stated three succeeding years with the same variety of corn (Clark). Plat 6 received during that time no fertilizing material; it was ploughed and worked with the cultivator in the same manner and at the same time when the other plats were thus treated; it was kept clear, as far as practicable, from every kind of vegetable growth (black fallow).

The details of the work and of the annual results of the course pursued in the management of the experiment have been described in the preceding annual report. The subsequent summary may suffice here to record the principal facts brought out before the beginning of the present year (1888).

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886 and 1887, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.			YIELD OF DRY FODDER CORN.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
PLAT 1, .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide),	480	430	720
PLAT 2, .	Nothing,	Nothing,	Nothing,	310	250	165
PLAT 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid),	350	310	240
PLAT 4, .	Nothing,	Nothing,	Nothing,	300	250	130
PLAT 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide),	360	280	635
PLAT 6, .	Fallow,	Fallow,	Fallow,	-	-	-
PLAT 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide),	280	255	730
PLAT 8, .	Nothing,	Nothing,	Nothing,	250	195	165
PLAT 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	945	840	655
PLAT 10, .	48½ lbs. of potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen),	845	895	940

A careful study of these results shows that neither phosphoric acid nor any form of nitrogen, when applied each by itself, even in exceptionally large proportions, has produced a material change in the annual yield, as compared with that obtained on unfertilized plats. The application of potash compounds alone shows in every instance a decided increase in the crop. The annual yield was increased by its use during the first two years to twice the amount of that previous to its special application.

1888. — The original plan of the experiment has not been altered materially during the past season. The principal aim of our investigation has been the same as during the three preceding years; namely, to study the direction and the degree of exhaustion on plant food of field "A" during the progress of our investigation.

The results of the past season (1888) confirm the conclusion presented in our previous annual report, 1887. An exceptional deficiency of the soil on available potash, produced by continued close rotation of grasses and corn fodder, without any substantial provision for an exceptionally large consumption of potash, proves still the first cause of a reduced annual yield of corn fodder.

The exhaustion on available plant food assumes, however, as might be expected, a more general character as years pass on. This fact shows itself plainly in a gradual falling off of the annual yield on plat 9, where a liberal amount of potash as the sole fertilizing material exerted in preceding years a marked beneficial influence on the annual yield. The same circumstance causes evidently the lower yield upon those plats (1 and 7) which received a liberal manuring with potash compounds two years later, and, after a repeated application of each, phosphoric acid or nitrogen had failed to improve the annual yield.

A manuring for three successive years with potash alone has sufficed in our case to terminate its beneficial effect on the natural productiveness of the soil, as far as the corn crop is concerned. More complete manures are required to restore a desirable degree of fertility of the soil.

The result obtained on plat 6 deserves a particular notice. This plat had been used, in common with the entire area occupied by our experiment, for two years in succession, — 1883 and 1884, — for the production of fodder corn without the use of any manurial matter. The degree of exhaustion of the entire field was very marked and practically uniform. During the spring of 1885, when all other plats were planted with the same variety of corn, plat 6 was ploughed and harrowed like the remainder, but not planted with corn; it was assigned to the task of ascertaining the effects of "black fallow" on the soil under treatment. It seemed of interest, in connection with our inquiry, to illustrate the influence of mere atmospheric agencies on the future productiveness of our field. For this purpose, during the years 1885, 1886 and 1887, the plat was ploughed, harrowed and treated with the cultivator in the same manner and at the same time as the remaining plats. During that entire period no manurial matter of any description was applied. The appearance of every description of vegetation was, as far as practicable, prevented by a timely use of the cultivator.

At the beginning of the past season, after having produced no crop for three succeeding years, it was prepared in the same way and at the same time as the other plats for the planting of one and the same variety of corn. No manurial matter was on that occasion applied to plat 6. The date of planting the corn, and the subsequent treatment of the crop to the time of harvesting, was the same in all cases. The yield of fodder corn upon plat 6 was the third lowest in the scale including all plats; *i. e.*, 1,930 pounds per acre. It was also the poorest-looking crop upon field "A" during the larger portion of the season. The result shows, in a very striking manner, that the growing of plants does materially assist in rendering available the inherent mineral plant food of the soil. The growth of three years, although in our case exceptionally small, was lost to us. Our observation in this connection confirms the results of more recent careful investigations into older systems of agricultural practice. Black fallow, as a rule, does not materially benefit the productiveness of an exhausted soil, and ought to be discouraged, therefore, from a mere financial point, at present rates of rent.

The subsequent more detailed description of the field work carried on during the past season, as well as the conditions of the crop at different stages of growth, upon different plats into which field "A" has been subdivided, will enable all parties interested in the experiment to draw their own conclusions regarding its teachings.

The entire field was ploughed twice, as in previous years,— in autumn, a short time after harvesting the crop, and early in the succeeding spring. The fertilizing materials, single or compound, wherever used, were applied broadcast, and slightly harrowed under some time before planting.

Plat 1. Received 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 2. 50 pounds of nitrate of soda (7–8 pounds of nitrogen).

Plat 3. 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

Plat 4. Nothing.

Plat 5. 97 pounds of magnesia sulphate.

Plat 6. Nothing.

Plat 7. 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 8. 50 pounds of sulphate of ammonia (10 pounds of nitrogen).

Plat 9. 50 pounds of muriate of potash (25 pounds of potassium oxide.

Plat 10. 97 pounds of sulphate of potash and magnesia (25 pounds of potassium oxide) ; 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

The corn (Clark) was planted in drills, May 29. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with six to eight seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised.

The young plants appeared above ground quite uniformly, June 5. They soon showed, however, marked differences in regard to the rate of growth upon different plats, and presented, as the season advanced, more or less striking differences in their general appearance.

Height of Corn on Plats, in inches (1888).

	June 27.	July 5.	July 12.	July 20.	July 27.	Aug. 3.	Aug. 10.	Aug. 17.	Aug. 24.
Plat 1, . .	8	8½	12	15	20	27	45	58	72
Plat 2, . .	7	7½	9	11	15	18	29	40	62
Plat 3, . .	7	9	12½	14½	19	22	34	41	45
Plat 4, . .	4½	5½	7	8½	12	14	20	25	35
Plat 5, . .	8	10	13½	17	23	30	45	60	72
Plat 6, . .	5	5½	6	6½	7	9	14	25	32
Plat 7, . .	8	10	15	19	26	36	56	67	74
Plat 8, . .	5	8	8½	10	13	15	19	25	29
Plat 9, . .	7	9	12	15	19	33	36	55	63
Plat 10, . .	9	13	17	20	30	49	72	85	84

A change in the color of the plants was first noticed at the beginning of July upon plat 6, and subsequently in those upon plat 8. Tassels appeared at about the same time on plats 1, 2, 3, 5, 7 and 9, and about three days later on plats 4, 6 and 8. An examination of the plants at the time of cutting, September 14, showed that those raised upon plats 2, 3, 4, 6 and 8 had either no ears or but a few imperfect ones, while those from plats 1, 5, 7 and 9 had more. Plat 10 had from two to three times as many as either of the last mentioned. The majority of the plats, with the exception of plat 10, had produced only small and imperfect ears.

The following tabular statement contains the exact results, as far as the character of the crop is concerned: —

	Height of Plants When Cut.	Weight of Stover.	Weight of Ears.
Plat 1, ...	72 inches.	559 lbs.	58 lbs.
Plat 2, ...	62 "	280 "	23 "
Plat 3, ...	45 "	150 "	0 "
Plat 4, ...	35 "	113 "	1 "
Plat 5, ...	72 "	510 "	54 "
Plat 6, ...	32 "	193 "	0 "
Plat 7, ...	74 "	626 "	50 "
Plat 8, ...	29 "	141 "	5 "
Plat 9, ...	63 "	487 "	66 "
Plat 10, ...	84 "	607 "	130 "

The experiment will be continued, with some modifications, for another year. As the condition of the soil in field "A" (see next page) becomes from year to year better known, its fitness for investigations of a similar character increases as time advances.

The photographic illustrations accompanying this chapter represent some of the most striking features noticeable in the growth of these plats. They illustrate in particular the striking influence of potash on the annual yield, and show the disadvantages of black fallow on the productiveness of farm lands.

The annual yield of crops of dry corn fodder is stated with reference to the same moisture, 48 per cent.

The crops raised during the years 1886, 1887 and 1888, on plats 1, 2, 6, 7 and 9, have served for our illustrations.

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887 and 1888, planted with "Clark" corn.]

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.		Yield per Acre.
	1887.	1888.	1887.	1888.	1888.
			Lbs.	Lbs.	Lbs.
Plat 1, . .	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate potash (= 25 lbs. potassium oxide).	50 lbs. muriate potash (= 25 lbs. potassium oxide), ...	720	617	6,170
Plat 2, . .	Nothing, ...	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen), .	165	303	3,030
Plat 3, . .	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	240	150	1,500
Plat 4, . .	Nothing, ...	Nothing, ...	130	114	1,140
Plat 5, . .	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. sulphate magnesia, ...	635	564	5,640
Plat 6, . .	Fallow, ...	Nothing, ...	-	193	1,930
Plat 7, . .	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	730	676	6,760
Plat 8, . .	Nothing, ...	50 lbs. sulphate of ammonia (= 10 lbs. nitrogen),	165	146	1,460
Plat 9, . .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	655	553	5,530
Plat 10, . .	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), .	940	737	7,370

EXPERIMENTS WITH CORN FODDER. FIELD A. PLAT 1.
(One-tenth of an acre.)

1886. 50 lbs. Sodium Nitrate (=7 to 8 lbs. nitrogen).
Yield of Dry Corn Fodder. 430 lbs.

1887. 50 lbs. Sodium Nitrate (=7 to 8 lbs. Nitrogen) and 50 lbs. Muriate of Potash (=25 lbs. potassium oxide).
Yield of Dry Corn Fodder, 720 lbs.

1888. 50 lbs. Muriate of Potash (=25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 617 lbs.

WRIGHT & POTTER PRINTING [illegible] STATE PRINTERS.

1886. No Fertilizer.
Yield of Dry Corn Fodder, 250 lbs.

1887. No Fertilizer.
Yield of Dry Corn Fodder, 165 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS.

1888. 50 lbs. Sodium Nitrate (= 7 to 8 lbs Nitrogen).
Yield of Dry Corn Fodder, 303 lbs.

A field with complete manure, consisting of Barn-yard manure and potash Salts.

Yield of Dry Corn Fodder, 2800 lbs.

Plat 6. 1888. Was kept free from any vegetation from 1885 to 1888; and planted in 1888 with corn without receiving any manurial matter.

Yield of Dry Corn Fodder, 193 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS.

1886. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid). Yield of Dry Corn Fodder, 255 lbs.

1887. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide). Yield of Dry Corn Fodder, 730 lbs.

WRIGHT & POTTER PRINTING CO. STATE PRINTERS.

1888. 50 lbs. Muriate of Potash (= 25 lbs. of Potassium Oxide). Yield of Dry Corn Fodder, 676 lbs.

1886. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 840 lbs.

1887. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 655 lbs.

1888. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 553 lbs.

II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops.

[Field " B."]

The field assigned to the above-stated inquiry is located west of field " A," and has been used, like the latter, for several years previous to the establishment of the Experiment Station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. During the spring of 1883 it was ploughed and prepared for raising corn fodder. This crop was raised for one year in drills, and without the aid of any manurial matter. The previous thorough mechanical treatment of the soil, as well as its impoverished condition, was considered favorable for the contemplated work. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. The fertilizer has been applied at an early date each spring, either broadcast or between the rows, as circumstances admitted. It was in each case subsequently slightly harrowed under. Since 1885, all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and in the case of grasses, two feet. The space between the different plats measured five feet; it has received thus far no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 are fertilized annually; plats 12, 14, 16, 18 and 20 have received thus far no fertilizer. The single plats are either occupied by one variety of plants or by two; in some instances several plats are used for one and the same crop. Corn and various prominent varieties of meadow grasses and of leguminous plants have thus far been selected for observation.

The details of the work carried on upon field "B" are from year to year recorded in the annual report of the Station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins and the reports of the succeeding year. These analyses may claim a special interest, as they are made of a variety of fodder crops, raised, as far as practicable, under corresponding circumstances with reference to climate, to soil, to system of manuring, to the adopted modes of cultivation, of harvesting and of analyzing. In making this statement, I do not mean to imply that our local conditions of climate and of soil are in every instance the most favorable ones to enable the various crops here on trial to attain in all cases the highest possible development. This qualification of our results applies with more or less propriety to some varieties of grasses as well as of leguminous plants.

The subsequent tabular record of the crops raised upon the different plats of field "B" since 1884 may assist in a desirable understanding of its past history and its condition at the beginning of the season of 1888. The single plats are, since 1886, each 175 feet long and 33 feet wide.

STATEMENT OF CROPS RAISED ON FIELD "B."

PLATS.	1884.	1885.	1886.	1887.
Plat 11 (fertilized),	Orchard grass (*Dactylis glomerata*), Meadow fescue (*Festuca pratensis*),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
Plat 12 (unfertilized),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
Plat 13 (fertilized),	Hungarian grass (*Panicum Germanicum*), Pearl millet (*Penicillaria spicata*),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).
Plat 14 (unfertilized),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass. English rye-grass.
Plat 15 (fertilized),	Timothy (*Pleum pratense*), Red-top (*Agrostis vulgaris*),	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
Plat 16 (unfertilized),	Timothy, Red-top,	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
Plat 17 (fertilized),	Corn (variety, Clark),	Corn,	Corn,	Meadow fescue.
Plat 18 (unfertilized),	Corn,	Corn,	Corn,	Alsike clover (*Trifolium hybridum*). Medium red clover (*Trifolium pratense*).
Plat 19 (fertilized),	Corn,	Corn,	Corn,	Alsike clover. Medium red clover.
Plat 20 (unfertilized),	Corn,	Corn,	Corn,	Mammoth red clover (*Trifolium medium*). Alfalfa or lucerne (*Medicago sativa*).
Plat 21 (fertilized),	Corn,	Corn,	Corn,	Mammoth red clover. Alfalfa.

1888. — At the beginning of the season but few changes became necessary in the management of the field; for, plats 13, 14, 17, 18, 19, 20 and 21 being still occupied by a perennial vegetation, only plats 11, 12, 15 and 16 required particular attention in that direction. It was decided to add the Kentucky blue-grass (*Festuca pratensis*) and the Soja bean (*Soja hispida*) to our list of prominent crops on trial upon field "B."

Plats 11 and 12 were seeded down, in drills two feet apart, with Kentucky blue-grass; and plats 15 and 16 with Soja beans, in rows three feet and three inches apart, to correspond with the rule adopted for grasses and leguminous plants. In both instances one plat was fertilized in the same way as heretofore, with fine-ground bones and muriate of potash (11 and 15), and the other two (12 and 16) received no fertilizer. The Kentucky blue-grass was seeded down rather late, May 24, and the Soja beans May 18. The mechanical condition of the soil was in both cases very satisfactory for the work.

Those plats which were still occupied by perennial plants, planted in preceding years, were treated between the rows at an early date with the cultivator, and subsequently the weeds and foreign growth in the rows removed with the hoe and the hand. Plats 13, 17, 19 and 21 received at the same time their annual supply of manure, consisting of fine-ground bones and muriate of potash. Plats 14, 16, 18 and 20 received none.

As the plats were 175 feet long and 33 feet wide, equal to an area of 5,775 square feet, each received a mixture of 80 pounds of ground bones and 27 pounds of muriate of potash.

The subsequent enumeration of crops raised upon field "B," during the years 1887 and 1888, shows the change made in crops at the beginning of the past season.

	1887.	1888.
Plat No. 11 (fertilized), .	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 12 (unfertilized),	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 13 (fertilized), .	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).	Italian rye grass. English rye grass.
Plat No. 14 (unfertilized),	Italian rye-grass. English rye-grass.	Italian rye-grass. English rye-grass.
Plat No. 15 (fertilized), .	Five varieties Southern cow-pea.	Soja bean.
Plat No. 16 (unfertilized),	Five varieties Southern cow-pea.	Soja bean.
Plat No. 17 (fertilized), .	Meadow fescue (*Festuca pratensis*).	Meadow fescue.
Plat No. 18 (unfertilized),	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 19 (fertilized), .	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 20 (unfertilized),	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.
Plat No. 21 (fertilized), .	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.

The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Perennial rye-grass, plat 14 (unfertilized), was almost entirely winter-killed; while upon plat 13 (fertilized) a much less serious effect could be noticed.

Italian rye-grass looked decidedly better preserved in both instances than the perennial rye-grass.

Meadow fescue, plat 17 (fertilized), appeared remarkably vigorous, and retained the lead for the entire season, as far as the varieties of grasses on trial are concerned.

Alsike clover was seriously winter-killed upon the unfertilized plat 18, while upon the fertilized plat 19 it was very well preserved.

Medium red clover appeared in fair condition upon plat 18 (unfertilized), yet fell behind the alsike clover on plat 19 (fertilized).

Alfalfa and *mammoth clover*, on plats 20 and 21, presented the same features in their growth as was noticed with reference to alsike clover and medium clover.

The weight of the hay obtained from the first cut of each kind of crop, when well advanced in blooming, gives a fair representation of their general character and condition at the time of harvesting. The yield is in every instance stated with reference to an entire plat (175×33 feet), in case of fertilized as well as unfertilized ones.

GRASSES.

	English Rye-Grass, cut July 5, 1888.	Italian Rye-Grass, cut July 5, 1888.	Meadow Fescue, cut July 2, 1888.
Fertilized plat, . .	300 lbs.	260 lbs.	700 lbs.
Unfertilized plat, . .	90 "	105 "	No plat.

LEGUMINOUS PLANTS.

	Medium Red Clover, cut July 5, 1888.	Alsike Clover, cut July 5, 1888.	Mammoth Red Clover, cut July 5, 1888.	Alfalfa, cut July 5, 1888.
Fertilized plat, . .	690 lbs.	490 lbs.	460 lbs.	150 lbs.
Unfertilized plat, .	250 "	70 "	20 "	50 "

SOJA BEAN (GREEN).

Cut Aug. 30, 1888.

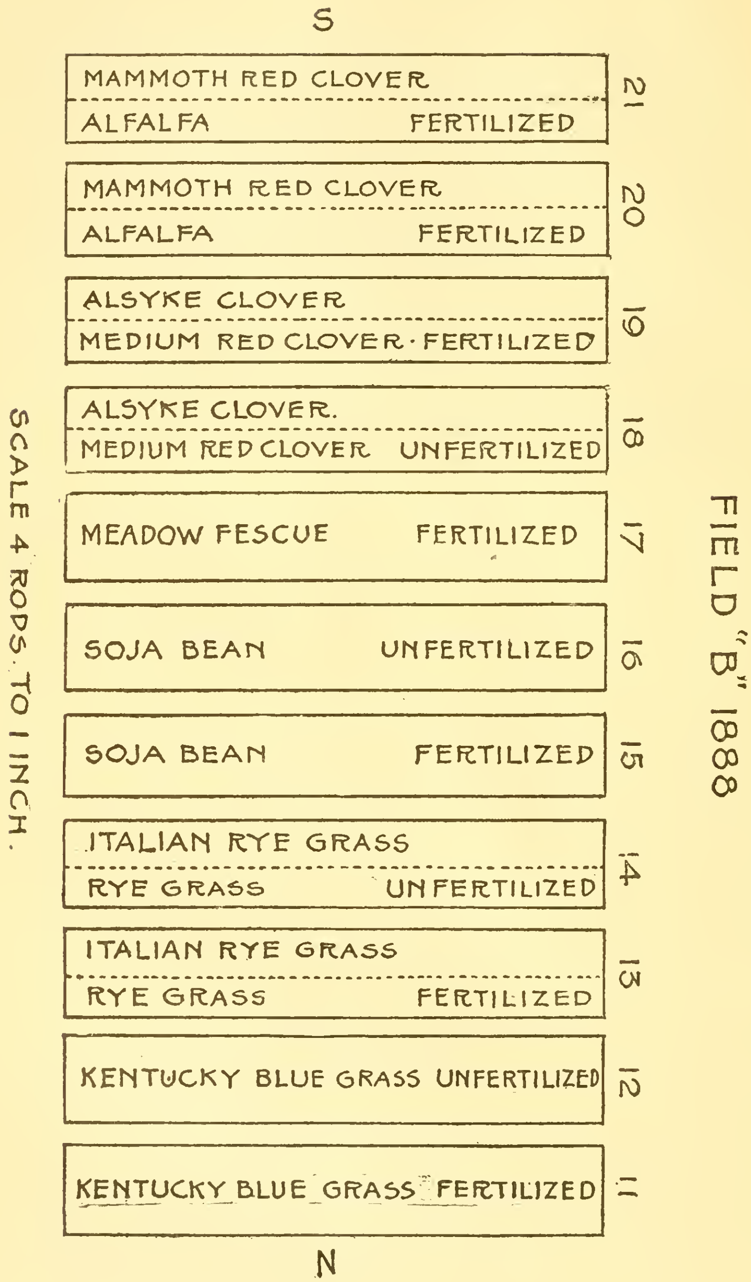
Fertilized plat, ...	2,080 lbs.
Unfertilized plat, ...	1,560 "

(The crop was put into a silo Aug. 30, 1888.)

The Soja bean has been raised during the past season in different parts of the field, to serve for ensilage. The investigation of this valuable plant is not yet finished, and a detailed description has been reserved for a future date.

As the cultivation in rows is an exceptional one as far as meadow grasses and clovers are concerned, no attempt has been made to state their yield per acre. The principal aim of the experiment on field "B" consists, as has been stated above, in securing suitable samples of each crop on trial, for the purpose of ascertaining the influence of stage of growth and of a different degree of fertility of the soil on their composition. Sufficient material has been collected of every crop stated above, and the results of a chemical analysis of each will be published from time to time as the work advances.

The analyses of alfalfa and of alsike clover of the first year's growth (1887) have been already published in the annual report for that year; also analyses of orchard grass, red-top, meadow fescue and timothy. (See pages 125–132.)


S
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
21
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
20
ALSYKE CLOVER
MEDIUM RED CLOVER · FERTILIZED
19
ALSYKE CLOVER.
MEDIUM RED CLOVER UNFERTILIZED
18
MEADOW FESCUE FERTILIZED
17
SOJA BEAN UNFERTILIZED
16
SOJA BEAN FERTILIZED
15
ITALIAN RYE GRASS
RYE GRASS UNFERTILIZED
14
ITALIAN RYE GRASS
RYE GRASS FERTILIZED
13
KENTUCKY BLUE GRASS UNFERTILIZED
12
KENTUCKY BLUE GRASS FERTILIZED
11
N
SCALE 4 RODS. TO 1 INCH.
FIELD "B" 1888

III. Experiments with Fodder Crops for Green Fodder.

[Field "C."]

In a discourse on fodder supply for dairy cows, in the preceding annual report, pages 89, 90, the following statement was made : —

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at a time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotations, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and, for this reason, largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder plants may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order:—

1.	Leguminous plants, clover, vetch, etc., . .	1 : 2.2 to 1 : 4.5
2.	Grasses, ...	1 : 5.0 to 1 : 8.0
3.	Green corn, roots and tubers, ...	1 : 6.0 to 1 : 15.0

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

Believing in the correctness of the previous remarks, it has been one of the aims of the manager of the Station to experiment with various new fodder crops, to ascertain their adaptation to our climate and soil, and their fitness for the support of the dairy industry at a period of the season when good hay is scarce, and when the green fodder corn has not yet reached a desirable condition to do its best.

Some, as the vetch, Southern cow-pea and serradella, have been cultivated for several years past on a comparatively large scale, with marked success. They yielded a liberal amount of green fodder from the beginning of June to the beginning of October. Their good services as green fodder for milch cows during that period have been described in the last annual report (1887, pages 35–48). Similar results have been obtained in this direction during the past season. The details of the feeding experiment form a part of this report.

The observations with reputed fodder crops have been extended during the past year; most of them were, however, raised on a small scale, to ascertain merely their general character and their particular degree of adaptation to our climate and soil, and to secure material for analysis, to compare their relative proportions of essential nutritive constituents.

The fact, as has been stated before, that all these crops are raised under corresponding conditions, as far as climate, soil, modes of cultivation and of fertilization and particular stages of growth are concerned, imparts to the results the claim of an exceptional value to decide judiciously their comparative merits.

1888. — Field "C" comprises at present an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passageway three feet wide.

The northern half of the field is 70 feet wide and 328 feet long; the southern half is of the same length, but 110 feet wide.

The latter is again sub-divided into three equal plats, each 111 × 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and of oats (variety, western). The middle division was planted the same day with serradella, and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart. The northern half of field "C" was occupied by a series of crops in rows, running from south to north, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning on the east end : —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.
Teosinte (*Euchlæna euxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture.

Vetch and Oats. — Twenty-five pounds of vetch and fifty pounds of oats were seeded broadcast May 8. The oats appeared above ground May 15, the vetch on May 17. The oats began to head out and the vetch to bloom June 30. Both crops had reached a height of 28 inches July 5, and of 32 inches July 12. The feeding of the crop began July 7 and terminated July 23. The total yield of the green crop amounted to 5,276 pounds, or 8 53 tons, per acre.

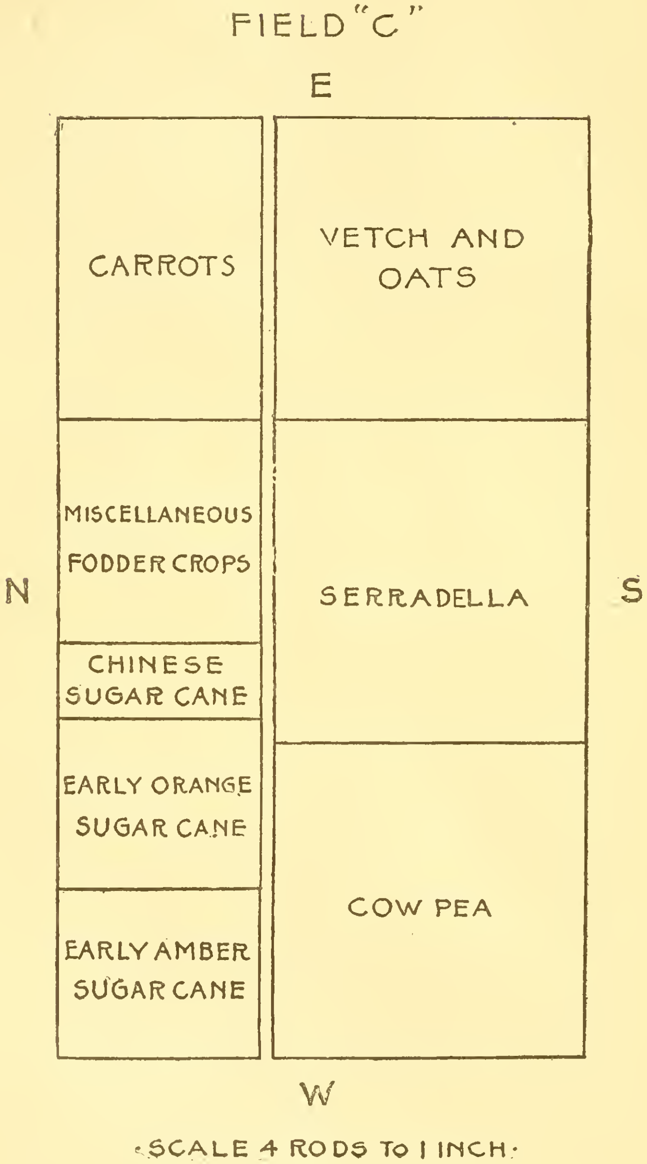
Southern cow-peas were seeded in rows, three feet and three inches apart, May 14. They appeared above ground May 28. The plants were six inches high June 27 ; twelve inches high July 12 ; and twenty inches high August 3. They began to fill out the space between the rows August 10 ; bloomed August 17, and formed pods August 23. The feeding of the crop commenced September 4, and was finished September 15. The crop had suffered somewhat from frost September 7. The total yield amounted to 4,050 pounds, or 7.36 tons, per acre.

Serradella was planted in rows, three feet three inches apart, May 14. The young plants appeared above ground May 26. They had reached a height of six inches July 5; began blooming July 12, and measured eleven inches, when a blight made its appearance on the leaves, which ultimately destroyed the crop to such an extent that no part of it was fed. The grounds occupied by the serradella had been used during the preceding season for the cultivation of different varieties of wheat, which seriously suffered from fungoid growth. The exceptionally wet season most likely contributed also towards the failure of the crop.

The early frost, September 7, terminated prematurely the observations on Chinese sugar cane, early orange cane and early amber cane.

Teosinte, pop-corn, flour corn, melilotus, sulla, hairy vetch and lotus, have been sampled for analysis.

The perennial varieties of leguminous plants are left in the field for observations during the coming season, when their special agricultural merits will be discussed.


FIELD "C"
E
CARROTS
VETCH AND OATS
MISCELLANEOUS FODDER CROPS
N
SERRADELLA
S
CHINESE SUGAR CANE
EARLY ORANGE SUGAR CANE
COW PEA
EARLY AMBER SUGAR CANE
W
SCALE 4 RODS TO 1 INCH

IV. Experiments with Potatoes.

The experiments reported in this connection are continuations of those described under the same heading in our last annual report.

One of the experiments has been carried on upon the same portion of field "D" since 1884. It was originally instituted for the purpose of studying the effects of high-grade German potash salts, muriate of potash and potash magnesia sulphate, as the main potash source of plant food, on the quantity and the quality of potatoes raised by their assistance.

The second one, observations with scabby potatoes, owes its origin to the interest created by some observations made in connection with the former; it was carried on, for important reasons, upon a different part of the farm.

A. *Observations upon Field "D."*

[Variety: Beauty of Hebron.]

An examination of the preceding records of this experiment cannot fail to show that our original plan has been seriously interfered with by an early and persistent appearance of either scab or blight, or of both combined. The scab appeared in some parts of the field sooner than in others, — in the fertilized part of the soil sooner or more extensively than in the unfertilized soil. The results in 1884 were not as bad as in 1885. The seed potatoes used in 1885 were selected from our own crop; they were planted upon the same part of the field where they had been produced the preceding season. The system of manuring and of general treatment was the same as in the previous year. A blight on the leaves appeared that year in August, and terminated the experiment prematurely. The crop, when harvested August 26, was found suffering from scab in all parts of the field engaged in the experiment.

It was decided, in sight of these facts, to continue the experiment in 1886 upon the same field, with some modifications, to ascertain, if possible, whether the main influence regarding the results in our past observation had to be ascribed to atmospheric agencies, or to the condition of the soil and the fertilizer applied, or to the quality of the seed potato used.

1886. — The same field was used as in 1885. The land was well prepared by ploughing and harrowing April 27, and subsequently fertilized the same as in previous years. The change regarding the character of the fertilizer applied consisted in using nearly twice the amount of potash salts, muriate and sulphate of potash, for the same area, in case of plats 1 and 3. A second important change from our previous practice consisted in securing first quality seed potatoes, in particular free from scab. The same variety, Beauty of Hebron, was obtained for that purpose from Vermont; it was as fair an article as could be desired. The system of planting and cultivating was the same as in previous years. The potatoes were planted upon all plats May 5, 1886. All the vines were in full blossom July 6; they began to turn yellowish and dry up July 30. The crop on the entire field was dried up August 8. This change seemed to appear most marked, and first, on the vines raised from whole potatoes. The crop was harvested August 28.

Neither a liberal use of our own mixture of commercial manurial substances, rich in potash compounds, nor the selection of a fair quality of seed potatoes from another locality, had affected our results, as compared with those of the previous season; for the entire crop, with scarcely any exception, was badly disfigured by scab. The potatoes were unfit for family use, and had to be sold at a low price for stock feeding.

A due consideration of all the circumstances which accompanied our course of observations thus far, induced us to draw the following conclusions: —

1. Medium-sized whole potatoes give better results, as far as a large-sized, marketable crop is concerned, than half potatoes obtained from tubers of a corresponding size.

2. Disregarding the results of the first year, when previously existing resources of plant food in liberal quantities

must have rendered the influences of an additional supply of manurial substances less marked, it appears that sulphate of potash produced better results in our case than muriate of potash.

3. The premature dying out of the vines, accompanied by blight or scab, or both, must be considered a controlling cause of an exceptionally large amount of small potatoes.

4. Some peculiar condition of the soil upon the lands used for this experiment is to be considered the real seat of our trouble. (For further details, see annual report.)

To test the correctness of conclusion 4 still further, the experiment was continued for another year.

1887. — The same plats as in previous years were utilized for the experiment. The subdivisions remained unchanged. The fertilizers applied were the same as in 1886.

The lands were ploughed and harrowed during the first week of May, and the potatoes planted in all plats May 11. First quality potatoes, Beauty of Hebron, raised in Vermont, were used as seed. The growth looked well upon all plats until July 28, when the vines on plats 2 and 3 began to turn yellow. They commenced drying up August 9, and by August 12 were dry on all plats. An examination of the little potatoes, July 1, showed already, in every case, the marks of scab.

The entire crop, when harvested, was so seriously affected by scab that it proved worthless in the general market.

The months of July and August were exceptionally wet and warm in our part of the State, a circumstance which has, most likely, aggravated our trouble.

The potato crop was in that year quite extensively a failure in our vicinity, wherever low lands had been used for its production.

1888. — The continued failure to raise upon this field a potato crop free from a serious attack of scab had strengthened our belief that neither the kind of fertilizer applied, nor the particular character of the season, nor the quality of the seed potatoes used, had any special relation to our results; but that some peculiar feature of the soil would ultimately prove to be the cause of our trouble.

Assuming that the presence of some injurious parasite in our soil might be the first cause of the scab, it was decided to devise some means by which its development would be prevented. The following course was adopted: Three plats, each forty-four by seventy feet, corresponding in location with plats 1, 2 and 3 in our description of preceding years, were assigned for the observation.

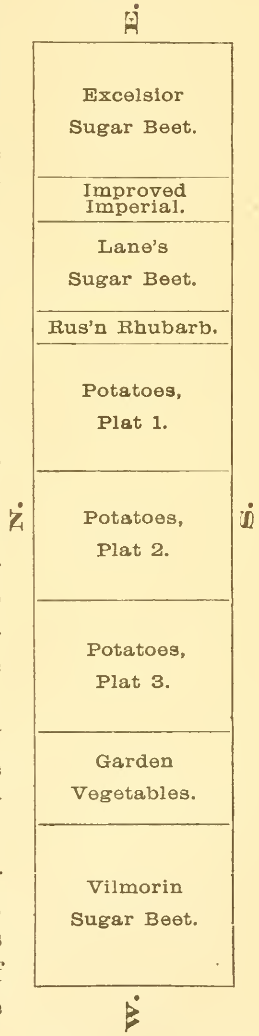
Plat 1, located on the eastern side of the stated area, received the same manure and in the same proportion as in the preceding year (600 pounds of fine-ground bones and 580 pounds of potash-magnesia sulphate per acre). The plat thus fertilized was subsequently subdivided into two equal parts, of which one received broadcast a mixture of one-half a pound of bi-sulphide of carbon and of ninety-five pounds of air-slaked lime; while the other half received broadcast a mixture of one-half a pound of carbolic acid and of ninety-five pounds of air-slaked lime.

In both instances the soil was subsequently slightly harrowed before the potatoes were planted.

Plat 2, located between plats 1 and 3, received, as in previous years, no fertilizer; but one hundred and ninety pounds of air-slaked lime were sown broadcast and harrowed in before planting. The application of lime was made here to assist in discriminating between the influence of a mere application of air-slaked lime, and that of a mixture of either bisulphide of carbon or carbolic acid and air-slaked lime.

Plat 3, forming the western end of our experimental field, received for manuring purposes, as in the preceding years, fine-ground bones and muriate of potash, at the rate of 600 pounds of the former to 300 pounds of the latter per acre. The fertilizer was applied broadcast and slightly harrowed in. The plat thus prepared, in a similar way to plat 1, was subsequently subdivided, like the latter, into two equal parts. One part was treated broadcast with a mixture of air-slaked lime and of bisulphide of carbon, and the other one with that of air-slaked lime and of carbolic acid, in the same way, as far as relative portions and total amount are concerned, before planting.

FIELD "D."*



* Scale, 4 rods to 1 inch.

The potatoes were planted on all the plats May 7; they appeared pretty uniform above ground May 27. The general treatment of the crop during the entire time was the same on all plats, and closely corresponded to the course pursued in preceding years. The vines began to change their color August 17, and were all dead August 31. The change seemed to be a natural one; no indications of blight could be discovered on the leaves; the extreme wetness of the season seemed to favor the continuation of the growing period. The crop on all the plats was harvested September 7. An examination of the entire crop, when spread out over the field, showed no marked difference in any particular part of the various plats. The potatoes were of a fair size, but seriously suffering from scab and rot.

Plat 1 yielded 1,080 pounds of potatoes; plat 2, 876 pounds, and plat 3, 976 pounds, of all sizes. Fifteen bushels of scabby potatoes, nearly one-third of the entire crop, were collected before the crop was removed from the field.

Although the results of the year are discouraging, the experiment will be repeated, with some modification, when a more favorable season may assist in the work.

B. *Observations with Scabby Potatoes.*

The experiments were inaugurated in 1886 for the purpose of inquiring into the circumstances which control the development and the propagation of the scab on potatoes.

1886. — The first year's work in this connection has been confined to the task of observing the behavior of scabby potatoes as seed potatoes, under some definite previous treatment. To prevent a possible propagation of scab in the new crop by infected seed potatoes, the following course was adopted: Thoroughly scabby potatoes, obtained from the previously described experimental plats, were treated with some substances known to be destructive to various forms of parasitic growth. This operation was carried out with the intention of destroying the propagating power of adherent germs of an objectionable character before planting the seed.

The field for the experiment was distinctly separate from other experimental plats for the cultivation of potatoes. It had been used for many years previous for the raising of grass, and had since been planted but once, — the preceding year (1885), — with corn. The land was prepared by ploughing and harrowing in the same way as other potato fields. It was fertilized broadcast, at the rate of 600 pounds of ground rendered bones and 290 pounds of potash-magnesia sulphate.

The field was subdivided into five plats of equal size, eighty feet long and fifty feet wide, and the potatoes subsequently planted in rows, three feet three inches apart, with hills three feet from each other in the rows. Three feet of space was left between the plats unoccupied. The scabby seed potatoes selected for the trial were, as far as practicable, of a uniformly medium size. Each lot was immersed in the particular solution prepared for the different plats; after being kept there for twenty-four hours they were removed and directly planted.

Plat 1 was planted with healthy and smooth potatoes, without any previous treatment. This course was adopted to learn whether soil, fertilizer, or atmospheric agencies of the season would favor the appearance of scab in the crop.

Plat 2. The scabby seed potatoes were allowed to remain for twenty-four hours in a saturated solution of muriate of potash before being planted.

Plat 3. A strong solution of hypochlorite of lime (bleaching lime) was applied in a similar way, for the preparation of the scabby seed, as in case of plat 2.

Plat 4. A saturated solution of carbolic acid in water served in this instance for the treatment of the scabby potatoes.

The potatoes were planted in all plats on the same day, May 7. The vines did not appear evenly at first; they were, however, equally vigorous upon all plats at the close of June.

The tops on all plats were pretty generally dried up August 8. The potatoes were harvested on the entire field August 30. The yield on all plats was fair, and the quality of the potatoes, almost without exception, excellent; this seemed to be more striking in regard to those on plats 2, 3 and 4, which had been, in the beginning of the season, somewhat behind in growth. Here and there could be seen a potato with a small mark of scab; a large proportion were perfectly smooth, and without any sign of it. The results were recorded as those of a first experiment.

The fact that a scabby potato may produce, under certain circumstances, a smooth and otherwise excellent potato, was confirmed. Good potatoes have been raised before from seed potatoes suffering from scab, without any previous treatment similar to ours. Without any intention of anticipating the results of future observations, or to point out with certainty the exact cause of our results, we expressed the opinion that a difference in the condition of the soil in our old and new experimental potato plats might have proved to be the principal cause of our trouble; for the former yielded, from healthy potatoes, most inferior scabby potatoes; while the latter produced, from scabby potatoes, a most superior, smooth potato, under otherwise almost identical conditions, as far as soil, mode of cultivation and kind of fertilizer were concerned, upon lands in close proximity, during the same season.

1887. — The experiment was repeated upon the same lands, with but a slight modification. The soil was ploughed and fertilized, as in the preceding year. Ten plats, each fifty feet long, were planted with four rows of potatoes, three feet three inches apart, and with nineteen hills in the row. Medium-sized, whole scabby potatoes (Beauty of Hebron), selected from the crop raised upon our own fields during the previous year, and which is described in some preceding pages under the heading "Potato Experiment, A," served as seed potatoes. One-half the plats were planted with scabby potatoes, all from the same lot, after being immersed for eighteen hours in some solution prepared for that purpose; and the other half were planted without any previous treatment of the seed, — plats 2, 6 and 10 with our scabby potatoes, Beauty of Hebron, and plats 4 and 8 with healthy, smooth tubers, of the same variety.

Plat 1. Scabby potatoes, soaked in a solution of potassium sulphide.
Plat 2. Scabby potatoes, without any particular treatment.
Plat 3. Scabby potatoes, treated with a solution of hypochlorite of lime (bleaching lime).
Plat 4. Smooth, healthy potatoes, without previous treatment.
Plat 5. Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
Plat 6. Scabby potatoes, without previous treatment.
Plat 7. Scabby potatoes, treated with a solution of carbolic acid.
Plat 8. Smooth, healthy potatoes, not treated.
Plat 9. Scabby potatoes, treated with copper sulphate (blue copperas).
Plat 10. Scabby potatoes, not treated.

The young plants made their appearance on all plats, except plat 9, June 1; those on plat 9 appeared eight or ten days later. The entire crop looked uniformly well. The vines dried up on all plats at about the same time. The crop was harvested with the following results: —

BEAUTY OF HEBRON.

PLAT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results (Sept. 12, 1887).
No. 1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
" 2,		Scabby.	None.	Good; not scabby.
" 3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
" 4,		Good.	None.	Somewhat scabby.
" 5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
" 6,		Scabby.	None.	Good; not scabby.
" 7,		Scabby.	Carbolic acid.	Especially good.
" 8,		Good.	None.	Especially good.
" 9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
" 10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results tends to show that a certain condition of the soil has been the leading cause for the origin and propagation of the scab; for scabby seed potatoes have produced healthy, smooth tubers, both with and without any special previous treatment (see plats 1, 2, 7 and 8). On the other hand, it is not without interest to notice that plats 1, 3 and 7 have furnished us with some of the best potatoes we have raised during the past season.

1888.— The field occupied by the experiment was the same as during the preceding year. The same arrangement of plats was adopted. The preparation of the soil, as far as ploughing and manuring are concerned, was the same as in the preceding season. The solutions of chemicals for the treatment of part of the seed potatoes was identical with that of the preceding year. All the details of the field work, beginning with planting and ending with harvesting, were closely corresponding to the course pursued in 1887.

The potatoes were planted May 9; the vines died on all plats, apparently without any exceptional external cause, between August 23 and 31. No marked difference could be noticed in the appearance of the potatoes from the various plats. All plats had produced some scabby potatoes. The result of the season is, to say the least, an indifferent one, as far as the action of the various solutions of antiseptics as a preventive of scabby potatoes is concerned.

The conclusion arrived at in previous years has evidently received an additional support by the results of the past season. Every one of our observations thus far made in this connection points towards the soil as the bearer of the cause of the scab on potatoes. The inquiry into the first cause of the scab will be continued.

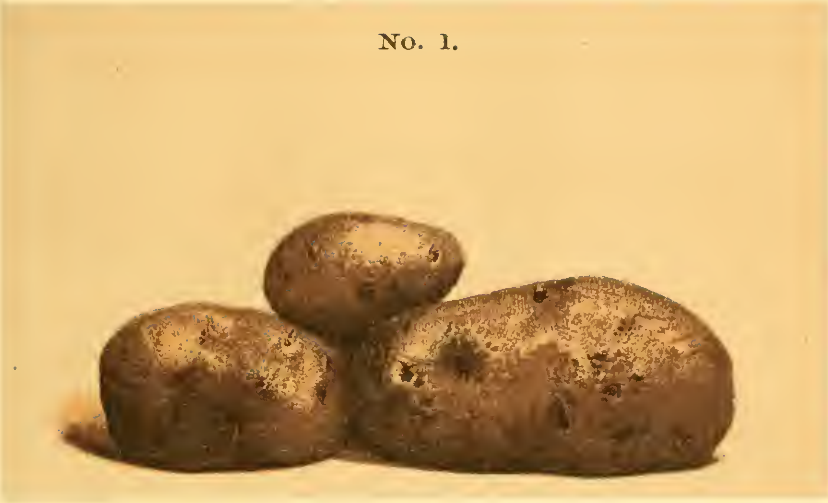
Those of our readers who are not familiar with the present views entertained by scientists regarding the real character of the scab on potatoes, will find Professor Humphrey's discussion of this subject, which accompanies this chapter of our annual report, very interesting and profitable reading.

It has been considered of interest to photograph the seed potatoes, and subsequently some specimens of a corresponding size of those raised from them. This course it is thought will furnish us in time with an exact record of the exterior characteristics of genuine varieties, and assist us in discriminating between new and old. As the Beauty of Hebron, Early Rose and Polaris (originated by H. F. Smith of Waterbury Centre, Vt.) have been the principal varieties raised upon the fields of the Station during the past season, their photographs accompany this report. A picture of the Colorado wild potato, raised on our lands, may not be without interest in this connection. The pictures are in every case taken at an equal distance, and thus allow a comparison of relative sizes.

Description of Photographs of Potatoes.

	Largest. Weight in ounces.	Medium. Weight in ounces.	Smallest. Weight in ounces.
Picture No. 1. Beauty of Hebron Potatoes,	7 to 19	3 to 6½	2½ to 3½
Picture No. 2. Early Rose Potatoes, . .	4 to 8	2½ to 3½	1½ to 2½
Picture No. 3. Polaris Potatoes, . .	6 to 11	3 to 5½	2 to 3
Picture No. 4. Colorado Wild Potatoes, .	–	–	–

No. 1.



BEAUTY OF HEBRON (SEED POTATOES FOR 1888).

BEAUTY OF HEBRON (POTATOES RAISED IN 1888).

No. 2.

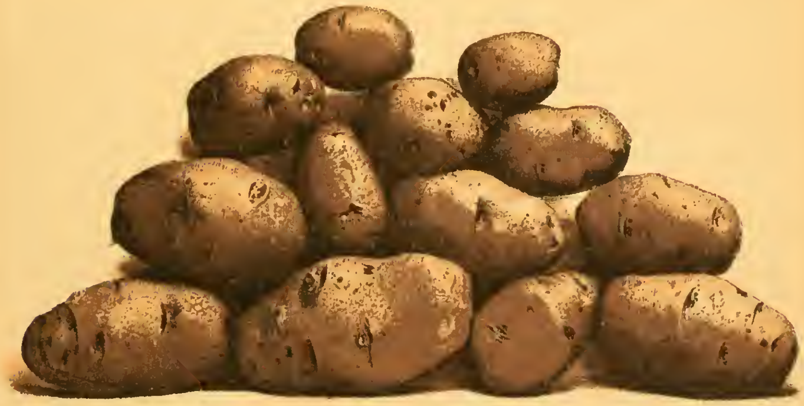
EARLY ROSE (SEED POTATOES FOR 1888).

WRIGHT & POTTER PRINTING CO., STATE PRINTERS.

EARLY ROSE (POTATOES RAISED IN 1888).

No. 3.

Polaris (Seed Potatoes for 1888).



Polaris (Potatoes Raised in 1888).

No. 4.

Colorado Wild Potatoes (Raised in 1888).

Wright & Potter Printing Co., State Printers.

POTATO SCAB.

BY JAS. ELLIS HUMPHREY, PROFESSOR OF VEGETABLE PHYSIOLOGY.

The value of the potato crop in Massachusetts exceeds that of any other planted crop; consequently, the loss by any widespread and serious disease of this crop must be an important item. The commonest and most constant disease which attacks the potato in the field is that commonly known as the "scab." It is well known in both Europe and America, and attacks the tubers, giving little or no evidence of its presence in those parts of the plant above ground. The cause of this trouble is not at all understood, though various theories are held as to its nature. It is proposed in the present paper to discuss briefly the present state of our knowledge of the potato scab, by way of introduction to a series of investigations of the disease which the writer expects to carry on during the coming year.

The disease first manifests itself in the form of small corroded spots or pustules on the surface of the potato. Writers on the subject generally agree that these spots replace the "lenticels" of the tubers.

If a smooth potato tuber be closely examined, there will be seen spots of the size of a pin's head or smaller, of a slightly different shade, and somewhat roughened or granular in appearance. These breaks in the continuity of the tissue of tabular cork-cells which form the so-called "skin" of the potato, are filled with loose, globular cork-cells, through whose intercellular spaces an interchange of gases can take place between the interior of the potato and the outer air. They are then, so to speak, the *ventilators* of the tuber, and are known as "lenticels." (The normal structure of the potato tuber is shown in the accompanying Fig. 2.) It is in these lenticels that the scab originates or first shows itself.

From these spots the disease rapidly spreads, until sometimes almost the whole exterior of the tuber becomes involved in the decay and breaking down of the surface tissue. In many cases, at least, there are developed over these patches, rough, brittle scales or crusts of corky tissue, which peel readily from the surface, and which render the name "scab" an appropriate one for the disease. In Fig. 1 is shown the appearance of the fully developed scab, reproduced from photographs of potatoes raised on the plats of the Station in 1888. This whole change goes on while the tuber is still in the ground; and after the crop is dug and stored, no further change occurs. The disease affects the tissue to a depth of only a few cells, all below remaining in a normal, healthy condition. The cells affected lose their starch, and contain, in its place, according to some writers, globular brown masses, usually regarded as disorganized cell-contents. In so far as the starch, which gives its chief food value to the potato, is destroyed, that value is lessened; but the unsightly appearance of "scabby" tubers causes a much greater proportional decrease in their selling value, since, by paring away the affected superficial tissue, the remainder is made perfectly suitable for food.

The cause of this disease has been discussed by several writers. Most of the views expressed are based on the first important discussion of the subject by Schacht, in a work on the potato plant and its diseases.* This author believes that the efficient cause of the scab is an excess of moisture in the soil. It can readily be shown, that, when a potato tuber is exposed to an abundance of moisture, the lenticels become more prominent, in consequence of the loosening and separation of the cells which fill them. This affords, Schacht thinks, an easy opportunity for the water to enter those tissues of the tuber bordering the lenticels. They thus become water-soaked, and rapidly decay, assuming a dark and muddy appearance. Two of the chief recent writers on the diseases of plants, Frank and Sorauer, adopt this view. Frank † regards the disease as a case of breaking down of tissue, originating in what is practically a wound. Sorauer ‡ thinks the scab develops rapidly during short but specially favorable periods, and instances, as such a period, the time of a heavy rain following a drought. Each of the above writers mentions as a possible cause, or at least an aggravating condition, the presence of lime, marls, or especially

* Bericht über die Kartoffelpflanze und deren Krankheiten, Berlin, 1854, p. 24.

† Krankheiten der Pflanzen, Berlin, 1880, p. 140.

‡ Handbuch der Pflanzenkrankheiten, Berlin, 1886, vol. i, p. 227.

of iron oxide in the soil; and Sorauer thinks that ammonia set free from the soil may sometimes have a similar influence. Another authority, W. G. Smith,* considers that the chief cause is mechanical irritation, from the presence in the soil of corrosive substances; and states that a difference may often be noticed in the degree of scabbiness of potatoes from different parts of the same field, depending on the relative proportions of refuse in the soil of the different parts. Smith also says that one form of the disease may be caused either by long drought or by excess of moisture. All authors agree that the scab-like crusts, which characterize the disease in its complete development, originate from the natural effort of the plant to repair the injury to the tuber by a secondary formation of cork. Sorauer differs from the others quoted, in rejecting the theory of irritation or corrosion as a primary cause of the trouble. He quotes at length several experiments, conducted in German experiment stations and elsewhere, whose results seem to be conclusive against the idea that foreign substances in the soil can cause the disease by mechanical or chemical action.

We may now proceed to consider the bearing of some recent American observations on the views already stated. The only experiments undertaken in this country for the purpose of testing current theories, with which I am acquainted, are those of Arthur and Beckwith of the New York Experiment Station.† Plats of potatoes were planted and kept under identical conditions, except that half of the hills were kept wet by irrigation, while the others were not artificially watered. One-half of the hills of each class were planted without manure, and the remainder were manured. In the unmanured hills, abundant moisture had practically no influence, for the percentage of scabby potatoes was very nearly the same in the irrigated and unirrigated portions. On the other hand, the irrigated hills on the manured ground produced seventy-one per cent. of scabby tubers, against only thirty per cent. from the unwatered hills. A general average gives forty-eight per cent. of scabby tubers on the irrigated

* Diseases of Field and Garden Crops, London, 1884, p. 37.

† Sixth Annual Report of the New York Agricultural Experiment Station, 1888, pp. 307 and 344.

ground, to thirty-one per cent. on that unirrigated; and fifty-one per cent. of diseased ones on the manured ground, against twenty-two per cent. where manure was not used. These results indicate that an abundance of moisture favors the development of scab, but can hardly be held to support the view that it is the chief *cause* of the disease. Beckwith concludes from his experiments that an increased yield is nearly always accompanied by an increase of scab; and that any marked change in the rapidity of the growth of the tubers favors its development, a continuous growth from their first formation to maturity being least favorable to the appearance of the disease. The last point may, perhaps, be regarded as another aspect of Sorauer's view that a heavy rain after drought especially aids the development of scab.

Observations made at this Station during the past five years, and detailed in its reports,* also bear interestingly on the subject. The experiments were begun with a wholly different end in view, but were vitiated the first year by the appearance of scab, which has persistently appeared on the same plats in every succeeding year. The first year, when the land was freshly broken, the trouble was less severe, and a difference in severity was noticed on plats differently fertilized. Since the first year, the crop has been uniformly scabby, but not more so in wet than in drier seasons. The experiments thus far, while by no means conclusive in their results, seem to point to peculiar soil conditions as the most probable cause of the disease.

In 1887 there appeared a paper by a Norwegian naturalist, Brunchorst,† on a disease of potatoes common in that country, and there called "Skurv," which he believes to be, and which, from his description, seems to be, the same as the German "Schorf" and the English and American "scab." This writer states that the masses noticed by other investigators in the dead cells of the tuber, and by them supposed to be composed of disorganized cell-contents, are really the resting condition of a parasitic organism, whose attacks

* Second to Sixth Annual Reports of Massachusetts Agricultural Experiment Station, 1885–89.

† Ueber eine sehr verbreitete Krankheit der Kartoffelknollen. In Bergens Museums Aarsberetning for 1886, p. 219.

cause the disease. He describes in detail the structure of these masses, as he understands them, but has not seen the supposed parasite in its active state. He names the organism *Spongospora Solani*, and regards it as closely related to *Plasmodiophora Brassicae*, discovered by Woronin * in 1877, and now generally regarded as the cause of the so-called "club foot" or "stump root" disease of cabbages and turnips. For a better understanding of Brunchorst's theory, it may be well to give here a very brief account of the "club foot" parasite.

On emerging from its resting state under the influence of favorable conditions for vegetation, it appears as an almost inconceivably tiny, naked mass of protoplasm, with the power of moving or creeping about in moist soil. Here it may attack a young root of either of several plants of the Mustard family, most commonly of a cabbage or turnip. Penetrating a surface cell, it lives and grows at the expense of the contents of that cell, moving on to another when the first is exhausted. Cells thus attacked increase in size, in consequence of the abnormal stimulus caused by the presence of the parasite, which often also causes a large increase in the number of cells in the affected region. This hypertrophy produces the characteristic swellings which give the disease its name. As a result of the growth and fusion of the protoplasmic masses of the organism, many of the root-cells become at length filled by them. Each of these masses separates, toward the close of the season, into numerous very small globular ones, and each of the latter secretes a wall or coat about itself. In this condition the organism can survive considerable extremes of cold or dryness, and can await the recurrence of favorable conditions. When the weather again permits, the walls or coats crack open, and the contained bits of protoplasm emerge from their rest, each one taking up its active life, and repeating the cycle just outlined. Brunchorst believes the history of his *Spongospora* to be very similar to the above, differing chiefly in the fact that the numerous masses, into which the parasitic contents of one cell divide, remain angular and closely compacted into a spongy structure, instead of becoming

* Pringsheim's Jahrbücher für wissenschaftliche Botanik, vol. xi, p. 548.

globular and separate, as in *Plasmodiophora*. In Fig. 3 are shown the active and resting stages of the latter, and Brunchorst's representation of the resting state of his supposed scab parasite.

Both the New York and the Massachusetts observations, before referred to, bear on Brunchorst's views. If the scab is caused by a living organism, its development must be checked by the application of substances fatal to parasitic forms of life; and scabby potatoes would be expected to produce usually a scabby crop, when planted, the infected tubers infecting the new generation. Experiments with fungicides, at both stations named, gave only negative results, the decrease in scabbiness where they were used being insignificant. The average proportion of scabby tubers produced from scabby "seed" in the New York experiments was forty-five per cent, while smooth "seed" yielded thirty-seven per cent. of diseased potatoes. At our own Station the crops have varied little in quality, when raised under similar conditions, whether from smooth or scabby "seed;" and badly diseased tubers have, in several cases, produced exceptionally good crops.

One further observation, noted by Beckwith in the report quoted, is of interest. He finds that, while forty-three per cent. of the white-skinned potatoes and fifty-three per cent. of the flesh-colored ones raised on the station farm were scabby, only twenty-seven per cent. of the dark-skinned ones were affected. Assuming the cause of the disease to be external to the tuber, such a result was to be expected.

From the above statement, it is evident that much remains to be learned before our knowledge of the cause of the potato scab will be at all satisfactory. And, until a pretty definite knowledge of its cause is gained, all attempts at discovering a remedy are so many leaps in the dark. The conditions at this Station are in many respects very favorable for a hopeful prosecution of investigations into the nature and origin of the pest, which are planned for the coming season. The writer will be very glad of suggestions or reports of experience from persons who have had to do practically with the disease, or to communicate with any who are interested in this subject of inquiry.

FIG. 1.

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Fig. 1. Two potatoes, "Beauty of Hebron," from Station plats, badly affected by "scab," illustrating the usual form of the disease. *From photographs.* Five-sixths natural size.

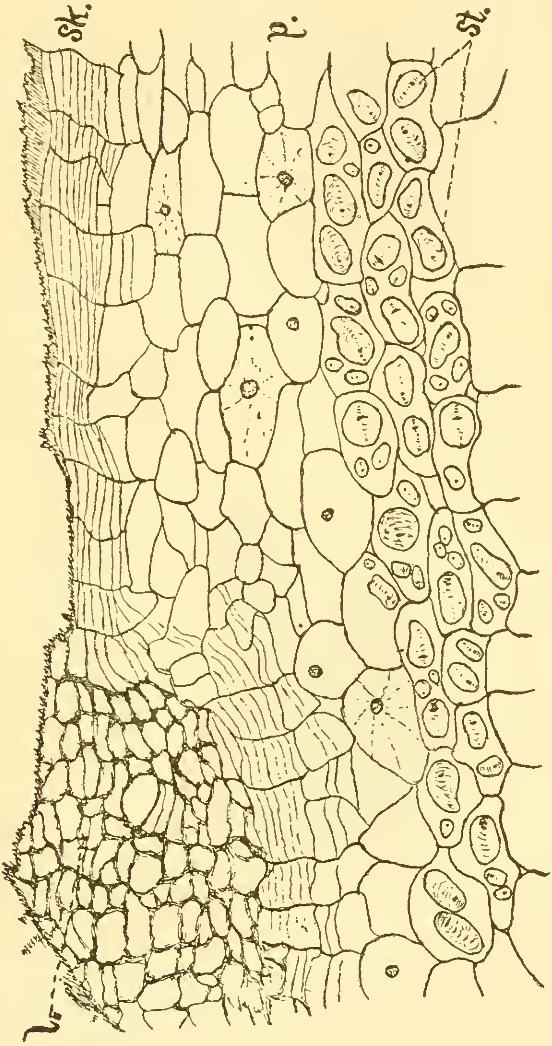

Fig. 2.

Fig. 2. Section taken at right angles to the surface of a healthy potato tuber, showing its normal structure.

sk. The "skin" of the tuber, of tabular cork-cells.

l. A lenticel, filled with rounded cork-cells.

p. The parenchymatous tissue, which forms the bulk of the tubers, containing starch-grains, *st.*

Original. Magnified one hundred diameters.

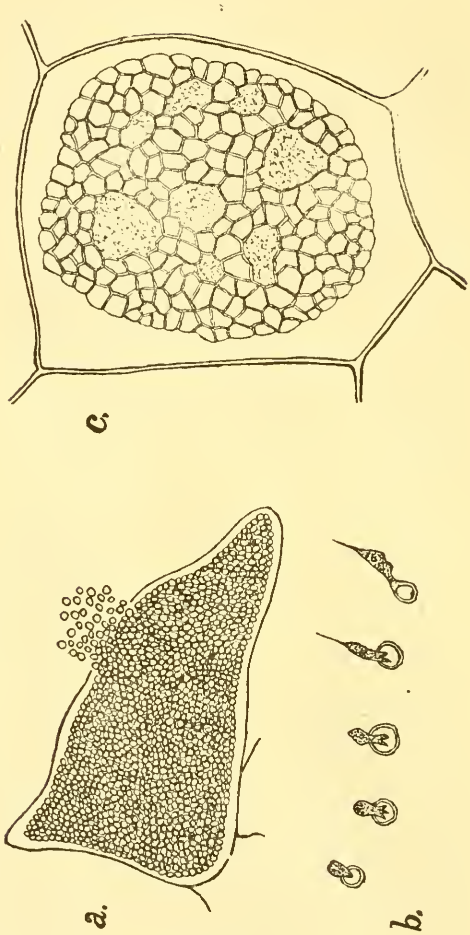

Fig. 3.

Fig. 3. *a.* Cell from diseased root of cabbage, showing resting stage of *Plasmodiophora Brassicae*, *Woronin*, the "club-foot" parasite.

b. Protoplasmic masses of *P. brassicae* emerging from the resting state.

c. Cell from scabby potato, showing resting stage of *Spongo-sporaSolani*, *Brunchorst*, the supposed "scab" parasite.

a and b, after Woronin. *a* magnified one hundred diameters, *b* magnified six hundred diameters.

c, after Brunchorst. Magnified one thousand diameters.

V. Experiments with Root Crops.

The importance quite generally conceded to the introduction of a liberal cultivation of root crops in a mixed farm management, wherever a deep soil and the general character of the climate favors their normal development, rests mainly on the following consideration: They furnish an exceptionally large amount of valuable vegetable matter, fit for fodder for various kinds of farm live stock, competing in this direction favorably with our best green fodder crops; and they pay well, on account of large returns, for the necessary care bestowed upon them by a thorough, deep cultivation to meet success.

The physical condition of the soil, however favorable it may have been for the production of crops of a similar character, will suffer if year after year the same system of cultivation is carried out. Diversity in the mechanical treatment of the soil, and change of season for such treatment, cannot otherwise but affect advantageously its mechanical condition and the degree of its chemical disintegration, promoting thereby its fitness for developing inherent plant food, as well as its power of turning to account atmospheric resources of plant growth. The roots of the same plants abstract their food year after year from the same layer of soil, while a change of crops with reference to a different root system renders it possible to make all parts of the agricultural soil contribute in a desirable succession towards an economical production of the crops to be raised. Deep-rooting plants, like our prominent root crops, for this reason deserve a particular consideration in the planning of a rational system of rotation of crops.

To raise roots the second year, after a liberal application of coarse barn-yard manure, or the turning over of grass lands with the assistance of some commercial phosphatic fertilizer in the interests of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two constituents of roots control, more than any other one, their increase in solids.

Root crops, although somewhat peculiar in their composition when compared with many of our prominent fodder articles, have proved a very valuable constituent in the diet of various kinds of farm live stock, when properly supplemented by hay, grain, oil cake, bran, etc., as circumstances may advise. Our experience at the Experiment Station confirms fully the valuable services of roots as an ingredient of fodder rations for milch cows. (For details on this point, see "Feeding Experiments with Milch Cows," in our fourth and fifth annual reports.)

The encouragement received on that occasion has served as an inducement to continue our work in this direction. The aim has been to experiment with the best varieties of roots at our disposal. The preceding annual report contains a short sketch of the field work carried out during the year 1887. The different varieties of roots raised had been photographed, and copies taken by the heliotype process accompanied the report. The discussion of their composition and of their comparative agricultural value had to be left for a later date, on account of the closing up of the annual report before that work was finished. The same course we are obliged to pursue, for the same reason, in regard to our field experiments with root crops during the late season (1888). Our present communication comprises, first, the analyses of roots raised in 1887; and second, a description of the work carried on in the field with different varieties of valuable roots for feeding purposes.

1. Analyses of Roots raised upon the Lands of the Station in 1887.

The seeds used in our experiments were sent on by the United States Department of Agriculture, with the exception of No. 7, — Saxony sugar beet, — which was taken from our collection of imported seeds. The field work was planned with a view to ascertain the general character and the particular composition of the different varieties of roots on trial, when raised, as far as practicable, under corresponding circumstances with reference to the peculiarity of season, the quality of soil, the system of manuring and the mode of cultivation.

The land consisted of a good loam in a fair condition of fertilization. It has been manured for several years past, annually, with a mixture consisting of six hundred pounds of fine-ground bone and two hundred pounds of muriate of potash per acre. The seeds, ten varieties in all, were sown May 25. Each variety occupied two rows across the field, of equal length (eighty feet).

No. 1. Beet, Mangel Wurzel, "Giant Long Red."
2. Beet, Mangel Wurzel, "Yellow Ovoid."
3. Beet, "Eclipse."
4. Beet, "Red Globe."
5. Beet, "Egyptian Turnip."
6. Beet, "Long Smooth Red."
7. Beet, "Saxony" Sugar Beet.
8. Turnip, Ruta-baga, "White Sweet German."
9. Turnip, "Early Yellow," or "Golden Stone."
10. Turnip, Ruta-baga, "Skirving's Purple Top."

The rows were three feet three inches apart. The young plants were in every case thinned out or transplanted, as circumstances advised, to about eight inches distant from each other in the rows.

The transplanting and thinning out took place between July 5 and 11; the weather during this time was favorable for transplanting. The seeds of Nos. 6 and 9 did not prove as good as the others; the young plants of Nos. 5 and 9, in particular, did not do as well after transplanting as the remainder.

The crop was harvested between October 31 and November 2. The roots, after being removed from the ground, were topped, and three of each kind were taken to the laboratory for a chemical examination, while three of an approximately corresponding size were photographed.

The three sample roots selected in each case represented, as far as practicable, the smallest, medium and largest of each variety raised.

The specimens selected for our fodder analyses were kept in the cellar, slightly covered with moist earth, until wanted for the chemical examination.

The photographs were taken in every case with the roots at an equal distance from the camera. (See illustrations, pages 148–150, in our last annual report.)

Statement of Field Results.

	NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples photographed.
				lbs.	lbs.
1.	Mangel Wurzel, "Giant Long Red,"	2	150	365	11.75
2.	Mangel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
3.	Beet, "Eclipse,"	2	163	285	4.
4.	Beet, "Red Globe,"	2	173	335	7.5
5.	Beet, "Egyptian Turnip,"	2	146	170	8.75
6.	Beet, "Long Smooth Red,"	2	145	185	5.
7.	Sugar Beet, "Saxony,"	2	144	314	8.75
8.	Ruta-baga, "White Sweet German,"	2	176	445	4.
9.	Turnip, "Early Yellow," or "Golden Stone,"	2	43	50	5.5
10.	Ruta-baga, "Skirving's Purple Top,"	2	140	295	12.75

Beets.

[I. Mangel Wurzel, "Giant Long Red," weight, 2 lbs. II. Mangel Wurzel, "Yellow Ovoid," weight, 2 lbs. 3 oz. III. "Eclipse," weight, 1 lb. 4 oz.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	Not determined.*
Dry matter,	13.08	12.34	
	100.00	100.00	
Analysis of Dry Matter.			
Crude ash,	8.35	11.01	8.86
" cellulose,	9.54	7.21	4.29
" fat,	.90	1.01	.85
" protein (nitrogenous matter),	7.83	10.45	10.09
Non-nitrogenous extract matter,	73.38	70.32	75.91
	100.00	100.00	100.00

* The sample had suffered a loss in original moisture from exposure.

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	–
Nitrogen,	.171	.206	.282
Phosphoric acid,	.102	.085	.156
Potassium oxide,	.305	.462	.587
Calcium oxide,	.064	.059	.062
Magnesium oxide,	.047	.031	.045
Sodium oxide,	.145	.105	.055
Ferric oxide,	.006	.004	.005
Insoluble matter,	.028	.018	.043
Valuation per 2,000 lbs,	$0 94	$1 17	$1 62

Beets.

[IV. "Red Globe," weight, 1 lb. 2 oz. V. "Egyptian Turnip," weight, 1 lb. 2 oz. VI. "Long Smooth Red," weight, 1 lb. 10 oz.]

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C,	86.95	85.80	85.49
Dry matter,	13.05	14.20	14.51
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.57	5.80	8.99
" cellulose,	4.52	6.23	5.47
" fat,	1.76	.82	.79
" protein (nitrogenous matter),	12.17	7.82	11.80
Non-nitrogenous extract matter,	70.98	79.33	72.95
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Nitrogen,	.264	.177	.236
Phosphoric acid,	.079	.070	.087
Potassium oxide,	.525	.303	.317
Calcium oxide,	.044	.049	.040
Magnesium oxide,	.025	.035	.044
Sodium oxide,	.110	.061	.099
Ferric oxide,	.004	.002	.003
Insoluble matter,	.013	.018	.028
Valuation per 2,000 lbs.,	$1 42	$0 92	$1 20

Sugar Beet.

[VII. "Saxony," weight, 1 lb. 11 oz.]

	Per cent.
Moisture at 100° C.,	83.32
Dry matter,	16.68
	100.00

Analysis of Dry Matter.

Crude ash,	5.09
" cellulose,	5.81
" fat,	.39
" protein (nitrogenous matter),	7.32
Non-nitrogenous extract matter,	81.39
	100.00

Fertilizing Ingredients in Sugar Beet.

Moisture at 100° C.,	83.32
Nitrogen,	.209
Phosphoric acid,	.136
Potassium oxide,	.383
Calcium oxide,	.052
Magnesium oxide,	.034
Sodium oxide,	.113
Ferric oxide,	.025
Insoluble matter,	.032
Valuation per 2,000 lbs.,	$1 18

Turnips.

[VIII. Ruta-baga, "White Sweet German," weight, 2 lbs. 2 oz. IX. "Early Yellow" or "Golden Stone," weight, 14 oz. X. Ruta-baga, "Skirving's Purple Top," weight, 2 lbs. 11 oz.]

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Dry matter,	12.77	12.80	11.60
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.81	8.01	9.24
" cellulose,	11.04	10.96	11.60
" fat,	1.23	1.42	2.32
" protein (nitrogenous matter),	10.34	10.81	11.16
Non-nitrogenous extract matter,	68.58	68.80	65.68
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Turnips.

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Nitrogen,	.211	.221	.207
Phosphoric acid,	.136	.116	.125
Potassium oxide,	.546	.412	.452
Calcium oxide,	.106	.117	.080
Magnesium oxide,	.030	.033	.027
Sodium oxide,	.051	.133	.141
Ferric oxide,	.002	.009	.004
Insoluble matter,	.001	.072	.017
Valuation per 2,000 lbs.,	$1 32	$1 22	$1 21

The closing months of the summer season of 1887 were marked by an exceptional amount of rainfall. The serious influence of that circumstance showed itself in various directions in our vicinity. Some crops in low localities suffered more or less a premature decay, others did not reach their full maturity in due time. Our root crop, judging from the results of our examination, evidently did not reach its full perfection on account of the exceptional wetness of the latter part of the growing season. The moderate amount of dry vegetable matter found in the well-studied variety of Saxony sugar beet, as well as the large proportion of the nitrogen most of them contained in other combinations than in that of true albuminoid substances, entitle to that conclusion. Root crops are commonly reported to contain on an average from thirty-five to forty-five per cent. of their nitrogen in other and less valued combinations than the typical albuminous matter or the genuine protein substances. An examination of the subsequent tabular statement of some tests in that direction shows that our roots, as far as they have been submitted to an actual observation (1–7), contained from fifty-two to seventy per cent. of their nitrogen in various combinations quite generally considered of less nutritive value than the group of typical albuminous substances. The last-named class of compounds reaches usually its highest attainable proportions in a plant or part of a plant at the state of maturity.

Determination of Albuminoid Nitrogen in Roots raised upon the Fields of the Station.

	Per Cent.		
	Total Nitrogen.	Albuminoid Nitrogen.	Non-Albuminoid Nitrogen.
Root No. 1, ...	1.20	0.58	0.62
" 2, ...	1.61	0.55	1.06
" 3, ...	1.53	0 56	0.97
" 4, ...	1.90	0.57	1.33
" 5, ...	1.20	0.58	0.62
" 6, ...	1.81	0.51	1.30
" 7, ...	1.25	0.60	0.65

The various kinds of roots usually raised on farms for feeding purposes differ essentially in regard to the amount of dry vegetable matter they contain. Turnips contain from seven to eight per cent.; ordinary mangolds from eleven to twelve per cent.; improved varieties of beet roots, like Lane's, from fifteen to sixteen per cent.; good carrots from fourteen to fifteen per cent.; a good sugar beet from eighteen to twenty per cent. of solids; or, in other words, one ton of an improved variety of good sugar beets is equal to from two to two and one-half tons of ordinary turnips, as far as the amount of dry vegetable matter is concerned.

Modes of cultivation and of manuring exert a decided influence in this direction on the composition of the roots. Large roots of the same variety contain quite frequently less solid matter than the smaller ones. Close cultivation in the rows, in connection with the use of well-decomposed manurial matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kind of root is concerned, is otherwise due, in the majority of cases, to a more or less perfect maturity. A liberal manuring with potash and nitrogen, in connection with a scanty supply of phosphoric acid, is frequently the cause of immatured roots at the ordinary harvest time.

2. *Field Observations with Root Crops in 1888.*

The field used for the work was of the same character as in the preceding trial. It represents a part of field "D" on our records, and is 328 feet long and 70 feet wide. The main field runs from east to west, and the rows run in all cases from south to north. The soil consists of a deep, sandy loam, and has been fertilized for several years annually with the same fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. Some of the land has been used before for the raising of root crops. It was ploughed in the autumn, 1887, and again on April 26, 1888. The fertilizer was applied April 30, in the customary way, broadcast, and slightly harrowed in before planting. The rows were seventy feet long and three feet three inches apart. The seed was taken partly from our own imported stock of previous years, and partly chosen from varieties sent on by the United States Department of Agriculture at Washington, D. C. The following varieties were seeded May 17 and 19: —

		Rows.
No. 1.	Excelsior Sugar Beet,	15
2.	Improved Imperial Sugar Beet,	6
3.	Vilmorin Sugar Beet,	14
4.	Lane's Sugar Beet,	9
5.	New Market Gardener Beet (red),	1
6.	Eclipse Beet (red),	1
7.	Osborn's Selected Beet (red),	1
8.	Yellow Danver's Carrot,	90

One row was planted with Saxony sugar beet, from our crop of 1887, for the purpose of raising seeds for our own consumption during the coming season.

The young plants appeared in all cases above ground May 28; they were in every instance, whenever necessary, thinned out to have them eight inches apart in the rows; none were transplanted.

The average number of roots in a row was at the end of the season as follows: —

	Plants.
Excelsior Sugar Beet,	89
Improved Imperial Sugar Beet,	96
Vilmorin Sugar Beet,	119
Lane's Sugar Beet,	105
New Market Gardener Beet,	67
Eclipse Beet,	118
Osborn's Selected Beet,	122

The entire yield of each of these varieties of beet roots without tops amounted to, —

1,870 pounds in fifteen rows of Excelsior.
1,070 pounds in six rows of Improved Imperial.
3,355 pounds in fourteen rows of Vilmorin.
1,250 pounds in nine rows of Lane's.
125 pounds in one row of New Market Gardener.
150 pounds in one row of Eclipse.
130 pounds in one row of Osborn's Selected.

The Vilmorin sugar beet exceeds in our case in yield all other sugar beets, allowing an equal number of rows with an equal number of plants. The yield per acre, with rows three feet and three inches apart, at our rate of production would amount to 22.95 tons.

No. 1. Saxony Sugar Beet, raised 1887.

No. 2. Excelsior Sugar Beet, raised 1888.

No. 3. Improved Imperial Sugar Beet, raised 1888.

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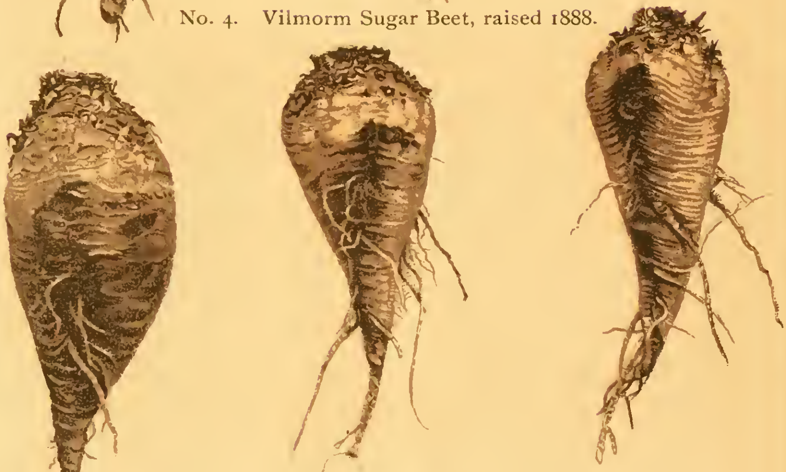
No. 4. Vilmorm Sugar Beet, raised 1888.



No. 5. Lane's Sugar Beet, raised 1888.

No. 6. New Market Gardener Beet, raised 1888.

STATE PRINTERS

No. 7. Eclipse Beet (red), raised 1888.

No. 8. Osborn's Selected Beet (red), raised 1888.

No. 9. Danver's Carrot (yellow), raised 1888.

Wright & Potter Printing Co., State Printers.

The crop was harvested October 22. The entire season was remarkable for its exceptional coolness in July, and its abundance of rain. The leaves retained even to the time of harvesting a considerable degree of vitality.

Carrots (Danver's Yellow). — This crop occupied an area of 109 by 70 feet; the field was manured in the same way and with the same quantity of fine-ground bones and muriate of potash as the one which served for the raising of the above-mentioned varieties of roots. The soil was in both instances practically of a corresponding character, and in a corresponding state of fertilization. The seed was planted in rows, fourteen inches apart, June 1. The young plants appeared above ground June 17; the crop was kept clean from weeds by the use of the hand and the cultivator. The roots were harvested October 31; they amounted to 6,850 pounds, or 137 bushels, at 50 pounds each, which is equal to 19.52 tons per acre.

Samples of all the varieties of roots raised at the Station have been carefully collected and at once photographed, to present a concise idea of their peculiarity, as far as their exterior is concerned. Analyses of each kind will be presented later on. Three samples of every variety, representing the largest, middle and smallest size of each, served the photographer. The picture was in each case taken at a corresponding distance, to allow comparison of size. The weight of each is also stated.

TABULAR STATEMENT OF WEIGHTS OF ROOTS PHOTOGRAPHED.

	Largest.	Medium.	Smallest.
Picture No. 1. Saxony Sugar Beet,*	–	–	–
" 2. Excelsior Sugar Beet, ...	2 lbs. 14 oz.	1 lb 15 oz.	1 lb. 5 oz.
" 3. Improved Imperial Sugar Beet, .	4 " 4 "	2 " 4 "	1 " 5 "
" 4. Vilmorin Sugar Beet, ...	5 " 0 "	2 " 7 "	1 " 2 "
" 5. Lane's Sugar Beet, ...	2 " 15 "	1 " 9 "	1 " 7 "
" 6. New Market Gardener Beet, . .	4 " 7 "	3 " 14 "	1 " 14 "
" 7. Eclipse Beet, ...	2 " 11 "	1 " 13 "	0 " 12 "
" 8. Osborn's Selected Beet, . . .	2 " 11 "	1 " 9 "	1 " 2 "
" 9. Danver's Carrot, ...	0 " 13 "	0 " 11 "	0 " 6 "

* Total weight of 3 sizes, 8 lbs. 12 oz.

VI. Notes on Miscellaneous Field Work.

Aside from the strictly experimental work on our older field, much preparatory work has been carried on during the past year on our more recent addition of lands. The older field, which has been for six years under our control, is located along the west side of the highway leading from Amherst to North Amherst; it covers an area of about twenty acres, including the grounds occupied by the present buildings of the Experiment Station. The more recent addition of lands (1886) is located along the east side of the highway; it covers an area of thirty acres, of which ten acres are occupied by a natural forest growth. The entire field forms the western slope of a prominent elevation. Most of the cultivated portion, which consisted of old grass lands, is gradually slanting towards the north-west, while a considerable portion of it is nearly on a level, with a slight depression towards the north. The entire area, consisting essentially of a good gravelly loam, admits of a satisfactory management of the work to be carried on upon it. The steeper portion along the wood land will be used for experiments with large and small fruits, the adjoining part towards the west for experiments with general farm crops, and the more level western termination for permanent grass lands. This plan for its future use was adopted after taking possession of the grounds in 1886.

As the lands along the slope are somewhat springy, and as its lower portion has at times to convey to the north a considerable amount of water coming from adjoining southern hillsides, a thorough system of underdraining was at once devised, and in its essential direction carried out, before any of the sod was turned over. Subsequently, during the autumn of 1886, the northern end of the entire field, to the extent of twelve acres, was ploughed; while the ploughing of the southern terminus of the field, comprising eight acres of old grass land, was for financial considerations reserved for a year later (1887).

The ploughed lands were thoroughly treated with a wheel harrow during the succeeding spring, before planting. Wood ashes, at the rate of one ton per acre, was the only fertilizer used during the first season. This mode of manuring these lands was adopted for the purpose of assisting in a rapid decomposition of a rank growth, and of bringing the soil, as far as practicable, to a corresponding state of fertilization in the interest of future experiments. A variety of crops was subsequently planted, with the main aim to secure, in every instance, a thorough mechanical working of the soil by drill cultivation or by the use of the hoe. Several varieties of barley and of oats, corn, potatoes, squashes, and a variety of other garden crops, occupied the field. The periodical stirring of the soil promised to free the land from a foul growth, which in the course of time naturally overruns old grass lands.

During the month of September about seven acres of the entire cultivated area were prepared for a permanent meadow, and seeded down with a mixture of herd's grass and red-top; some varieties of clover were added the succeeding spring (1888).

The southern end of the field, which had still served, as above stated, for the production of hay, was turned over late in the season, to be prepared during the succeeding spring for future experiments in the same manner as the north end.

1888. — The preparatory work has been continued in all parts of this field. The exceptional rainfall has seriously tested the capacity of our drain tiles; they have stood the test, on the whole, satisfactorily. Needed alterations have been attended to, and the prospects are that no further serious trouble may be expected. No fertilizers but wood ashes have been used thus far. Drill cultivation has been generally adopted, to assist in future cultivation. Several acres of oats, barley and corn have been raised, to assist in the support of feeding experiments. The permanent grass lands have been increased here to from nine to ten acres. Definite grass mixtures have been used as seed, to test their respective merits in our locality. The results will be carefully watched, from a botanical as well as from an economical stand-point. An orchard will be laid out during the coming year.

The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the Station, or engaged in a course of preparation for future experiments: —

	Tons
Good English hay,	23
Rowen,	9
Corn stover,	$3\frac{1}{2}$
Corn fodder,	$4\frac{1}{2}$
Roots (carrots and sugar beets),	7
Oats (grain and straw),	$4\frac{1}{4}$
Barley (grain and straw),	2
Green fodder (vetch, oats and cow-pea),	$4\frac{1}{2}$
Crops for ensilage (corn, $9\frac{1}{2}$ tons; Soja bean, cow-pea and Hungarian grass, $3\frac{1}{2}$ tons),	13
Potatoes (mainly Beauty of Hebron, Early Rose and Polaris),	260 bush.

From four to five acres of Southern cow-pea, Soja bean, horse bean, lupine and buckwheat have been subjected to drill cultivation, for the purpose of renovating old grass lands and to serve ultimately as green manure.

NEW LAWS

FOR THE

REGULATION OF THE SALE OF COMMERCIAL FERTILIZERS.

Work in the Chemical Department.

I. Fertilizer Laws and Fertilizer Analyses.

II. Miscellaneous Analyses.

The Legislature of 1888, at the suggestion of the State Board of Agriculture, has enacted a new law, entitled, "An Act to regulate the Sale of Commercial Fertilizers," chapter 296. This Act, which has been in operation since Sept. 1, 1888, assigns the supervision of the sale of commercial fertilizers to the director of the Massachusetts State Agricultural Experiment Station at Amherst, Mass.

The provisions of the Act are as follows: —

[Chap. 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes, sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients, namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

Sect. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

Sect. 5. Any person selling, or offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in presence of said party or parties in interest or their representative, and taken from a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples, and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be made substantially equivalent to the statement of analysis made by the manufacturer or importer.

Sect. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

Sect. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

The above-stated regulations are now in force, and a compliance with them is imperative on all manufacturers, importers, agents or sellers of any brand of commercial fertilizer or of any material used for manurial purposes, the retail selling price of which is ten dollars or more per ton.

It will be noticed that the new provisions for the control of the trade in fertilizers in Massachusetts apply not only, as heretofore, to a certain class of more or less compound, distinct brands of commercial fertilizers, but to all materials, single or compound, used for manurial purposes, without regard to source, when offered for sale at ten dollars or more per ton.

The official report of analyses and of all materials used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted to a statement of chemical composition, and to such additional information as relates to the former. This change, it is expected, will tend to direct the attention of the consumer of fertilizers more towards the composition of the different brands of fertilizers offered for sale.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. Those who are not yet familiar with the current market value of fertilizing constituents may benefit by a short discussion of that subject at the close of this chapter.

The approximate market value of different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value. The higher or lower market price of different brands of fertilizer does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crop to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage requires in the main two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some instances it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the previously stated considerations.

The new duties assigned to the director of the Station render it necessary to discriminate in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

More detailed information in this connection, regarding the duties of the director of the Massachusetts State Agricultural Experiment Station, and the obligations of the manufacturers, dealers and agents engaged in the sale of commercial fertilizers or materials used for manurial purposes, may be obtained by addressing the director at Amherst, Mass. Copies of the above-printed Act may be had on application.

I.—Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
1	"Americus" Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Springfield.
2	"Americus" Potato Fertilizer,	" " " "	"
3	H. L. Phelps' Complete Manure; Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
4	H. L. Phelps' Phosphate,	" " " "	"
5	H. L. Phelps' Complete Manure for Corn and Grain,	" " " "	"
6	Bradley's X L Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
9	Crocker's Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
10	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Co., New York City,	"
12	Mapes' Potato Manure,	" " " " "	"
14	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
15	Stockbridge's Manure for Vegetables,	" " " "	"
20	Randall's Combined Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
23	Crocker's Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Concord.
24	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
25	Allen Fertilizer,	American Manufacturing Co., Boston, Mass.,	"
26	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	"
60	Swan Island Guano,	. . . . . .	Springfield.
61	Hargrave's Ground Bone,	Hargrave Manufacturing Co., Fall River, Mass.,	Amherst.
62	Cotton-seed Hull Ashes,	. . . . . .	Whately.
63	Cotton-seed Hull Ashes,	. . . . . .	South Deerfield.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1	"Americus" Ammoniated Bone Superphosphate,	14.87	2.91	2-3	9.63	0.61	0.41	10.65	11–13	10.24	10–12	2.54	2-3*
2	"Americus" Potato Fertilizer,	10.85	3.97	3-4	6.35	1.01	1.63	8.99	7–8	7.36	6-8	7.94	8-10*
3	H. L. Phelps' Complete Manure; Guano and Potash,	8.94	6.50	3.3–4.1	3.34	2.39	3.26	8.99	–	5.73	4–5	6.12	5–7
4	H. L. Phelps' Phosphate,	9.75	3.71	2.5–3.3	5.46	2.98	2.70	11.14	10–12	8.44	–	3.75	3–4
5	H. L. Phelps' Complete Manure for Corn and Grain,	9.74	4.07	4.1–5	5.83	1.64	4.47	11.94	8–10	7.47	6–8	7.19	7–8
6	Bradley's X L Superphosphate of Lime,	14.57	3.03	2.5–3.25	9.44	0.61	3.71	13.79	11–14	10.08	9–11	1.81	2–3*
9	Crocker's Potato, Tobacco and Hop Phosphate,	13.32	2.71	2–3	8.01	3.01	2.29	13.31	8–12	11.02	8–12	4.09	3.5–4.5*
10	Mapes' Corn Manure,	12.73	4.40	3.7–4.1	6.66	2.37	4.42	13.45	10–12	9.03	–	6.36	6–7
12	Mapes' Potato Manure,	9.98	4.08	3.7–4.4	4.22	3.53	6.18	13.93	8–10	7.75	6–8	6.72	6–8*
14	Bowker's Hill and Drill Phosphate,	13.06	3.27	2.5–3.25	7.84	2.98	2.31	13.13	11–14	10.82	10–12	2.25	2–3*
15	Stockbridge's Manure for Vegetables,	11.03	3.77	3.25–4.25	6.21	3.11	1.68	11.00	–	9.32	8–10	4.04	5–6
20	Randall's Combined Bone and Potash,	12.33	2.33	1.6–2.5	2.29	5.10	7.01	14.43	13–16	7.39	5–7	2.44	2–3
23	Crocker's Ammoniated Bone Superphosphate,	11.32	3.20	2.9–3.7	7.87	1.01	2.92	11.80	–	8.88	8–12	1.22	1–3*
24	Standard Superphosphate,	10.85	3.56	2.25–3.25	9.05	1.92	3.04	14.01	11–16	10.97	9–13	1.83	2–4
25	Allen Fertilizer,	21.14	2.50	2.0–3.1	5.45	2.47	1.79	9.71	6–10	7.92	5–8	5.19	4–6
26	Darling's Animal Fertilizer,	17.08	4.08	3.3–5	2.67	2.04	5.84	10.55	10–12	4.71	–	4.16	4–6
60	Swan Island Guano,	14.97	0.52	–	–	4.15	16.77	20.92	–	4.15	–	0.89	–
61	Hargrave's Ground Bone,	12.43	2.68	3.93	0.13	6.20	19.34	25.67	18.8	6.33	4–12	–	–
62	Cotton-seed Hull Ashes,	8.90	–	–	–	–	–	9.76	–	–	–	26.66	–
63	Cotton-seed Hull Ashes,	10.15	–	–	–	–	–	15.37	–	–	–	19.07	–

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
27	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
30	Soluble Pacific Guano,	Pacific Guano Co., Boston, Mass.,	Concord.
35	Darling's Lawn Dressing,	L. B. Darling Fertilizing Co., Pawtucket, R. I.,	Boston.
36	Cumberland Superphosphate,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
38	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	North Hadley.
39	Chittenden's Complete Fertilizer for Potatoes,	" " " " "	South Deerfield.
40	Pequot Fish and Potash,	Quinnipiac Co., New London, Conn.,	"
42	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Plymouth.
45	Baker's A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York City, N. Y.,	New Bedford.
49	Tucker's Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Taunton.
52	Original Bay State Bone Superphosphate,	" " " "	W. Bridgewater.
53	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
54	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	"
67	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	E. Frank Coe, New York City, N. Y.,	Lowell.
74	Dole's 203 Fertilizer,	Dole Fertilizer Co., Boston, Mass.,	"
77	E. Frank Coe's Alkaline Bone,	E. Frank Coe, New York City, N. Y.,	"
85	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
115	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Co., Boston, Mass.,	Mendon.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Swansea.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
27	Standard Superphosphate, ...	14.86	3.41	2.25–3.25	8.60	2.09	2.94	13.63	11–16	10.69	9–13	2.96	2–4
30	Soluble Pacific Guano, ...	12.54	2.97	2.25–3	7.16	1.58	3.54	12.28	10.5–16	8.74	8.5–12	3.21	2–3.5
35	Darling's Lawn Dressing, ...	19.85	5.25	5–6.5	2.12	3.88	4.05	10.05	9–11	6.00	–	5.20	4–6
36	Cumberland Superphosphate, ...	14.55	2.89	2–4	6.17	2.95	3.58	12.70	12–14	9.12	9–13	2.57	2–3
38	Chittenden's Complete Tobacco Fertilizer, . . .	9.45	3.07	3.3–5	3.87	5.28	3.45	12.60	8–10	9.15	6–8	4.26	*
39	Chittenden's Complete Fertilizer for Potatoes, . .	11.44	3.23	3.2–4.2	4.51	3.94	2.97	11.42	8–10	8.45	6–8	5.75	6–8
40	Pequot Fish and Potash, ...	23.25	3.40	2.5–3.3	0.35	3.37	2.11	5.83	–	3.72	3–5	4.22	4–6*
42	Soluble Pacific Guano, ...	14.20	3.00	2.25–3	7.87	1.11	1.77	10.75	10.5–12	8.98	8.5–12	2.29	2–3.5
45	Baker's A. A. Ammoniated Superphosphate, . .	19.32	3.40	1.7–3.2	10.40	1.23	0.14	11.77	–	11.63	10–12	3.18	2–3
49	Tucker's Imperial Bone Superphosphate, . . .	21.29	2.45	2–2.5	5.98	1.73	2.70	10.41	9–10	7.71	7–8	2.98	*
52	Original Bay State Bone Superphosphate, . . .	18.78	3.00	2.5–2.9	7.20	1.57	2.40	11.19	10–12	8.79	9–9.5	1.38	2–3
53	Darling's Fine Ground Bone, ...	5.79	2.95	3.5–4.5	–	7.42	17.31	24.73	22–25	7.42	–	–	–
54	Dow's Nitrogenous Superphosphate, ...	16.88	2.76	2.1–2.9	4.80	3.90	2.16	10.86	8–10	8.70	–	2.57	–
67	The Lawrence Fertilizer, ...	13.51	1.86	2.1–2.9	8.85	2.78	2.57	14.20	10–12	11.63	–	4.21	6
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	9.42	2.62	2–2.5	8.37	1.51	2.17	12.05	11–13	9.88	9–12	2.34	*
74	Dole's 203 Fertilizer, ...	11.14	3.12	3–4	4.16	2.88	3.80	10.84	10–12	7.04	8–10	3.09	3–4
77	E Frank Coe's Alkaline Bone, ...	10.24	1.94	0.8–1.6	8.64	1.42	1.97	12.03	11–15	10.06	9–12	2.77	*
85	Great Eastern General Fertilizer, ...	12.35	2.95	2.9–3.7	5.37	3.31	2.58	11.26	9–15	8.68	8–12	2.01	2–4
115	Bradley's Complete Manure for Potatoes and Vegetables, ...	15.24	3.93	3.7–4.5	8.96	2.78	1.44	13.12	9–12	11.74	8–10	6.57	6–7
117	Brightman's Fish and Potash, ...	27.11	3.22	2.5–4.1	0.69	2.87	2.23	5.79	6.9	3.56	–	2.67	2–3

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
8	Bradley's Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
31	Americus Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Concord.
43	Bay State Fertilizer,	Clark Cove Guano Co , New Bedford, Mass.,	Plymouth.
64	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
66	Common Sense Fertilizer,	Common Sense Fertilizer Co., Boston, Mass.,	Haverhill.
80	Lowell Bone Fertilizer,	Josiah M. Butman, Lowell, Mass.,	Chelmsford.
81	Jefferds' Animal Fertilizer,	John Jefferds, Worcester, Mass.,	Greenfield.
82	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
87	Orient Complete Manure,	Orient Guano Manufacturing Co., Long Island, N. Y.,	Lee.
91	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
95	E. Frank Coe's Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Westfield.
118	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	South Deerfield.
119	N. Ward's High Grade Animal Fertilizer,	N. Ward & Co , Boston, Mass.,	Boston.
120	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Weston.
121	Whittemore Bros.' Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
124	Economic Fertilizer, No. 3,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
127	Cleveland's Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	Lowell.
128	Lister's Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	"
17	Williams & Clark Co.'s Potato Phosphate,	Williams & Clark Co., New York City, N. Y.,	Worcester.
32	Bradley's X L Superphosphate,	Bradley Fertilizer Co., Boston, Mass.,	Westborough.
109	Pacific Guano Co.'s Fish and Potash,	Pacific Guano Co., Boston, Mass.,	South Amherst.
130	Cotton-seed Hull Ashes,	. . . .	Boston.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
8	Bradley's Dry Fish Guano,	7.25	8.83	8.2-9.9	0.41	2.91	3.05	6.37	6-8	3.32	-	-	-
31	Americus Ammoniated Bone Superphosphate,	15.09	3.26	2-3	9.07	1.52	-	10.59	11-16	10.59	10-12	2.71	2-3
43	Bay State Fertilizer,	12.07	3.22	2.1-2.8	8.24	0.98	1.50	10.72	9.5-14	9.22	9-11	2.51	2-3
64	Ames' Bone Fertilizer,	16.76	4.02	3.3-4.5	5.94	4.04	1.02	11.00	11-13	9.98	-	0.98	1
66	Common Sense Fertilizer,	11.14	1.74	2-4	0.03	7.16	2.53	9.72	9-14	7.19	-	1 83	1-2
80	Lowell Bone Fertilizer,	9.88	2.65	2-3	4.96	6.51	2.03	13.50	10-14	11.47	6-10	2.94	2-4
81	Jefferds' Animal Fertilizer,	5.39	3.88	4.1-5.8	0.18	6.15	11.19	17.52	14-16	6.33	-	6.04	5-7
82	Crocker's Potato, Hop and Tobacco Phosphate,	7.71	2.65	2-3	8.50	0.85	1.00	10.36	9-14	9.35	8-12	4.04	3.5-4.5*
87	Orient Complete Manure,	14.11	2.54	1.7-2.5	7.52	1.53	-	9.05	10-17	9.05	8-12	1.87	1-2.5*
91	Adams' Market Bone Fertilizer,	12.67	4.10	2.5-3.5	1.30	6.14	3.64	11.08	8-10	7.44	6-8	4.52	3-5
95	E. Frank Coe's Potato Fertilizer,	14.64	1.91	1.7-2.5	7.87	0.81	1.57	10 25	-	8.68	8-10	3.71	*
118	Chittenden's Complete Tobacco Fertilizer,	10.08	3.16	3.3-5	5.42	4.94	1.58	11.94	8-10	10.36	6-8	6.38	*
119	N. Ward's High Grade Animal Fertilizer,	14.43	3.69	2.88-3.7	5 69	5.37	1.41	12.47	-	11.06	12-14	3.89	4-5
120	Mayo's Superphosphate,	9.33	2.61	2.5-3	8.03	1.78	1.80	11.61	11.5-13.5	9 81	10.5-11.5	3.27	3-4
121	Whittemore Bros.' Fertilizer,	17.65	2.38	2.5-3.3	6 91	5.99	0.90	13.80	-	12.99	8-12	3.81	3-4
124	Economic Fertilizer, No. 3,	9.33	0.27	0.25-0.75	0.06	1.63	9.13	10.82	6-9	1.69	-	0.13	-
127	Cleveland Superphosphate,	7.73	2.71	2.05-2.55	7.74	3.19	3.18	14.11	10-13	10.93	8-10	2.14	3-4*
128	Lister's Success Fertilizer,	13.15	1.87	1.2-1.7	6.68	3.17	2.57	12.42	-	9 87	10.5-12	1.50	1.5-2*
17	Williams & Clark Co.'s Potato Phosphate,	14.46	3.03	2-3	7.24	2.30	5.94	15.48	8-10	9.54	7-10	5.61	6-8*
32	Bradley's XL Superphosphate,	15.78	3 07	2.5-3 25	7.26	2.87	2.12	12.25	11-14	10.13	9-11	1.99	2-3*
109	Pacific Guano Co.'s Fish and Potash,	13.90	2 65	2.5-3.3	3.44	3.05	3.12	9.61	6-9	6.49	4-7	5.28	4-6
130	Cotton-seed Hull Ashes,†	6.51	-	-	-	-	-	3.11	-	-	-	17.37	-

* Sulphate of potash, the source of potash. † Insoluble matter, 39.29 per cent., exceptionally large.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
21	Randall's Market Garden Fertilizer,	Benjamin Randall, Boston, Mass.,	Boston.
22	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Co., Boston, Mass.,	Concord.
34	Breck's Lawn and Garden Dressing,	Standard Fertilizer Co., Boston, Mass.,	Boston.
69	Darling's Pure Dissolved Bone Superphosphate,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Ipswich.
71	The Allen Fertilizer for Corn,	American Manufacturing Co., Boston, Mass.,	Reading.
86	E. Frank Coe's High Grade Fish Guano and Potash,	E. Frank Coe, New York City, N. Y.,	Westfield.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
99	H. Preston & Son's Ammoniated Bone Superphosphate,	H Preston & Son, Greenpoint, Long Island,	"
104	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., New London, Conn.,	Williamstown.
107	Pacific Guano Co.'s Fish and Potash,	Glidden & Curtis, Boston, Mass.,	"
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	Geo. W. Miles, Milford, Conn.,	Amherst.
122	Bartlett's Bone,	C. A Bartlett, Worcester, Mass.,	Worcester.
129	Lister's Celebrated Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Lowell.
131	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	Somerset.

Table I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Randall's Market Garden Fertilizer, ...	14.52	3.83	2.9–3.3	4 61	3.24	2.25	10.10	–	7.85	8.5–11	4.12	4-5
22	Stockbridge's Manure for Strawberries, ...	10.90	3 38	2.88-3.7	4 16	2.96	4.55	11.67	7-9	7.12	6-7	3.29	4-5
34	Breck's Lawn and Garden Dressing, ...	8.68	5.42	4.1-5	6.54	1.94	1.34	9.82	–	8.48	8–9	4 67	4-6
69	Darling's Pure Dissolved Bone Superphosphate, . .	11.01	2.40	2.06–2.47	6.12	10.45	1.16	17.73	16–18	16.57	15-17	–	–
71	The Allen Fertilizer for Corn, ...	20.77	2.42	2.06–3.09	4.54	1.72	1.44	7.70	6–10	6.26	5-8	2.91	4-6
86	E. Frank Coe's High Grade Fish Guano and Potash, .	12.07	2.66	3.3-4.1	2.08	2.36	5.25	9.69	–	4.44	6–8	3.26	*
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer, .	12.07	2.95	2.06–2.88	6.05	2.42	2.09	10.57	9–15	8.47	8-12	5.98	6-8
99	H. Preston & Son's Ammoniated Bone Superphosphate,	15.12	2.50	2.47–3 3	5.04	2.24	3.42	10.70	–	7.28	9-10	1.86	2-3
104	Quinnipiac Phosphate, ...	15.69	3.23	2.75–3.25	8.11	2.20	1.11	11.24	–	10.31	9-12	2.34	2-3*
107	Pacific Guano Co.'s Fish and Potash, ...	11.78	3.47	2.47–3.3	4.27	1.94	2.64	8.85	6-9	6.21	4-7	6.55	4-6
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	19.18	2.27	2.06-3.3	7.75	1.69	1.10	10.54	–	9.44	8-12	2.20	1-3
122	Bartlett's Bone, ...	4.41	2.28	–	0.25	15.78	13.79	29 82	–	16.03	–	–	–
129	Lister's Celebrated Bone, ...	10.62	3.51	2.7–2.9	0.51	9.29	3.13	12.93	12–14	9.80	–	–	–
131	Church's Fish and Potash, ...	26 55	3.62	3.71-4.12	1.62	2.32	0.79	4.91	5-6	3.94	–	4.28	3.5-4*

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
16	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	" " " "	Ware.
29	Stockbridge's Manure for Potatoes,	" " " "	"
37	Seeding Down Fertilizer,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
41	Quinnipiac Dry Ground Fish,	Quinnipiac Fertilizer Co., New London, Conn.,	South Deerfield.
46	Baker's Complete Grass Manure,	H. J. Baker & Bro., New York City,	New Bedford.
47	Baker's Special Corn Fertilizer,	" " "	"
51	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
55	Brightman's Dry Ground Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	"
56	Brightman's Fish and Potash,	" " " "	"
58	Dow's Grass Fertilizer,	John C. Dow & Co , Boston, Mass.,	"
65	Farmers' New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Newburyport.
70	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
76	The Lawrence Fertilizer,	" " " "	"
83	Jefferds' Fine Ground Bone,	John Jefferds, Worcester, Mass.,	Greenfield.
84	Adams' Market Bone Fertilizer for Potatoes,	Adams & Thomas, Springfield, Mass.,	Springfield.
88	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	"
123	Economic No. 1,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide in 100 Pounds. Guaranteed.
16	Stockbridge's Manure for Seeding Down,	12.81	3.20	2.5–3.3	4.22	2.91	6.40	13.53	–	7.13	14–15	3.22	4–5
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	15.23	5.28	5.5–6.5	3.91	1.67	4.61	10.22	6–8	5.61	5–6	2.85	2.5–3.5
29	Stockbridge's Manure for Potatoes,	10.38	3.98	3.25–4.25	5.90	2.23	2.59	10.72	9–11	8.13	7–9	4.82	5–6
37	Seeding Down Fertilizer,	16.27	1.89	1.60	1.55	5.91	16.14	23.60	18–20	7.46	5–9	0.26	1
41	Quinnipiac Dry Ground Fish,	7.63	7.94	7.5–10	0.50	2.31	3.77	6.58	–	2.81	4–6	–	–
46	Baker's Complete Grass Manure,	18.50	4.34	3.71	5.28	0.62	–	5.90	–	5.90	5	7.68	7.5
47	Baker's Special Corn Fertilizer,	10.47	5.81	4.12	1.65	5.23	0.10	6.98	7.25–9.25	6.88	6.25	6.55	7
51	Darling's Animal Fertilizer,	15.07	3.48	3.3–4.94	2.70	4.90	2.92	10.52	10–12	7.60	–	4.95	4–6
55	Brightman's Dry Ground Fish Guano,	14.02	7.18	8.24–9.89	0.38	2.30	6.22	8.90	6.8–9.16	2.68	–	–	–
56	Brightman's Fish and Potash,	23.59	2.90	2.5–4.1	1.48	2.21	1.08	4.77	6.8–8.2	3.69	2–3	3.35	2–3
58	Dow's Grass Fertilizer,	12.48	3.50	3.3–4.12	0.72	2.75	7.52	10.99	12–14	3.47	–	3.04	2–3
65	Farmers' New Method Fertilizer,	14.90	1.32	0.82–1.82	8.60	0.93	1.06	10.59	10–12	9.53	8–10	1.50	*
70	The Lawrence Fertilizer,	13.29	1.73	2.06–2.88	8.28	2.38	2.97	13.63	10–12	10.66	–	4.86	10
76	The Lawrence Fertilizer,	12.62	1.67	2.06–2.88	9.60	2.66	2.94	15.20	10–12	12.26	–	0.58	2–3
83	Jefferds' Fine Ground Bone,	9.03	1.86	2.47–3.3	0.13	7.73	21.68	29.54	27–30	7.86	–	–	–
84	Adams' Market Bone Fertilizer,	9.58	3.95	2.5–3.5	1.38	4.31	5.47	11.19	8–10	5.72	6–8	5.30	3–5
88	Church's Fish and Potash,	26.48	2.48	3.71–4.12	1.91	2.74	0.35	5.00	5–6	4.65	–	4.22	3.5–4*
123	Economic No. 1,	11.68	1.71	1–2	–	0.61	4.22	4.83	2–4	0.61	–	0.19	–

* Sulphate of potash, the source of potash.

Table I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
7	Bone and Potash (Circle Brand),	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
33	Randall's Farm and Field,	Benj. Randall, Boston, Mass.,	Boston.
59	Dow's Ground Bone,	J. C. Dow & Co., Boston, Mass.,	Cochesett.
75	Unicorn Brand Ammoniated Superphosphate,	Clark's Cove Guano Co., New Bedford, Mass.,	Ipswich.
78	Bradley's Sea Fowl Guano,	Bradley Fertilizer Co., Boston, Mass.,	"
89	World of Good Tobacco Grower,	Thomson & Edwards Fertilizer Co., Chicago, Ill.,	North Hatfield.
90	Original Coe's Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Shelburne Falls.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
93	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Glendale.
100	Chittenden's Universal Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
101, 105, 112	Soluble Pacific Guano,	Glidden & Curtis, Agents, Boston, Mass.,	Williamstown.
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Co., New York,	Great Barrington.
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	E. Frank Coe, New York,	North Adams.
110	Geo. W. Miles' Fish and Potash Manure,	Geo. W. Miles, Milford, Conn.,	Amherst.
125	Economic No. 4, for Potatoes,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
132	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	
134	Cotton-seed Hull Ashes,		Granby.

TABLE I. — *Concluded.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
7	Circle Brand of Bone and Potash,	8.04	2.05	1.9-2.6	2.98	4.08	6.55	13.61	8-12	7.06	–	1.72	2-3
33	Randall's Farm and Field,	19.34	2.50	1.6-2.7	4.99	2.65	1.57	9.21	10-16	7.64	8-11	2.20	2-4
59	Dow's Ground Bone,	9.11	2.76	2.06-2.47	0.67	3.20	13.97	17.84	18-22	3.87	–	1.95	3-4
75	Unicorn Brand Ammoniated Superphosphate,	12.91	2.37	1.8-2.5	4.67	2.05	3.79	12.51	10-13	8.72	8.5-10	3.40	2.25-3
78	Bradley's Sea Fowl Guano,	16.55	2.41	2.5-3.25	8.25	2.70	2.03	12.98	11-14	10.95	9-11	1.90	2-3*
89	World of Good Tobacco Grower,	6.81	1.66	3.30-4.11	5.85	1.57	4.73	12.15	10-12	7.42	–	1.35	*
90	Original Coe's Superphosphate of Lime,	14.82	3.36	2.05-2.25	7.28	2.96	1.25	11.49	10-13	10.24	8-10	1.18	1-2*
92	Chittenden's Ammoniated Bone Superphosphate,	13.81	2.41	1.5-2.47	5.44	2.43	5.18	13.05	9-11	7.87	7-9	2.78	2-4
93	Great Eastern General Fertilizer,	13.09	3.74	2.88-3 71	5.22	3.50	2.81	11.53	9-15	8.72	8-12	1.87	2-4
100	Chittenden's Universal Phosphate,	8.48	2.73	2.06-2.88	2.21	4.99	8.54	15.74	11-12	7.20	9-11	3.20	2-3
101, 105, 112	Soluble Pacific Guano,	11.51	3.23	2.25-3	6.26	2.89	2.67	11.82	10.5-16	9.15	8.5-12	1.97	2-3.5
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	13.57	3.22	2-3	6.78	2.97	0.49	10.24	11-16	9.75	8-9	3.78	2-3*
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	10.72	2.52	2-2.5	7.80	1.27	2.83	11.90	11-13	9.07	9-12	2.16	*
110	Geo. W. Miles' Fish and Potash Manure,	13.45	3 02	2.47-4.12	5.37	2.91	1.31	9.59	7-10	8.28	6-7	4.46	3-5
125	Economic No. 4, for Potatoes,	12.15	0.69	0.25-0.75	0.25	0.84	5.28	6.37	2-4.5	1.09	–	0.56	–
132	Darling's Fine Ground Bone,	8.12	3.60	3.5-4.5	0.17	9.12	14 75	24.13	22-25	9.29	–	–	–
134	Cotton-seed Hull Ashes,	13.50	–	–	–	–	–	8.83	–	–	–	20.97	–

* Sulphate of potash, the source of potash.

II.—Analysis of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I. Sent on from Ipswich, Mass. II. and III. Sent on from Concord, Mass]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.24	14.50	14.13
Calcium oxide,	38.30	33.34	33.45
Magnesium oxide,	2.82	3.83	3.39
Potassium oxide,	2 55	5.76	6.32
Phosphoric acid,	1.83	1.28	1.40
Insoluble matter (before calcination),	21.58	14.96	14.83
Insoluble matter (after calcination),	19.81	9.95	11.67

Sample I. contains but one-half the amount of potash of an ordinary quality of Canada wood ash. Samples II. and III. are of a good quality, and correspond fairly with the guaranty of the dealer. The question has been repeatedly asked, on what basis to adjust differences between a stated guaranty of composition and the actual results of an analysis of a sample of wood ash. Our answer has been, in these cases, to allow 5½ cents for every pound of potassium oxide and 6 cents for every pound of phosphoric acid which the analysis shows to be less than the guaranty states to be present.

Wood Ashes.

[I. Sent on from Amherst, Mass. II. Sent on from Amherst, Mass. III. Sent on by F. H. Greeley, Salisbury, Mass. IV. Sent on by J. D. W. French, North Andover, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.67	19.14	7.29	17.14
Phosphoric acid,	1.25	1.72	3.09	5.04
Calcium oxide,	39.06	30.16	45.22	35.59
Potassium oxide,	5.38	4.76	4.37	4.22
Magnesium oxide,	2.88	3.04	4.27	6.45
Insoluble matter (before calcination),	17.42	21.72	18.14	17.47
Insoluble matter (after calcination),	8.79	13.45	11.23	12.19

[V. Sent on by C. F. Clark, Boston, Mass. VI. Sent on by Coolidge Bros., South Sudbury, Mass. VII. and VIII. Sent on by Fred L. Ames, Boston, Mass.]

	Per Cent.			
	V.	VI.	VII.	VIII.
Moisture at 100° C.,	4.94	4.41	12.33	8.20
Phosphoric acid,	1.54	1.28	1.54	1.87
Calcium oxide,	31.70	35.50	34.17	40.15
Potassium oxide,	4.80	4.76	4.39	4.70
Magnesium oxide,	4.58	4.87	3.26	4.42
Insoluble matter (before calcination),	20.85	9.64	15.37	20.55
Insoluble matter (after calcination),	18.57	6.10	12.19	18.33

Wood Ashes.

[I. Sent on by F. H. Williams, Sunderland, Mass. II. Sent on by C. H. Thompson & Co., Boston, Mass. III. and IV. Sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.31	2.57	8.67	19.14
Phosphoric acid,	1.65	1.53	1.25	1.72
Magnesium oxide,	2.41	5.29	2.88	3.04
Calcium oxide,	37.39	26.94	39.06	30.16
Potassium oxide,	7.78	7.95	5.38	4.76
Insoluble matter (before calcination),	10.93	17.44	17.42	21.76
Insoluble matter (after calcination),	6.15	15.66	8.79	13.45

Wood Ashes.

[I. Sent on by S. M. Farnsworth, Harvard, Mass. II. Sent on by J. J. H. Gregory, Marblehead, Mass. III. Sent on by D. G. Lang, Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	16.51	2.76	22.07
Phosphoric acid,	1.37	3.09	0.48
Magnesium oxide,	4.03	2.84	3.48
Calcium oxide,	32.54	32.03	29.11
Potassium oxide,	5.07	10 24	5.84
Insoluble matter (before calcination),	16.13	24.39	19.70
Insoluble matter (after calcination),	13.06	17.91	15.13

Cotton-seed Hull Ashes.

[I. Sent on from Hatfield, Mass. II. Sent on from Agawam, Mass. III. Sent on from South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.26	7.15	10.19
Phosphoric acid (6 cts. per lb.),	8.83	8.06	15.37
Potassium oxide (5½ cts. per lb.),	24.13	28.22	19.07
Calcium oxide,	8.92	10.50	5.14
Magnesium oxide,	8.60	15.25	9 78
Insoluble matter (before calcination),	14.29	12.75	18.11
Insoluble matter (after calcination),	12.22	10.57	12.16
Valuation per 2,000 lbs,	$37.14	$40.71	$39.42

The samples are of an exceptionally good quality.

Cotton-seed Hull Ashes.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	6.95
Phosphoric acid,	3.14
Potassium oxide,	25.10
Calcium oxide,	12.41
Magnesium oxide,	5.84
Insoluble matter (before calcination),	55.48
Insoluble matter (after calcination),	9.58

Potash Fertilizers.

[I. Muriate of Potash. II. Sulphate of Potash and Magnesia, sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.21	8.08
Potassium oxide,	49.77	21.88
Sodium oxide,	10.06	5.06
Calcium oxide,	2.07	3.54
Magnesium oxide,	0.45	11.93
Sulphuric acid,	0.55	43.43
Chlorine,	50.00	3.10
Insoluble matter,	0.17	0.77

Saltpetre Waste from Gunpowder Works.

[Sent on from Acton, Mass.]

	Per cent.
Moisture at 100° C.,	5.19
Potassium oxide,	15.04
Sodium oxide,	36.82
Total calcium oxide,	.47
Total magnesium oxide,	.27
Nitrogen,	1.90
Sulphuric acid,	1.02
Total chlorine,	53.50
Calcium chloride,	.05
Magnesium chloride,	.63
Insoluble matter,	Trace.

The composition of this material varies in different samples in a marked degree. Its application on forage crops and on grass lands in particular has proved highly satisfactory.

Muck.

[I. and II. Sent on from Marlborough, Mass. III. Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	33.64	40.63	56.46
Dry matter,	66.36	59.37	43.54
Nitrogen in dry matter,	1.65	1 21	1.16
Ash constituents in dry matter,	6.44	18.73	4.72
Insoluble matter in ash,	5.76	15.07	Not determined.

These samples are fair representatives of their kind. As the agricultural value of this material has been repeatedly discussed in previous reports, no further statement seems to be called for.

Muck.

[I. and II. Sent on by A. A. Rice, Mount Hermon, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	30.26	75.44
Dry matter,	69.74	24.56
Nitrogen,	2.54	.37
Ash constituents in dry matter,	8.28	12.00

Muck.

[Sent on by W. H. Earle, Worcester, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.030	11.231
Ash,	51.289	51.400
Ferric oxide,	Trace.	Trace.
Aluminic oxide,	6.672	6.953
Calcium oxide,	.038	.049
Magnesium oxide,	.030	.031
Potassium oxide,	.051	.062
Phosphoric acid,	.198	.232
Nitrogen,	1.470	1.460
Insoluble silicious matter,	39.755	39.635

Sea-weed.

[Sent on from Eastham, Mass., — two samples.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.05	14.96
Nitrogen (16½ cts. per lb.),	1.66	1.28
Phosphoric acid (6 cts. per lb.),	.44	.17
Potassium oxide (4¼ cts. per lb.),	3.81	.36
Calcium oxide,	2.73	3 86
Magnesium oxide,	1.48	1.30
Sodium oxide,	11.75	8.40
Chlorine,	6.40	5.28
Insoluble matter,	7.73	.78
Valuation per 2,000 lbs.,	$9.25	$4.72

The samples were received in an air-dry state. According to statement, I. had been dried without any serious exposure to bad weather; II. had suffered from exposure for a considerable length of time.

Cotton-seed Meal (for manurial purposes).

[I. Sent on by Geo. Frost, Boston, Mass. II. and III. Sent on by C. L. Warner, Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	6.26	8.30	8.30
Ash,	6.16	5.77	5.77
Calcium oxide,	.31	.31	.31
Magnesium oxide,	.95	.77	.77
Potassium oxide,	1.80	1.21	.89
Phosphoric acid,	1.32	1.45	1.26
Nitrogen,	7.26	6.69	6.88
Insoluble matter,	.53	.40	.40

Refuse Camel's Hair from Cotton-seed Oil Works.

[Sent on by W. H. Bowker, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.80
Ash,	7.25
Nitrogen,	5.92
Potassium oxide,	2.56
Phosphoric acid,	2.77
Insoluble matter,	1.27

Castor Pomace.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	8.67
Ash,	5.70
Nitrogen,	5.72
Phosphoric acid,	1.57
Potassium oxide,	.97
Calcium oxide,	.71
Magnesium oxide,	.65
Insoluble matter,	1.21

Cotton Waste.

[Sent on by Samuel Pillsbury, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.24
Nitrogen,	2.09
Phosphoric acid,	.83
Calcium oxide,	2.52
Magnesium oxide,	.66
Potassium oxide,	1.62
Insoluble matter,	20.10

Wool Waste.

[Sent on by A. S. Shepard, Franklin, Mass.]

	Per cent.
Moisture at 100° C.,	7.67
Ash,	10 63
Phosphoric acid,	1.15
Potassium oxide,	.54
Nitrogen,	5.26
Insoluble matter,	5.83

Waste from Cotton-seed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	6.83
Ash,	23.47
Phosphoric acid,	.96
Potassium oxide,	.20
Nitrogen,	4.24
Insoluble matter,	17.74

Waste from Linseed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	7.06
Ash,	2.34
Phosphoric acid,	2.43
Potassium oxide,	.24
Nitrogen,	8.05
Insoluble matter,	1.00

Scouring Liquor of Raw Wool.

[Sent on from Plymouth, Mass.]

	Per cent.
Moisture at 100° C.,	92.03
Dry matter,	7.97
Nitrogen (in liquid),	.09
Ash,	3.28
Calcium oxide,	.04
Magnesium oxide,	Trace.
Potassium oxide,	1.09
Sodium oxide,	.92
Iron and alumina oxides,	.09
Insoluble matter,	.22

One hundred parts of ash contained, —

	Per cent.
Calcium oxide,	1.22
Magnesium oxide,	Trace.
Potassium oxide,	33.23
Sodium oxide,	28.05
Iron and alumina oxides,	2.74
Insoluble matter,	6.91

The above-stated liquid was obtained, according to information received, by scouring raw wool with a solution of soda-ash and soap. The most noticeable constituent of the material is its comparatively large amount of potash (1.09 per cent.) in the calcined residue or ash. The presence of a liberal amount of potash compounds in raw wool is well known. A sample of raw wool from South America, tested here in that direction some years ago, showed from 3.92 to 4.2 per cent. of potassium oxide. The washings of sheep and of raw wool may be used with a good effect on grass lands. Solutions like the one above described are, however, too concentrated for direct use; they ought to be diluted with from ten to twenty times their weight of water, to render advisable their direct application on any growing vegetation.

Refuse Material from Soap Works.

[Sent on by Holyoke Soap Works, Holyoke, Mass.]

	Per cent.
Moisture at 100° C.,	19.70
Total phosphoric acid,	15.37
Soluble phosphoric acid,	.03
Reverted phosphoric acid,	5.29
Insoluble phosphoric acid,	10.05
Nitrogen,	4.24
Insoluble matter,	1.37

This material is similar to tankage in composition and in mechanical condition.

Fish Fertilizers.

[Sent on from Eastham, Mass. I. Salt Fish Waste. II. Fish Chum. III. Salt Fish Trimmings. IV. Whalebone. V. Whale Scrap.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	37.35	53.86	5.22	6.81	9.51
Total phosphoric acid,	2.89	3.80	5.50	20.84	1.15
Soluble phosphoric acid (8 cts. per lb.),	.58	.36	.69	.34	.84
Reverted phosphoric acid (7½ cts. per lb.),	1.16	1.77	2.15	1.84	.07
Insoluble phosphoric acid (3 cts. per lb.),	1.15	1.67	2 66	18.69	.24
Nitrogen (12 cts. per lb.),	5.26	4.26	7.63	3.40	9.64
Insoluble matter,	.10	.06	.26	3.69	9.10
Valuation per 2,000 lbs.,	$15.96	$14.46	$24.24	$22.67	$24 73

The main quantity of these substances was in a very coarse state.

Dry Ground Fish.

[I. and II. Sent on by R. P. Smith, Hatfield, Mass. III. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.34	9.92	10.10
Ash,	37.76	28.37	21.50
Total phosphoric acid,	8.23	7.96	6.67
Soluble phosphoric acid,	.10	.61	.32
Reverted phosphoric acid,	3.81	3.79	.75
Insoluble phosphoric acid,	4.32	3.56	5.60
Nitrogen,	6.81	6.82	6.98
Insoluble matter,	82	1.34	4 57

Peruvian Guano.

[From P. Williams & Co., Taunton, Mass. I. Warranted Peruvian Guano, No. 1. II. Low-grade Peruvian Guano.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.18	16.14
Ash,	47.36	65.01
Total phosphoric acid,	19.91	22.26
Soluble phosphoric acid,	7.34	2.24
Reverted phosphoric acid,	6.05	5.03
Insoluble phosphoric acid,	6.52	14.99
Potassium oxide,	2.80	4.17
Nitrogen,	8.01	4.06
Insoluble matter,	4.04	7.83

Phosphatic Fertilizers.

[Sent on from Ashby, Mass. I. Acid Phosphate. II. Dissolved Bone-black. III. South Carolina Rock Phosphate.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.93	13.86	1.68
Total phosphoric acid,	13.84	16.37	25.81
Soluble phosphoric acid (8 cts. per lb.),	10.91	14.60	.27
Reverted phosphoric acid (7½ cts. per lb.),	.69	1.53	.47
Insoluble phosphoric acid (2 cts. per lb.),	2.24	.24	25.07
Insoluble matter,	9.54	2.09	11.64
Valuation per 2,000 lbs.,	$19.38	$25 80	$11.16

Bone-black.

[Sent on by F. G. Arnold, Swansea, Mass.]

	Per cent.
Moisture at 100° C.,	5.04
Ash,	67.43
Phosphoric acid,	16.56
Insoluble matter,	.37

Ground Bones.

[I., II. and III. Sent on from Amherst, Mass. IV. Sent on from Jamaica Plain, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	63.29	40.44	56.69	37.48
Fine medium, smaller than $\frac{1}{25}$ inch,	27.78	30.91	34.97	35.51
Medium, smaller than $\frac{1}{12}$ inch,	8.93	25.30	8.34	18.91
Coarser than $\frac{1}{12}$ inch,	–	3.35	–	8.10
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.12	11 24	6.31	6.92
Ash,	41.62	58.66	47.63	68.64
Total phosphoric acid,	24.13	20.85	19.72	22.59
Soluble phosphoric acid,	.17	4.87	1.16	.20
Reverted phosphoric acid,	9.12	1.20	9.34	6.65
Insoluble phosphoric acid,	14.75	14.78	9.22	15.74
Nitrogen,	3.60	2.85	6.84	4.82
Insoluble matter,	.55	.48	.71	3.23

Ground Bones.

[I. Sent on from Amherst, Mass. II. Sent on by A. S. Belcher, North Easton, Mass. III. Sent on by Edmund Hersey, Hingham, Mass. IV. Sent on by W. W. Sanderson, South Deerfield, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	22.59	18.53	34.79	59.00
Fine medium, smaller than $\frac{1}{25}$ inch,	18.71	10.14	21.22	24.09
Medium, smaller than $\frac{1}{12}$ inch,	24.61	7.12	14.71	12.32
Coarser than $\frac{1}{12}$ inch,	34.09	64.21	29.28	4.59
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	3.97	12.43	6.75	9.96
Ash,	49.35	64.21	61.35	55.83
Total phosphoric acid,	19.49	25.67	24.71	18.41
Soluble phosphoric acid,	–	.13	.09	2.73
Reverted phosphoric acid,	3 80	6.20	8.10	9.94
Insoluble phosphoric acid,	15.69	19.34	16.52	5.74
Nitrogen,	4.04	2.68	3.14	3.12
Insoluble matter,	.78	.42	.42	5.79

Phosphate Slag.

[I. German "Phosphate Slag," New York. II. "Phosphate Slag" sent on from England.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	5.08	.37
Ferric oxide and aluminum oxide,	15.98	8.55
Total phosphoric acid,	21.05	18 91
Calcium oxide,	53.97	49.22
Magnesium oxide,	3.83	Not determined.
Insoluble matter,	Not determined.	5.06

This material has been of late introduced into our markets in a fine-ground state as "phosphate meal," manufactured of the "Peine-Thomas Scoria." P. Weidinger, No. 76 Pine Street, New York City, who has advertised the sale of the above material for trial, makes the following statement: —

"We offer to the American fertilizer trade the article above stated, whose rapid and successful introduction into various countries, with constantly increasing demand, gives us a guarantee that its importance for agriculture will not be underrated. This is a very finely ground phosphate meal, obtained from the so-called 'Peine-Thomas Scoria,' through the dephosphorization of pig iron, after the patented method of Sidney Gilchrist Thomas. The dephosphorization of the iron takes place by melting the iron with lime in a current of air, a proceeding by which pig iron, rich in phosphorus, is converted into steel, free from phosphorus (ingot iron). In this manner the phosphorus of the pig iron is converted into phosphoric acid, which, uniting with the lime added, forms phosphate of lime. The melted mixture of phosphate of lime with excess of lime and combinations of the iron and manganese, obtained by this proceeding, is called 'Thomas Scoria.' It is brought into the market for the purposes of agriculture in a finely ground state."

The phosphoric acid present is neither to any extent soluble in water nor in a solution of citrate of ammonia. The composition of the slag is peculiar, on account of an excess of caustic lime, which favors a breaking up into minute particles when exposed to air and moisture. The more finely ground when exposed to atmospheric influences, the more rapidly takes place a general disintegration. This behavior tends to diffuse the phosphoric acid, and favors absorption by the roots. No previous treatment by acids has been found necessary to secure satisfactory returns when used as a phosphoric acid source for plant growth. On account of the alkaline reaction of the "phosphate meal," no ammonia salts or organic nitrogen compounds are used as an admixture for the production of more complete fertilizers. In case nitrogen shall be applied, nitrate of soda is used, to furnish that element. Muriate of potash and kainite are recommended as potash sources.

European agricultural chemists speak well of this new source of phosphoric acid. As it is claimed that phosphoric acid can be furnished at less cost and more efficiently in the form of "phosphate meal" than in any of our known mineral resources of insoluble phosphoric acid, it seems desirable that experiments should be instituted to test its merits.

Fifteen dollars per 2,000 pounds has been asked in our vicinity for a finely ground material.

Concentrated Flower Food.

[Sent on from Springfield, Mass.]

	Per cent.
Moisture at 100° C.,	11.20
Ash,	42.89
Phosphoric acid,	5.30
Sulphuric acid,	15.73
Potassium oxide,	4.72
Sodium oxide,	17.45
Calcium oxide,	6.18
Nitrogen in organic matter,	2.31
Nitrogen in nitrates,	4.66
Insoluble matter,	.25

Compound Fertilizers.

[I. Sent on by A. S. Hawley, North Hadley, Mass. II. Sent on by Staples & Phillips, Taunton, Mass. III. Sent on by C. M. Allen, Franklin, Mass. IV. Sent on by F. G. Arnold, Swansea, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.86	11.71	6.76	6.26
Ash,	48.44	57.84	52.96	56.88
Total phosphoric acid,	11.07	13.30	8.32	12 56
Soluble phosphoric acid,	5.87	5.80	2.86	2.09
Reverted phosphoric acid,	3.60	1.85	5.01	6.10
Insoluble phosphoric acid,	1.60	5.65	.45	4.37
Nitrogen in organic matter,	1.65	2.10	.19	3.78
Nitrogen in nitrate,	–		3.44	
Potassium oxide,	3.19	1.63	8.60	9.87
Insoluble matter,	5.50	6.01	1.52	3.03

Compound Fertilizers.

[I. Sent on by A. Bradley, Lee, Mass. II. Sent on by F. H. Bardwell, Hatfield, Mass. III. and IV. Sent on by Oscar L. Dorr, Sharon, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.43	12 34	10.50	19.47
Ash,	41.15	64.14	56.62	50.40
Total phosphoric acid,	8 90	12.33	12.86	8.32
Soluble phosphoric acid,	7.45	5.65	4.72	4.02
Reverted phosphoric acid,	1.06	3.22	5.25	2.02
Insoluble phosphoric acid,	.39	3.46	2.89	2.28
Potassium oxide,	7.28	1.34	5.00	2.54
Nitrogen,	4.73	1.52	3.80	3.28
Insoluble matter,	.94	6.56	1.61	10.19

Compound Fertilizers.

[I. Sent on by J. M. Aiken, Prescott, Mass. II. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.47	6.26
Ash,	54.21	62.53
Total phosphoric acid,	13.61	9.88
Soluble phosphoric acid,	3.91	3.97
Reverted phosphoric acid,	6.24	3.09
Insoluble phosphoric acid,	3.46	2.82
Potassium oxide,	1.45	3.54
Nitrogen,	2.48	1.38
Insoluble matter,	7.44	7.38

Compound Fertilizers.

[I. Sent on by Lawrence Hardware Co., Lawrence, Mass. II. Sent on by J. M. Aiken, Prescott, Mass. III. Sent on by A. Bradley, Lee, Mass. IV. Sent on by J. M. Aiken, Prescott, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.36	10.66	17.07	13.34
Ash,	59.19	60.64	44.24	49.38
Total phosphoric acid,	16.44	12.50	9.28	13.02
Soluble phosphoric acid,	4.03	5.50	7.47	6.81
Reverted phosphoric acid,	8.46	1.29	1.43	2.56
Insoluble phosphoric acid,	3.95	5.71	.38	3.65
Potassium oxide,	1.15	2.50	7.64	2.16
Nitrogen,	2.65	1.70	1.34	3.02
Insoluble matter,	3.43	8.09	1.69	5.07

VALUATION OF FERTILIZERS AND FERTILIZER ANALYSES.

The hitherto customary valuation of manurial substances is based on the average trade value of the fertilizing elements specified by analyses. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the cash retail price at which the several specified essential elements of plant food, in an efficient form, have been offered of late for sale in our large markets.

The market value of low-priced materials used for manurial purposes, such as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different descriptions, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The market price of manurial substances is liable to serious fluctuations; for supply and demand exert here, as well as in other branches of commercial industry, a controlling influence on their temporary money value. As farmers in many instances have but little chance to obtain the desired information, agricultural chemists charged with the inspection of commercial fertilizers assist in the work, by ascertaining as far as practicable the actual market price of the leading manurial substances in our principal markets for a given period of time. The results of the inquiries into the condition of the trade during the six months preceding the 1st of March, 1888, are embodied in the subsequent tabular statement of cost of fertilizing ingredients for the opening of the season of 1888.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultation with leading manufacturers of fertilizers, and notes on actual sales of individual farmers and farmers' associations, etc., furnish the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1, 1888, and increasing them by twenty per cent., to cover expenses of sales, credits, etc.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1888. Cents per Pound.
Nitrogen in ammoniates,	17½
Nitrogen in nitrates,	16
Organic nitrogen in dry and fine-ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,*	7½
Phosphoric acid in dry-ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarser bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in forms free from muriate and chlorides,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

*Dissolved from two grams of phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in thirty minutes at 65° C., with agitation once in five minutes; commonly called "reverted" or "back-gone" phosphoric acid.

The above trade values are the figures at which, in the six months preceding March 1, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dried ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substances. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers and refuse materials of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practical, on guaranty of composition with reference to their essential constituents, and see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Analyses of Water sent on for Examination.

[Parts per Million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
I.,	.108	.160	17.80	148.00	60.00	4.03	-	No. Amherst.
II.,	.01	.06	7.00	104.00	56.00	4.57	None.	Amherst.
III.,	.23	.34	47.00	312.00	206.00	9.14	None.	Amherst.
IV.,	.25	.44	19.00	202.00	68.00	2.86	Present.	Littleton.
V.,	.09	.10	6.00	132 00	72.00	3.25	None.	No. Amherst.
VI.,	.40	.12	137.20	546.00	124.00	-	-	Amherst.
VII.,	.03	.05	6.00	64.00	46.00	1.56	None.	Ipswich.
VIII.,	SO_3 — CaO —	82.00 63.00	64.00	310.00	100.00	9.57	-	Ashby.
IX.,	.12	.09	None	38.00	30.00	.63	-	Ashby.
X.,	.08	.08	42.00	300.00	76.00	7.00	-	Ashby.
XI.,	.17	.05	20 00	192.00	104.00	3.12	None.	No. Amherst.
XII.,	.07	.02	9.00	138.00	60.00	2.86	None.	Ashby.
XIII.,	None	.02	20.00	178.00	70.00	1.82	None.	Ashby.
XIV.,	.44	.28	22.00	160.00	40.00	3.12	None.	Ashby.
XV.,	.05	.18	144.00	530.00	102.00	5.43	None.	Ashby.
XVI.,	.13	.46	None	70.00	36.00	1.43	-	Amheist.
XVII.,	.08	.08	42.00	354.00	108.00	5.29	None.	Amherst.
XVIII.,	.12	.28	6.00	86.00	26.00	1.43	None.	East Amherst.
XIX.,	.05	.44	20.00	146.00	52.00	4.57	None.	East Amherst.
XX.,	None	.04	9.00	72.00	24.00	1.27	None.	East Amherst.
XXI.,	.26	.24	20.00	124.00	46.00	1.11	None.	Boston.
XXII.,	.10	.10	9.10	72.00	52.00	1.11	None.	Boston.
XXIII.,	.64	.36	45 00	268.00	96.00	8.43	-	Sherborn.
XXIV.,	None	.06	12.00	106.00	56.00	2.21	None.	Wellesley.
XXV.,	None	.09	25.04	318.00	76.00	7.86	Present.	No. Hadley.
XXVI.,	-	-	-	-	-	-	None.	No. Hadley.
XXVII.,	.066	.14	18.00	208.00	96.00	5.00	-	No. Amherst.
XXVIII.,	3.33	.80	127.00	720.00	224.00	10.00	None.	No. Hadley.
XXIX.,	Trace	.06	Trace	38.00	30.00	1.69	None.	No. Hadley.
XXX.,	None	.06	31.00	196.00	76.00	3.51	None.	Shirley.
XXXI.,	1.30	.40	47.40	7.14	380.00	98.00	None.	Shirley.
XXXII.,	.08	.06	8.00	98.00	22.00	2.60	None.	No. Amherst.
XXXIII.,	4.70	1.50	125.00	844.00	182.00	10.10	-	No. Hadley.
XXXIV.,	.12	.20	None	40 00	24.00	-	-	Amherst.
XXXV.,	.09	.09	Trace	68.00	28.00	-	-	Amherst.
XXXVI.,	.12	.05	3.00	68.00	26.00	2.21	None.	Amherst.

ANALYSES OF WATER — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
XXXVII., .	.02	.04	None	38.00	22.00	-	-	Worthington.
XXXVIII., .	.01	.05	None	52.00	30.00	.79	-	Worthington.
XXXIX., .	Trace	.02	None	22.00	14.00	1.43	-	Worthington.
XL., . .	1.15	.05	28.00	306.00	82.00	7.86	-	Amherst.
XLI., . .	.02	.14	None	24.00	12.00	-	-	Worthington.
XLII., . .	Trace	.02	Trace	54.00	40.00	.95	-	Worthington.
XLIII., . .	.04	.03	None	52.00	36.00	2.08	-	Worthington.
XLIV., . .	-	-	-	-	-	-	Present.	East Amherst.
XLV., . .	-	-	-	-	-	-	None.	East Amherst.
XLVI., . .	-	-	-	-	-	-	None.	Amherst.
XLVII., . .	-	-	-	-	-	-	None.	Berlin.
XLVIII., .	Trace	.05	None	22.00	2.00	-	-	Worthington.
XLIX., . .	.12	.12	None	148.00	64.00	1.56	None.	No. Hadley.
L., . . .	.14	.58	.60	74.00	34.00	3.12	None.	Westhampton.
LI., . . .	.05	.20	5.00	86.00	54.00	2.34	None.	Wellesley.
LII., . .	.10	.14	Trace	238.00	114.00	7.00	-	So. Hadley.
LIII., . .	.01	.10	23.00	154.00	50.00	2.86	-	Ashby.
LIV., . .	1.40	7.90	4.00	422.00	322.00	17.06	None.	Amherst.
LV., . . .	1.50	.70	126.00	482.00	198.00	8.29	None.	Amherst.
LVI., . .	.40	.55	8.00	142.00	58.00	3.90	None.	Amherst.
LVII., . .	.01	.016	2.00	148.00	64.00	4.71	Present.	Amherst.
LVIII., . .	.02	.05	18.00	148 00	40.00	4.86	None.	Amherst.
LIX., . .	.04	.05	11.00	52.00	16.00	1.95	None.	Amherst.
LX., . .	.05	.05	9.00	20.00	8.00	1.56	None.	Amherst.
LXI., . .	.03	.04	13.00	116.00	60 00	2.36	None.	Amherst.
LXII., . .	.01	.07	34.00	292.00	156.00	5.86	None.	Amherst.
LXIII., . .	.03	.10	6.00	216.00	44.00	5.00	None.	Amherst.
LXIV., . .	.03	.16	Trace	88.00	48 00	.32	None.	Amherst.
LXV., . .	1.36	1.20	57.00	412.00	108.00	8.14	-	Amherst.
LXVI., . .	.003	.04	24.00	120.00	56.00	6.29	-	Amherst.
LXVII., . .	.016	.044	3.00	140.00	70.00	.63	None.	No. Dana.
LXVIII., .	.45	.35	8.00	52.00	20.00	1.56	None.	No. Amherst.
LXIX., . .	.06	.10	22.00	116.00	26 00	2.21	None.	Amherst.
LXX., . .	.026	.08	33.00	324.00	160.00	8.29	None.	Amherst.
LXXI., . .	.024	.044	22.00	308.00	64 00	5.14	None.	Amherst.
LXXII., . .	.124	.148	2.00	56.00	12.00	1 11	None.	Amherst.
LXXIII., .	-	.05	Trace	45.00	35.00	1.56	None.	Littleton.

ANALYSES OF WATER — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
LXXIV., .	.06	.05	53.00	325.00	177.00	7.43	None.	Northampton.
LXXV., . .	Trace	.04	25.00	212.00	112.00	4.86	–	Amherst.
LXXVI., .	.04	.06	19.00	92.00	40.00	.95	–	Amherst.
LXXVII., .	.07	.05	Trace	62.00	42.00	.79	None.	Amherst.
LXXVIII., .	.04	.22	Trace	34.00	4.00	–	–	Amherst.
LXXIX., .	.01	.04	3.00	68.00	22.00	1.56	None.	Amherst.
LXXX., . .	.02	.07	5.00	40.00	10.00	1.11	None.	Amherst.
LXXXI., .	.03	.08	12.00	112.00	51.00	2.99	None.	Framingham.
LXXXII., .	Trace	.18	13.00	153.00	94.00	3.25	None.	Amherst.
LXXXIII., .	.03	.10	Trace	70.00	45 00	1.11	None.	Sunderland.
LXXXIV., .	.04	.08	Trace	45.00	30.00	–	None.	Northampton.
LXXXV., .	.04	.07	15.00	111.00	70.00	3 79	None.	Northampton.

The analyses have been made according to Wanklyn's process, familiar to chemists, and are directed towards the indications of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wanklyn and E. T. Chapman.)

Mr. Wanklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundreths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

5. Albuminoid ammonia over .15 parts per million ought to absolutely condemn the water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the above results of analyses shows that Nos. 5, 9, 10, 11, 17, 22, 27, 35, 36, 64, 78 and 82 are of a suspicious character, and that Nos. 1, 3, 4, 6, 14, 15, 16, 18, 19, 21, 23, 28, 31, 33, 34, 40, 49, 50, 51, 52, 54, 55, 56, 64, 65, 68 and 72 ought to be condemned, on account of a large amount of free and albuminoid ammonia, due most likely to access of sewage water. An examination of the above statement shows that a large proportion of the samples received were from bad wells. Of fifty-eight samples of water tested for lead, four were found to be poisoned by that metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live stock, and on the personal attention bestowed, from time to time, on the condition of the well and its surroundings. Good wells are liable to change for the worst at any time, on account of circumstances too numerous to state in this connection. To ascertain, from time to time, the exact condition of the water which supplies the wants of the family and of the live stock, is a task which no farmer can, for any length of time, neglect, without incurring a serious risk to health and prosperity.

The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities which an apparently good water may contain are disguised beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopic observations, are, in the majority of cases, the only reliable means, in our present state of scientific inquiry, by which desirable information regarding the true character of a drinking water can be obtained.

Parties sending on water for an analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.*

Prepared by Mr. W. H. Beal.

As the basis of valuation changes from year to year, no valuation is stated.

1868 to 1889

Muriate of Potash (45 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.05	.05	2.05
Potassium oxide,	58.98	45.94	52.46
Sodium oxide,	11.26	2.13	6.69
Magnesium oxide,	.90	.30	.55
Chlorine,	54.00	43.20	48.60
Insoluble matter,	2.00	.15	.75

Sulphate of Potash (15 Analyses).

Moisture at 100° C.,	5.00	.19	1.00
Potassium oxide,	51.28	20.44	35.86
Sodium oxide,	8.59	.34	4.46
Magnesium oxide,	2.63	.24	1.50
Sulphuric acid,	59.30	10.86	45.00
Insoluble matter,	31.55	.14	.75

* This compilation does not include the analyses made of licensed fertilizers. They are to be found in the Reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the Reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

Sulphate of Potash and Magnesia (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.58	1.95	5.50
Potassium oxide,	27.77	11.70	22.50
Sodium oxide,	18.97	2.09	6.50
Magnesium oxide,	13.66	10.86	12.25
Calcium oxide,	3.38	.82	2.50
Sulphuric acid,	47.90	31.91	43.00
Chlorine,	7.80	.14	2.50
Insoluble matter,	2.36	.26	1.41

German Potash Salts (11 Analyses).

	Highest.	Lowest.	Average.
Moisture at 100° C.,	25.83	.45	13.14
Potassium oxide,	50.40	7.56	21.63
Sodium oxide,	26.23	1.30	13.76
Calcium oxide,	1.26	.06	.85
Magnesium oxide,	9.83	Trace.	9.25
Sulphuric acid,	21.53	.17	10.85
Chlorine,	49.11	22.27	35.63
Insoluble matter,	3.76	.90	2.08

Kainite (3 Analyses).

	Highest.	Lowest.	Average.
Moisture at 100° C.,	13.57	2.15	9.26
Potassium oxide,	16.48	12.51	14.04
Sodium oxide,	–	–	21.38
Calcium oxide,	1.41	.82	1.12
Magnesium oxide,	11.30	6.65	8.97
Sulphuric acid,	23.71	17.53	21.05
Chlorine,	–	–	32.38
Insoluble matter,	1.56	.17	.86

Carnallite (1 Analysis).

	Per cent.
Potassium oxide,	13.68
Sodium oxide,	7.66
Magnesium oxide,	13.19
Sulphuric acid,	.56
Chlorine,	41.56

Krugite (1 Analysis).

	Per cent.
Moisture at 100° C.,	4.82
Calcium oxide,	12.45
Magnesium oxide,	8.79
Potassium oxide,	8.42
Sodium oxide,	5.57
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter,	14.96

Sulphate of Magnesia (9 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	31.90	7.50	22.50
Calcium oxide,	3.89	1.15	2.52
Magnesium oxide,	25.29*	13.50	18.25
Sulphuric acid,	52.23*	31.91	37.00
Insoluble matter,	11.06	.40	5.73

* Kieserite, natural and calcined.

Nova Scotia Plaster (9 Analyses).

Moisture at 100° C.,	15.79	.52	6.50
Calcium oxide,	37.59	30.60	33.50
Magnesium oxide,	1.40	.36	.75
Sulphuric acid,	54.10	33.56	44.00
Insoluble matter,	7.95	.45	2.00

Onondaga Plaster * (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.25	8.95	13.27
Calcium oxide,	31.46	29.15	30.00
Magnesium oxide,	6.06	3.89	4.66
Sulphuric acid,	36.00	31.58	33.00
Carbonic acid,	8.80	7.20	8.20
Insoluble matter,	12.00	8.28	9.83

* Contains 1 sample of Cayuga plaster.

Gypseous Shale (1 Analysis).

	Per cent.
Calcium sulphate,	38.55
Calcium carbonate,	11.05
Magnesium carbonate,	2.65
Insoluble matter,	37.15

Gas-house Lime (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	33.55	11.01	22.28
Calcium oxide,	45.80	40.00	42.66
Magnesium oxide,	8.30	8.30	8.30
Sulphuric acid,*	20.73	20.73	20.73
Insoluble matter,	15.00	.40	6.05

* Sulphuric acid includes all forms of sulphur present.

Lime Waste.

	Per Cent.		
	Liquid from Lime-vats (evaporated).	Mass from bottom of Lime-vats.	Lime waste from Sugar Factory.
Moisture at 100° C.,	11.50	17.54	36.30
Ash,	41.00	65.24	–
Calcium oxide,	23.40	47.80	27.51
Magnesium oxide,	–	–	Trace.
Potassium oxide,	–	–	.22
Phosphoric acid,	.77	.81	2.25
Nitrogen,	6.87	1.06	–
Insoluble matter,	.10	5.50	.32

Lime-kiln Ashes (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	30.70	.20	15.45
Calcium oxide,	50.16	36.00	43.08
Magnesium oxide,	4.45	1.26	2.60
Potassium oxide,	1.70	.02	.86
Phosphoric acid,	3.16	Trace.	1.18
Carbonic acid,	39.36	9.66	16.66
Insoluble matter,	53.77	3.30	14.54

Marls * (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	55.80	.60	18.18
Calcium oxide,	50.61	20.72	40.07
Magnesium oxide,	1.03	.22	.64
Iron and alumina,	1.00	.36	.69
Phosphoric acid,	2.72	.07	1.05
Carbonic acid,	40.38	16.63	28.51
Insoluble matter,	3.44	3.44	3.44

* Massachusetts.

Virginia Marl.

	Per Cent.	
	2 feet below Surface.*	4 feet below Surface.†
Moisture at 100° C.,	16.70	15.26
Calcium oxide,	9.21	5.29
Magnesium oxide,	.25	.16
Potassium oxide,	.61	.37
Phosphoric acid,	.09	.08
Sulphuric acid,	1.00	.31
Carbonic acid,	4.23	1.76
Insoluble matter,	59.59	68.86

* No. 1 contained a large amount of shells. † No 2 was largely sand.

Wood Ashes. (Canada.) (87 Analyses.)

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	28.57	.70	12.00
Calcium oxide,	50.89	18.00	34.44
Magnesium oxide,	7.47	2.28	3.50
Iron oxide,	–	–	.83
Potassium oxide,	10.24	2.49	5.50
Phosphoric acid,	3.99	.29	1.85
Insoluble matter,	24.10	2.10	12.50

Cotton-seed Hull Ashes (23 Analyses).

Moisture at 100° C.,	26.81	2.30	7.33
Calcium oxide,	39.75	3.35	10.00
Magnesium oxide,	17.15	2.02	9.50
Iron oxide,	–	–	1.50
Potassium oxide,	42.12	5.00	20.95
Phosphoric acid,	13.67	.76	7.52
Insoluble matter,	32.48	5.38	11.79

Ashes of Spent Tan-bark (3 Analyses).

Moisture at 100° C.,	7.45	4.87	6.31
Calcium oxide,	37.26	31.35	33.46
Magnesium oxide,	5.10	2.57	3.55
Potassium oxide,	2.87	1.14	2.04
Phosphoric acid,	2.77	.13	1.61
Insoluble matter,	24.33	24.33	24.33

Ashes of Waste Products.

	Per Cent.		
	Chestnut R. R. Ties.	Logwood.	Mill.
Moisture at 100° C.,	6.15	1.50	.53
Calcium oxide,	4.71	3.90	34.93
Magnesium oxide,	1.80	Trace.	1.35
Potassium oxide,	.19	.08	1.60
Phosphoric acid,	1.54	2.30	.46
Insoluble matter,	77.83	9.70	36.36

Hard Pine Wood Ashes.

	Per cent.
Moisture at 100° C.,	.75
Calcium oxide,	24.95
Magnesium oxide,	8.39
Potassium oxide,	10.16
Phosphoric acid,	2.24
Insoluble matter,	29.90

Nitrate of Potash (2 Analyses).

	Per cent.	
Moisture at 100° C.,	1.75	2.10
Potassium oxide,	44.76	45.62
Nitrogen,	11.60	14.58
Insoluble matter,	Trace.	

Nitrate of Soda (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	2.00	.85	1.25
Sodium oxide,	70.97	35.00	35.50
Calcium oxide,	.41	Trace.	Trace.
Magnesium oxide,	.04	Trace.	Trace.
Nitrogen,	16.26	14.44	15.75
Sulphuric acid,	.20	Trace.	Trace.
Chlorine,	2.52	.20	.50
Insoluble matter,	.90	.24	.50

Saltpetre Waste from Gunpowder Works (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.24	.50	2.75
Potassium oxide,	30.94	4.65	18.00
Sodium oxide,	45.92	22.08	34.00
Calcium oxide,	.83*	.71*	.75
Magnesium oxide,	.28*	.09*	.19
Nitrogen,	3.30	.80	2.43
Sulphuric acid,	4.85*	.84*	2.85
Chlorine,	56.00	37.66	48.30

* Only estimations reported.

Nitre Salt-cake (2 Analyses).

Moisture at 100° C.,	6.71	5.34	6.03
Potassium oxide,	.87	Trace.	.87
Sodium oxide,	32.72	26.40	29.56
Nitrogen,	2.29	–	2.29
Sulphuric acid,	48.85	46.69	47.77
Insoluble matter,	4.12	3.73	3.92

Sulphate of Ammonia (22 Analyses).

Moisture at 100° C.,	2.40	.13	1.00
Nitrogen,	22.23	19 70	20.50
Sulphuric acid,	70.70	57.68	60.00
Insoluble matter,	–	–	Trace.

Ammonite.

	Per cent.
Moisture at 100° C.,	5.88
Phosphoric acid,	3.43
Nitrogen,	11.33
Insoluble matter,	1.38

Dried Blood (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	21.52	7.65	12.50
Ash,	10.04	3.56	6 37
Phosphoric acid,	6.23	1.53	1.91
Nitrogen,	13.55	7.80	10.52

Refuse Materials (Animal).

	Per Cent.		
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.
Moisture at 100° C.,	8.54	39.24	7.25
Ash,	14.42	33.53	–
Calcium oxide,	–	–	3.94
Magnesium oxide,	–	–	1.27
Phosphoric acid,	.88	–	3.19
Nitrogen,	12.12	5.26	2.43
Insoluble matter,	.96	8.44	39.05

Horn and Hoof Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.27	10.08	10.17
Ash,	14.62	1.05	7.63
Phosphoric acid,	–	–	2.30
Nitrogen,	16.10	11.84	14.47
Insoluble matter,	–	–	.24

Wool Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.12	8.43	9.27
Nitrogen,	6.25*	5.00	5.62

* Saturated with oil.

Raw Wool and Wool Washings.

	Per Cent.			
	Raw Wool.	Water Washings.	Acid Washings.	Liquid from Wool Washings.
Moisture at 100° C.,	6.95	–	–	92.03
Ash,	7.54	–	–	3.28
Fat,	3.92	–	–	–
Calcium oxide,	–	.28	.61	.04
Magnesium oxide,	–	None.	.20	Trace.
Potassium oxide,	–	3.92	4.20	1.09
Sodium oxide,	–	.49	.40	.92
Nitrogen,	12.88	–	–	.09
Insoluble matter,	3.63	–	–	.22

Meat Mass (6 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	18.75	8.16	12.09
Ash,	14.66	2.90	13.60
Total phosphoric acid,	3.58	.56	2.07
Nitrogen,	11.50	9.69	10.44
Insoluble matter,	.77	.40	.58

Refuse from Rendering Establishments.

	Per Cent.					
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap Grease Refuse. I.	Soap Grease Refuse. II.
Moisture at 100° C.,	82.92	14.80	10.80	92.14	38.79	19.70
Ash,	7.07	8.40	7.50	–	43.13	59.65
Phosphoric acid,	1.26	.53	.46	.14	11.04	15.37
Nitrogen,	1.14	9.97	14.47	1.12	2.21	4.20
Insoluble matter,	–	.64	.26	–	1.20	1.37

Bones (103 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.90	3.05	7.47
Ash,	74.90	37.25	56.07
Total phosphoric acid,	29.83	12.06	22.50
Soluble phosphoric acid,	.76	.10	.43
Reverted phosphoric acid,	16.78	2.24	6.50
Insoluble phosphoric acid,	23.37	8.13	15.70
Nitrogen,	6.75	1.50	4.12
Insoluble matter,	6.00	.04	2.00

Tankage (12 Analyses).

Moisture at 100° C.,	28.09	5.46	14.61
Ash,	37.06	19.40	23.23
Total phosphoric acid,	14.60	8.00	10.67
Soluble phosphoric acid,	.27	.27	.27
Reverted phosphoric acid,	–	–	3.25
Insoluble phosphoric acid,	–	–	8.79
Nitrogen,	8.07	5.82	7.08
Insoluble matter,	2.00	.56	1.23

Fish containing 20 per cent. or less of Moisture (47 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	19.88	6.61	13.24
Ash,	72.23	15.99	20.00
Total phosphoric acid,	16.64	4.33	8.25
Soluble phosphoric acid,	1.70	.37	.55
Reverted phosphoric acid,	4.57	1.78	2.17
Insoluble phosphoric acid,	7.16	2.11	3.80
Potassium oxide,	.45	.45	.45
Nitrogen,	10.24	3.87	7.05
Insoluble matter,	4.99	.74	2.50

Fish containing between 20 per cent. and 40 per cent. of Moisture (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	38.11	20.58	29.34
Ash,	36.50	16.87	24.14
Total phosphoric acid,	8.90	5.60	7.25
Soluble phosphoric acid,	–	–	.82*
Reverted phosphoric acid,	–	–	2.87*
Insoluble phosphoric acid,	–	–	3.99*
Potassium oxide,	–	–	.85†
Nitrogen,	7.41	4.22	5.81
Insoluble matter,	2.89	.82	1.85

* Fish pomace. † Dry ground fish.

Fish containing 40 per cent. and more of Moisture (12 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	50.58	40.35	45.46
Ash,	20.78	1.92*	12.50
Total phosphoric acid,	8.56	1.02*	5.08
Soluble phosphoric acid,	1.51	.83	1.17
Reverted phosphoric acid,	2.02	.64	1.33
Insoluble phosphoric acid,	3.62	1.88	2.75
Nitrogen,	7.60	2.43	4.97
Insoluble matter,	2.44	.16	1.35

* Fish-liver refuse.

Whale Flesh.

	Per Cent.			
	Raw.	Dry (with Fat).	Dry (without Fat).	Whale Scrap.
Moisture at 100° C.,	44.50	–	–	9.51
Ash,	1.04	1.86	3 20	11.74
Fat,	22.81	40.70	–	–
Flesh,	32.10	57.44	96.80	–
Nitrogen,	4.86	8.68	14.60	9.64

Lobster Shells.

	Per cent.
Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	.27

Peruvian Guano (26 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.61	7.02	14 81
Ash,	61.65	13.58	37.61
Total phosphoric acid,	23.10	3.43	13.26
Soluble phosphoric acid,	8.80	.35	4.57
Reverted phosphoric acid,	6.20	1.38	3.79
Insoluble phosphoric acid,	16.50	4.67	10.58
Potassium oxide,	4.08	1.14	2.61
Nitrogen,	11.26	4.44	7.85
Insoluble matter,	11.91	1.30	6.60

Bat Guano (9 Analyses).

[One sample contained 1.31 per cent. potassium oxide.]

Moisture at 100° C.,	72.38	7.80	40.09
Ash,	72.14	4.34	38.24
Phosphoric acid,	6.53	1.00	3.76
Nitrogen as nitrates,	1.80	.24	1.02
Nitrogen as ammoniates,	3.42	1.49	2.45
Nitrogen in organic matter,	5.66	.34	3.00
Insoluble matter,	54.15	.20	2.00

Cuba Guano (7 Analyses).

Moisture at 100° C.,	36.85	12.10	24.27
Potassium oxide,	1.20	.14	.67
Phosphoric acid,	24.35	11.54	17.94
Nitrogen as nitrates,	1.00	.24	.62
Nitrogen as ammoniates,	.26	.14	.20
Nitrogen in organic matter,	1.48	.23	.85
Insoluble matter,	3.40	2.95	3.17

Caribbean Guano (Orchilla) (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.50	2.12	7.31
Calcium oxide,	45.00	34.91	39.95
Magnesium oxide,	4.13	2.46	3 29
Phosphoric acid,	35.43	18.11	26.77
Sulphuric acid,	2.36	1.80	2.08
Insoluble matter,	2.40	.17	1.27

South American Bone Ash.

	Per cent.
Moisture at 100° C.,	7.00
Calcium oxide,	44.89
Phosphoric acid,	35.89
Insoluble matter,	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	1.90	.10	1.50
Calcium oxide,	–	–	41.87*
Magnesium oxide,	–	–	3.03*
Iron and alumina oxide,	–	–	4.26*
Total phosphoric acid,	30.51	25.81	28.03
Soluble phosphoric acid,	–	–	.27*
Reverted phosphoric acid,	.47	.19	.33
Insoluble phosphoric acid,	30.31	25 07	27.69
Insoluble matter,	13.74	9.18	11.61

* Only estimate.

Navassa Phosphate (2 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	–	–	5.60*
Calcium oxide,	37.67	37.22	37.44
Iron oxide,	11.79	8.75	10.27
Alumina oxide,	–	–	4.24*
Phosphoric acid,	34.45	34.09	34.27
Insoluble matter,	–	–	2 70*

* Only one test.

Brockville Phosphate (1 Analysis).

	Per cent.
Moisture at 100° C.,	2 50
Phosphoric acid,	35.21
Insoluble matter,	6.46

Bone-black (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.65	1.55	4.60
Phosphoric acid,	30.54	23.47	28.28
Insoluble matter,	6.60	1.53	3.64

Phosphatic Slags.

[I. German phosphatic slag. II. English slag.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.10	.37
Calcium oxide,	41.87	49.82
Magnesium oxide,	3.03	–
Iron and alumina oxides,	4.26	–
Total phosphoric acid,	30.51	18.91
Soluble phosphoric acid,	–	–
Reverted phosphoric acid,	.19	5.93
Insoluble phosphoric acid,	30.32	12.98
Insoluble matter,	13.74	5.06

Castor Bean Pomace (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100 C.,	10.18	9.25	9.98
Calcium oxide,	.96	.77	.87
Magnesium oxide,	.37	.20	.29
Potassium oxide,	1.70	.64	1.12
Phosphoric acid,	2.22	2.03	2.16
Nitrogen,	5.72	5.33	5.56
Insoluble matter,	2.38	1.12	1.75

Cotton Refuse.

	Per Cent.			
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	Cotton Waste.
Moisture at 100° C.,	34.46	5.53	34.69	8.24
Ash,	50.93	–	–	–
Calcium oxide,	.90	1.45	2.45	2.52
Magnesium oxide,	.90	.87	1.13	.66
Potassium oxide,	.19	.89	.80	1.62
Phosphoric acid,	.21	.84	1.54	.83
Nitrogen,	.50	1.32	1.30	2.09
Insoluble matter,	47.46	49.68	41.33	20.10

Cotton-seed Meal (6 Analyses).

[I. Average of five analyses. II. Damaged.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.80	9.90
Ash,	5.77	–
Calcium oxide,	.39	.22
Magnesium oxide,	.99	.56
Potassium oxide,	.89	1.21
Phosphoric acid,	1.45	1.26
Nitrogen,	6.10	3.73
Insoluble matter,	.60	.20

Rotten Brewer's Grain.

	Per cent.
Moisture at 100° C.,	78.77
Calcium oxide,	.26
Magnesium oxide,	.15
Potassium oxide,	.04
Phosphoric acid,	.43
Nitrogen,	.72
Insoluble matter,	.59

Tobacco Stems (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.18	8.95	10.61
Ash,	15.00	13.30	14.07
Calcium oxide,	4.76	3.39	3.89
Magnesium oxide,	1.40	1.11	1.23
Potassium oxide,	8.82	3.34	6.44
Sodium oxide,	.68	.16	.34
Phosphoric acid,	.87	.44	.60
Nitrogen,	2.69	.90	2.29
Insoluble matter,	1.35	.29	.82

Refuse Materials (Vegetable).

	Per Cent.		
	Glucose Refuse.	Hop Refuse.	Sumac Waste.
Moisture at 100° C.,	8.10	8.98	63.06
Ash,	–	–	6.80
Calcium oxide,	.18	.27	1.14
Magnesium oxide,	.02	.10	3.25
Potassium oxide,	.15	.11	.17
Phosphoric acid,	.29	.20	–
Nitrogen,	2.62	.98	1.19
Insoluble matter,	.07	.63	2.25

Sea-weed.

	Per Cent.				
	Eel-Grass.		Rockweed.		Wet Kelp.
	I.	II.	Green.	Dry.	
Moisture at 100° C.,	45.61	25.17	68.50	10.68	88.04
Ash,	20.39	10.81	23.70	55.75	2.26
Calcium oxide,	1.56	2.70	–	7.66	–
Magnesium oxide,	.09	.12	–	.21	–
Potassium oxide,	1.61	.21	–	4.89	–
Sodium oxide,	2.51	.74	–	7.90	–
Phosphoric acid,	.41	.22	–	2.75	–
Nitrogen,	.70	.96	.62	1.45	.26
Insoluble matter,	.46	1.66	–	10.40	–

Sea-weed Ashes.

	Per cent.
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	.92
Sodium oxide,	8.76
Phosphoric acid,	.30
Sulphuric acid,	2.98
Sulphur,	.14
Chlorine,	6.60
Magnesium chloride,	.14
Insoluble matter,	63.65

Rockweed.

[I. Collected in May. II. Collected in December.]

	Per Cent.	
	I.	II.
Fresh wet rockweed lost, in air, of water,	78.700	65.920
Fresh wet rockweed lost, at 100° C., of water,	90.400	76.920
Air-dried rockweed contained, of vegetable matter,	88.220	89.000
Air-dried rockweed contained, of water,	11.780	11.000
The filled pods left, at 100° C., of solid organic matter,	7.360	–
The fresh stems left, at 100° C., of solid organic matter,	30.650	–
The slime of the pods, dried at 100° C., contained, of nitrogen,	2.920	–
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	2.286	1.721
Rockweed, air-dried, contained, of nitrogen,	2 017	1.432
" fresh (wet), contained, of nitrogen,	.487	.397
" dried at 100° C., contained, ashes,	28.930	24.890
" air-dried, contained, ashes,	6.220	22.150
" fresh (wet), contained, ashes,	3.770	5.825
The slime of the pods contained, ashes,	49.356	–

One hundred parts of the ash contained (I.) : —

	Per cent.
Potassium oxide,	4 842
Sodium oxide,	12.050
Calcium oxide,	2.691
Magnesium oxide,	2.753
Ferric oxide,	.338
Sulphuric acid,	7.986
Phosphoric acid,	6.240

Mud.

	Per Cent.					
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.
Moisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37
Ash,	27.29	72.02	49.28	33.09	39.60	–
Calcium oxide,	.93	23.39	.90	.91	.91	1.27
Magnesium oxide,	.14	–	.31	.43	.66	.29
Potassium oxide,	6.17	–	.33	.32	.38	.22
Sodium oxide,	.70	–	.94	.94	.86	–
Ferric oxide,	3.48	8.26	4.55	3.70	4.26	1.80
Phosphoric acid,	.10	.35	Trace.	Trace.	Trace.	.26
Nitrogen,	.21	.72	.39	.40	1.64	1.37
Insoluble matter,	–	37.60	43.55	26.20	31.84	18.26

Soil from a Diked Marsh.

	Per cent.
Moisture at 100° C.,	33.40
Ash,	7.85
Calcium oxide,	1.24
Potassium oxide,	.26
Phosphoric acid,	.13
Nitrogen,	1.64
Insoluble matter,	3.65

Muck (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	89.89	12.03	55.13
Ash,	26.12	3.05	13.75
Nitrogen,	1.82	.26	.95

Peat (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	85.38	11.29*	61.50
Ash,	33.72	1.20	7.71
Calcium oxide,	–	–	.50
Nitrogen,	1.79	.41	.75
Insoluble matter,	–	–	.38

* German peat mass.

Turf (2 Analyses).

	Per Cent.	
	I.	II.
Moisture at 100° C.,	25.58	13.00
Ash,	3.28	9.43
Nitrogen,	1.91	1.97

Hen Manure.

	Per Cent.	
	Dried.	Fresh.
Moisture at 100° C.,	8.35	45.73
Calcium oxide,	2.22	.97
Magnesium oxide,	.62	–
Potassium oxide,	9 94	.18
Phosphoric acid,	2.02	.47
Nitrogen in organic matter,	1.85	.79
Nitrogen as ammoniates,	.28	
Insoluble matter,	34.65	39.32

Poudrette.

	Per cent.
Moisture at 100° C.,	5.25
Ash,	35.45
Potassium oxide,	49
Phosphoric acid,	5.74
Nitrogen,	3.58
Insoluble matter,	4.65

Valuation { K_2O = .02, P_2O_5 = .35, N = .54 — $.91

Miscellaneous.

	Per Cent.	
	Soot.	Ashes from Blue Works.
Moisture at 100° C.,	5.54	12.74
Organic and volatile matter,	22.90	36.22
Magnesium oxide,	–	Trace.
Potassium oxide,	1.83	9.02
Cyanogen compounds,	–	Trace.
Insoluble matter,	35.34	12.30

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS AND SUGAR-PRODUCING PLANTS, ETC.,

MADE AT

AMHERST, MASS.

1868–1889.

Prepared by Mr. W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with reference to Fertilizing Ingredients.

C. Analyses of Fruits.

D. Analyses of Sugar-producing Plants.

A. — *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained — Protein.			Fat.			Nitrogen — free extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	10	29.73	11.39	20.65	17.19	8.36	11.43	3.38	1.81	2.59	63.05	42.02	55.70	27.29	20.93	24.56	5.43	1:7.18
Fodder corn (ensilaged),	12	28.40	13.12	20.34	12.58	6.91	8.70	6.07	3.15	3.89	65.69	42.99	56.93	35.25	17.67	25.36	5.21	1:9.98
Whole ears (ensilaged),	1	-	-	49.73	-	-	6.63	-	-	7.84	-	-	75.68	-	-	8.50	1.35	-
Green oats,	2	28.82	21.39	25.11	7.10	7.05	7.08	2.44	2.02	2.23	50.69	50.38	50.54	33.12	32.83	32.97	7.19	1:13.14
Herds-grass (timothy),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.28	33.23	32.50	32.87	5.33	1:10.84
Hungarian grass,	1	-	-	25.93	-	-	9.38	-	-	1.01	-	-	57.80	-	-	24.67	7.15	1:6.86
Vetch and oats { 9 parts oats, 1 part vetch }	2	24.04	13.89	18.97	10.76	10.59	10.68	2.74	2.29	2.52	43.75	40.10	41.98	35.81	34.20	35.01	9.88	1:7.04
Horse bean,	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1:2.71
Cow-pea,	1	-	-	19.55	-	-	17.93	-	-	2.62	-	-	46.13	-	-	25.88	7.44	1:11.71
White lupine,	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Serradella,	1	-	-	15.40	-	-	17.75	-	-	2.65	-	-	41.54	-	-	26.21	11.85	1:4.07
II. Hay and Dry Coarse Fodders.																		
Fodder corn,	3	93.35	91.17	92.62	8.63	6.17	7.21	2.06	1.11	1.53	55.68	53.86	54.98	33.75	29.05	31.40	4.88	1:11.85
Corn stover,	6	93.05	75.00	83.73	12,15	6.47	8.21	2.63	1.27	2.09	63.05	48.82	54.65	36.10	20.93	30.41	4.66	1:10.43
Oats (in blossom),	1	-	-	93.57	-	-	6.58	-	-	2.92	-	-	50.03	-	-	34.06	6.41	1:14.23

Oats (seed in milk),	1	-	-	90.45	-	-	10.89	-	-	2.69	-	-	46.02	-	-	34.32	6.08	1:7.90
Oats (ripe),	1	-	-	91.30	-	-	6.05	-	-	2.61	-	-	48.92	-	-	36.31	6.11	1:15.03
Winter rye,	1	-	-	91.45	-	-	10.66	-	-	2.57	-	-	47.40	-	-	32.97	6.40	1:8.28
Barley (seed in milk),	1	-	-	89.75	-	-	10.26	-	-	2.76	-	-	52.91	-	-	29.12	4.95	1:9.59
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.63	35.91	29.80	33.54	5.49	1:7.78
English hay,	3	91.70	89.22	90.12	9.75	8.75	9.12	2.65	2.55	2.61	54.43	45.96	50.59	35.55	29.21	31.65	5.97	1:10.24
Rowen (field-cured),	2	91.16	80.29	85.73	14.70	13.20	13.95	4.96	3.05	4.01	43.79	41.92	42.86	29.46	29.43	29.45	9.75	1:6.12
Rowen, ensilaged (air-dry),	1	-	-	81.56	-	-	12.34	-	-	6.98	-	-	43.99	-	-	27.93	8.76	-
Herds-grass (timothy),	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.75	36.59	29.21	32.90	4.85	1:11.44
Red-top,	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.67	34.11	31.12	32.92	4.97	1:12.06
Orchard grass,	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue,	2	92.60	91.97	92.21	7.27	7.02	7.15	2.17	1.78	1.98	49.18	48.16	48.67	34.61	34.46	34.54	7.68	1:12.98
Barn-yard grass,	1	-	-	93.35	-	-	15.27	-	-	1.95	-	-	38.24	-	-	33.72	10.82	1:2.94
Hungarian grass,	1	-	-	92.55	-	-	9.45	-	-	2.22	-	-	50.64	-	-	31.96	5.73	1:6.22
White daisy,	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Lucerne (alfalfa),	3	91.67	84.00	89.09	16.34	11.12	13.47	2.50	1.54	2.03	51.62	45.29	48.74	28.54	25.42	27.27	8.49	1:4.30
Sand lucerne,	1	-	-	91.20	-	-	16.26	-	-	2.59	-	-	50.31	-	-	21.27	9.57	1:3.50
Alsike clover,	2	91.70	91.36	91.53	17.32	14.97	16.15	3.26	2.89	3.08	44.94	44.63	44.79	26.28	21.44	23.86	12.14	1:4.96
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.94	23.58	19.06	21.67	9.29	1:4.82
Serradella,	2	92.80	91.30	92.05	17.85	15.26	16.56	2.91	2.37	2.64	50.23	49.54	49.89	25.14	24.37	24.76	6.17	1:4.97
Vetch,	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.82	30.68	30.05	30.37	8.24	1:3.87
Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55

A.—*Analyses of Fodder Articles*—Concluded.

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained—													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen—Free Extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	4	14.51	13.05	13.92	12.17	7.82	10.47	1.76	.79	1.06	79.33	70.98	74.29	6.23	4.29	5.13	8.56	-
Beets, sugar,	6	19.53	14.01	16.48	17.44	7.32	11.63	.83	.39	.62	81.39	72.79	75.70	6.98	5.27	6.17	4.33	1:9.12
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.78	9.54	7.08	7.94	9.06	1:10.07
Ruta-bagas,	2	12.77	11.60	12.19	11.16	10.34	10.75	2.32	1.23	1.78	68.58	65.68	67.13	11.60	11.03	11.32	9.03	1:12.29
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	2	12.52	9.98	11.25	9.63	8.90	9.27	3.94	1.89	2.92	73.96	67.24	70.60	10.76	7.55	9.16	8.07	1:9.39
Potatoes,	9	21.95	13.91	18.78	13.56	9.58	10.48	.83	.27	.51	81.74	78.80	80.76	3.55	1.91	2.85	5.41	1:11.64
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.33	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	21	91.98	87.90	89.55	15.02	8.80	12.75	9.43	4.25	5.62	82.64	71.06	77.85	3.38	1.86	2.42	1.70	1:8.50
Corn kernels and cobs,	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.63	9.77	5.39	7.34	1.67	1:8.63
Wheat, grain,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18	1:6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24

V. FLOUR AND MEAL.																			
Corn meal,	17	89.29	82.96	87.14	16.08	10.07	11.30	5.74	3.10	4.46	83.24	73.20	79.87	3.92	1.56	2.73	1.65	1:8.79
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	0.33	78.07	68.00	72.27	4.78	3.69	4.08	2.71	1:8.82
Broom-corn meal,	1	–	–	86.46	–	–	11.14	–	–	4.13	–	–	74.30	–	–	8.00	2.43	–
VI. BY-PRODUCTS AND REFUSE.																			
Cotton-seed meal,	7	93.16	90.11	91.92	47.04	18.17	42.22	14.72	5.22	13.48	54.55	25.03	27.89	14.80	6.28	8.22	8.06	1:1.45
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.07	51.40	40.24	45.82	3.07	–
Wheat bran,	12	90.75	86.30	89.03	20.24	15.67	17.79	6.08	2.80	4.61	62.18	56.89	59.58	14.26	7.60	11.18	6.84	1:3.78
Wheat middlings,	3	90.75	89.45	90.45	19.21	17.23	18.21	6.46	3.19	4.63	74.30	61.62	69.52	8.40	1.40	4.11	3.45	1:4.10
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.40	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	–	–	87.46	–	–	13.15	–	–	5.61	–	–	73.52	–	–	3.70	4.02	1:7.28
Gluten meal,	11	91.57	88.32	90.39	39.28	28.24	32.07	9.34	3.92	6.71	66.26	48.84	59.68	4.74	.27	1.16	.38	1:2.54
Refuse from starch works,	1	–	–	42.96	–	–	22.41	–	–	10.17	–	–	58.98	–	–	7.54	.90	–
Spent brewers' grain,	1	–	–	93.02	–	–	20.49	–	–	1.05	–	–	55.51	–	–	15.90	6.15	–
Linseed cake,	1	–	–	91.65	–	–	37.25	–	–	5.69	–	–	40.85	–	–	8.69	7.52	1:1.62
Pea meal,	1	–	–	91.15	–	–	20.95	–	–	1.67	–	–	55.02	–	–	19.42	2.94	1:2.07
Broom-corn waste,	1	–	–	91.30	–	–	6.78	–	–	1.00	–	–	48.09	–	–	39.25	4.88	–
Cocoa dust,	1	–	–	92.90	–	–	15.47	–	–	25.85	–	–	45.99	–	–	5.86	6.83	–
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	71.57	16.58	13.15	14.86	1.46	–
Apple pomace (ensilage),	1	–	–	14.67	–	–	8.22	–	–	7.36	–	–	58.03	–	–	22.18	4.21	–
Sugar-beet pulp,	1	–	–	10.32	–	–	12.41	–	–	.05	–	–	61.86	–	–	23.74	1.04	1:7.10
Corn cobs,	4	–	–	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.79	33.77	31.36	32.93	1.21	1:30.85

B.—*Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
I. GREEN FODDERS.												
Fodder corn,	3	71.96	4.84	.52	.08	.24	.09	.03	.21	.64	.57	$3.76
Fodder corn (ensilaged),	1	71.60	–	.33	.05	.10	.09	.02	.14	.36	.04	1.68
Vetch and oats,	1	86.11	1.72	.79	.03	.09	.03	.01	.09	.23	.33	1.58
Cow-pea,	2	79.63	1.77	.45	.06	.44	.12	.01	.11	.42	.11	1.94
Serradella,	2	82.59	1.82	.42	.09	.46	.67	.02	.14	.41	.10	1.92
White lupine,	1	85.35	.74	1.73	.68	3.07	.73	.17	.35	.44	.90	3.39
Horse bean (whole plant),	1	74.71	–	1.37	.09	1.37	.62	.20	.33	.68	2.04	3.87
II. HAY AND DRY COARSE FODDER.												
Fodder corn,	5	–	4.91	.76	.10	.60	.69	.07	.51	1.80	1.65	7.38
Corn stover,	1	24.87	3.86	1.47	.79	.31	.09	.03	.20	1.00	1.32	4.89
Rowen,	1	8.84	9.57	2.86	.12	.85	.20	.06	.36	1.93	2.18	9.50
Herds-grass (timothy),	2	7.52	4.93	1.53	.22	.71	.10	–	.46	2.26	1.17	5.42
Red-top,	4	7.71	4.59	1.02	.44	.57	.13	.04	.36	1.15	1.74	5.21
Orchard grass,	4	8.84	6.42	1.88	.23	.46	.30	.03	.41	1.31	2.66	6.54

Meadow fescue,	2	7.71	7.08	2.00	.11	.50	.14	.03	.23	1.05	1.68	5.55
White daisy,	1	9.65	6.37	1.25	.16	1.30	.20	.03	.44	.28	1.11	2.54
Lucerne (alfalfa),	2	8.37	6.82	1.46	1.08	2.02	.42	.10	.45	1.76	.70	7.76
Alsike clover,	2	8.47	11.11	2.17	.40	1.74	.67	.33	.80	2.36	3.23	10.82
Serradella,	1	10.54	10.60	.26	.55	2.63	.39	-	.90	2 54	.21	11.93
Vetch and oats,	1	11.42	10.96	.50	.20	.56	.19	.08	.60	1.50	2.12	6.25
III Roots, Bulbs, Tubers, etc.												
Beets, red,	4	86.08	1.13	.45	.08	.05	.04	-	.10	.24	.03	1.32
Beets, sugar,	2	84.65	.80	.22	.15	.12	.09	.02	.08	.25	.07	1.14
Mangolds,	2	87.29	1.22	.38	.13	.06	.04	.01	.09	.19	.03	1.08
Ruta-bagas,	2	87.82	1.10	.50	.10	.09	.03	-	.13	.21	.01	1.30
Turnips,	1	87.20	1.01	.41	.13	.12	.03	.01	.12	.22	.07	1.22
Carrots,	1	90.02	-	.07	.11	.54	.02	.01	.10	.14	.01	1.06
Apples,	2	79.91	.41	.19	.03	.03	.03	-	.01	.13	-	.61
IV. Grains and Other Seeds.												
Corn kernels,	8	10.88	-	.44	.04	.02	.21	.01	.73	1.93	.02	7.81
Corn and cob,	4	10.00	1.45	.44	.12	.66	.16	-	.60	1.46	.09	6.05
V. Flour and Meal.												
Wheat meal,	1	9.83	1.22	.17	.11	.54	.05	-	.57	2.21	-	8.65
Hominy feed,	1	8.93	1.89	.18	-	.49	.28	-	.98	1.63	-	6.14

B. — *Analyses of Fodder Articles with Reference to Fertilizing Constituents* — Continued.

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
VI. By-Products and Refuse.												
Cotton-seed meal,	5	8.34	6.27	1.54	.17	.78	1.08	–	1.87	4.77	.58	$19.77
Cotton hulls,	3	10.13	2.61	1.08	–	.18	.26	–	.20	.75	.06	3.74
Wheat bran,	4	11.01	6.44	1.62	.18	.20	.90	.02	2.87	2.88	.13	14.61
Wheat middlings,	1	9.18	2.30	.63	.11	.20	.21	–	.95	2.63	–	10.63
Rye middlings,	1	12.54	3.52	.81	.03	.09	.32	.02	1.26	1.84	.17	8.46
Gluten meal,	3	8.75	.65	.05	.02	.03	–	.05	.40	5.21	–	18.23
Spent brewers' grain,	1	6.98	6.15	.30	.35	1.55	.29	.16	1.26	3.05	1.77	12.14
Linseed cake,	1	8.35	6.89	1.43	–	.64	.77	–	1.86	5.46	–	22.01
Pea meal,	1	8.85	–	.99	.62	.30	.30	.03	.82	3.08	.12	11.31
Broom-corn waste,	1	10.37	4.70	1.86	–	.24	.17	–	.46	.87	1.00	5.09
Cocoa dust,	1	7.10	6.35	2.11	–	.63	–	–	1.34	2.30	–	11.22
Apple pomace,	2	80.50	.27	.13	.03	.04	.03	.01	.02	.23	.01	.91

Note. — Basis of valuation, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide 4¼ cents per pound.

C. — *Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	* Soda Sol. required to neutralize 100 pts. Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), . . .	Sept. 1,	20.14	1.055	12-15	3.09	-	-	-
" " . . .	Oct. 9,	19.66	1.065	" "	6.25	-	-	-
" " . . .	Nov. 27,	-	1.075	" "	10.42	-	-	-
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	" "	3.16	-	-	-
" " " . .	Oct. 9,	19.68	1.066	" "	7.14	-	-	-
" " " † . .	Nov. 27,	20.25	1.080	" "	11.36	-	-	-
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	" "	4.77	-	-	-
" "	Sept. 7,	16.55	1.060	" "	5.68	-	-	-
" "	Sept. 20,	-	1.065	" "	8.62	-	-	-
" " ‡	Sept. 22,	-	1.060	" "	8.93	-	-	-
Cranberries, ...		10.71	1.025	15	1.35	-	-	-§
"	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe), . .	-	-	1.045	25	-	1.92	6.09	45
" " " (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42 3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
" " (mellow), .	-	11.36¶	1.055	18	-	1.70	8.94	76
" " (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. — *Analyses of Fruits* — Continued.

Wild and Cultivated Grapes.

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 pts. of Juice.
	1876.			Per ct.	Per ct.	Per ct.	C. C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	–
"	July 20,	1.0150	31	8.10	.625	7.72	216
"	Aug. 2,	1.0200	25	9.94	.938	9.44	249
"	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
"	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
"	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
"	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape,	July 19,	1.020	31	9.00	.714	7.93	204
" " "	Aug. 4,	1.020	28	12.25	1.100	8.98	249
" " "	Aug. 16,	1.025	28	12.48	2.000	16.03	233
" " "	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
" (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16 41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
"	Sept. 26,	1.075	24	19.34	15.43	79 78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
" " " (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2CO_3 in 100 parts water.

C. — *Analyses of Fruits* — Continued.

Effect of Girdling on Grapes.

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
" " girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
" girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
" girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
" girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
" girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
" girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
" not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
" girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
" not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
" girdled,	Oct. 5,	1.085	12	–	17.86	–	54

* One part of Na_2CO_3 in 100 parts of water.

C. — *Analyses of Fruits* — Continued.

Effect of Fertilization upon the Organic Constituents of Wild Grapes.

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per cent. of Grape Sugar.	Per cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
" " " " . .	"	19.55	–	–	13.51	–	Fertilized.
" " " Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
" " " " . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, . .	"	20.02	–	–	–	–	Unfertilized.
" " " " . .	"	21.65	–	–	–	–	Fertilized.
" " " Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
" " " " . .	"	–	–	–	14.29	.923	Fertilized.

Effect of Fertilization upon the Ash Constituents of Grapes.

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
" " "	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
" " .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	"
" " .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	"
" " .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	"
	1878.								
" " .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C.—*Analyses of Fruits*—Concluded.

Ash Analyses of Fruits and Garden Crops.

	Ash.	100 Parts of Ash contained—						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord grape (fruit),	-	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	-	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	-	40.69	-	6.85	6.24	-	9.04	-
Skins and pulp,	-	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	-	-	3.03	-	17.20	.29
Stems of grapes,	4.69	20.91	-	20.20	8.45	-	17.75	2.09
Young branches, *	-	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	-	9.72	4.28	-	14.07	23.84
Clinton grape (fruit),	-	58.45	3.51	13.34	7.37	.90	18.19	-
Baldwin apple,	-	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),‡	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
" " §	-	58.47	-	14.64	6.12	3.37	17.40	-
" vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	-	14.27	-
" vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	-
" white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	-
Crawford peach, sound,	-	74.46	-	2.64	6.29	.58	16.02	-
" " diseased,‖	-	71.30	-	4.68	5.49	.46	18.07	-
Branch, sound,	-	26.01	-	54.52	7.58	.52	11.37	-
" diseased, ‖	-	15.67	-	64.23	10.28	1.45	8.37	-
Asparagus stems,	-	42.94	3.58	27.18	12.77	1.22	12.31	.08
" roots,	-	56.43	5.42	15.48	7.57	-	15.09	3.67
Onions,	-	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. — *Analyses of Sugar-producing Plants.*

Composition of Sugar Beets raised upon the college grounds during the season of 1870 and 1871.

NAME.	Date.	Brix Saccharometer (Degrees).	Per cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

Percentage of Sugar in Different Varieties of Sugar Beets grown on college farm during the season of 1882.

NAME.	Source of Seed.	Weight in Pounds.	Per cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. "	"	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	"	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. " "	"	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	"	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, . . .	"	$1\frac{1}{2}$ to 2	13.10
II. " " . . .	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Soil and Fertilization on Electoral Sugar Beets.*

Soil.	Manure.	Specific Gravity Brix (Degrees).	Per cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	" " " .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard manure and chemicals, . . .	12.75	9.17	3.58	71.92
" " .	Fresh hog manure, .	13.5	9.53	3.97	70.06
Light sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm.

Effect of Fertilization on Sugar Beets.*

Fertilizers.	Percentages of Sugar in Juice.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . .	12.55	13.24	10.50
Kainite and superphosphates, . .	13.15	12.16	10 50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam.

D.— *Analyses of Sugar-producing Plants* — Continued.

Effect of Different Modes of Cultivation on Electoral Sugar Beets.

Locality of Beet-field.	Brix Saccharometer (Degrees).	Per cent. of Cane Sugar.	Non-saccharine Substances.
Sing Sing, N. Y.,	11	7.80	3.20
Washington, N. Y.,	14	10.97	3.03
South Hartford, N. Y.,	15	11.70	3.30
Greenwich, N. Y.,	12	9.50	2.50
Frankfort, N. Y.,	13.5	11.00	2.50
Albion, N. Y.,*	18	15.10	2.90
" " †	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 12 lbs.

D. — *Analyses of Sugar-producing Plants* — Continued.

Early Amber Cane.

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Sol. required to neutralize 100 pts. of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,*	4.2	27	2 48	None	6.8	7.93
Aug. 16, .	" " " " *	5.8	24	4.06	None	9.0	11.10
Aug. 20, .	Flower stalks developed,* . . .	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* . .	13.2	22	3.57	7.65	-	-
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	-	-
Sept. 18, .	Tops and leaves removed on Sept. 9,* .	11.5	22	3.16	5.85	-	-
Sept. 18, .	Tops removed; left on field 9 days,* .	12.8	22	10.00	.60	-	-
Sept. 21, .	Juice from the above,*	13.0	21	-	-	-	-
Sept. 23, .	" " " *	15.0	18	-	-	-	-
Sept. 25, .	Left on field 3 weeks,†	19.8	21	11.91	6.27	-	-
Sept. 28, .	" " " †	17.8	12	16.60	-	-	-
Oct. 4, .	" " " †	16.1	17	8.62	6.16	12.0	-
Oct. 7, .	Freshly cut. Ground with leaves,† .	16.7	20	4.16	9.94	6.8	-
Oct. 8, .	" " Stripped 2 weeks,† . .	12.8	17	5.16	5.27	7.0	-
Oct. 9, .	" " " " † . .	18.4	17	7.57	-	10.6	-
Oct. 14, .	Several weeks old,†	18.2	15	10.42	-	10.4	-
Oct. 18, .	" " " †	15.1	23	7.57	-	-	-
Oct. 19, .	" " " †	15.5	15	9.22	-	13.6	-
Oct. 22, .	" " " †	16.2	16	8.30	-	-	-
Oct. 23, .	" " " †	18.3	17	11.30	5.5	14.0	-
Oct. 24, .	" " " †	16.6	15	8.63	-	9.0	-

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. — *Analyses of Sugar-producing Plants* — Concluded.

Composition of the Juice of Corn Stalks and Melons.

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4 85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
" "	1.025	19	3 84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
" " ¶	1.050	20	2.27	5.38	–
" " **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

Dairy Products.

NAME.	Volatile Matter and Moisture at 100° C.	Ash.	Fat.	Casein.	Non-nitrogenous Extract.
Whole milk, ...	87.40	.70	4.00	3.20	4.70
Skim milk, ...	89.81	.80	.37	3.53	5.49
Buttermilk, ...	91.84	.80	.21	2.79	4.36
Whole milk cheese (Jersey),* .	37.16	3.39	37.32	22.13	–
Whole milk cheese,* . . .	35.83	3.14	34 34	26.69	–
Cheese from milk skimmed after 12 hours' standing,* . .	37.30	4.52	27.81	30.37	–
Cheese from milk skimmed after 24 hours' standing,* . .	42.24	2.35	23.42	31.99	–
Cheese from milk skimmed after 36 hours' standing,* . .	43.95	5.14	17.67	33.24	–
Cheese from milk skimmed after 48 hours' standing,* . .	45.41	3.88	15.77	34.94	–
Cheese from skim milk with addition of buttermilk,* . .	48.38	4.64	18.35	28.63	–
Genuine oleomargarine cheese,*	37.90	4.50	31.66	25.94	–

* From analyses made in 1875.

METEOROLOGY.

The meteorological observations of the past year have been a continuation of those of preceding years, being on the same general plan as recommended to voluntary observers of the United States Signal Service. Observations are made at 7 A.M., 2 P.M. and 9 P.M., and include observations of temperature, quantity and movements of the clouds, direction of the wind, the humidity of the air during the summer months, rain and snow fall, and of casual phenomena.

January opened with 4 inches of snow and good sleighing, which continued through the larger part of the month. On the 26th, a heavy snow-storm. At the close of the month the snow averaged about 18 inches. Quite a depth of snow remained on the ground until the thaw of the 20th of February. The snowfall for the month of February amounted to 9.5 inches. At the close of the month there were 6 inches on the ground.

From the 11th to the 16th of March occurred the severest storm of the season. This storm is recorded as giving 16 inches of snow, which amounted to 3.35 inches of water. The storm was accompanied by high winds. The comparatively warm weather which followed took the snow off rapidly. At the close of the month there were but 2 inches of snow on the ground. The last storm of the season occurred on April 10, with a record of 1.5 inches of snowfall.

The rainfall for the year amounted to 58.04 inches, or an average of 4.84 per month. According to the observations at Amherst, this is the heaviest since they were begun in 1836.

The average rainfall for the years 1836–1888 amounts to 44.34 inches. The smallest rainfall during this time was in

1864, 34.44 inches; this was preceded, however, by a rainfall of 56.19 inches in 1863, which is, next to 1888, the highest for the period.

The largest rainfall during any one month was 10.70 inches in September. This record for one month has been exceeded only five times during the period covered by the Amherst observations (1836–1889). The rainfall was pretty evenly distributed throughout the rest of the year.

The mean annual temperature for the year is 43.98°. The average for the period from 1837–88 is 46.81. The average for the year 1875 was 44.22, which is the lowest except for the year 1888. The highest average thus far for any year has been 49.47°, in 1878. January, 1888, was the coldest month since 1837, being 9.5 lower than the average for that period. The temperature for October has been lower but once, — 1841, — and for April and July but twice, since the records began. The temperature for June, August and November was the average for those months, while December shows a considerably higher mean. February, March, May and September were considerably below the average. The weather during the growing months was quite favorable to the grass crop, but corn suffered considerably from the wet weather. The latter was unfavorable for the curing of both these crops.

The last killing frost of the season occurred May 8; the first in the autumn, September 7. The average date of the first killing frost in this vicinity is September 20. Light frost occurred May 16 and September 6. Snow-squalls occurred October 9; the first snow-storm happened November 25. This snowfall, amounting to 5 inches, was the only appreciable one during the month. The snow disappeared quickly. In December there were two slight storms, amounting to less than 3 inches.

The prevailing direction of the wind for the year was N. W. It was north-west in January, February, March, April, June, July, August, September, October and December; south-west in May, and north-east in November.

The number of days when the sky was less than four-tenths covered by clouds, clear days, was 58; the greatest number, 9, being in January, and the fewest, 1, in August.

There were 97 "cloudy" days, or those when the sky was more than seven-tenths covered by clouds. March and October had 12 cloudy days each; April and July the fewest, 3 each. The remaining days were variable, being partly cloudy and partly fair.

The highest temperature of the year was 94.5°, occurring July 23; the lowest, —21.5°, occurring January 23. The maximum for the previous year, 1887, was 93.6°, on the 2d of July, and the minimum was —22.2°, on the 19th of January. The absolute range of temperature for 1888 was 116°, practically the same as for 1887, 1° less than for 1886.

Summary of Meteorological Observations, 1888.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A.M.	2 P.M.	9 P.M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . . .	11.0	18.6	12.9	13.78	28.9	—3.5	32.4	41.0	2d	—21.5	23d	-	-	-	-	3.87	1st
February, . .	16.1	28.7	22.1	22.05	36 9	.3	36.6	49.0	14th	—19.0	10th	-	-	-	-	3.94	20th
March, . . .	22.2	32.5	26.3	26.82	41.9	18.8	23.1	49.0	21st	—3.0	19th	-	-	-	-	5.96	11th to 14th
April, . . .	35.8	49.2	39.5	40.44	67.3	28.3	39.0	84.0	29th	15.0	9th	-	-	-	-	3.08	5th
May, . . .	49.6	62.7	53.2	54.70	68.0	39.7	28.3	80.0	29th	26.0	3d	82.7	61 3	79.3	74.4	4.29	11th
June, . . .	61.5	74.1	63.6	65.82	79.2	56.4	22.8	94.5	23d	38.0	2d	81.4	60.4	77.7	73.1	5.40	23d
July, . . .	61.6	76.5	65.5	67.20	73.4	60.2	13.2	85.5	5th	46.0	14th, 18th	82.9	53.1	78.6	71.5	3.63	19th to 20th
August, . . .	63.1	75.4	65.5	67.38	78.6	57.0	21.6	87.0	16th	42.0	23d	85.5	61.5	83.0	76.7	4.29	12th to 13th
September, . .	52.6	65.1	56.0	57.10	70.9	36.9	34.0	76.0	2d, 17th	25.0	30th	93.3	63.0	86.5	80.9	10.70	20th to 21st
October, . .	38.7	49.2	42.1	43.12	56.0	35.1	20.9	66.0	5th	26.0	11th	89.0	65.2	82.1	78.1	5.19	6th to 7th
November, . .	35.2	47.9	38.0	38.93	59.6	13.9	45.7	71.0	2d	5.7	23d	-	-	-	-	3.91	8th to 10th
December, . .	26.4	35 4	29.9	30.40	49 4	9.4	40.0	56.5	25th	3.5	14th	-	-	-	-	3.78	16th to 18th
Sums, . .	473.8	615.3	514.6	527.74	710.1	352.5	357.6	839.5	-	188.7	-	514.8	364.5	487.2	451.7	58.04	-
Means, . .	39.5	51.3	42.9	43.98	59.2	29.4	29.8	70.0	-	15.7	-	85.8	60.8	81.2	72.5	4.84	-

Miscellaneous Phenomena — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.
January,	-	4, 8, 10, 13, 17, 25, 26,	1, 15,	-	-
February,	-	4, 7, 10, 11, 18, 25,	4, 8, 20, 25,	-	24
March,	-	2, 11, 12, 13, 21, 26,	20, 21, 22, 26, 27, 28,	-	25
April,	4, 17, 23, 24, 25,	10,	1, 2, 5, 10, 12, 14, 18, 20,	5,	-
May,	3, 8, 16,	-	1, 5, 8, 10, 11, 12, 13, 14, 15, 16, 18, 28, 29,	14,	21
June,	-	-	6, 7, 14, 15, 20, 21, 23, 24, 26, 28, 30,	6, 14, 15, 21, 23, 24, 30	-
July,	-	-	1, 5, 9, 11, 19, 20, 27, 31,	1, 5, 11,	-
August,	-	-	4, 5, 6, 12, 13, 17, 21, 22,	4, 17,	18
September,	6, 7, 29, 30,	-	1, 8, 12, 16, 17, 18, 20, 21, 26,	20, 21,	15
October,	1, 3, 4, 11, 15, 19, 22, 26, 30,	-	1, 2, 6, 7, 12, 13, 14, 16, 17, 19, 24, 27, 28,	-	-
November,	13, 17, 21, 22, 23, 24,	25,	3, 8, 9, 10, 15, 16, 19, 26, 27, 29,	-	14
December,	3, 7, 21, 22,	4, 9,	6, 11, 16, 17, 18, 27,	-	15

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter beginning with the year 1836.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23.026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24.510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25.276	1867, . . .	67.920

Record of Temperature, etc.—Concluded.

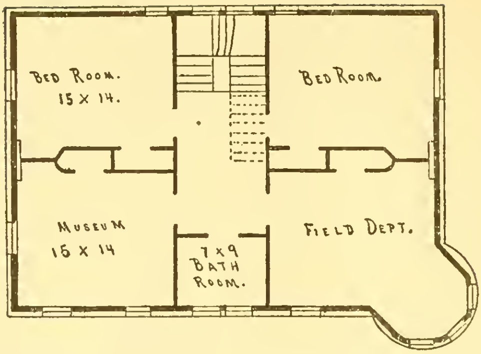
December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30.506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24 220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893

JAMES P. LYNDE, *Treasurer, in Account with the* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

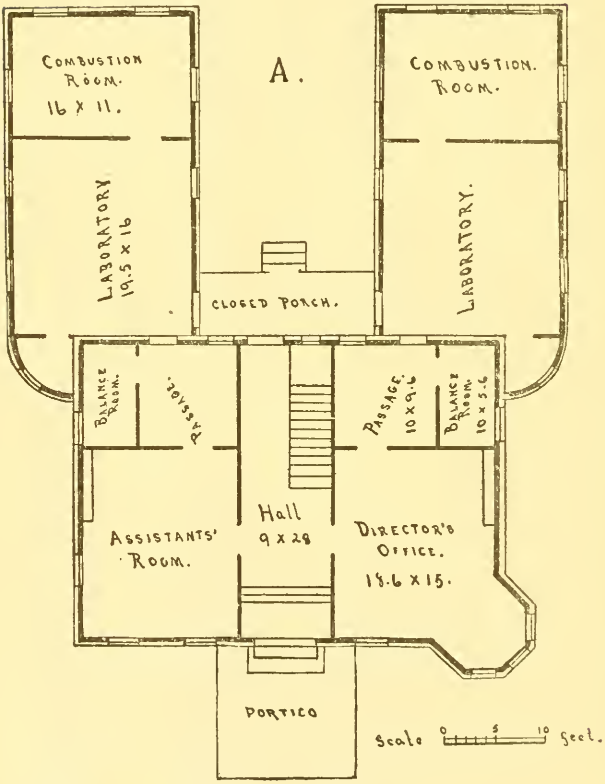
1888.	Received.		1888.	Expended.	
Jan. 1,	Cash balance in bank,	$263.11		Salaries,	$3,873.76
4,	State Treasurer,	2,500.00		Laboratory supplies,	747.61
11,	Dr. C. A. Goessmann, Director,	222.46		Printing and postage,	641.00
11,	Dr. C. A. Goessmann, Director,	176.27		Office expenses,	287.33
April 2,	State Treasurer,	2,500.00		Farmer and farm labor,	1,813.73
June 19,	Dr. C. A. Goessmann, Director,	99.62		Farm supplies,	533.34
July 5,	State Treasurer,	2,500.00		Stock,	95.00
Sept. 28,	State Treasurer,	2,500.00		Feed,	281.55
Oct. 13,	Dr. C. A. Goessmann, Director,	162 00		Miscellaneous expenses,	491.83
Nov. 6,	Dr. C. A. Goessmann, Director,	200.00		Construction and repairs,	2,935.84
Dec. 3,	Dr. C. A. Goessmann, Director,	10.00		Expenses Board of Control,	137.80
22,	Transferred from Hatch Funds,	705.33			
		$11,838.79			$11,838.79

Examined, compared with the vouchers, found correct, and approved. WM. R. SESSIONS, *Auditor*.

B.



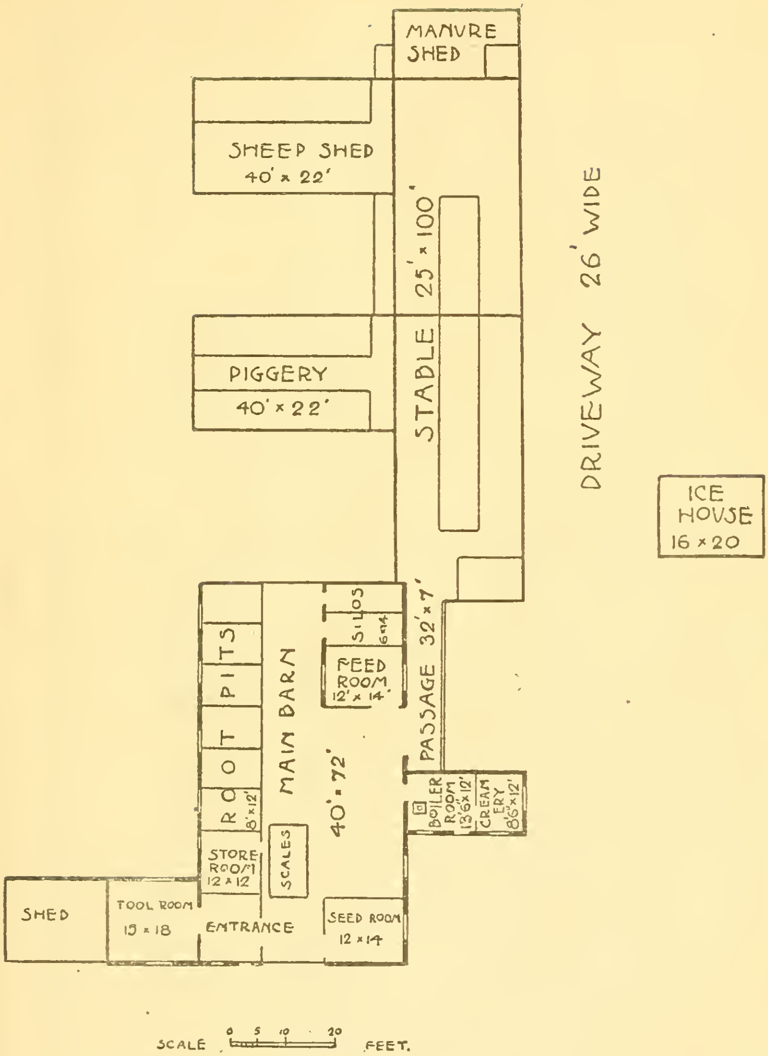
STATION BUILDING — 2nd FLOOR.



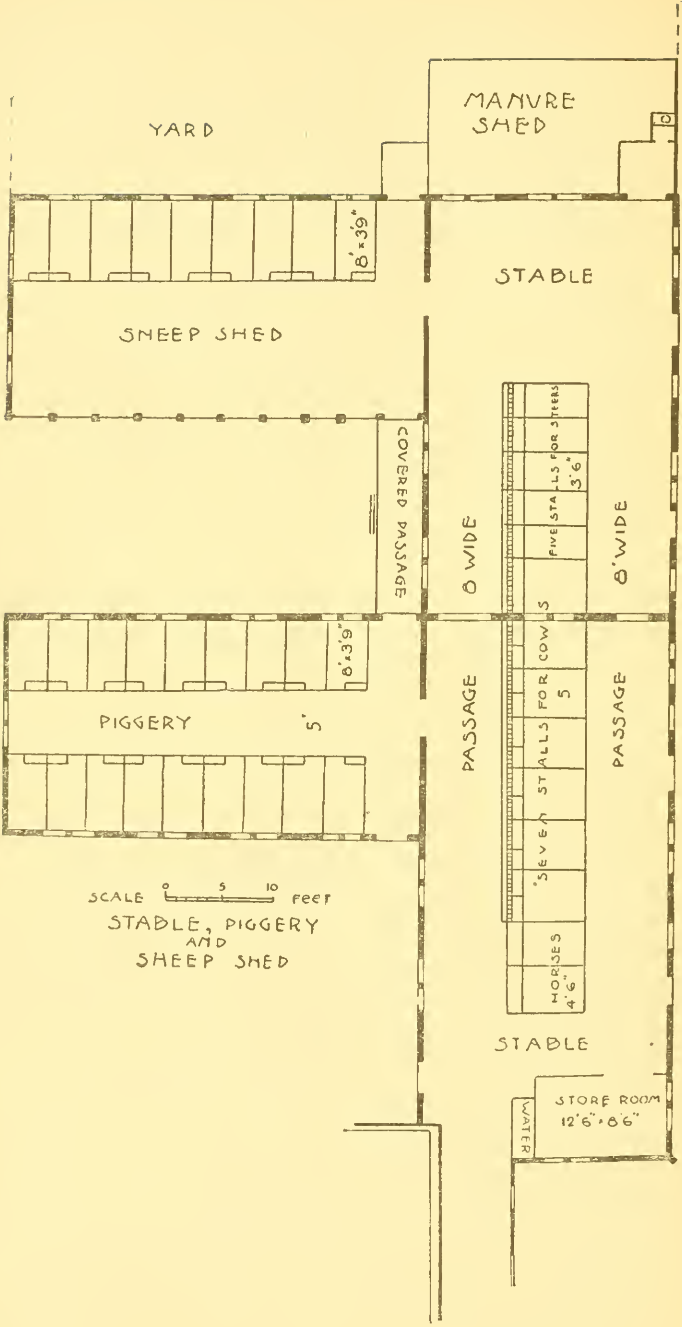
STATION BUILDING — GROUND PLAN.

A. LABORATORY BUILDING........ GROUND PLAN

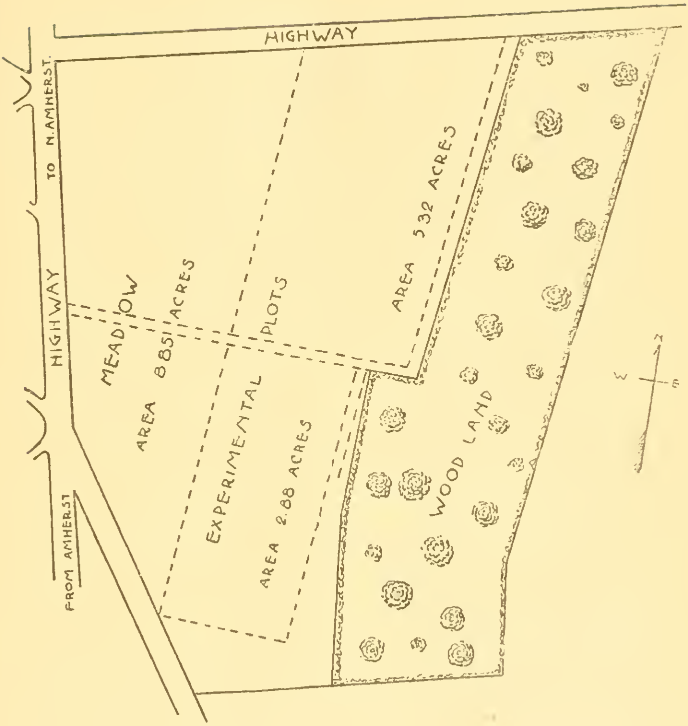
B " " SECOND FLOOR



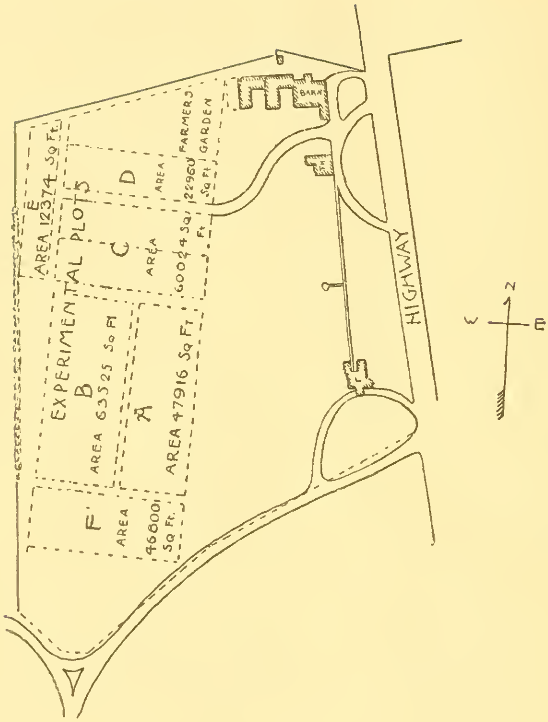
PLAN OF FARM BUILDINGS.



STABLE, PIGGERY AND SHEEP SHED



MAP·OF·LAND·LEASED·TO·THE
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·EAST OF THE·HIGHWAY
·AREA·TAKEN ·3052 ACRES



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·FROM·THE·

·AGRICULTURAL·COLLEGE·FARM

·WEST·OF·THE HIGHWAY·

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TO SIXTH ANNUAL REPORT, 1888.

PUBLIC DOCUMENT. No. 33.

SEVENTH ANNUAL REPORT

OF THE

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OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

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1889.

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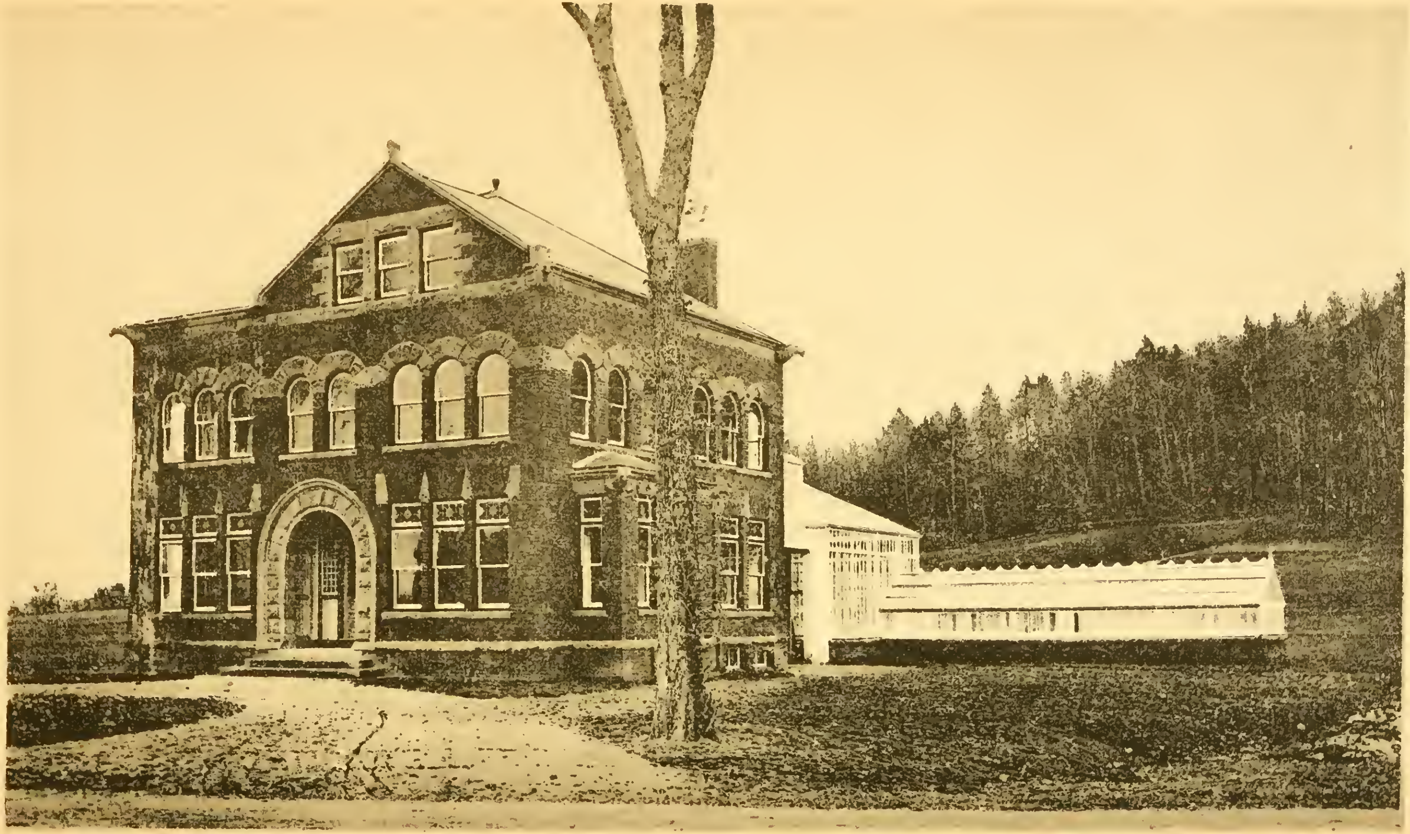
Chemical Laboratory of the Massachusetts State Experiment Station, Amherst, Mass.



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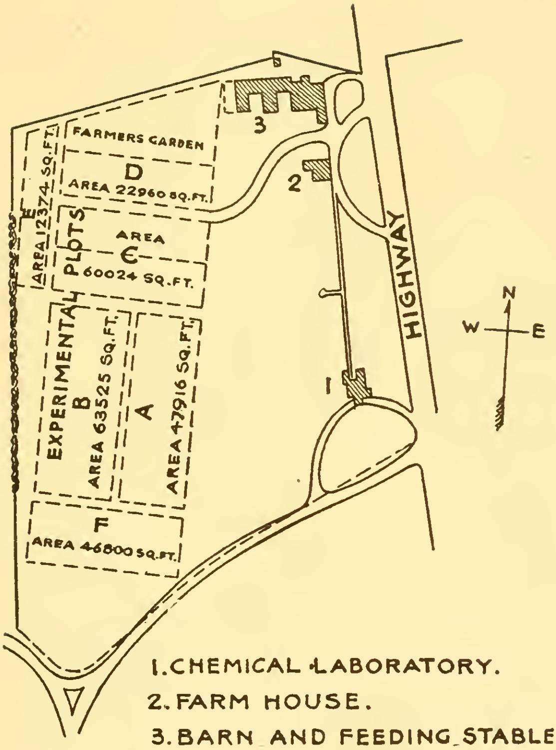
Agricultural and Physiological Laboratory of the Massachusetts State Agricultural Station, Amherst, Mass.



1. CHEMICAL LABORATORY.
2. FARM HOUSE.
3. BARN AND FEEDING STABLES.

·MAP·OF·LAND·LEASED·TO·THE·

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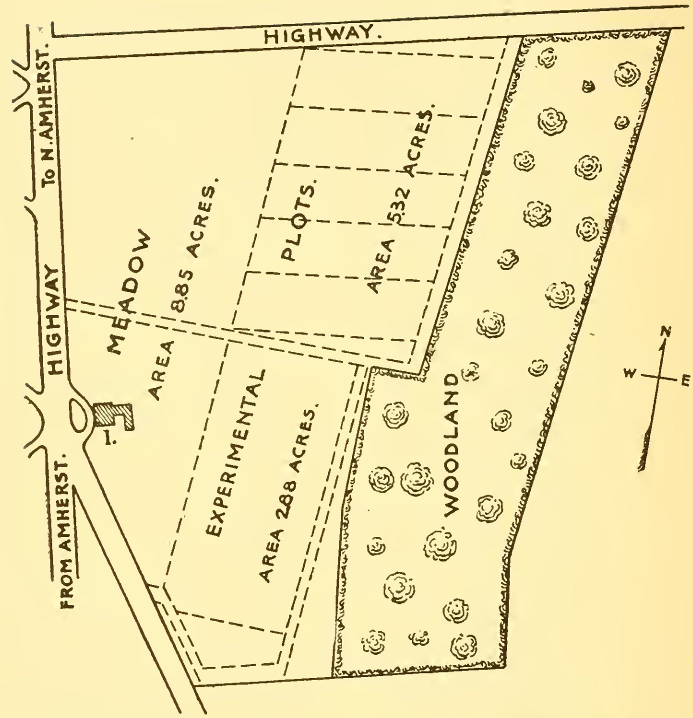
·AREA·TAKEN··17.72·ACRES·



1. AGRICULTURAL AND PHYSIOLOGICAL LABORATORY.

·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
AGRICULTURAL·COLLEGE·FARM·
·EAST·OF·THE·HIGHWAY·
AREA·TAKEN· 30,52 ACRES·

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1889.

OFFICERS APPOINTED BY THE BOARD OF CONTROL.

Hon. W. R. Sessions, *Secretary and Auditor of the Board*,	.	Hampden.
Dr. J. P. Lynde, *Treasurer of the Board*, . . .	.	Athol.
C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*,	.	Amherst.
J. E. Humphrey, S.B., *Vegetable Physiologist*, . .	.	Amherst.

ASSISTANTS.

W. H. Beal, A.B., M.E, . .	*General and Analytical Chemistry.*
E. R. Flint, B.S , . . .	" " "
R. B. Moore, B.S., . . .	" " "
E. E. Knapp, B.S., . . .	" " "
C. S. Crocker, B.S., . .	" " "
B. L. Hartwell, B.S., . .	" " "
W. A. Parsons, B.S., . .	*Field Experiments and Stock Feeding.*
David Wentzell, . . .	*Farmer.*

Boston, Jan. 14, 1890.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Seventh Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

SEVENTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The past year has been a prosperous one. The State Legislature has granted your application for the appropriation of means to erect suitable buildings required for much-needed investigations into some special features of plant growth and of diseases of agricultural plants. The plans adopted for the construction of an agricultural and physiological laboratory have been successfully carried out, and the building will be shortly ready for occupation. The expenses incurred in carrying on this work are fairly within the sum assigned for that purpose.

No serious loss of any description has happened to the property of the State. The various structures of the station are in a well-preserved condition, and the live stock for experimental purposes is at present more complete as far as the different kinds of farm live stock are concerned than at any previous period.

The experimental work of the year has been, as far as practicable, in conformity with the plans from time to time presented for your endorsement. No material changes have been made in regard to the principal lines of investigations decided upon during the preceding years. The work in the field, in the barn and in the laboratory, has received, as far as practicable, an equal share of attention.

Professor Humphrey has devoted much attention to various subjects in his special line of investigation. A detailed description of his work on fungoidal diseases, etc., prepared by him, forms a part of the accompanying annual report.

The experiments to determine the cost of feed for the production of milk and of pork have been continued, with some modifications; to these have been added of late experiments to ascertain the cost of feed for the production of beef and mutton. A variety of field crops, in particular reputed fodder crops, have been raised for testing their relative feeding value, and to determine their general merits in a mixed farm management. Some of these crops suffered, in common with our grain crops, from exceptionally cool and wet weather during the latter part of June and the months of July and August.

The laboratory work has been exceptionally large and in various directions, in consequence of the additional chemical work called for by the Hatch Experiment Station, and by the State inspection of commercial fertilizers; aside from the numerous applications of farmers, associations, and parties interested in farming, for the examination of fertilizers, fodder articles, well-waters, etc.

The details of the work carried on in the previously stated directions are recorded in the subsequent pages under the following headings: —

Feeding Experiments.

I. Feeding experiments with milch cows, to ascertain the feeding value of fodder corn, corn stover and corn ensilage, as compared with English hay, and also of sugar beets and of carrots.

II. Feeding experiments with milch cows, to ascertain the value of a mixed crop of vetch and oats, of Southern cow-pea and of serradella, when fed as green fodder in part or in the whole for English hay.

III. Financial record of twelve cows, kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; with some observations made during several visits to the farms of one hundred and ninety-three patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

Field Experiments.

VI. Experiments to compare the effect of different forms of nitrogen on the growth, etc., of corn.

VII. Influence of fertilizers on the quantity and quality of fodder crops.

VIII. Experiments with field and garden crops.

IX. Experiments with green crops for summer feed.

X. Professor Humphrey's report: —

1. General account of fungi.
2. Potato scab.
3. Diseases on station farm.
4. Observations of material sent on for examination.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

XI. Analyses of licensed commercial fertilizers.

XII. Miscellaneous analyses of material sent on.

XIII. Water analyses.

XIV. Compilation of fodder analyses, with reference to fodder constituents and fertilizing constituents; analyses of industrial products, garden crops, fruits, etc., made at Amherst, Mass.

XV. Meteorological observations.

The periodical publications of the station have been more numerous than in preceding years, on account of the monthly publications of the analyses of licensed fertilizers required by the new laws for the regulation of the trade of commercial fertilizers. Four bulletins, containing reports of progress on investigations, and six monthly circulars of fertilizer analyses, have been issued. The interest in the publications of the station is steadily growing. From ten to eleven thousand copies have been published of late.

It gives me particular pleasure to acknowledge the valuable assistance rendered by all parties engaged in the work of the station. To their marked industry and faithful execution of the various tasks assigned to them is largely due the successful termination of the work recorded in this report.

Thanking you sincerely for your kind indulgence in the performance of my duties, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 14, 1890.

ON FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows, to determine the value of fodder corn, corn stover and corn ensilage, as compared with English hay; and also of corn ensilage, as compared with that of sugar beets and carrots. The statement closes with a summary of observations in that connection during four successive years, 1885 to 1889.

II. Feeding experiments with milch cows, to ascertain the value of vetch and oats, of cow-pea and of serradella when fed as green fodder in part or in the whole for English hay. The results reported are those of the third year of our trial.

III. Record of twelve cows kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; and some observations made during visits to the patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim-milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

VI. Fodder analyses.

I. Record of Feeding Experiments with Milch Cows, to determine the Relative Value of Fodder Corn, Corn Stover and Corn Ensilage, as compared with that of English Hay; and of Corn Ensilage as compared with that of Sugar Beets and of Carrots, under Otherwise Corresponding Circumstances. Fourth Year of Observation, from November, 1888, to May, 1889.

The experiment was conducted upon the same general plan as during the preceding years, the principal object of the investigation remaining the same as stated above. A larger number of cows (nine) than in any of the preceding years took part in the trial; not more, however, than six cows at any one time. Whenever the daily yield of milk of any particular animal fell below from six to seven quarts, on account of advanced milking period, a new-milch cow was substituted, to secure, as far as practicable, corresponding conditions throughout the entire experiment. Grades of various descriptions, yet of a similar quality with regard to the production of quantity and quality of milk, constituted our herd. They varied in age from five to eleven years; the mean in case of nine cows was seven years. Each served from two to seven months for our observation.

The course adopted in preparing the daily diet was essentially the same as in the preceding year. English hay, fodder corn, corn stover, corn ensilage, sugar beets and carrots served as coarse fodder articles; and corn meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous to non-nitrogenous substances in the daily fodder rations (commonly called nutritive ratio). The fodder corn, corn stover and corn ensilage were cut to an even length (one and one-half to two inches) before fed. The daily amount of fodder corn left behind unconsumed was, on an average, two and one-half pounds, and that of corn stover and ensilage about three pounds.

The same variety of corn, Pride of the North, a dent corn, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same variety and the same state of maturity as the one which furnished the dry fodder corn; *i. e.*, at the beginning of the glazing over of the kernels.

The experiment was subdivided into nine feeding periods, extending over a period of seven months. The same quantity of corn meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily, from the beginning to the close of the trial. Corn ensilage and roots were fed in different proportions, with one-half or one-fourth of a full English hay ration. Fodder corn and corn stover were fed most of the time by themselves.

The quantity of different fodder rations stated below represents in each case the daily average of the amount actually consumed per head during the entire feeding period. The variations in the daily consumption of the various ingredients of the daily diet in case of different animals were confined entirely to the fodder corn, the corn stover and the corn ensilage, when serving as substitutes in part or in the whole for hay; and to hay, when fed alone as the coarse or bulky part of the daily diet. The amount consumed in that case was controlled by the appetite of the animal, as somewhat larger quantities than the figures represent were offered for their consumption. The daily consumption of the grain feed was limited to the amount stated in each case; the same statement applies to the hay when fed in connection with some other coarse fodder articles, as corn ensilage, sugar beets, etc.

The nutritive ratio of the different diets used varied from 1 : 5.13 to 1 : 6.79. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

The temporary changes in diet, whenever decided upon, were carried out gradually, as is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates, which accompany all detailed reports in our feeding experiments, past and present, furnish exact figures in that direction. This is in particular the case whenever such statements are of a special interest, for an intelligent appreciation of the final conclusions presented.

The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of fodder ingredients is based, in this connection, on the local market price per ton of each article for the period of observation.

Corn meal,	$21 90	Fodder corn,	$5 00
Wheat bran,	20 70	Corn stover,	5 00
Gluten meal,	23 40	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4½ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management; while twenty per cent. is assumed to be sold with the milk, and thus lost to the farm.

The obtainable manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed. In some instances it amounts to more than one-half of the original cost of the feed consumed.

Net cost of feed represents the sum obtained by subtracting eighty per cent. of the commercial value of the fertilizing constituents contained in the fodder consumed, from the total cost of the feed. Nothing but the net cost of feed is considered in the discussion of the cost of production of milk and of cream.

An examination of the subsequent detailed description of the experiment under consideration leads to the same conclusions as our observations in this direction during preceding years: —

1. The high nutritive value of fodder corn, corn stover and good corn ensilage, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animal on trial, as well as the quality and the quantity of the milk obtained, point in that direction.

2. To produce one quart of milk, using the same quantity and quality of grain feed, required in every instance a larger quantity of perfectly dried hay than of either fodder

corn, corn stover or corn ensilage in a corresponding state of dryness, — corn stover leading.

3. The net cost of feed in the case of the same ration of grain feed is from one-third to one-half less per quart of milk, when fodder corn, corn stover or corn ensilage serve as substitutes for English hay in the daily diet of milch cows; corn fodder, as a rule, leading, while corn stover leads the corn ensilage in four out of six cases.

4. Sugar beets, as well as carrots, when fed pound for pound of dry matter in place of part of the hay ration, with the same kind and quantity of grain feed, have raised almost without an exception the temporary yield of milk; exceeding, as a rule, the corn ensilage in that direction.

5. Corn ensilage, as well as roots, proved best when fed in place of one-fourth to one-half of the full hay ration. From twenty-five to twenty-seven pounds of roots, or from thirty-five to forty pounds of corn ensilage, per day, with all the hay called for to satisfy the animal in either case, seems for various reasons a good proportion, allowing the stated kind and quantity of grain feed.

6. The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids.

Quarts of Milk required to make One Space of Cream. (Average of Six Cows fed upon the Following Rations.)

Hay Period.	Fodder Corn Period.	Corn Stover Period.	Carrot Period.	Corn Ensilage Period.	Sugar Beet Period.
1.98	1.68	1.59	2.16	1.92	1.88

For further details, consult the subsequent record of our experiment (November, 1888, to May, 1889), and also the summary of our investigations during 1885, 1886, 1887, 1888 and 1889, in connection with the subject under discussion.

FEEDING RECORD.

ANNIE: *Age, six years; grade, Jersey; last calf, June 19, 1888.*

Feeding Periods.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	18.67	–	–	–	–	–	–	25.84	10.68	2.42	1 : 6.14	830
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	13.27	–	–	–	–	–	17.05	8.51	2.00	1 : 5.44	784
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	14.36	–	–	–	–	15.83	7.09	2.23	1 : 5.66	766
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	37.05	–	–	–	21.55	10.27	2.10	1 : 6.16	808
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5 00	–	–	–	29.91	–	–	20.88	10.10	2.07	1 : 6.34	806
March 1 to March 14, .	3.25	3.25	3.25	15.00	–	–	–	–	–	–	22.46	9.07	2.48	1 : 5.90	842
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.53	–	23.43	10.28	2.28	1 : 6.12	847
April 9 to April 22, .	3.25	3.25	3.25	16 50	–	–	–	–	–	–	23.84	10.20	2.34	1 : 6.00	880
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	16.64	23.49	10.42	2.25	1 : 5.13	888

MAY: *Age, eight years; grade, Jersey; last calf, June 6, 1887.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	10.13	2.67	1 : 6.22	950
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	17.68	–	–	–	–	–	19.84	8.05	2.46	1 : 5.71	907
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	21.82	–	–	–	–	19.55	8.43	2.32	1 : 6.19	902
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	9.53	2.29	1 : 6.20	892
Jan. 29 to Feb. 19, .	3.25	3.25	3 25	5.00	–	–	–	38.86	–	–	23.15	9.13	2.54	1 : 6.66	937
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.33	–	23.41	9.64	2.43	1 : 6.11	930
April 9 to April 22, .	3.25	3.25	3 25	16.93	–	–	–	–	–	–	24.24	9.29	2.61	1 : 6.03	976
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	18.05	24.74	10.01	2.47	1 : 5.18	962

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	14.95	1.81	1 : 6.22	1,018
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	18.23	–	–	–	–	–	20.18	11.76	1.72	1 : 5.70	972
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	19.00	–	–	–	–	18.15	10.84	1.67	1 : 6.00	941
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39 35	–	–	–	21.78	12.13	1.80	1 : 6 20	964
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5 00	–	–	–	43 00	–	–	24.21	11.58	2.09	1 : 6 79	980
March 1 to March 14, .	3.23	3.25	3.25	20.43	–	–	–	–	–	–	27.45	10.73	2.49	1 : 6.25	1,025
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	46.20	–	23.77	10.99	2.16	1 : 6.14	992

MELIA: *Age, eleven years; grade, Dutch; last calf, Aug. 5, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	18.73	–	–	–	–	–	–	25.89	9.60	2.70	1 : 6.15	1,063
Nov. 20 to Dec. 11, .	3 25	3 25	3.25	–	13.45	–	–	–	–	–	17.16	7.17	2.39	1 : 5.45	1,025
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	17.18	–	–	–	–	17.24	6.48	2.66	1 : 5.87	1,027
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	7.66	2.84	1 : 6.20	1,062
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	34.32	–	–	22.00	7.20	3.05	1 : 6.50	1,094

FEEDING RECORD — *Continued.*

DAISY: *Age, six years; grade, Durham; last calf, Jan. 5, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	22.00	–	–	–	–	–	–	28.90	9.87	2.93	1 : 6.34	1,164
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	19.59	–	–	–	–	–	21.04	6.35	3.31	1 : 5.81	1,168
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	26 36	–	–	–	–	21.82	5.43	4.02	1 : 6.44	1,170
Jan. 3 to Jan. 18, .	3.25	3.25	3.25	10.00	–	–	43.25	–	–	–	22.17	6.09	3.64	1 : 6.26	1,195

MINNIE: *Age, nine years; grade, Ayrshire; last calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	17.52	–	–	–	–	–	–	24.78	7.83	3.16	1 : 6.07	1,051
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	11.68	–	–	–	–	–	16.05	6.15	2.61	1 : 5.33	1,016

FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.05	–	–	–	21 75	15.30	1.42	1 : 6.20	900
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	30.91	–	–	21.13	13.31	1.59	1 : 6.38	862
March 1 to March 14, .	3.25	3.25	3.25	14.86	–	–	–	–	–	–	22.33	12.05	1.85	1 : 5 39	877
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.47	–	23.43	13 10	1.79	1 : 6.11	873
April 9 to April 22, .	3.25	3.25	3.25	18.21	–	–	–	–	–	–	25.41	13.02	1 95	1 : 6.12	917
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	19.23	25.80	13.37	1.93	1 : 5.21	918

FEEDING RECORD — *Concluded.*

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	42.09	–	–	23 98	14.12	1.70	1 : 6.76	735
March 1 to March 14, .	3.25	3.25	3.25	15.21	–	–	–	–	–	–	22.66	11.46	1.98	1 : 5.96	736
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	47.47	–	23.94	11.73	2.04	1 : 6.16	734
April 9 to April 22, .	3.25	3.25	3.25	18.93	–	–	–	–	–	–	25.08	12.78	1.96	1 : 6.16	794
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	20.27	26.72	13.23	2.02	1 : 5.24	800

ELSIE: *Age, six years; grade, Dutch; last calf, Feb. 26, 1889.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 19 to April 2, .	3.25	3.25	3 25	10.00	–	–	–	–	49.60	–	24.21	13.64	1.78	1 : 6.18	1,112
April 9 to April 22, .	3.25	3.25	3.25	21.32	–	–	–	–	–	–	28.27	12.25	2.31	1 : 6.30	1,115
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	23.45	29.55	12.33	2.39	1 : 5.31	1,128

TOTAL COST OF FEED PER QUART OF MILK.

Annie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	160.25	10.68	48.75	48.75	48.75	280.00	–	–	–	–	–	–	$3 71	2.32
Nov. 20 to Dec. 11, .	187.25	8.51	71.50	71.50	71.50	–	302.00	–	–	–	–	–	3 11	1.66
Dec. 17 to Dec. 27, .	78.00	7.09	35 75	35.75	35.75	–	–	158 00	–	–	–	–	1 58	2.02
Jan. 3 to Jan. 21, .	195.25	10.27	61.75	61.75	61 75	190.00	–	–	704.00	–	–	–	5 93	3.04
Jan. 29 to Feb. 19, .	222.25	10.10	71.50	71.50	71.50	110.00	–	–	–	659.00	–	–	4 09	1.84
March 1 to March 14, .	127.00	9.07	45.50	45.50	45.50	210.00	–	–	–	–	–	–	3 08	2 43
March 19 to April 2, .	154.13	10.28	48.75	48.75	48 75	150.00	–	–	–	–	653.00	–	4 37	2.84
April 9 to April 22, .	142.75	10.20	45.50	45.50	45.50	231.00	–	–	–	–	–	–	3 23	2.26
April 30 to May 21, .	229.25	10.42	71.50	71.50	71.50	–	–	–	–	–	–	366.00	5 10	2.22

May.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	152.00	10.13	48.75	48.75	48.75	300.00	–	–	–	–	–	–	$3 86	2.54
Nov. 20 to Dec. 11, .	177.00	8.05	71 50	71 50	71.50	–	389.00	–	–	–	–	–	3 33	1.88
Dec. 17 to Dec 27, .	92 75	8.43	35.75	35.75	35.75	–	–	210.00	–	–	–	–	1 78	1.92
Jan. 3 to Jan. 21, .	181.00	9.53	61 75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	3.36
Jan. 29 to Feb. 19, .	200.75	9.13	71.50	71.50	71.50	110.00	–	–	–	855.00	–	–	4 36	2.17
March 19 to April 2, .	144.63	9.64	48.75	48.75	48.75	150.00	–	–	–	–	650.00	–	4 36	3.01
April 9 to April 22, .	130.13	9.29	45.50	45.50	45.50	237.00	–	–	–	–	–	–	3 28	2.52
April 30 to May 21, .	220.25	10.01	71.50	71.50	71.50	–	–	–	–	–	–	397.00	5 34	2.42

Total Cost of Feed per Quart of Milk — *Continued.*

Eva.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	224 25	14.95	48.75	48.75	48.75	300.00	–	–	–	–	–	–	$3 86	1.72
Nov. 20 to Dec. 11, .	258 75	11.76	71.50	71.50	71 50	–	401.00	–	–	–	–	–	3 36	1.30
Dec. 17 to Dec. 27, .	119.25	10.84	35.75	35.75	35.75	–	–	209.00	–	–	–	–	1 70	1.43
Jan. 3 to Jan. 21, .	230 50	12.13	61.75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	2.64
Jan. 29 to Feb. 19, .	254.75	11.58	71.50	71.50	71.50	110.00	–	–	–	946.00	–	–	4 49	1.76
March 1 to March 14, .	150.25	10.73	45.50	45.50	45.50	286.00	–	–	–	–	–	–	3 65	2.43
March 19 to April 2, .	164.88	10.99	48.75	48.75	48.75	150.00	–	–	–	–	693.00	–	4 47	2 71

Melia.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	144 00	9.60	48.75	48.75	48.75	281.00	–	–	–	–	–	–	$3 76	2.58
Nov. 20 to Dec. 11, .	157.75	7.17	71.50	71.50	71.50	–	296.00	–	–	–	–	–	3 10	1.97
Dec. 17 to Dec. 27, .	71.25	6.48	35 75	35.75	35 75	–	–	189.00	–	–	–	–	1 65	2.32
Jan. 3 to Jan. 21, .	145.50	7.66	61.75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	4.18
Jan. 29 to Feb. 19, .	158.50	7.20	71.50	71.50	71.50	110.00	–	–	–	755.00	–	–	4 22	2.66

Total Cost of Feed per Quart of Milk — *Continued.*

Daisy.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	148.00	9.87	48.75	48.75	48.75	330.00	–	–	–	–	–	–	$4 08	2 76
Nov. 20 to Dec. 11, .	139.75	6.35	71.50	71.50	71.50	–	431.00	–	–	–	–	–	3 44	2.46
Dec. 17 to Dec. 27, .	59.75	5 43	35.75	35.75	35.75	–	–	290.00	–	–	–	–	1 90	3.18
Jan. 3 to Jan. 18, .	97.50	6.09	52.00	52.00	52.00	160.00	–	–	692.00	–	–	–	5 34	5.48

Minnie.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	117.50	7.83	48.75	48.75	48.75	262.75	–	–	–	–	–	–	$3 58	3.05
Nov. 20 to Dec. 11, .	135.25	6.15	71.50	71.50	71.50	–	257.00	–	–	–	–	–	3 00	2.22

Total Cost of Feed per Quart of Milk — *Continued.*

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 3 to Jan. 21, .	290.75	15.30	61.75	61.75	61.75	190.00	–	–	742.00	–	–	–	$6 06	2.08
Jan. 29 to Feb. 19, .	292.75	13.31	71.50	71.50	71.50	110.00	–	–	–	680.00	–	–	4 12	1.41
March 1 to March 14, .	168.63	12.05	45.50	45.50	45.50	208.00	–	–	–	–	–	–	3 06	1.81
March 19 to April 2, .	196.50	13.10	48.75	48.75	48.75	150.00	–	–	–	–	653.00	–	4 37	2.22
April 9 to April 22, .	182.25	13.02	45.50	45.50	45.50	255.00	–	–	–	–	–	–	3 41	1.87
April 30 to May 21, .	294.13	13.37	71.50	71.50	71.50	–	–	–	–	–	–	423.00	5 53	1.88

Jessie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Jan. 29 to Feb. 19, .	310.75	14.12	71.50	71.50	71.50	110.00	–	–	–	926.00	–	–	$4 46	1.43
March 1 to March 14, .	160.50	11.46	45.50	45.50	45.50	213.00	–	–	–	–	–	–	3 10	1.93
March 19 to April 2, .	176.00	11.73	48.75	48.75	48.75	150.00	–	–	–	–	712.00	–	4 51	2.56
April 9 to April 22, .	178.88	12.78	45.50	45 50	45.50	265.00	–	–	–	–	–	–	3 49	1.95
April 30 to May 21, .	291.12	13.23	71.50	71.50	71.50	–	–	–	–	–	–	446.00	5 70	1.96

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Elsie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
March 19 to April 2, .	204.63	13.64	48 75	48.75	48.75	150.00	–	–	–	–	744.00	–	$4 59	2.24
April 9 to April 22, .	171.50	12.25	45.50	45.50	45.50	298.50	–	–	–	–	–	–	3 74	2 18
April 30 to May 21, .	272.25	12.33	71.50	71.50	71.50	–	–	–	–	–	–	516.00	6 23	2.29

Valuation of Essential Fertilizing Constitutents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)
[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.
Moisture, . .	12.890	10.080	10.220	8.060	36.850	50.130	90.050	74.760	87.210	10.950
Nitrogen, . .	1.550	2.556	4.330	1.480	.992	.638	.127	.331	.208	2.030
Phosphoric acid,	.713	2.900	.392	.112	.367	.133	.100	.138	.086	.351
Potassium oxide,	.430	1.637	.049	.457	.801	.976	.070	.301	.462	2.794
Valuation per 2,000 pounds,	$6 51	$13 64	$15 23	$5 58	$4 53	$3 21	$0 62	$1 56	$1 23	$9 83

Net Cost of Milk and Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 71	$1 64	$1 31	$2 40	1.50	825
Nov. 20 to Dec. 11, .	3 11	1 95	1 56	1 55	0.83	790
Dec. 17 to Dec. 27, .	1 58	89	71	87	1.12	772
Jan. 3 to Jan. 21, .	5 93	1 84	1 47	4 46	2.28	812
Jan. 29 to Feb. 19, .	4 09	2 09	1 67	2 42	1.09	812
Mar. 1 to Mar. 14, .	3 08	1 39	1 11	1 97	1 55	845
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.96	859
Apr. 9 to Apr. 22, .	3 23	1 45	1 16	2 07	1.45	895
Apr. 30 to May 21, .	5 10	3 07	2 46	2 64	1.15	890
Total, . .	$34 20	$16 00	$12 79	$21 41	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Continued.*

May.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.64	950
Nov. 20 to Dec. 11, .	3 33	2 14	1 71	1 62	.92	900
Dec. 17 to Dec. 27, .	1 78	1 02	81	97	1.05	907
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	2.54	911
Jan. 29 to Feb. 19, .	4 36	2 24	1 79	2 57	1.28	940
Mar. 19 to Apr. 2, .	4 36	1 68	1 34	3 02	2.09	935
Apr. 9 to Apr. 22, .	3 28	1 47	1 18	2 10	1.61	990
Apr. 30 to May 21, .	5 34	3 22	2 58	2 76	1.25	935
Total, . .	$32 39	$15 33	$12 26	$20 13	–	–
Eva.						
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.11	1,020
Nov. 20 to Dec. 11, .	3 36	2 17	1 74	1 62	.63	958
Dec. 17 to Dec. 27, .	1 70	97	78	92	.77	940
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	1.99	970
Jan. 29 to Feb. 19, .	4 49	2 31	1 85	2 64	1.04	978
Mar. 1 to Mar. 11, .	3 65	1 60	1 28	2 37	1.58	1,030
Mar. 19 to Apr. 2, .	4 47	1 70	1 36	3 11	1.89	1,000
Total, . .	$27 61	$12 31	$9 86	$17 75	–	–
Melia.						
Nov. 1 to Nov. 15, .	$3 72	$1 65	$1 32	$2 40	1.67	1,075
Nov. 20 to Dec. 11, .	3 10	1 93	1 54	1 56	.99	1,036
Dec. 17 to Dec. 27, .	1 65	94	75	90	1.26	1,025
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	3.15	1,075
Jan. 29 to Feb. 19, .	4 22	2 16	1 73	2 49	1.57	1,096
Total, . .	$18 77	$8 54	$6 83	$11 94	–	–
Daisy.						
Nov. 1 to Nov. 15, .	$4 08	$1 78	$1 42	$2 66	1.80	1,170
Nov. 20 to Dec. 11, .	3 44	2 24	1 79	1 65	1.18	1,165
Dec. 17 to Dec. 27, .	1 90	1 10	88	1 02	1.71	1,176
Jan. 3 to Jan. 18, .	5 34	1 58	1 26	4 18	4.29	1,220
Total, . .	$14 76	$6 70	$5 35	$9 41	–	–

Net Cost of Milk and Manurial Value of Feed — *Concluded.*

Minnie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 58	$1 60	$1 28	$2 30	1.96	1,050
Nov. 20 to Dec. 11, .	3 00	1 85	1 48	1 52	1.12	1,017
Total, . .	$6 58	$3 45	$2 76	$3 82	–	–

Flora.

Jan. 3 to Jan. 21, .	$6 06	$1 85	$1 48	$4 58	1.58	882
Jan. 29 to Feb. 19, .	4 12	2 10	1 68	2 44	.83	859
Mar. 1 to Mar. 14, .	3 06	1 39	1 11	1 95	1.16	870
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.54	875
Apr. 9 to Apr. 22, .	3 41	1 52	1 22	2 19	1.20	927
Apr. 30 to May 21, .	5 53	3 34	2 67	2 86	.97	918
Total, . .	$26 55	$11 88	$9 50	$17 05	–	–

Jessie.

Jan. 29 to Feb. 19, .	$4 46	$2 29	$1 83	$2 63	0.85	736
Mar. 1 to Mar. 14, .	3 10	1 40	1 12	1 98	1.23	730
Mar. 19 to Apr. 2, .	4 51	1 72	1 38	3 13	1.78	751
Apr. 9 to Apr. 22, .	3 49	1 54	1 23	2 26	1.26	806
Apr. 30 to May 21, .	5 70	3 47	2 78	2 92	1.00	809
Total, . .	$21 26	$10 42	$8 34	$12 92	–	–

Elsie.

Mar. 19 to Apr. 2, .	$4 59	$1 74	$1 39	$3 20	1.56	1,105
Apr. 9 to Apr. 22, .	3 74	1 64	1 31	2 43	1.42	1,120
Apr. 30 to May 21, .	6 23	3 80	3 04	3 19	1.17	1,120
Total, . .	$14 56	$7 18	$5 74	$8 82	–	–

Analyses of Milk.

[Per cent.]

Annie.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids,	13.68	15.22	14.83	14.10	14.30	14.25	14.52	14.06	14.18
Fat,	3.65	5.10	4.90	4.10	4.55	4.61	4 72	4.60	4.67
Solids not fat,	10.03	10.12	9.93	10.00	9.75	9.64	9.80	9.46	9.51

May.

Solids,	14.90	14.42	15.37	15.42	15.05	–	15.02	15.24	14.61
Fat,	4.13	5.30	4.74	4.60	4.65	–	4.60	5.20	4.87
Solids not fat,	10.77	9.12	10.63	10.82	10.40	–	10.42	10.04	9.74

Eva.

Solids,	14.40	14.45	15.11	14.90	14.95	15.52	15.63	–	–
Fat,	4.85	5.25	5.17	4.82	4.95	5.51	5.33	–	–
Solids not fat,	9.55	9.20	9.94	10.08	10.00	10.01	10.30	–	–

Melia.

Solids,	13.82	13.87	14.40	13.86	13.30	–	–	–	–
Fat,	3.70	4.38	4.34	3.50	3.80	–	–	–	–
Solids not fat,	10.12	9.49	10.06	10.36	9.50	–	–	–	–

Daisy.

Solids,	15.48	14.18	16.70	15.73	–	–	–	–	–
Fat,	4.44	4.48	4.93	3.24	–	–	–	–	–
Solids not fat,	11.04	9.70	11.77	12.49	–	–	–	–	–

Minnie.

Solids,	14.22	14.07	–	–	–	–	–	–	–
Fat,	4.49	4.85	–	–	–	–	–	–	–
Solids not fat,	9.73	9.22	–	–	–	–	–	–	–

ANALYSES OF MILK — *Concluded.*

Flora.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids, . .	–	–	–	12.90	12.77	13.15	13.17	12.57	12.77
Fat, . . .	–	–	–	3.15	3.55	3.68	3.73	3.40	3.46
Solids not fat, .	–	–	–	9.75	9.22	9.47	9.44	9.17	9.31

Jessie.

Solids, . .	–	–	–	–	13.22	13.75	15.12	14.91	15.00
Fat, . . .	–	–	–	–	4.25	4.57	5.34	5 45	4.67
Solids not fat, .	–	–	–	–	8.97	9.18	9.78	9.46	10.33

Elsie.

Solids, . .	–	–	–	–	–	–	12.20	12.75	12.65
Fat, . . .	–	–	–	–	–	–	3.14	3.09	3.38
Solids not fat, .	–	–	–	–	–	–	9.06	9.66	9.27

Analyses of Fodder Articles fed during the Previously Described Feeding Experiments. (November, 1888, to May, 1889.)

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.89	257.80	–	–	1 : 9.01
Dry matter,	87.11	1,742.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.36	27.20	–	–	
" cellulose,	1.90	38.00	12.92	34	
" fat,	4.16	83.20	63.23	76	
" protein (nitrogenous matter),	11.12	222.40	189.04	85	
Non-nitrogenous extract matter,	81.46	1,629.20	1,531.45	94	
	100.00	2,000.00	1,796.64	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.08	201.60	–	–	1 : 3.80
Dry matter,	89.92	1,798.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.38	127.60	–	–	
" cellulose,	10.74	214.80	42.96	20	
" fat,	4.34	86.80	69.44	80	
" protein (nitrogenous matter),	17.77	355.40	312.75	88	
Non-nitrogenous extract matter,	60.77	1,215.40	972.32	80	
	100.00	2,000.00	1,397.47	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.22	204.40	–	–	
Dry matter, . . .	89.78	1,795.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.52	10.40	–	–	
" cellulose, . . .	.56	11.20	3.81	34	1 : 2.74
" fat, ...	5.50	110.00	83.60	76	
" protein (nitrogenous matter), . .	30.15	603.00	512.55	85	
Non-nitrogenous extract matter, ...	63.27	1,265.40	1,189.48	94	
	100.00	2,000.00	1,789.44	–	

Hay.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.06	161.20	–	–	
Dry matter, . . .	91.94	1,838.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.67	133.40	–		
" cellulose, . . .	33.75	675.00	391.50	58	1 : 9.05
" fat, ...	2.09	41 80	19.23	46	
" protein (nitrogenous matter), . .	10.06	201.20	114.68	57	
Non-nitrogenous extract matter, ...	47.43	948.60	597.62	63	
	100.00	2,000.00	1,123.03	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Corn Fodder.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	36.85	737.00	–	–	1 : 8.46
Dry matter,	63.15	1,263.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.84	96.80	–	–	
" cellulose,	21.96	439.20	316.22	72	
" fat,	2.02	40.40	30.30	75	
" protein (nitrogenous matter),	9.82	196.40	143.37	73	
Non-nitrogenous extract matter,	61.36	1,227.20	822.22	67	
	100.00	2,000 00	1,312.11	–	

Corn Stover.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	50.13	1,002.60	–	–	1 : 10.78
Dry matter,	49.87	997.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.73	74.60	–	–	
" cellulose,	34.49	689.80	496.66	72	
" fat,	1.75	35 00	26.25	75	
" protein (nitrogenous matter),	8.00	160.00	116.80	73	
Non-nitrogenous extract matter,	52.03	1,040.60	697.20	67	
	100.00	2,000.00	1,336.91	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Carrots (Danvers).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.05	1,801.00	–	–	1 : 9.17
Dry matter,	9.95	199.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.28	165.60	–	–	
" cellulose,	10.26	205.20	205.20	100	
" fat,	1.67	33.40	33.40	100	
" protein (nitrogenous matter),	7.98	159.60	159.60	100	
Non-nitrogenous extract matter,	71.81	1,436.20	1,436.20	100	
	100.00	2,000.00	1,834.40	–	

Corn Ensilage.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.56	1,491.20	–	–	1 : 11.72
Dry matter,	25.44	508.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.07	21.40	–	–	
" cellulose,	20.11	402.20	289.58	72	
" fat,	6.49	129.80	97.35	75	
" protein (nitrogenous matter),	8.14	162.80	118.84	73	
Non-nitrogenous extract matter,	64.19	1,283.80	860.15	67	
	100.00	2,000.00	1,365.92	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Sugar Beets (Average).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	87.21	1,744.20	–	–	1 : 8.36
Dry matter,	12.79	255.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.47	129.40	–	–	
" cellulose,	6.16	123.20	123.20	100	
" fat,	.98	19.60	19.60	100	
" protein (nitrogenous matter),	10.15	203.00	203.00	100	
Non-nitrogenous extract matter,	76.24	1,524.80	1,524.80	100	
	100.00	2,000.00	1,870.60	–	

Rowen.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.95	219.00	–	–	1 : 6.28
Dry matter,	89.05	1,781.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.49	129.80	–	–	
" cellulose,	31.50	630.00	365.40	58	
" fat,	5.03	100.60	46.28	46	
" protein (nitrogenous matter),	14.25	285.00	162.45	57	
Non-nitrogenous extract matter,	42.73	854.60	538.40	63	
	100.00	2,000.00	1,110.53	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Concluded.*

Corn Fodder.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	53.70	1,074.00	–	–	1 : 13.92
Dry matter,	46.30	926.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.44	68.80	–	–	
" cellulose,	39.31	786.20	566.06	72	
" fat,	2.83	56.60	42.45	75	
" protein (nitrogenous matter),	6.47	129.40	94.46	73	
Non-nitrogenous extract matter,	47.95	959.00	642.53	67	
	100.00	2,000.00	1,345.50	–	

Corn Stover.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	62.85	1,257.00	–	–	1 : 15.30
Dry matter,	37.15	743.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.36	47.20	–	–	
" cellulose,	37.52	750.40	540.29	72	
" fat,	3.50	70.00	52.50	75	
" protein (nitrogenous matter),	5.94	118.80	86.72	73	
Non-nitrogenous extract matter,	50.68	1,013.60	679.11	67	
	100.00	2,000.00	1,358.62	–	

Summary of Feeding Experiments with Milch Cows.
(November, 1885, to May, 1889.)

Fodder Corn, Corn Stover and Corn Ensilage vs. English Hay.

In preceding communications it will be found that some years ago, November, 1885, a series of observations with milch cows was inaugurated at our institution, for the purpose of securing, under well-defined circumstances, information needed to assist in answering the following questions: —

1. What is the comparative feeding effect of dry fodder corn, of dry corn stover, and of a good corn ensilage, when used in part or in the whole as a substitute for English hay (upland meadow hay) in the daily diet of milch cows, and also that of a good root crop in place of corn ensilage; the amount and kind of grain feed remaining, for obvious reasons, the same under otherwise corresponding circumstances?

2. What is the *total cost*, as well as the *net cost* of the *daily feed* per head in case of different fodder combinations used; making in all cases alike an allowance of a loss of twenty per cent. of the fertilizing constituents contained in the feed consumed, in consequence of the sale of the milk?

3. What is the commercial value, at current market rates, of the manurial refuse obtainable in the case of different fodder combinations used as daily diet for the support of cows, assuming that eighty per cent. of the value of the fertilizing constituents contained in the fodder consumed can be secured to the farm by a careful management?

The results of experiments carried on in this connection during a number of months of the years 1885, 1886, 1887 and 1888, have already been described in detail in our respective annual reports and periodical bulletins. More recent observations in the same direction are reported upon some preceding pages.

As a careful consideration of all our results to date leads practically to the same conclusions, the subsequent final summary of our work has been prepared with a view of enabling, as far as practicable, all parties interested in our special line of inquiry into the economy of milk production to draw their own conclusions, and to ascertain for themselves whether the stand-point taken in our several reports, of progress, is justifiable by the facts presented.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Nov. 20, 1885, to July 4, 1886.	Corn meal, . .	$23 00							
	Wheat bran, . .	20 00							
	English hay, . .	15 00	1 : 6.7 to 1 : 10.17	1. Daisy (1)	16.3 – 8.4	12.77	.97–2.64	.50–1.64	1.44–2.86
	Corn stover, . .	5 00	Mean, 1 : 7.86	2. Mollie	12.62– 8.60	11.00	1.02–2.50	.51–1.61	1.56–2.80
	Corn ensilage, .	2 75							
	Sugar beets, . .	5 00							
Oct. 1, 1886, to April 24, 1887.	Corn meal, . .	$23 00							
	Wheat bran, . .	20 00							
	Gluten meal, . .	23 00		1. Susie	13.5 – 9.4	11.92	1.04–2.37	.43–1.67	1.66–2.76
	Rye middlings, .	24 00	1 : 5.99 to 1 : 7.90	2. Meg	13.9 –10.3	11.93	.95–2.76	.41–1.96	1.72–2.43
	English hay, . .	15 00	Mean, 1 : 6.60	3. Dora	16.3 –11.7	13.94	.85-2.26	.34–1.60	1.58–2.23
	Corn stover, . .	5 00							
	Corn ensilage, .	2 75							
	Carrots, . . .	7 00							

* For more details, consult the respective annual reports on the work of this station.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Jan. 8, 1888, to May 15, 1888.	Corn meal, . .	$23 00	1 : 5.20 to 1 : 6.10; Mean, 1 : 5.80	1. May (1)	12.3-10.1	11.23	1.51–2.51	.77–1.63	1.94–2.50
	Wheat bran, . .	20 70		2. Minnie (1)	12.7–10.2	11.49	1.40–2 53	.74–1.65	1.73–2.52
	Gluten meal, . .	27 00		3. Melia (1)	14.6–10.9	12.62	1.28–2.44	.66–1.59	1.73–2.43
	Corn and cob meal,	20 70		4. Eva (1)	7.2– 5.5	6 22	2 58–4.74	1 39–3.09	3.36–4.74
	English hay, . .	15 00		5. Lizzie	10.6– 7.9	9 06	1.68–3.36	.95–2.19	2.17–3.35
	Corn stover, . .	5 00		6. Daisy (2)	19.2–13.5	16.22	1.01–1.97	.50–1.28	1.38–1.96
	Corn ensilage, .	2 75							
	Fodder corn, . .	5 00							
Nov. 1, 1888, to May 21, 1889.	Corn meal. . .	$21 90	1 : 5.13 to 1 : 6.79; Mean, 1 : 6.02	1. Annie	10.68– 7.09	9.65	1.66–3.04	.83–2.28	2.00–2.48
	Wheat bran, . .	20 70		2. May (2)	10.13– 8.05	9.21	1.88–3.36	.92–2.54	2.29–2.67
	Gluten meal, . .	23 40		3. Eva (2)	14.95–10.73	11.79	1.30–2.72	.63–1.99	1.67–2.49
	English hay, . .	15 00		4. Daisy (3)	9.87– 5.43	6.95	2.46–5.48	1.18–4.29	2.93–4 04
	Fodder corn, . .	5 00		5. Jessie	14.12–11.46	12.84	1.43–2.56	.85–1.78	1.70–2.04
	Corn stover, . .	5 00		6. Melia (2)	9.60– 7 17	7.05	1.97–4.18	.99–3.15	2.39–3.05
	Corn ensilage, .	2 75		7. Elsie	13.64–12 25	12.71	2.18–2.29	1.17–1.56	1.78–2.39
	Carrots, . . .	7 00		8. Minnie (2)	7.83– 6.15	6.83	2 22–3.05	1.12–1.96	2 61–3.16
	Sugar beets, . .	5 00		9. Flora	15.30–12.05	13.82	1 41–2.22	.83–1.58	1.42–1.95
	Rowen, . . .	15 00							

* For more details, consult the respective annual reports on the work of this station.

A short discussion of the most important facts presented in the preceding tabular statement may assist in a desirable appreciation of the questions involved.

During our first year of observation, November, 1885, to July, 1886, either corn meal and wheat bran or wheat bran alone served as grain feed; while, during the succeeding years, as a rule, the same weight parts of corn meal, wheat bran and gluten meal were fed.

The above-stated variations of daily yield of milk refer to the highest and lowest yield in each case, and do not bear a direct relation to any particular diet.

The valuation of the fodder ingredients is based in this connection on the average of the local market price per ton of each article for the entire period of observation.

Corn meal, . . .	$22 75	Fodder corn, . . .	$5 00
Wheat bran, . . .	21 00	Corn stover, . . .	5 00
Gluten meal, . . .	24 50	Corn ensilage, . . .	2 75
Hay, ...	15 00	Carrots, ...	7 00
Rowen, ...	15 00	Sugar beets, . . .	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4¼ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management, while twenty per cent. is assumed to be sold with the milk.

Principal Daily Fodder Rations used.

November, 1885, to July, 1886.

1.		2.	
Corn meal, . . .	3.25 lbs.	Corn meal, . . .	3.25 lbs.
Wheat bran, . .	3.25 "	Wheat bran, . .	3.25 "
Hay, ...	21.75 "	Hay, ...	10.00 "
Total cost, . . .	23.43 cts.	Corn stover, . .	8.00 "
Net cost, . . .	15.43 "	Total cost, . . .	16.62 cts.
Manurial value obtainable, . . .	8.00 "	Net cost, . . .	10.04 "
Nutritive ratio, . .	1 : 8.02	Manurial value obtainable, . . .	6.58 "
		Nutritive ratio, . .	1 : 7.83

PRINCIPAL DAILY FODDER RATIONS USED — *Continued.*

3.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	5.00 "
Corn stover,	12.75 "
Total cost,	14.06 cts.
Net cost,	7.83 "
Manurial value obtainable,	6 23 "
Nutritive ratio,	1 : 7.81

4.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	25.12 cts.
Net cost,	17.10 "
Manurial value obtainable,	8.02 "
Nutritive ratio,	1 : 7.20

5.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	21.41 cts.
Net cost,	14.31 "
Manurial value obtainable,	7.10 "
Nutritive ratio,	1 : 6.93

6.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	40.00 "
Total cost,	24.66 cts.
Net cost,	16.66 "
Manurial value obtainable,	8.00 "
Nutritive ratio,	1 : 6.81

October, 1886, to April, 1887.

7.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	18.75 "
Total cost,	25.14 cts.
Net cost,	15.77 "
Manurial value obtainable,	9.37 "
Nutritive ratio,	1 : 6.11

8.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	5.00 "
Corn ensilage,	34.00 "
Total cost,	19.60 cts.
Net cost,	11.62 "
Manurial value obtainable,	7.98 "
Nutritive ratio,	1 : 6.12

9.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Carrots,	38.00 "
Total cost,	31.89 cts.
Net cost,	23.05 "
Manurial value obtainable,	8.84 "
Nutritive ratio,	1 : 5.99

PRINCIPAL DAILY FODDER RATIONS USED — *Concluded.*

January to May, 1888.

10.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Fodder corn,	17.75 "
Total cost,	15.53 cts.
Net cost,	7.54 "
Manurial value obtainable,	7.99 "
Nutritive ratio,	1 : 5 82

11.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Corn stover,	17.25 "
Total cost,	15.40 cts.
Net cost,	7.44 "
Manurial value obtainable,	7.96 "
Nutritive ratio,	1 : 5.98

12.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Corn ensilage,	21.75 "
Total cost,	21.64 cts.
Net cost,	13.15 "
Manurial value obtainable,	8.49 "
Nutritive ratio,	1 : 6.12

November, 1888, to May, 1889.

13.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Sugar beets,	47.25 "
Total cost,	30 40 cts.
Net cost,	20.22 "
Manurial value obtainable,	10.18 "
Nutritive ratio,	1 : 5.56

14.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Rowen,	19.50 "
Total cost,	25.72 cts.
Net cost,	13.51 "
Manurial value obtainable,	12.21 "
Nutritive ratio,	1 : 5.06

Fodder rations Nos. 3, 8, 10, 11 and 14 deserve particular attention for trials. The remainder, although in some instances not without special interest, are published to illustrate our essential variations in the daily diet used.

TABULAR STATEMENT OF THE COST PER DAY OF THE ABOVE-MENTIONED FODDER COMBINATIONS.

	Total Cost.	Net Cost.	Manurial Value Obtainable.
	Cents.	Cents.	Cents.
No. 1,	23.43	15.43	8.00
" 2,	16.62	10.04	6.58
" 3,	14.06	7.83	6.23
" 4,	25.12	17.10	8.02
" 5,	21.41	14.31	7.10
" 6,	24.66	16.66	8.00
" 7,	25.14	15.77	9.37
" 8,	19.60	11.62	7.98
" 9,	31.89	23.05	8.84
" 10,	15.75	7.54	7.99
" 11,	15.40	7.44	7.96
" 12,	21.64	13.15	8.49
" 13,	30.40	20.22	10.18
" 14,	25.72	13.51	12.21

Considering the previously described fodder combinations from a mere financial stand-point, they rank, with reference to their net cost, beginning with the lowest, as follows: 11, 10, 3, 2, 8, 12, 14, 5, 1, 7, 6, 4, 13, 9. A close inquiry into the character of the coarser or bulky part of the various fodder compositions cannot fail to show that, wherever fodder corn, corn stover or corn ensilage have been fed in part or in the whole as a substitute for English hay, in connection with the same kind and amount of grain feed, the commercial value of the manurial refuse obtainable has been but slightly if any affected; while the net cost of the daily feed of the animals on trial has been materially reduced (from one-third to one-half). It seems scarcely necessary to mention, here, that only equally well-prepared fodder articles are considered in the discussion.

Sugar beets compare well, as far as net cost is concerned, with good corn ensilage, when fed in quantities of from twenty to twenty-five pounds of the former in place of from thirty to thirty-five pounds of the latter.

In view of these facts, it becomes a question of first importance to ascertain to what extent it will be judicious, as far as their commercial feed value is concerned, to advocate the substitution of dry fodder corn, corn stover and a good corn ensilage for English hay in the daily diet of dairy stock.

It is generally admitted that the present condition of the market for dairy products calls for the closest investigation of every point which bears on the cost of the production of milk; and it will be not less conceded, that next in importance to the selection of cows of good milking qualities comes the consideration of the cost of their daily diet.

Net Cost of Feed.

The actual cost of a daily diet for any kind of farm live stock does not alone depend on the temporary market cost of a given quantity of the various ingredients which constitute the daily fodder rations, but also in a controlling degree upon the quantity of some essential articles of plant food (in particular of nitrogen, phosphoric acid and potassium oxide) which they contain, and the amount of these which may be secured in some definite proportion in form of manurial refuse, after the fodder has served its purpose for the support of the life and the functions of the animal which consumes it. As has been already stated on previous occasions, the net cost of a daily diet is ascertained by deducting from the sum of the market price of its ingredients, the sum expressing the commercial value of their manurial constituents obtainable in each particular case. This circumstance deserves, for obvious reasons, the most serious consideration on the part of farmers, when choosing from among the various suitable fodder articles offered for their patronage, those for a daily diet of their farm live stock which will ultimately prove the cheapest in their position, in consequence of the higher commercial value of the manurial refuse they furnish.

It becomes the more important to select with that view in mind; as the fluctuations in the local market price of oil cakes, gluten meal, corn meal, wheat bran and of similar refuse materials (by-products) of flour mills, glucose works, starch works, breweries, etc., are, as a rule, liable to be more frequent and more serious than in case of home-raised coarse or bulky fodder articles, as English hay, corn stover, corn ensilage, etc. The commercial value of the manurial refuse obtainable from the first-named class, in case of corresponding weights and under similar circumstances, exceeds quite frequently from two to three times that obtainable in case of the latter.

Applying this standard of valuation to our feeding experiments, we notice the following relations : —

Fodder Articles used during our Feeding Experiments.

Name of Article.	Market Price per Ton.	Value of Manurial Constituents per Ton.	Relative Net Cost per Ton.
English hay,	$15 00	$5 58	$10 54
Rowen (dry),	15 00	9 83	7 14
Fodder corn (dry),	5 00	4 53	1 38
Corn stover (dry),	5 00	3 21	2 43
Corn ensilage,	2 75	1 56	1 50
Corn meal,	21 90	6 51	16 69
Wheat bran,	20 70	13 64	9 79
Gluten meal,	23 40	15 23	11 22

Considering our entire feeding experiments, 1885 to 1889, we find that corn meal has cost per ton $22.75, wheat bran $21, and gluten meal $24.50. The latter sells to-day at $23 per ton, corn meal at $19, and wheat bran at $16.50. The market price of hay, corn stover, etc., has practically remained the same, as far as the same season of the year is concerned. Serious variations in the market price of our fodder articles not infrequently advise changes from one article to another of a similar character and composition. At present local market prices of feed stuffs, hay and corn meal are very costly fodder articles ; the same applies to carrots.

Feeding Value or Nutritive Value of Fodder Articles.

From preceding remarks it will be apparent that we have secured a satisfactory basis for our guidance to decide the relative money value of current fodder articles, as well as that of an entire diet. Quite different, however, is our situation, when the determination of their relative feeding value is involved; for it is an undeniable fact that the relative commercial value of fodder articles does not necessarily coincide with their relative feeding value; it rarely does. This circumstance arises from the fact that both are determined by different standards. The *commercial* or *money value* of *fodder articles*, as far as they enter the general market, is regulated like that of other articles of merchandise, by supply and demand; the greater the former and the less the latter, the lower is the market price, etc.; the relative money value of a given quantity can be expressed for the same locality by one definite sum.

The *feeding value* or *nutritive value* of a *fodder article* refers especially to its feeding effect; it depends usually on the co-operation of a series of varying conditions, sometimes more or less beyond our control. Foremost among these are: —

1. A higher degree of adaptation with reference to particular kind and organization of the animal under consideration; its age and functions, etc.

2. The chemical composition and the general physical conditions, depending on stage of growth, mechanical preparation, etc., of the fodder ingredients to be used.

3. Whether the article constitutes the sole diet, or serves as a more or less prominent part of the daily diet. The feeding effect of most fodder articles is more or less modified by, and thus in a controlling degree dependent on, the character of the associated ingredients in the daily diet.

These few remarks suffice to show that the comparative feeding value of one and the same fodder article, even when of a stable composition, cannot be fully expressed by one numerical value. The practice of stating the comparative feeding value of current fodder articles with reference to that of good English hay equal to 100, has been for years abandoned, as devoid of any substantial support. There is no single fodder article on record which furnishes the best diet — *i. e.*, the cheapest and at the same time most nutritive food — for even the same class of animals, under different circumstances. Both net cost of feed and its relative nutritive or feeding effect under existing circumstances, have to be consulted when aiming at an economical diet for farm live stock. Actual feeding experiments, under well-defined circumstances, alone can give us the desired information.

Although much needs still to be done in this direction to recognize in many instances more clearly the principles which underlie a successful practice, it must be admitted that some valuable facts have been already established in regard to a rational and thus economical system of stock feeding, by European investigators and others, which can serve advantageously as guides in compounding economical fodder combinations for all kinds of farm live stock. The economy of milk production, in particular, has received much attention. European investigators recommend in this connection quite generally a daily diet, rich in digestible nitrogenous constituents, as beneficial to the general condition of cows, and at the same time reducing the net cost of the feed consumed, by furnishing larger quantities of valuable home-made manure at the lowest market cost. The European standard for a daily diet of milch cows calls for one part of digestible nitrogenous fodder constituents to five and four-tenths parts of digestible non-nitrogenous food constituents. Our results, on the whole, point in the same direction. The nitrogenous food constituents of the fodder rations received special attention.

The main interest of our inquiry, however, consists in the partial or entire successful substitution, under otherwise corresponding circumstances, of dry fodder corn or corn stover or corn ensilage for English hay, as far as net cost of feed and quality and quantity of milk are concerned. The results of former years of observation are already on record in our respective annual reports; they lead to the same conclusions as those stated in the introduction to our latest experiment, described in preceding pages. The net cost of the daily feed during our late experiment has been reported in that connection. The quality of the milk and cream obtained on that occasion may be learned from the subsequent tabular creamery records of the station. (See "Feeding Experiment," chapter IV., creamery record of the Massachusetts State Agricultural Experiment Station during the years 1885 to 1889, contained in this report.)

II. Feeding Experiments with Milch Cows; Green Crops *vs.* English Hay. June 19 to Oct. 22, 1889.

The first experiment in this direction was instituted in 1887, for the purpose of comparing the feeding effects of good English hay with that of some reputed green fodders. The green crops selected for our observation consisted of a mixed crop of oats and vetch, of Southern cow-pea and of serradella.

1887. — Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 24 pounds. The excess of hay left over was weighed back and subsequently deducted from the original quantity (about ⅓ to ½ pound per day).

Three cows received periodically the above-stated daily rations, and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-pea, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period. The rate of consumption of green crops decreased gradually with the progress of their growth.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the fifth annual report of the station.

1888. — The experiment was repeated with some modifications. A mixed crop of vetch and oats, of Southern cow-pea and of serradella, was raised for that purpose. The latter crop suffered seriously from blight, and was not fit for feeding.

The quantity of green fodder fed at stated times was somewhat less in pounds than in the trial during the preceding year, on account of the addition of gluten meal to the fodder ration of that year. The daily diet (1888) consisted of corn meal, $3\frac{1}{4}$ pounds; wheat bran, $3\frac{1}{4}$ pounds; gluten meal, $3\frac{1}{4}$ pounds; English hay, 5 pounds; and as much vetch and oats or cow-pea as the animal would consume, which amounted, in the case of green vetch and oats, to from 54 to 68 pounds; and in that of green Southern cow-pea, from 70 to 80 pounds. One-fourth (five pounds) of the ordinary daily hay ration was retained in our green fodder diet, for the purpose of preventing disorders in the digestion of a liberal quantity of green fodder.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15 per ton; allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre. This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Fodder Articles. (1888.)

Corn meal,	$24 00	Vetch and oats (green),	$2 75
Corn and cob meal,	20 70	Cow-pea (green),	3 14
Wheat bran,	22 50	Serradella (green),	3 16
Gluten meal,	22 50	Rowen,	15 00
English hay,	15 00		

1889. — Six cows at a time served in the trial; the observation began in June and closed in October, 1889. The course adopted during the preceding year was adhered to in every essential point. The daily diet consisted of $3\frac{1}{4}$ pounds each of corn meal, wheat bran and gluten meal, with 5 pounds of hay, and all the green vetch and oats, green cow-pea or green serradella called for by each individual cow. The amount actually consumed per day varied in case of vetch and oats from 30 to 55 pounds; of cow-pea, from 66 to 84 pounds; and, in case of serradella, from 63 to 85 pounds; showing but little preference for one as compared with the others. The difference in the daily consumption of the green fodders was due largely to their variations in dry vegetable matter during the progress of the experiment. The experiment was sub-divided into five feeding periods, beginning and ending with a hay fodder ration. The daily waste of coarse feed amounted per head to four pounds in case of oats and vetch, to two pounds in case of serradella, to one and one-half pounds in case of cow-pea; and, in case of hay, to one-half pound.

The results obtained fully sustain the conclusions presented in our previous reports, namely: —

1. The weight of dry vegetable matter contained in the feed consumed for the production of one quart of milk is less in case of the green fodder rations than in the hay ration; indicating a superior nutritive value of the former, as compared with the latter.

2. The yield of milk is in every instance increased, when changing from a hay ration to a green fodder ration.

3. The quality of milk is but slightly altered in case of different cows; the solids in some instances are slightly increased, in others they are slightly decreased. The creamery record, as will be seen from subsequent abstracts, is very satisfactory in case of the green fodder rations.

4. The net cost of feed for the production of milk is in every instance less in case of green fodder rations than in the hay ration.

5. The weight of the animal has in most instances increased towards the close of the experiment.

Valuation of Fodder Articles for the Months of June to October of the Year 1889.

	Per Ton.		Per Ton.
Corn meal,	$19 00	Cow-pea,	$3 14
Wheat bran,	18 50	Serradella,	3 16
Gluten meal,	22 00	Hay,	15 00
Vetch and oats,	2 75		

FEEDING RECORD.

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	18.70	–	–	–	25.56	10.90	2.34	1 : 6.23	819
July 2 to July 15,	3.25	3.25	3.25	3.64	55.43	–	–	23.89	10.59	2.26	1 : 6.52	833
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	84.30	–	27.43	11.74	2.34	1 : 6.12	823
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	85.77	27.18	11.00	2.47	1 : 4.68	805
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19.74	–	–	–	26.50	9.51	2.79	1 : 6.29	855
FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*												
June 19 to June 24,	3.25	3.25	3.25	18.80	–	–	–	25.65	11.71	2.19	1 : 6.24	940
July 2 to July 15,	3.25	3.25	3.25	5.00	30.14	–	–	19.71	10.01	1.97	1 : 6.01	904
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	80.90	–	26.85	13.51	1.99	1 : 6.07	932
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	79.54	26.16	11.72	2.23	1 : 4.70	930
Oct. 4 to Oct. 22,	3.25	3.25	3.25	17.79	–	–	–	24.74	10.69	2.31	1 : 6.17	974

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	17.20	–	–	–	24.20	10 04	2.41	1 : 6.13	1,044
July 2 to July 15,	3.25	3.25	3.25	5.00	41.79	–	–	22 24	9.88	2.25	1 : 6.30	1,039
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	83.50	–	27.30	11.41	2.39	1 : 6.11	1,015
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	82.46	26.64	9.13	2.92	1 : 4.69	1,039
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19 26	–	–	–	26.07	8 21	3.18	1 : 6.26	1,078

ANNIE: *Age, six years; grade, Jersey; last calf. June 19, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
June 19 to June 27,	3.25	3.25	3.25	16.00	–	–	–	23.12	10.03	2.31	1 : 6.06	909
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	66.30	–	24.38	10.64	2.29	1 : 5.97	903
Sept. 15 to Sept 27,	3.25	3.25	3.25	5 00	–	–	63.15	23.48	9.04	2.60	1 : 4.74	898
Oct. 4 to Oct. 22,	3.25	3.25	3.25	17.32	–	–	–	24.31	8.39	2.90	1 : 6.14	936

FEEDING RECORD — *Concluded.*

ELSIE: *Age, six years; grade, Holstein; last calf, Feb. 26, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
1889.												
June 19 to June 27,	3.25	3.25	3.25	20.00	–	–	–	26.74	10.58	2.53	1 : 6.31	1,148
July 2 to July 15,	3.25	3.25	3.25	5.00	55.29	–	–	25 18	10.25	2 46	1 : 6 60	1,145
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5 00	–	69.60	–	24.94	9.93	2.51	1 : 5.99	1,132
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	77.08	25.76	9 22	2.79	1 : 4.70	1,141
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19.95	–	–	–	26.69	8.51	3.14	1 : 6 31	1,188

JUNO: *Age, six years; grade, Ayrshire; last calf, June 22, 1889.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
July 2 to July 15,	3.25	3.25	3.25	5.00	49.36	–	–	23.89	14.74	1.62	1 : 6.47	975
Sept. 1 to Sept. 10,	3 25	3 25	3.25	5.00	–	72.80	–	25.48	14.74	1.73	1 : 6.02	1,014
Sept. 15 to Sept. 27,	3.25	3 25	3.25	5.00	–	–	81.38	26.46	12.93	2.05	1 : 4.69	984
Oct. 4 to Oct. 22,	3.25	3.25	3.25	21.74	–	–	–	28.31	12.15	2.33	1 : 6.40	1,040

Total Cost of Feed per Quart of Milk.

Annie.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27, ...	90.25	10.03	29.25	29.25	29.25	144.00	–	–	–	$1 95	2.16
Sept. 1 to Sept. 10, ...	106.38	10.64	32.50	32 50	32.50	50.00	–	663.00	–	2 38	2.24
Sept. 15 to Sept. 27, ...	117.50	9.04	42.25	42.25	42.25	65.00	–	–	821.00	3 04	2.59
Oct. 4 to Oct. 22, ...	159.38	8.39	61.75	61.75	61.75	329.00	–	–	–	4 30	2.70
Elsie.											
June 19 to June 27, ...	95.25	10.58	29.25	29.25	29.25	180.00	–	–	–	$2 22	2.33
July 2 to July 15, ...	143.50	10.25	45.50	45.50	45.50	70.00	774.00	–	–	2 94	2.05
Sept. 1 to Sept. 10, ...	99.25	9.93	32.50	32.50	32.50	50.00	–	696.00	–	2 43	2.45
Sept. 15 to Sept. 27, ...	119.88	9.22	42.25	42.25	42.25	65.00	–	–	1,002.00	3 33	2.78
Oct. 4 to Oct. 22, ...	161.63	8.51	61.75	61.75	61.75	379.00	–	–	–	4 68	2.89
Juno.											
July 2 to July 15, ...	206.38	14.74	45.50	45.50	45.50	70.00	691.00	–	–	$2 83	1.37
Sept. 1 to Sept. 10, ...	147.38	14.74	32.50	32.50	32 50	50 00	–	728.00	–	2 49	1.69
Sept. 15 to Sept. 27, ...	168.13	12.93	42.25	42.25	42.25	65.00	–	–	1,058.00	3 42	2.03
Oct. 4 to Oct. 22, ...	230.88	12.15	61.75	61.75	61.75	413.00	–	–	–	4 93	2.14

Total Cost of Feed per Quart of Milk — *Continued.*

Jessie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27,	98.13	10.90	29.25	29.55	29.25	168.00	–	–	–	$2 13	2.17
July 2 to July 15,	148.25	10.59	45.50	45.50	45.50	51.00	776.00	–	–	2 81	1.89
Sept. 1 to Sept. 10,	117.38	11.74	32.50	32.50	32.50	50.00	–	843.00	–	2 67	2.27
Sept. 15 to Sept. 27,	143 00	11.00	42.25	42.25	42.25	65.00	–	–	1,115.00	3 51	2.45
Oct. 4 to Oct. 22,	180.75	9.51	61.75	61.75	61.75	375.00	–	–	–	4 64	2.56

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
June 19 to June 24,	70.25	11.71	19.50	19.50	19.50	113.00	–	–	–	$1 43	2.04
July 2 to July 15,	140.13	10.01	45.50	45.50	45.50	70.00	422.00	–	–	2 46	1.76
Sept. 1 to Sept. 10,	135.13	13.51	32.50	32 50	32.50	50.00	–	809.00	–	2 61	1.93
Sept. 15 to Sept. 27,	152.38	11.72	42.25	42.25	42.25	65.00	–	–	1,034 00	3 38	2.22
Oct. 4 to Oct. 22,	203.13	10.69	61.75	61.75	61.75	338.00	–	–	–	4 37	2.15

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Eva.

FEEDING PERIODS	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27,	90.38	10.04	29.25	29.25	29.25	155.00	–	–	–	$2 03	2.25
July 2 to July 15,	137.38	9.88	45.50	45.50	45.50	70.00	685.00	–	–	2 82	2.06
Sept. 1 to Sept. 10,	114.13	11.41	32.50	32.50	32.50	50.00	–	835.00	–	2 65	2 32
Sept. 15 to Sept. 27,	118.75	9.13	42.25	42.25	42.25	65.00	–	–	1,072.00	3 44	2.90
Oct. 4 to Oct. 22,	156.00	8.21	61.75	61.75	61.75	366.00	–	–	–	4 58	2.94

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)

[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.
Moisture,	13.290	10.92	10.19	9.48	78 26	83.07	83.65
Nitrogen,	1.564	2.447	4.230	1.463	.268	.304	.470
Phosphoric acid,	.720	2.900	.392	.303	.112	.098	.112
Potassium oxide,	.434	1.637	.049	1.350	.324	.172	.178
Valuation per 2,000 lbs.,	$6 57	$13 27	$14 90	$6 55	$1 34	$1 31	$1 89

NET COST OF MILK AND MANURIAL VALUE OF FEED.

Jessie.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 27,	$2 13	$0 98	$0 78	$1 35	1.38	838
July 2 to July 15,	2 81	1 48	1 18	1 63	1.10	840
Sept. 1 to Sept. 10,	2 67	1 28	1 02	1 65	1.41	810
Sept. 15 to Sept. 27,	3 51	2 00	1 60	1 91	1.34	820
Oct. 4 to Oct. 22,	4 64	2 30	1 84	2 80	1.55	888
Total,	$15 76	$8 04	$6 42	$9 34	–	–

Flora.

June 19 to June 24,	$1 43	$0 71	$0 57	$0 86	1.22	952
July 2 to July 15,	2 46	1 30	1 04	1 42	1.01	905
Sept. 1 to Sept. 10,	2 61	1 26	1 01	1 60	1.18	938
Sept. 15 to Sept. 27,	3 38	1 92	1 54	1 84	1.21	933
Oct. 4 to Oct. 22,	4 37	2 18	1 74	2 63	1.29	1,000
Total,	$14 25	$7 37	$5 90	$8 35	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 24, .	$2 03	$0 94	$0 75	$1 28	1.42	1,046
July 2 to July 15, .	2 82	1 48	1 18	1 64	1.19	1,030
Sept. 1 to Sept. 10, .	2 65	1 27	1 02	1 63	1.43	1,030
Sept. 15 to Sept. 27, .	3 44	1 96	1 57	1 87	1 58	1,038
Oct. 4 to Oct. 22, .	4 58	2 27	1 82	2 76	1.77	1,109
Total, . .	$15 52	$7 92	$6 34	$9 18	–	–

Annie.

June 19 to June 27, .	$1 95	$0 91	$0 73	$1 22	1.35	915
Sept. 1 to Sept. 10, .	2 38	1 16	93	1 45	1.36	888
Sept. 15 to Sept. 27, .	3 04	1 72	1 38	1 66	1.41	896
Oct. 4 to Oct. 22, .	4 30	2 15	1 72	2 58	1.62	976
Total, . .	$11 67	$5 94	$4 76	$6 91	–	–

Elsie.

June 19 to June 27, .	$2 22	$1 01	$0 81	$1 41	1.48	1,150
July 2 to July 15, .	2 94	1 54	1 23	1 71	1.19	1,142
Sept. 1 to Sept. 10, .	2 43	1 18	94	1 49	1.50	1,134
Sept. 15 to Sept. 27, .	3 33	1 89	1 51	1 82	1.52	1,148
Oct. 4 to Oct. 22, .	4 68	2 31	1 85	2 83	1.75	1,210
Total, . .	$15 60	$7 93	$6 34	$9 26	–	–

Juno.

July 2 to July 15, .	$2 83	$1 48	$1 18	$1 65	.80	990
Sept. 1 to Sept. 10, .	2 49	1 20	96	1 53	1.04	1,010
Sept. 15 to Sept. 27, .	3 42	1 95	1 56	1 86	1.11	978
Oct. 4 to Oct. 22, .	4 93	2 42	1 94	2 99	1.29	1,046
Total, . .	$13 67	$7 05	$5 64	$8 03	–	–

Analyses of Milk.

[Per cent.]

Jessie.

1889.	June 25.	July 16.	Sept. 12.	Sept. 24.	Oct. 15.
Solids,	14.76	15.03	13.90	15.43	14.74
Fat,	5.36	5.32	4.74	5.56	5.33
Solids not fat,	9.41	9.71	9.16	9.87	9.41

Flora.

Solids,	15.56	13.33	12.46	14.11	13.35
Fat,	4.78	3.76	3.33	4.36	4.10
Solids not fat,	10.78	9.57	9.13	9.75	9 25

Eva.

Solids,	14.79	15.06	14.07	16.25	16.25
Fat,	4.89	5.13	4.65	6.00	6.10
Solids not fat,	9.90	9.93	9.42	10.25	10.15

Annie.

Solids,	14.18	14.20	14.12	15.71	15.68
Fat,	4.39	4.65	4.55	5.12	5.18
Solids not fat,	9.79	9.55	9.57	10.59	10.50

Elsie.

Solids,	12.70	13.05	12.29	13.33	12.82
Fat,	3.45	3.52	3.42	5.17	3.55
Solids not fat,	9.25	9.53	8.87	8.16	9.27

Juno.

Solids,	–	12.53	11.35	12.87	13.22
Fat,	–	2.93	2.78	4.11	4.03
Solids not fat,	–	9.60	8.57	8.76	9.19

Composition of Fodder Articles fed during this Experiment.

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.29	265.80	–	–	1 : 9.09
Dry matter,	86.71	1,734.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.67	33.40	–	–	
" cellulose,	1.69	33.80	11.49	34	
" fat,	4.04	80.80	61.41	76	
" protein (nitrogenous matter),	11.00	220.00	187.00	85	
Non-nitrogenous extract matter,	81.60	1,632.00	1,534.08	94	
	100.00	2,000.00	1,793.98	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.92	218.40	–	–	1 : 3.99
Dry matter,	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
" cellulose,	11.52	230.40	46.08	20	
" fat,	5.43	108.60	86.88	80	
" protein (nitrogenous matter),	17.17	343.40	302.19	88	
Non-nitrogenous extract matter,	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.19	203.80	–	–	
Dry matter,	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.57	11.40	–	–	
" cellulose,	.56	11.20	3.81	34	1 : 2.86
" fat,	6.40	128.00	97.28	76	
" protein (nitrogenous matter),	29.45	589.00	500.65	85	
Non-nitrogenous extract matter,	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

Hay (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.48	189.60	–	–	
Dry matter,	90.50	1,810.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.12	142.40	–	–	
" cellulose,	33.22	664.40	385.35	58	1 : 8.99
" fat,	2.30	46.00	21.16	46	
" protein (nitrogenous matter),	10.09	201.80	115.03	57	
Non-nitrogenous extract matter,	47.27	945.40	595.60	63	
	100.00	2,000.00	1,117.14	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Vetch and Oats.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	78.26	1,565.20	–	–	1 : 11.26
Dry matter,	21.74	434.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.53	90.60	–	–	
" cellulose,	36.22	724.40	–	–	
" fat,	2.53	50.60	25.30	50	
" protein (nitrogenous matter),	7.72	154.40	92.64	60	
Non-nitrogenous extract matter,	49.00	980.00	980.00	100	
	100.00	2,000.00	1,097.94	–	

Cow-pea.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.07	1,661.40	–	–	1 : 7.46
Dry matter,	16.93	338.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	21.87	437.40	205.58	47	
" fat,	2.99	59.80	35.28	59	
" protein (nitrogenous matter),	11.24	224.80	134.88	60	
Non-nitrogenous extract matter,	56.55	1,131.00	712.53	69	
	100.00	2,000.00	1,088.27	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Concluded.*

Serradella.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.65	1,673 00	–	–	
Dry matter,	16.35	327.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.94	178.80	–	–	
" cellulose,	25.92	518.40	–	–	
" fat,	2.38	47.60	28.56	60	1 : 4.27
" protein (nitrogenous matter),	17.97	359.40	226.42	63	
Non-nitrogenous extract matter,	44.79	895.80	895.80	100	
	100.00	2,000.00	1,150.78	–	

Vetch and Oats. (1889.)

[Left uneaten by the cows during experiment.]

	Per Cent.
Moisture at 100° C.,	4.94
Dry matter,	95.06
	100.00
Analysis of Dry Matter.	
Crude ash,	4.61
" cellulose,	36.72
" fat,	1.79
" protein (nitrogenous matter),	10.52
Non-nitrogenous extract matter,	46.36
	100.00

III. Record of Twelve Cows which served at the Station for Experiments to ascertain the Cost of Feed for the Production of Milk.

When entering at this station upon the task of ascertaining the cost of feed for the production of milk (1884), it was decided to begin the inquiry with cows of moderate milking qualities. Grades of all kinds of breeds were to serve for that purpose. A selection from that class of cows, at the outset of our observation, promised to prove of a special interest, not only on account of their large representation in our dairy stock, but also for the particular chance which our final results would offer to draw more directly the line where milk production ceases to be a profitable business. The material for the subsequent report has been carefully collected during a period of several years. The results, it is true, are obtained under somewhat exceptional circumstances; yet their detailed description cannot fail to show more clearly the financial relation of milk production to a system of a mixed farm management.

The cows which served in our trials were in every instance secured a few days after calving. They were sold to the butcher usually when their daily yield of milk fell below from five to six quarts, to make room for a new-milch cow. The cost of the different animals varied from fifty-five to seventy-two dollars each; they sold at the close of their trial for from twenty-five to thirty-seven dollars each.

The management of the entire experiment was conducted with a view to promote the general health of the animals on trial. Two cows had lost in weight during the experiment, and ten had gained more or less. The change from one diet to another was as a rule a gradual one.

The temporary change in the composition of the daily diet was mainly confined to the coarser and bulky fodder ingredients. English hay, dry fodder corn, corn stover, corn ensilage and roots, besides some small quantity of various dried fodder crops, incidental to some field experiments with forage crops, were fed during the latter part of autumn, the winter and the spring; while several green crops, as oats or barley and vetch, serradella and cow-peas, were substituted during the summer and part of the fall season. The several previously named fodder crops served in the majority of cases either in part or in the whole as substitutes for English hay.

The daily rations of grain fed consisted throughout the entire period, in all cases alike, substantially of the same materials; namely, corn meal or corn and cob meal, and wheat bran, which were supplemented, in the majority of instances, more or less by gluten meal, to secure as far as practicable the desired comparative nutritive character of the diet. The daily diet per head consisted of from eighteen to twenty or more pounds of hay, or its equivalent in part or in the whole of dry vegetable matter of the above-mentioned bulky fodder articles, and from six and one-half to nine and three-quarters pounds of grain feed, usually composed of corn meal or corn and cob meal, and wheat bran, with or without gluten meal (three and one-fourth pounds).

The ruling local average market price of each fodder article has been used for the determination of the cost of feed consumed. The estimates of fertilizing constituents contained in the various fodder articles used are based on our own analysis, and on their local market price during the past year. Twenty per cent. loss of the fertilizing constituents contained in the feed has been allowed for the amount sold with the milk.

The period of observation varied, in case of different cows, from 261 to 747 days; the average daily yield of milk per head for the whole period of observation varied from 7.7 to 12.4 quarts.

Three cents per quart of milk produced has been adopted as the average price realized for the entire year, in case of milk contracts in our vicinity.

The essential details of our observations are subsequently recorded in tabular form, under the following headings: —

1. History of cows.
2. Statement of the amount of each kind of fodder ingredients consumed by each animal, with total cost of feed for period of observation.
3. Local market value per ton of each fodder article used.
4. Value of essential fertilizing constituents contained in the various articles of fodder consumed.
5. Summary of financial record of cows.
6. Some conclusions suggested by the financial record.

1. *History of Cows on Trial.*

NAME AND AGE OF COW.		Breed (Grades).	Number of Calves.	Last Calf.	Date of Arrival.	Date of Departure.	Number of Days milked.	Total Yield of Milk during Observation (Quarts).	Average Yield of Milk per Day at Beginning of Observation (Quarts).	Average Yield of Milk per Day during Ninth Month (Quarts).	Average Yield of Milk per Day at Close of Observation (Quarts).	Average Yield of Milk per Day during Entire Observation (Quarts).	Total Yield of Milk for First 300 Days of Observation (Quarts).	Average Yield of Milk per Day for First 300 Days of Observation (Quarts).	Live Weight of Animal at Beginning of Observation (Pounds).	Live Weight of Animal at Close of Observation (Pounds).
1. Bessie,	8 yrs.,	Jersey, .	4	Oct. 17, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	3,724.3	16.5	9.2	6.9	10.0	3,213.3	10.7	809	833
2. Lady Horace,	8 yrs.,	Ayrshire,	4	Oct. 15, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	4,063.5	16.7	9.8	7.9	10.9	3,486.3	11.6	931	970
3. Daisy (1),	7 yrs.,	Ayrshire,	3	Nov. 10, 1885,	Nov. 17, 1885,	Sept. 16, 1886,	304	3,613.5	15.3	7.9	10.5	11.9	3,571.5	11.9	911	838
4. Mollie,	7 yrs.,	Ayrshire,	3	Nov. 6, 1885,	Nov. 17, 1885,	Sept. 19, 1886,	307	3,124.6	12.1	8.1	8.5	10.2	3,063.5	10.2	891	880
5. Susie,	5 yrs.,	Ayrshire,	2	July 14, 1886,	July 30, 1886,	May 3, 1887,	278	3,446.5	15.5	9.8	9.8	12.4	3,653 3*	12.2	849	1,025
6. Meg,	6 yrs.,	Devon, .	3	Aug. 2, 1886,	Aug. 16, 1886,	May 3, 1887,	261	3,233.8	17.2	10.8	10.9	12.4	3,623.8*	12.1	1,018	1,152
7. Lizzie,	5 yrs.,	Native, .	2	Feb. 1, 1887,	Feb. 5, 1887,	June 22, 1888,	503	6,023.3	19.7	9.2	8.3	12.0	4,176.8	13.9	995	1,102
8. Ida,	7 yrs.,	Durham,	4	Feb. 3, 1887,	Feb. 7, 1887,	Jan. 3, 1887,	331	2,527.8	16.0	3.9	1.3	7.7	2,496.0	8.3	978	1,000
9. Minnie,	7 yrs.,	Ayrshire,	4	May 3, 1887,	May 17, 1887,	Dec. 22, 1888,	584	6,779 0	17.5	12.8	5.1	11.6	3,996.3	13.3	885	1,011
10. Daisy (2),	5 yrs.,	Durham,	3	Jan. 5, 1888,	Jan. 16, 1888,	Jan. 19, 1889,	369	4,557.8	18 9	10.2	6.3	12.4	4,106.5	13.7	1,132	1,185
11. May,	8 yrs.,	Jersey, .	3	June 6, 1887,	June 13, 1887,	June 28, 1889,	747	7,843.5	14.3	12.0	9.6	10.5	3,419.0	11.4	817	990
12. Melia,	10 yrs.,	Dutch, .	7	Aug. 5, 1887,	Aug. 11, 1887,	Mar. 1, 1889,	569	6,366.6	14.3	11.8	7.1	11.2	3,866 5	12.9	964	1,115
Averages, . .		. . .		. . .	. . .	. . .	417	4,608.7	16.2	9.6	7.7	11.1	3,556.1	11.9	932	1,008

* Estimated.

2. Amount of Each of the Various Kinds of Feed consumed (in Pounds) by the Cows on Trial.

	1. Bessie.	2. Lady Horace.	3. Daisy (1).	4. Mollie.	5. Susie.	6. Meg.	7. Lizzie.	8. Ida.	9. Minnie.	10. Daisy (2).	11. May.	12. Melia.
Corn meal,	941.25	941.25	877.50	890.50	900.25	848.50	1,126.50	1,075.75	1,343.50	642.25	1,846.00	1,292.00
Corn and cob meal,	–	–	–	–	–	–	508.25	–	557.25	557.25	557.25	557.25
Wheat bran,	931 25	931.25	939.25	955.50	825.50	776.75	1,530.75	975.00	1,868.75	1,199.25	2,403.25	1,849 25
Rye middlings,	–	–	–	–	74 75	71 50	156.00	156 00	65.00	–	–	–
Gluten meal,	74.75	74.75	–	–	520.00	523.25	771.50	304.00	1,083.00	1,134.50	1,685.25	1,312.50
Hay,	4,228.75	5,122.00	2,962.00	2,780.00	4,073.50	3,311.50	7,418 75	4,925.25	6,886.00	4,354.50	8,086.50	6,656.50
Rowen,	–	–	–	–	–	500.00	1,833.25	1,268.00	1,836.00	528 00	2,464.00	1,843.00
Corn fodder (dry),	324.75	408.00	435.00	473.00	399 50	313.00	713.25	–	824.50	1,600.00	1,059.00	925.00
Corn stover (dry),	–	–	–	–	91.00	90.50	112.00	90.50	86.25	368.00	304 00	242.00
Corn ensilage,	2,098.00	2,188 00	2,990 00	2,959.00	930.00	826.50	878.00	–	1,017 25	1,539.25	2,415.00	2,150.00
Millet (dry),	156.00	119 00	37.00	32.00	–	–	–	–	–	–	–	–
Vetch and lucerne (dry),	72.00	98 00	–	–	–	–	–	–	–	–	–	–
Lucerne and clover (dry),	24.00	30.00	–	–	–	–	–	–	–	–	–	–
Oats (dry),	–	–	308.00	528.00	–	–	–	–	–	–	–	–
Oats (green),	–	–	585.00	585.00	70.00	140.00	–	–	–	–	–	–
Vetch and oats (green),	–	–	–	–	–	–	–	–	2,059.50	1,051.00	2,206.00	998 00
Vetch (green),	–	–	319.00	251.00	40.00	45 00	–	–	–	–	–	–
Serradella (green),	–	–	580.00	725.00	320.00	–	–	–	2,408.50	–	2,374.00	–
Cow-pea (green),	–	–	656.00	676.00	700.00	711.00	–	–	3,109.00	821.00	3,110.00	783.00
Barley and beans (green),	215.00	245.00	–	–	–	–	–	–	–	–	–	–
Potatoes,	–	–	–	–	–	–	–	1,190.00	–	–	–	–
Carrots,	–	–	–	–	–	–	–	–	–	859.00	916.00	918.00
Roots (sugar beets),	–	–	1,592.00	1,592.00	1,041.50	1,052.00	519.50	567.50	91.00	92.00	92.00	92.00
Total cost of feed,	$59 00	$65 65	$56 46	$56 04	$63 25	$59 50	$118 96	$80 08	$135 05	$88 33	$174 60	$130 51

3. Local Market Value per Ton of the Various Articles of Fodder used.

Corn meal,	$23 00
Corn and cob meal,	20 70
Wheat bran,	21 50
Rye middlings,	21 50
Gluten meal,	23 00

Hay,	$15 00	Vetch and oats (green),	$2 75
Rowen,	15 00	Vetch (green),	3 50
Corn fodder,	5 00	Serradella (green),	3 16
Corn stover,	5 00	Cow-pea (green),	3 14
Corn ensilage,	2 25	Barley and horse bean (green),	3 00
Millet (dry),	12 00	Potatoes,	6 67
Lucerne and vetch (dry),	12 00	Carrots,	7 00
Lucerne and clover (dry),	12 00	Sugar beets,	5 00
Oats (dry),	12 00		
Oats (green),	3 60		

4. Valuation of the Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

[Per cent.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Corn and cob meal,	1.46	0.603	0.441	5 91
Wheat bran,	2 82	3.05	1.49	14 24
Rye middlings,	1.84	1.26	0.81	8 27
Gluten meal,	5.22	0.40	0.05	17 75
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Millet (dry),	1.106	0.38	2.49	6 23
Lucerne and vetch (dry),	2 02	0.70	2.273	9 44
Lucerne and clover (dry),	2 06	0.623	1.805	9 08
Oats (dry),	1.47	0.51	2.41	7 51
Oats (green)..	0.33	0.155	0.68	1 85
Vetch and oats (green).	0.23	0 09	0.79	1 54
Vetch (green),	0.49	0 20	0.66	2 42
Serradella (green),	0.411	0.14	0.423	1 89
Cow-pea (green),	0.561	0.098	0.306	2 23
Barley and beans (green),	0.50	0.20	0.40	2 23
Potatoes,	0.476	0.18	0.56	2 18
Carrots,	0.14	0.10	0.54	1 04
Sugar beets,	0.29	0.03	0.18	1 15

5. *Summary of Financial Record of Cows.*

NAME OF COW.	Total Value of Milk at Three Cents per Quart.	Total Cost of Feed consumed.	Manurial Value of Food, less Twenty Per Cent. taken by Milk.	Net Cost of Feed.	Original Cost of Cow.	Selling Price of Cow.	Total Value received above Net Cost of Feed and of Cow.	Value received in Form of Manure.	Value received in Form of Cash.	Total Value received per Day.
										Cents.
1. Bessie,	$111 73	$59 00	$22 27	$36 73	$65 00	$25 00	$35 00	$22 27	$12 73	9.36
2. Lady Horace,	121 90	65 65	24 69	40 96	65 00	26 50	42 44	24 69	17 75	11.35
3. Daisy (1),	108 41	56 46	21 95	34 51	60 00	25 00	38 90	21 95	16 95	12.80
4. Mollie,	93 74	56 04	22 24	33 80	60 00	25 00	24 94	22 24	2 70	8.12
5. Susie,	103 40	63 25	24 81	38 44	60 00	37 40	42 36	24 81	17 55	15.24
6. Meg,	97 01	59 50	23 84	35 67	60 00	37 51	38 88	23 83	15 05	14.90
7. Lizzie,	180 70	118 96	47 64	71 32	65 00	28 00	72 38	47 64	24 74	14.39
8. Ida,	75 83	80 08	30 28	49 80	55 00	25 00	—3 97	30 28	—34 25	—1.20
9. Minnie,	203 37	135 05	56 93	78 12	60 00	28 00	93 25	56 93	36 32	15.97
10. Daisy (2),	136 33	88 33	37 94	50 39	72 50	35 00	48 44	37 94	10 50	13.13
11. May,	235.31	174 60	73 35	101 25	60 00	30 00	104 06	73 35	30 71	13.93
12. Melia,	191 00	130 51	54 50	76 01	65 00	30 00	79 99	54 50	25 49	14.06
Averages,	$138 23	$90 62	$36 70	$53 92	$62 29	$29 38	$51 40	$36 70	$14 70	11.83

Average cost of cow (twelve),	$62 29
Average selling price of cow,	29 38
Average of total cost of feed per day,	21.54 cents.
Average product per day for entire observation, per head,	11.06 quarts.
Average of net cost of feed per day,	12.94 cents.
Average of value received above net cost of feed and of cow, per day,	12.33 cents.
Average of value received in form of manure, per day,	8.81 cents.
Average of value received in form of cash, per day,	3.52 cents.

The average yield of milk at the end of the ninth month, since day of calving, was sixty-one per cent. of original yield. The shrinkage in the temporary market value of cow varies from five to eleven and four-tenths cents per day, and averages eight cents per head in our case.

The net cost of the feed consumed is obtained by deducting eighty per cent. of the current commercial value of the essential fertilizing constituents contained in the feed from the market cost of the feed. See —

Bessie.

Market value of feed consumed,	$59 00
Value of manure obtainable,	22 27
Net cost of feed,	$36 73

The total value obtained for the feed consumed is ascertained by adding the value secured from the sale of milk produced to the commercial value represented in the manure obtainable. See —

Bessie.

Value of milk sold,	$111 73
Value of eighty per cent. of the manurial substances in the feed,	22 27
Total value obtained from feed consumed,	$134 00

The total value secured from any individual cow, after net cost of feed and of cow has been accounted for, is represented by subtracting the sum resulting from the addition of the difference between the original cost of the cow and its selling price, and of the total cost of feed consumed, from the total value obtained in form of milk and manurial refuse. See —

Bessie.

Original cost of cow,	$65 00
Selling price of cow,	25 00
Difference,	$40 00
Loss on cow,	$40 00
Total cost of feed,	59 00
	$99 00
Total value obtained from feed,	$134 00
Total cost of feed and loss on cow,	99 00
Net return for feed,	$35 00

It seems to be scarcely necessary to add that the above estimates refer only to the cost of feed and of the cow, and do not include cost of labor, housing, interest and risk of life of animal, etc.

6. *Some Conclusions suggested by the Preceding Financial Record.*

1. The total value received above net cost of feed and of cow does in no instance exceed 15.97 cents per day; its average in eleven cases is 13.02 cents. There is an actual loss of 1.2 cents per day in one case (No. 8), where the average daily yield of milk for the entire period of observation (331 days) is as low as 7.7 quarts.

2. The total value received above net cost of feed and of cow consists in every instance in a controlling degree on the manure obtainable. In No. 8 it prevents a serious loss, while in No. 4 it represents practically the entire gain; in some instances it amounts to from three-fourths to two-thirds (Nos. 12 and 3), and in none as low as one-half of the total value secured.

3. As the value of the manure depends in a controlling degree on the amount of fertilizing constituents contained in the feed, it becomes apparent that this point ought to be seriously considered when selecting suitable fodder articles for a remunerative daily diet of dairy cows. The table containing the valuation of the essential fertilizing constituents of the fodder articles used in our experiments is very sug-

gestive in this connection, when compared with the preceding statements of respective market prices of the latter.

4. Recognizing the correctness of the preceding conclusion, it is evident that the most serious attention ought to be bestowed on collecting and preserving the manurial refuse obtained in connection with the production of milk; for it depends largely on a judicious management of that matter, how much of the stated manurial value will be actually secured. The liability of a loss in the manurial value of the refuse matter renders it advisable, for financial reasons, not to depend on too close a margin of cash returns.

5. Although it will be conceded that the dairy cow, aside from the special service, is a most important factor in mixed farm management, as far as an economical disposition of home-raised fodder crops and a liberal production of home-made manure are concerned, yet, when reduced to a mere manure-producing medium, this value may be well questioned from a financial stand-point.

6. A cow whose total milk record averages not more than from seven to eight quarts per day, judging from our own conditions, promises to prove a better investment when prepared for the meat market than when constituting a liberal proportion of the stock kept for supplying the general milk market at stated prices.

IV. Creamery Record of the Station during the Years 1887, 1888 and 1889; and Some Observations made during Visits to the Patrons of Two Creameries in Our Vicinity.

In preceding pages has been stated the financial record of twelve cows, grades which had served during past years for feeding experiments at the station. It was stated in that connection that the primary object at that time was to test the comparative merits of corn fodder, corn stover, corn ensilage and root crops, in the whole or in part, as circumstances advised, as substitutes for a good meadow hay, as far as quantity, quality and cost of production of milk are concerned. The cows selected for that investigation, were, for stated reasons, of moderate milking qualities. Our financial records, although obtained under somewhat exceptional circumstances, are published with full recognition of that point, considering them not without some interest to others studying the financial side of the dairy industry in its varying aspects.

The subsequent communication contains a discussion of our creamery record, which covers, to a considerable extent, the time when the above-mentioned milk record was obtained. The milk was weighed at the station, and the cream secured and measured by means of a Cooley creamery apparatus. A copy of the daily record was kept in our dairy room by the agent of the creamery. Two quarts of milk used daily for family purposes are accounted for in our calculations of total results. Analyses of milk were made where a change of daily diet rendered it advisable.

The cost of feed consumed is based on the same market price of the various ingredients as was adopted in the preceding milk record. The same is true in regard to the valuation of the whole milk, — three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are also based upon those given in connection with the preceding milk record.

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved; for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock, and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.

1. Statement of Articles of Fodder used during 1887, 1888 and 1889 (in Pounds).

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Potatoes.	Carrots.	Sugar Beets.
1887.																
January, .	299.0	–	299.0	–	299.0	366.0	–	184.5	–	2,590.0	–	–	–	–	–	–
February, .	523.5	–	523.5	–	409.5	1,630.0	–	–	467.5	–	–	–	–	–	–	4,255.0
March, .	585.0	–	585.0	–	585.0	390.0	2,975.0	–	115.0	–	–	–	–	–	–	663.5
April, . .	585.0	–	481.0	101.0	585.0	3,550.0	–	–	–	–	–	–	–	–	–	–
May, . .	466.0	–	81.5	637.0	130.0	2,860 0	–	–	–	–	–	–	–	–	–	–
June. . .	549.5	–	549.0	–	–	3,380.0	–	–	–	–	–	–	–	–	–	–
July, . .	598.0	–	552.5	–	–	2,521.5	–	–	–	–	3,415.0	–	–	–	–	–
August, .	572.0	–	572.0	–	–	2,494.0	–	–	–	–	–	–	6,150.0	–	–	–
September, .	585.0	–	585.0	–	–	2,660.5	–	–	–	–	–	7,185.0	735.0	–	–	–
October, .	604.5	–	604.5	–	–	4,368.5	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	–	212.5	4,194.5	–	–	–	–	–	–	570.0	–	–
December, .	590.0	–	589.5	–	24.0	1,183.0	3,023.5	–	–	–	–	–	–	620.0	–	–
1888.																
January, .	280.0	282.0	562.5	–	522.5	3,378.0	–	–	–	–	–	–	–	–	–	–
February, .	–	565.5	565.5	–	565.5	1,155.0	–	2,064.0	–	225.0	–	–	–	–	–	–
March, .	–	604.5	604.5	–	604.5	1,307.5	–	79.5	–	5,094.0	–	–	–	–	–	–
April, . .	–	585.0	585 0	–	585.0	1,050.0	–	1,319.5	–	1,303.5	–	–	–	–	–	–
May, . .	–	604.5	604.5	–	510.0	3,600.0	–	27.0	–	–	–	–	–	–	–	551.0

1. STATEMENT OF ARTICLES OF FODDER USED DURING 1887, 1888 AND 1889 (IN POUNDS)—*Concluded.*

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Potatoes.	Carrots.	Sugar Beets.
June, . .	–	585.0	585.0	–	291.0	3,600.0	–	–	–	–	–	–	–	–	–	–
July, . .	413.0	117.0	530.0	–	530.0	2,054.0	–	–	–	–	4,730.5	–	–	–	–	–
August, .	504.0	–	504.0	–	504.0	620.0	2,534.0	–	–	–	–	–	–	–	–	–
September, .	510.0	–	510.0	–	510.0	2,148.5	–	–	–	–	–	–	3,970.0	–	–	–
October, .	575.5	–	575.5	–	575.5	3,431.0	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	585.0	1,845.0	–	1,348.5	–	–	–	–	–	–	–	–
December, .	588.5	–	588.5	–	588.5	223.0	–	1,183.0	1,488.5	–	–	–	–	–	461.0	–
1889.																
January, .	608.75	–	604.75	–	584.75	1,772.00	–	–	–	1,475.00	–	–	–	–	4,868.00	–
February, .	552.50	–	552.50	–	552.50	1,268.50	–	–	–	5,069.50	–	–	–	–	–	–
March, .	591.50	–	591.50	–	591.50	2,396.00	–	–	–	–	–	–	–	–	–	4,084.00
April, . .	572.00	–	562.25	–	563.88	2,395.50	838.00	–	–	–	–	–	–	–	–	1,125.00
May, . .	604.50	–	583.38	–	604.50	900.50	2,713.50	–	–	–	–	–	–	–	–	–
June, . .	585.00	–	585.00	–	585.00	1,858.50	1,295.50	–	–	–	582.75	–	–	–	–	–
July, . .	604.50	–	604.50	–	604.50	434.00	1,871 00	–	–	–	4,308.75	–	–	–	–	–
August, .	402.00	–	402.00	–	402.00	180.00	3,755.25	–	–	–	–	–	1,512.00	–	–	–
September, .	585.00	–	585.00	–	585.00	1,002.00	–	–	–	–	–	8,182.50	4,983.00	–	–	–
October, .	604.50	–	604.50	–	604.50	3.574.50	–	–	–	–	–	–	–	–	–	–

2. (A) Record of Average Quality of Milk and of Fodder Rations (1887).

1887.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds). Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January, .	12.38	3.45	2.17	1 : 6.20	3.25	–	3.25	–	3.25	5.00	–	–	–	29.00	–	–	–	–
February, .	13.13	4.07	2.02	1 : 5.90	3.25	–	3.25	–	3.25	10.00	–	–	–	–	–	–	–	35.00
March, .	13.13	3.97	2.19	1 : 6.20	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
April, .	12.84	3.73	2.42	1 : 6.10	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
May, } .	13.31	4.13	{ 1.80	1 : 9.15	3.25	–	–	6.25	–	20.00	–	–	–	–	–	–	–	–
June, }			{ 1.82	1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
July, . .	13.11	4.28	1.97	{ 1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				{ 1 : 6.94	3.25	–	3.25	–	–	5.00	–	–	–	–	62.00	–	–	–
August, .	12.70	3.78	1.73	{ 1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				{ 1 : 5.19	3.25	–	3.25	–	–	5.00	–	–	–	–	–	–	98.00	–
September,	13.04	4.04	1.74	{ 1 : 5.40	3.25	–	3.25	–	–	5.00	–	–	–	–	–	98.00	–	–
				{ 1 : 8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
October, .	13.54	4.50	1.63	1 : 8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
November,	–	–	1.97	1 : 5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
December, .	13.16	4.24	1.67	1 : 5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
Averages, .	13.04	4.00	1.93															

2. (*B*) Record of Average Quality of Milk and of Fodder Rations (1888).

1888.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds). Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January, .	13.18	4.08	1.58	1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
February, .	13.98	3.67	1.75	1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
March, . .	13.77	3.79	1.71	1 : 5.5	–	3.25	3.25	–	3.25	7.50	–	–	–	30.00	–	–	–	–
April, . .	13.83	4.00	1.73	{ 1 : 5.5	–	3.25	3.25	–	3 25	7.50	–	–	–	30.00	–	–	–	–
				{ 1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
May, . .	–	–	1.67	1 : 5.9	–	3 25	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
June, . .	–	–	1.76	1 : 7.3	–	3 25	3.25	–	1.50	20.00	–	–	–	–	–	–	–	–
July, . .	13.04	3.14	1.93	1 : 5.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	60.00	–	–	–
August, .	12.87	3.86	1.83	1 : 5.9	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
September,	13.26	3.79	1.85	{ 1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
				{ 1 : 4.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	–	–	78.00	–
October, .	–	–	1 72	1 : 6.3	3.25	–	2.25	–	3.25	20.00	–	–	–	–	–	–	–	–
November,	14.39	4.55	1.63	{ 1 : 6.3	3.25	–	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
				{ 1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
December, .	14.78	4.86	1.43	{ 1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
				{ 1 : 6.7	3.25	–	3.25	–	3.25	–	–	–	22.00	–	–	–	–	–
Averages,	13.68	3.97	1.72															

2. (C) Record of Average Quality of Milk and of Fodder Rations (1889).

1889.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds).													
					Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Carrots.	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January,	14.49	3.90	1.76	1:6.21	3.25	-	3.25	-	3.25	10.00	-	-	39.57	-	-	-	-	-
February,	13.93	4.29	1.74	1:6.57	3.25	-	3.25	-	3.25	5.00	-	-	-	36.51	-	-	-	-
March,	14.12	4.36	1.65	1:5.99	3.25	-	3.25	-	3.25	16.40	-	-	-	-	-	-	-	-
				1:6.14	3.25	-	3.25	-	3.25	10.00	-	-	-	-	-	-	-	45.60
April,	14.14	4.56	1.62	1:6.12	3.25	-	3.25	-	3.25	18.38	-	-	-	-	-	-	-	-
May,	14.03	4.31	1.60	1:5.21	3.25	-	3.25	-	3.25	-	19.53	-	-	-	-	-	-	-
June,	14.42	4.58	1.62	1:5.30	3.25	-	3.25	-	3.25	-	20.60	-	-	-	-	-	-	-
				1:6.18	3.25	-	3.25	-	3.25	18.00	-	-	-	-	-	-	-	-
July,	13.92	4.30	1.72	1:6.38	3.25	-	3.25	-	3.25	5.00	-	-	-	46.50	-	-	-	-
				1:5.30	3.25	-	3.25	-	3.25	-	20.60	-	-	-	-	-	-	-
August,	13.85	4.21	1.70	1:5.62	2.00	-	2.00	-	2.00	-	24.10	-	-	-	-	-	-	-
September,	13.82	4.48	1.65	1:6.05	3.25	-	3.25	-	3.25	5.00	-	-	-	-	-	76.23	-	-
				1:4.70	3.25	-	3.25	-	3.25	5.00	-	-	-	-	78.23	-	-	-
October,	14.34	4.72	1.53	1:6.26	3.25	-	3.25	-	3.25	19.30	-	-	-	-	-	-	-	-
Averages,	14.11	4.37	1.66															

3. VALUE OF CREAM PRODUCED AT CREAMERY BASIS OF VALUATION.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1887.					
January,	$16 21	$9 69	$0 27	$6 79	$17 24
February,	40 39	17 76	69	23 32	38 85
March,	46 93	27 10	71	20 54	40 20
April,	46 34	22 68	57	24 23	31 14
May,	36 02	15 34	64	21 32	32 47
June,	37 57	16 87	66	21 36	30 03
July,	36 42	16 93	59	20 08	27 69
August,	41 09	14 94	68	26 83	35 91
September,	45 48	22 54	69	23 63	36 30
October,	46 21	20 66	64	26 19	36 30
November,	47 97	27 02	52	21 47	29 48
December,	47 01	25 08	60	22 53	35 23
Averages,	$40 60	$19 72	$0 61	$21 52	$32 57
1888.					
January,	$43 53	$21 42	$0 76	$22 87	$45 76
February,	32 51	20 05	73	13 19	44 00
March,	35 44	20 05	69	16 08	40 91
April,	31 71	19 19	65	13 17	35 99
May,	47 06	22 63	65	25 08	34 23
June,	42 69	20 11	58	23 16	28 67
July,	39 66	20 63	63	19 66	30 94
August,	40 66	23 64	61	17 63	32 48
September,	39 57	21 42	57	18 72	32 02
October,	45 15	22 44	62	23 33	35 92
November,	36 95	21 03	64	16 56	37 67
December,	29 82	17 97	59	12 44	34 67
Averages,	$38 73	$20 88	$0 64	$18 49	$36 11
1889.					
January,	$52 21	$21 23	$0 66	$31 64	$40 60
February,	33 86	19 15	63	15 34	36 19
March,	48 14	21 77	75	27 11	42 48
April,	46 17	23 40	78	23 55	42 84
May,	47 28	27 23	83	20 88	39 28
June,	44 21	23 98	72	20 95	33 06
July,	43 63	25 28	76	19 11	34 92
August,	45 41	27 54	76	18 66	36 33
September,	48 01	28 08	73	20 66	38 25
October,	37 21	23 47	71	14 45	39 06
Averages,	$44 62	$24 11	$0 73	$21 24	$38 31

4. Cost of Skim-milk at the Selling Price of Three Cents Per Quart for Whole Milk.

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1887.								Cents.	
January,	976.2	445	130.9	845.3	3.88	1.76	$17 24	1.43	$12 05
February,	2,093.1	1,036	304.7	1,788.4	3.75	1.86	38 85	1.34	23 94
March,	2,352.7	1,072	315.3	2,037.4	3.75	1.71	40 20	1.43	30 38
April,	2,083.4	859	252.6	1,830.8	3.63	1.50	31 14	1.71	31 36
May,	1,729.0	962	282.9	1,446.1	3.38	1.88	32 47	1.34	19 40
June,	1,818.7	1,001	294.4	1,524.3	3.00	1.65	30 03	1.61	24 53
July,	1,749.7	886	260.6	1,489.1	3.13	1.58	27 69	1.67	24 80
August,	1,772.6	1,026	301.8	1,470.8	3.50	2.03	35 91	1.17	17 27
September,	1,808.4	1,037	305.0	1,503.4	3.50	2.01	36 30	1.19	17 95
October,	1,574.4	968	284.7	1,289.7	3.75	2.31	36 30	0.85	10 93
November,	1,545.6	786	231.2	1,314.4	3.75	1.91	29 48	1.28	16 89
December,	1,522.3	909	267.3	1,255.0	3.88	2.31	35 23	0.83	10 44
Averages,	1,752.2	916	269.3	1,482.9	3.58	1.89	$32 57	1.32	$19 99
1888.									
January,	1,807.5	1,144	336.5	1,471.0	4.00	2.53	$45 76	0.58	$8 47
February,	1,925 8	1,100	323.5	1,602.3	4.00	2.28	44 00	0.86	13 77
March,	1,794.5	1,049	308.5	1,486.0	3.90	2.28	40 91	0.87	12 93
April,	1,702.5	986	290.0	1,412.5	3.65	2.11	35 99	1.07	15 09
May,	1,638.1	978	287.6	1,350.5	3.50	2 10	34 23	1.10	14 91
June,	1,553.9	882	259.4	1,294.5	3.25	1.85	28 67	1.39	17 95
July,	1,841.5	952	280.0	1,561.5	3.25	1.68	30 94	1.56	24 31
August,	1,696.9	928	272.9	1,424.0	3.50	1.91	32 48	1.29	18 43
September,	1,580.1	854	251.2	1,328.9	3.75	2.03	32 02	1.16	15 38
October,	1,606.8	933	274.4	1,332.4	3.85	2.24	35 92	1.00	12 28
November,	1,576.0	966	284.1	1,291.9	4.00	2.39	37 67	0.74	9 61
December,	1,270.3	889	261.5	1,008.8	4.00	2.73	34 67	0.34	3 44
Averages,	1,666.2	972	285.8	1,380.4	3.72	2.18	$36 11	1.00	$13 88
1889.									
January,	1,791.1	1,015	298.5	1,492.6	4.00	2.27	$40 60	0.88	$13 13
February,	1,680.0	965	283.8	1,396.2	3.75	2.15	36 19	1.02	14 21
March,	1,895.0	1,148	337.6	1,557.4	3.70	2.24	42 48	0.92	14 37
April,	1,931.6	1,190	350.0	1,581.6	3.60	2.22	42 84	0.96	15 11
May,	2,025.2	1,267	372.6	1,652.6	3.10	1.94	39 28	1.30	21 48
June,	1,785.6	1,102	324.1	1,461.5	3.00	1.85	33 06	1.40	20 51
July,	2,001.2	1,164	342.4	1,658.8	3.00	1.74	34 96	1.51	25 12
August,	1,991.9	1,172	344.7	1,647.2	3.10	1.82	36 33	1.42	23 43
September,	1,856.0	1,125	330.9	1,525.1	3.40	2.06	38 25	1.14	17 43
October,	1,665.0	1,085	319.1	1,345 9	3.60	2.35	39 06	0.81	10 89
Averages,	1,862.3	1,123	330.4	1,531.9	3.43	2.06	$38 31	1.14	$17 57

5. Fertilizing Constituents of Cream.

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen (16½ cents per pound),	.54
Potassium oxide (4¼ cents per pound),	.123
Phosphoric acid (6 cents per pound),	.168

6. Some Conclusions drawn from the Preceding Records.

1. The relative proportion of digestible nitrogenous and non-nitrogenous constituents consumed differs on the whole in a larger degree during the year 1887 than in 1888. During one-half of the year 1887 it ranged above 1 : 8.5 ; during the year 1888 it reached 1 : 7.3 in only one case, and for six of the remaining months it was below 1 : 6 (nutritive ratio). In 1889 it was in one case only 1 : 6.59, while in all others it resembled quite closely those of the preceding year. The different nutritive ratios averaged, for the year 1887, 1 : 7.08 ; for the year 1888, 1 : 6.00 ; for the year 1889, 1 : 5.80.

2. The amount of fat in the milk varied, during the year 1887, from 3.45 to 4.50 per cent., with an average of 4.00 per cent. ; during the year 1888 it varied from 3.14 to 4.86 per cent., with an average of 3.97 per cent. ; while during the year 1889 it varied from 3.90 to 4.72 per cent., with an average of 4.37 per cent.

3. The quantity of milk, in quarts, required to produce one space of cream, during the year 1887, varied from 2.42 to 1.63, and amounted, on the average, to 1.93 quarts for the entire year ; during the year 1888 it varied from 1.93 to 1.43, averaging for the year 1.72 quarts ; and during the year 1889 it varied from 1.76 to 1.53 quarts, with an average of 1.66 quarts.

4. The value received for one space of cream during the year 1887 varied from 3.00 to 3.88 cents, with an average of 3.58 cents ; during the year 1888 from 3.25 to 4.00 cents were received for each space, with an average of 3.72 cents ; which would equal 12.17 cents per quart of cream for 1887 and 12.65 cents for 1888. During the year 1889 the money value allowed by the creamery for one space of cream varied from 3.00 to 4.00 cents, with an average of 3.43 cents, or 11.66 cents per quart.

5. The total cost of feed consumed for the production of one quart of cream amounted for the year 1887 to 15.09 cents, for the year 1888 to 13.55 cents, and for the year 1889 the same as in 1888.

6. The value of fertilizing constituents which are lost to the farm by the sale of cream produced, amounted, according to the analyses of our cream, during the year 1887 to 3.09 per cent., during 1888 to 3.65 per cent., and in 1889 to 3.03 per cent., of the total fertilizing value of the feed. From these figures it will be seen that in selling the cream from the farm much less fertilizing constituents are lost to the farm than in selling the whole milk. A loss of twenty per cent. of the fertilizing constituents contained in the feed has been allowed in our previous publications, when selling the whole milk. The statement of net cost of feed, as compared with that of its total cost, refers to the original cost of the feed less the value of fertilizing constituents obtainable in manure.

7. The net cost of feed consumed per quart of cream (1 quart = 3.4 spaces) averaged, for the year 1887, 8 cents; for the year 1888, 6.47 cents, and for the year 1889, 6.4 cents. As we obtained 12.17 cents per quart of cream during 1887, 12.65 cents during 1888, and 11.5 cents in 1889, we secured a profit above net cost of feed of 4.17 cents per quart in 1887; in the year 1888, 6.18 cents; and in 1889, 5.1 cents, for the same quantity.

8. We produced, during the year 1887, 1,752.2 quarts of whole milk per month; during the year 1888, 1,662.2 quarts; and in 1889, 1,862.3 quarts. It required, on an average, 6.51 quarts of whole milk to produce one quart of cream during 1887, 5.83 quarts during 1888, and 5.64 quarts during 1889. We secured, on an average per month during 1887, 1,482.9 quarts of skim-milk and 269.3 quarts of cream; in 1888, 1,380.4 quarts of skim-milk and 285.8 quarts of cream; and in 1889, 1,531.9 quarts of skim-milk and 330.4 quarts of cream.

9. Counting the whole milk at three cents per quart, then skim-milk has cost us, on an average, during the year 1887, 1.32 cents per quart; during the year 1888, 1.00 cent per quart; and in 1889, 1.14 cents per quart. The cost of

skim-milk varied considerably during different months of the year, mainly on account of the changes in the valuation of the cream. During 1887, the cost of skim-milk varied from .83 to 1.71 cents per quart; in 1888, from .34 to 1.56 cents per quart; and in 1889, from .81 to 1.51 cents per quart.

The feeding value of skim-milk containing 9.5 per cent. of solids, is stated by good authority to stand in the relation of 3.1 to 4, when compared in that respect with whole milk. In case an average whole milk is charged at three cents per quart, skim-milk would be worth, on the previously stated basis, 2.33 cents. The feeding value of skim-milk, estimated on the customary basis of 4.33 cents per pound of digestible nitrogenous substances and of fat, and .9 cents for non-nitrogenous substances, would amount, per gallon, to 1.91 cents.

We have bought, during the past years, creamery butter-milk containing from 7 to 8 per cent. of solids, at 1.37 cents per gallon. (See third annual report, page 42.) Our own skim-milk, with 9.5 per cent. of solids, would represent, on this basis, a value of 1.75 cents per gallon, or .44 cents per quart.

Some Facts concerning Two Creameries.

It seemed of interest to us to learn from personal observation some facts concerning the supply of cream to some creameries in our vicinity. By the courtesy of the officers in charge of these establishments, Mr. Edward R. Flint, assistant in the chemical department of the station, has been permitted to accompany the collectors of cream at their round trips, and to take notes as directed. He has visited at different times all the patrons of these creameries, in all, 193 farms. Cream and butter have been repeatedly tested. The results of our work in this connection are embodied in a few subsequent pages.

Creamery A.

This creamery receives 350 gallons of cream per day, from 129 farms. This is set for sixteen hours at a temperature of 64 degrees F., together with a small amount of sour cream to hasten the ripening process. The cream is then churned for one hour at a temperature of 64 degrees F., and washed twice with clear water. It is worked once, at which time it is salted at the rate of one ounce of salt per pound. The product of this creamery is about 4,200 pounds per week; 6.13 spaces of cream are considered to make a pound of butter.

Creamery B.

This creamery receives 200 gallons of cream per day, from 64 farms. This is set in one vat for twenty-four hours, at a temperature of 60 degrees F. It is then churned for one hour at 65 degrees F., and washed twice in the churn with clear water. It is worked twice, 1½ ounces of salt per pound being added when first worked. This creamery produces 1,850 pounds of butter per week. A little less than six spaces are considered to make a pound of butter.

Butter samples from creameries A and B show the following results of analysis: —

Creamery A.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 6, . . .	12.35	81.54	.80	5.13
10, . . .	11.73	81.43	.70	6.45
16, . . .	12.68	81.65	.71	4.93
18, . . .	11.02	83.32	.51	3.97
21, . . .	11.04	81.79	.60	4.55
23, . . .	10.54	84.35	.54	4.04
25, . . .	12.31	82.40	.52	5.04
26, . . .	12.95	82.21	.60	4.63
October 28, . . .	12.52	82.62	.58	4.28
29, . . .	12.78	87.37	.55	Trace.
30, . . .	11.48	83.69	.64	4.30
31, . . .	11.76	82.17	.88	4.45
Average, . . .	11.93	82.88	.64	4.31

Creamery B.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 27, . . .	10.77	84.09	.64	5.92
30, . . .	11.00	84.25	.56	5.60
October 1, . . .	9.88	83.15	.56	4.76
3, . . .	7.43	86.64	.58	4.53
17, . . .	9.22	85.00	.75	5.11
18, . . .	9.51	84.10	.62	5.32
21, . . .	11.90	84.00	.89	4.15
22, . . .	10.37	84.01	.63	3.61
November 1, . . .	9.21	86.33	.70	4.12
4, . . .	10.12	86.74	.72	5.90
5, . . .	10.14	83.51	.70	5.63
7, . . .	7.11	89.05	.62	3 96
Average, . . .	9.64	85.07	.66	4.72

Cream samples from creameries A and B show the following results of analysis: —

Creamery A.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6, ...	24.34	16.86	7.48
10, ...	23.75	16.69	7.06
16, ...	24.25	17.15	7.10
18, ...	23.68	16.39	7.29
21, ...	23.66	15.86	7.80
23, ...	24.58	18.53	6.05
25, ...	24.91	13.74	11.17
26, ...	23.54	15.72	7.82
October 26, ...	23.38	16.51	6.87
29, ...	25.17	18.70	6.47
30, ...	24.96	17.38	7.58
November 6, ...	24.44	18.23	6.21
8, ...	24.60	16.94	7.66
December 10, ...	23.73	15.95	7.78
13, ...	24.91	16.75	8.16
14, ...	24.04	15.73	8.31
26, ...	24.87	16 24	8.63
27, ...	23.81	15.58	8.23
Average, ...	24.26	16.61	7.65

Creamery B.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 27,	22.65	15.80	6.85
30,	24.37	16.77	7.60
October 1,	22.89	15.67	7.22
3,	23.24	16.05	7.19
17,	23.58	16.54	7.04
18,	23.50	16.24	7.26
21,	23.91	16.98	6.93
22,	22.82	16.06	6.76
November 1,	22.81	15.26	7.43
4,	23.24	15.81	7.52
5,	23.80	16.28	7.53
7,	24.72	17.40	7.32
December 12,	23.38	15.08	8.30
Average,	23.45	16.13	7.30

Analyses of Cream from the station dairy, from samples collected during the time of collection from the creameries, the grain feed consisting of three and one-quarter pounds corn meal, three and one-quarter pounds bran, and three and one-quarter pounds gluten meal; the coarse feed of five pounds hay, seventy-five pounds serradella (green).

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6,	28.09	20.33	7.76
11,	24.65	17.91	6.74
17,	25.25	18.95	6.30
18,	27.65	20.42	7.23
21,	27.20	20.51	6.69
24,	27.27	20.16	7.11
25,	26.21	18.32	7.89
26,	26.18	17.13	9.05
Average,	26.56	19.22	7.34

Summary of Butter and Cream Analyses.

Butter.

	Moisture.	Butter Fat.	Casein.	Salt.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A, .	11.93	82.88	.64	4.31
Average of Creamery B, .	9.64	85.07	.66	4.72

Cream.

	Solids.	Fat.	Solids not Fat.
	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A, .	24.26	16.61	7.65
Average of Creamery B, .	23.45	16.13	7.30
Average of Station Dairy, .	26.56	19.22	7.34

Details of Farms contributing to Creamery A.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	Number of Months since Last Calf. 3 mos. to 9 mos.	Number of Months since Last Calf. More than 9 mos.
1	4	–	17	–	4.25	–	5½	Three pure, one grade Jersey,	Hay, corn fodder, pumpkins,	None,	– –	1	2	1
2	13	13	38	48	2.92	3.69	4	Pure and grade Jersey,	Rowen, hay, corn stalks,	4 qts. cob meal and rye,	Same,	–	6	5
3	7	5	28	20	4	4	4½	Jersey and native,	Pasture (Nov.), rowen, stover,	None,	4 qts. meal and bran,	1	3	2
4	5	5	10	13	2	2.60	4	Grade Jersey,	Hay, corn fodder,	4 qts. bran,	Same,	2	6	–
5	11	10	45	32	4.09	3.20	7	Pure and grade Jersey, Holstein, native,	Pasture (Nov.), hay,	None,	4 qts. bran,	–	5	–
6	2	6	10	21	5	3.50	7½	Grade Jersey,	Pasture (Nov.), soft corn, hay,	None,	4 qts. meal and bran,	4	2	–
7	5	6	13	29	2.60	4.83	6	Grade Durham,	Hay, corn fodder,	Meal and bran,	8 qts. cob meal and bran,	5	1	–
8	18	20	59	77	3.28	3.85	5	Grade Jersey, Holstein, Durham, Guernsey,	Hay, corn fodder,	4 qts. meal and bran,	Same, with 1 qt. linseed,	11	6	3
9	9	4	21	9	2.33	2.25	6½	Grade Jersey, Guernsey, native,	Rowen, corn stover,	4 qts. cob meal and rye,	Same,	–	–	9
10	4	4	17	14	4.25	3.50	5	Grade Jersey,	Hay, sugar beets,	4 qts. meal and bran,	Same,	1	3	–
11	9	12	31	55	3.33	4.51	7	Grade Jersey, Durham, native,	Pasture (Nov.), rowen, hay,	2 qts. meal,	4 qts. bran, cotton seed, corn,	9	3	–
12	12	12	36	37	3	3.08	6½	Grade Durham,	Hay, corn fodder,	4 qts. cob meal,	5 qts. meal and bran,	1	6	5
13	15	17	48	52	3.20	3.06	6½	Grade Jersey, Holstein, native,	Hay, corn fodder,	5 qts. meal, bran, rye,	Same, with broom seed,	3	4	10

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
14	5	7	17	–	3.40	–	7	Grade Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	2	5	–
15	24	24	86	82	3.58	3.41	5½	Grade Jersey, Holstein, native,	Rowen, corn fodder,	2 qts. bran, 4 qts. cob meal,	Same,	–	24	–
16	3	–	14	16	4.67	–	4	Grade Durham, Holstein,	Pasture (Nov.), hay,	3 qts. corn, rye, oats,	– –	2	1	–
17	6	6	25	23	4.17	3.83	8	Grade Jersey, Durham, Holstein,	Hay, corn fodder,	5 qts. meal and bran,	Same,	–	3	3
18	10	10	47	19	4.70	1.90	8	Grade Durham,	Hay, corn fodder,	None,	None,	1	9	–
19	3	4	20	19	6.67	4.75	6	Grade Jersey and Ayrshire,	Pasture (Nov.) hay,	2 qts. meal and bran,	Same,	3	1	–
20	4	4	12	19	3	4.75	5	Grade Jersey, Holstein, native,	Pasture (Nov.), rowen, hay,	None,	6 qts. bran,	2	2	–
21	4	12	17	39	4.25	3.25	6	Grade Durham, Holstein,	Rowen, hay,	2 qts. bran,	8 qts. meal and bran,	2	7	3
22	8	8	33	27	4.13	3.38	4½	Grade Durham, Holstein,	Pasture, soft corn (Nov.), hay,	None,	4 qts. meal,	–	4	4
23	4	4	20	16	5	4	5½	Grade Jersey, native, Durham,	Pasture, soft corn (Nov.), hay, corn fodder,	None,	6 qts. cob meal,	1	2	1
24	9	9	30	31	3.34	3.44	6½	Native and grade Jersey,	Pumpkins (Nov.), hay, corn fodder,	4 qts. cob meal and bran,	3 qts. cob meal and bran,	–	5	4
25	3	6	18	34	6	5.67	5	Pure and grade Jersey,	Hay, corn fodder,	7 qts. cob meal and bran,	Same,	5	1	–

26	8	8	26	–	3.25	–	6½	Grade Jersey, ...	Pasture (Nov.), corn stover, hay,	None, . . .	Bran, ...	–	–	–
27	2	3	5	10	2.50	3.33	4	Grade Jersey, Ayrshire, . .	Rowen, soft corn, corn stover, .	None, . . .	2 qts. meal and bran, . .	1	2	–
28	13	13	62	44	4.77	3.38	7½	Native, grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder, rowen, ...	None, . . .	3 qts. meal and bran, . .	3	6	4
29	3	2	16	15	5.34	7.50	4	Grade Jersey, ...	Pumpkins (Nov.), hay, corn fodder, ...	None, . . .	3 qts. meal and bran, . .	–	2	–
30	7	7	23	20	3.29	2.86	7	Pure Jersey, ...	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. cob meal and bran, .	2	1	4
31	4	4	27	20	6.75	5	6	Grade Jersey, native, . .	Pasture (Nov.), hay, corn fodder,	4 qts. corn, oats, bran,	Same, ...	4	–	–
32	4	4	11	–	2.75	–	8	Grade Jersey, ...	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same, ...	–	–	–
33	3	3	8	–	2.67	–	8	Grade Durham, Holstein, Jersey,	Pasture (Nov.), hay, . . .	None, . . .	None, ...	–	–	–
34	3	3	18	13	6	4.33	6	Pure and grade Jersey, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. meal and bran, . .	1	1	1
35	10	10	29	28	2.90	2.80	4	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	None, ...	1	9	–
36	11	11	31	20	2.82	1.81	5½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. cob meal and rye, .	6	5	–
37	7	7	38	46	5.43	6.57	6	Grade Durham, Holstein, .	Hay, corn fodder, . . .	4 qts. clear meal, .	Same, ...	2	5	–
38	40	40	123	108	3.08	2.70	7½	Grade Durham, Holstein, .	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, ...	1	35	4
39	4	4	13	14	3.25	3.50	6½	Grade Durham, ...	Hay, corn fodder, . . .	4 qts. meal, oats and bran, . . .	Same, ...	1	3	–
40	14	18	39	45	2.79	2.50	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. meal and bran, . .	3	18	–
41	7	11	35	33	5	3	7	Grade Durham, ...	Rowen, corn fodder, . . .	None, . . .	4 qts. cob meal and bran, .	1	10	–
42	16	15	65	51	4.06	3.40	5	Grade Durham, Holstein, . .	Rowen, corn fodder, . . .	2 qts. bran, . .	4 qts. meal, bran, rye, .	6	9	–
43	4	4	20	17	5	4.25	7	Native, ...	Pasture (Nov.), rowen, . .	3 qts. bran, . .	Same, ...	–	–	–
44	12	12	30	34	2.50	2.83	8	Grade Durham, ...	Rowen, hay, pumpkins (Nov.), corn fodder, ...	2 qts. malt sprouts, .	4 qts. bran, ...	10	2	–
45	3	6	16	40	5.34	6.67	5	Grade Jersey, native, . .	Sugar beets, hay, corn fodder, .	6 qts. meal and bran,	Same, ...	3	1	2

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
46	4	4	15	–	3.75	–	4½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, rowen,	4 qts. malt sprouts,	Bran,	1	3	–
47	16	16	82	45*	5.13	2.81	6	Grade Jersey, native,	Hay, corn fodder,	4 qts. clear meal,	Same,	8	6	–
48	4	4	15	17	3.75	4.25	5	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	None,	Bran and meal,	4	–	–
49	6	4	22	24	3.67	6	8	Pure Ayrshire, native, grade Holstein,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	2	2	4
50	6	6	13	25	2.17	4.17	5	Grade Jersey,	Pasture (Nov.), rowen, corn stover, hay,	None,	4 qts. meal and bran,	2	–	4
51	6	6	33	31	5.50	5.17	6	Grade Jersey, Durham, Ayrshire, Holstein,	Hay,	3½ lbs. each, bran, meal and gluten,	Same,	–	1	5
52	20	20	70	47	3.50	2.35	4½	Pure Jersey, Guernsey, Ayrshire, Holstein,	Hay,	8 qts. bran, oats, cotton seed,	Same,	–	–	–
53	3	3	12	9	4	3	6	Grade Jersey, Holstein,	Pasture (Nov.), hay, corn stover,	None,	None,	1	2	–
54	2	3	5	10	2.50	3.33	2	High-grade Jersey, Holstein,	Pasture (Nov.), hay, squashes,	None,	6 qts. meal and middlings,	–	3	–
55	6	6	14	17	2.33	2.83	8	Grade Jersey,	Pasture (Nov.), hay,	2 qts. meal,	Same,	1	4	1
56	13	15	22	43	1.69	2.87	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn stover,	None,	4 qts. meal and bran,	6	8	1
57	5	9	21	38	4.20	4.22	4	High-grade Jersey, native,	Pasture (Nov.), hay,	2 qts. meal, oats, bran,	Same,	3	5	1
58	7	9	37	47	5.29	5.22	3½	Grade Jersey and Guernsey,	Pasture (Nov.), hay,	4 qts. provender,	4 qts. bran,	9	–	–

59	8	6	26	21	3.25	3.50	4	Grade Jersey, Guernsey, Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	1	2
60	6	5	33	14	5.50	2.80	6½	Grade Jersey, Durham,	Pasture (Nov.), rowen, oats,	12 qts. meal and bran,	Same,	3	3	–
61	8	8	18	8	2.25	1	7	Grade Holstein, native,	Pasture (Nov.), hay, corn fodder,	None,	None,	–	8	–
62	5	5	24	22	4.80	4.40	7	Grade Jersey, Holstein,	Pasture (Nov.), hay, corn stover,	2 qts. bran,	4 qts. cob meal and bran,	5	–	–
63	6	6	31	27	5.17	4.50	5	Grade Jersey,	Pasture (Nov.), rowen, hay,	4 qts. bran,	Same,	–	6	–
64	11	11	30	28	2.73	2.55	5	Pure and grade Jersey, Holstein, Durham,	Hay, corn fodder,	4 qts. meal,	Same,	4	7	–
65	5	4	31	22	6.20	5.50	5	Grade Jersey,	Pasture (Nov.) hay,	2 qts. meal and bran,	Same,	4	–	–
66	5	5	25	17	5	3.40	5	Pure and grade Jersey, Holstein,	Pasture (Nov.), hay,	2 qts. meal,	Same,	1	4	–
67	6	6	22	23	3.67	3.83	7½	Grade Jersey, Holstein, native,	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 3 qts. bran,	1½ qts. meal, 4 qts. bran,	–	6	–
68	7	7	30	–	4.29	–	5	Grade Holstein and Durham,	Pasture (Nov.), rowen, corn stover,	4 qts. meal and bran,	Same,	3	2	2
69	7	7	45	34	6.43	4.86	4½	Grade Jersey and Durham,	Pasture (Nov.), hay,	4 qts. meal and bran,	Same,	2	5	–
70	4	4	9	6	2.25	1.50	6	Grade Jersey,	Pasture (Nov.), hay,	None,	None,	–	4	–
71	10	10	38	43	3.80	4.30	6	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	3 qts. meal and bran,	8 qts. meal and bran,	5	5	–
72	13	13	44	44	3.38	3.38	5½	Grade Jersey, native,	Hay, corn stover,	5 qts. cob meal and shorts,	Same,	3	2	6
73	5	5	13	23	2.60	4.60	6	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same,	4	1	–
74	3	3	3	7	1	2.33	2½	Grade Jersey, Durham, Devon,	Pasture (Nov.), hay, corn fodder,	None,	Bran,	3	–	–
75	14	–	53	48	3.79	–	5	Grade Jersey,	Hay,	8 qts. meal and bran,	Same,	–	–	–
76	4	4	12	12	3	3	2	High-grade Jersey, grade Durham,	Hay,	6 qts. bran, bakery waste,	Same,	–	–	–
77	6	6	26	24	4.33	4	6	Grade Jersey, native,	Hay, rowen, corn fodder,	4 qts. bran, 2 qts. meal,	Same,	–	–	–

* Sells milk.

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Months since Last Calf. Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
78	12	12	28	27	2.33	2.25	4	Pure and grade Jersey,	Pasture (Nov.), hay, corn stover,	None,	None,	–	–	–
79	12	12	4*	–*	.33	–	4	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. bran and meal,	Same,	–	–	–
80	7	6	14	17	2	2.83	8	Grade Jersey,	Hay,	2 qts. bran,	Same,	–	–	7
81	6	6	11	13	1.83	2.17	5	Grade Jersey and Durham,	Hay, corn stover,	None,	2 qts. fine feed,	1	4	1
82	4	4	31	26	7.75	6.50	6	Pure Jersey,	Hay,	6 qts. meal and bran,	Same,	4	–	–
83	6	6	26	24	4.33	4	7	Grade Jersey, native,	Hay, corn fodder,	5 qts. bran, 2 qts. meal,	Same,	2	4	–
84	7	7	20	16	2.86	2.29	6	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	2 qts. meal,	Same,	–	–	–
85	8	8	24	25	3	3.13	5	Grade Jersey, Durham,	Hay, corn fodder,	1 qt. meal and bran,	Same,	1	4	3
86	5	5	20	20	5	5	6½	Pure and grade Jersey, grade Guernsey,	Hay, corn stover,	6 qts. meal and bran,	Same,	–	5	–
87	7	7	13	–	1.86	–	5	Grade Jersey,	Hay, corn fodder,	3 qts. meal and bran,	Same,	2	4	–
88	8	8	21	13	2.63	1.63	5	Native,	Hay, corn fodder,	4 qts. bran, 2 qts. meal,	Same,	3	5	–
89	6	6	19	16	3.17	2.67	6	Native,	Pasture (Nov.), hay, corn fodder,	4 qts. bran,	4 qts. bran, 2 qts. meal,	1	4	1
90	7	3	7	13	2.43	4.33	4½	Grade Jersey,	Hay, rowen, corn fodder,	4 qts. bran, rye, corn,	Same,	2	1	–
91	8	8	27	16	3.38	2	7	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	–	4	4

92	12	12	41	31	3.42	2.58	6	Grade Jersey, Durham, Holstein, native,	Pasture (Nov.), rowen, corn stover,	2 qts. meal and bran,	Same,	2	5	5
93	5	5	13	13	2.60	2.60	6	Native,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	4	1
94	18	18	80	71	4.44	3.94	6	Grade Jersey, native,	Hay, corn fodder,	Meal and bran,	Same,	–	–	–
95	7	7	26	20	3.71	2.86	6	Grade Jersey,	Pasture (Nov.), oats, hay, corn fodder,	None,	3 qts. cob meal and oats,	1	3	3
96	5	5	23	18	4.60	3.60	5	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	2 qts. bran,	4 qts. meal and bran,	–	5	–
97	2	–	6	–*	3	–	4½	High-grade Jersey,	Pasture (Nov.), hay,	5 qts., ⅓ rye, ⅔ corn,	4 qts. corn and rye,	10	2	–
98	12	12	55	50	4.58	4.17	6	Grade Jersey and Durham,	Pasture (Nov.), hay,	2 qts. meal, 4 qts. bran,	Same,	–	12	–
99	11	11	54	46	4.91	4.18	6	Grade Jersey, Durham,	Soft corn (Nov.), corn fodder, rowen, hay,	None,	4 qts. corn and oats,	3	1	7
100	12	12	45	49	3.75	4.08	4	Grade Durham, Holstein, Hereford, Devon,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	Same,	2	10	–
101	13	14	77	70	5.92	5	7	Grade Jersey,	Rowen, hay, corn fodder,	4 qts. meal and bran,	3 qts. meal, 2 qts. shorts,	7	6	1
102	7	9	31	35	4.43	3.89	7	Grade Jersey, Guernsey, Holstein, native,	Hay, corn fodder,	8 qts. meal, bran, middlings,	4 qts. meal and middlings,	5	4	–
103	5	5	25	23	5	4.60	4½	Grade Jersey, native,	Hay, corn fodder,	None,	1 qt. meal,	2	3	–
104	10	10	42	56	4.20	5.60	3½	Grade and pure Guernsey,	Hay,	4 qts. meal and middlings,	Same,	1	6	3
105	8	8	36	31	4.50	3.88	6½	Pure and grade Jersey,	Hay, corn stover,	3 qts. meal,	Same,	–	–	8
106	2	6	9	19	4.50	3.17	7½	Pure Jersey and Hereford,	Hay, corn fodder,	8 qts. meal and bran,	Same,	–	6	–
107	7	–	26	36	3.71	–	5	Grade Jersey, Durham,	Hay, corn fodder,	2 qts. meal and bran,	Same,	–	–	–
108	5	5	19	20	3.80	4	5	Grade Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	2	–
109	4	4	16	15	4	3.75	5	Pure and grade Jersey,	Hay, corn fodder,	Meal,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery A—Concluded.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
110	9	9	21	31	2.33	3.44	$5\frac{1}{2}$	Grade Jersey, Holstein, native,	Hay, corn stover, . . .	4 qts. meal and bran,	Same, ...	1	8	–
111	6	12	17	30	2.83	2.50	6	Grade Durham, ...	Hay, corn stover, . . .	Meal and bran, . .	Same, ...	–	11	1
112	11	11	26	31	2.36	2.82	6	Grade Jersey, native, . .	Hay, corn stover, . . .	6 qts. meal, bran, oats,	Same, ...	–	11	–
113	10	10	27	55	2.70	5.50	$3\frac{1}{2}$	Grade Jersey, Ayrshire, . .	Pasture (Nov.), hay, . . .	None, . . .	None, ...	1	9	–
114	4	4	13	10	3.25	2.50	5	Grade Jersey, native, . .	Hay, ...	4 qts. meal, . .	Same, ...	–	4	–
115	5	6	24	32	4.80	5.33	$5\frac{1}{2}$	Grade Jersey, Durham, . .	Rowen, corn stover, . . .	4 qts. meal and bran,	Same, ...	2	4	–
116	2	2	10	14	5	7	5	Grade Jersey, Ayrshire, native,	Rowen, hay, corn stover, . .	4 qts. cob meal, .	Same, ...	1	1	–
117	4	4	18	20	4.50	5	5	Grade Jersey, Durham, . .	Hay, corn stover, . . .	$5\frac{1}{2}$ qts. meal and bran,	7 qts. meal and bran,	1	3	–
118	6	6	24	20	4	3.33	$4\frac{1}{2}$	Grade Jersey, Holstein, native,	Hay, ...	3 qts. corn and rye, .	Same, ...	2	4	–
119	13	13	48	40	3.69	3.08	$5\frac{1}{2}$	Grade Jersey, Ayrshire, . .	Hay, corn fodder, . . .	8 qts. meal and middlings, . . .	Same, ...	2	11	–
120	10	–	51	57	5.10	–	4	Grade Jersey, ...	Hay, corn fodder, . . .	6 qts. meal and bran,	Same, ...	4	6	–
121	13	13	23	29	1.77	2.23	5	Grade Durham, Guernsey, pure Holstein, ...	Pasture (Nov.), hay, corn fodder,	$4\frac{1}{2}$ qts. meal and bran,	Same, ...	3	6	4
122	7	10	31	48	4.43	4.80	6	Grade Jersey, Ayrshire, . .	Pasture (Nov.), hay, corn stover,	3 qts. meal and bran,	$4\frac{1}{2}$ qts. cob meal, bran, rye,	4	2	4
123	8	8	19	10	2.38	1.25	7	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	4 qts. meal, . .	Same, ...	–	8	–

124	6	6	14	23	2.33	3.83	5	Pure and grade Jersey, grade Durham, Ayrshire,	Rowen, corn fodder,	None,	4 qts. cob meal,	2	4	–
125	13	20	52	48	4	2.40	5½	Grade Holstein, native,	Hay, corn stover,	6 qts. meal and bran,	3 qts. cob meal,	–	20	–
126	4	4	13	14	3.25	3.50	4½	Native,	Hay, corn stover,	1 qt. meal,	Same,	1	2	1
127	5	5	22	18	4.40	3.60	5	Grade Jersey,	Hay, corn fodder,	4 qts. meal and bran,	Same,	1	3	1
128	19	19	63	58	3.33	3.06	6	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	4 qts. bran,	Same,	3	10	5
129	7	7	27	23	3.85	3.29	6	Grade Jersey, Durham,	Rowen, corn fodder,	4 qts. meal,	Same,	3	2	2
130	–	6	–	43	–	7.17	5	Grade Jersey, Holstein,	Hay, corn fodder,	– –	4 qts. cob meal, 6 qts. bran,	5	1	–
131	–	4	–	11	–	2.75	6	Grade Jersey,	Hay,	– –	2 qts. cob meal and bran,	3	1	–

Details of Farms contributing to Creamery B.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
1	3	3	13	12	3.33	4	5	Grade Jersey,	Rowen, oat straw,	6 qts. meal and bran,	Same,	1	2	–
2	4	4	9	10	2.25	2.50	4	Grade Jersey, Durham, native,	Rowen, hay,	None,	None,	–	–	4
3	6	6	17	14	2.83	2.33	8½	Grade Holstein, native,	Pasture (Nov.), rowen,	None,	None,	–	3	3
4	14	6	32	22	2.29	3.67	6	Grade Jersey, Durham, Holstein,	Hay, corn fodder,	2 qts. meal, 4 qts. bran,	Same,	2	6	6
5	8	7	20	21	2.50	3	5½	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	6	2
6	11	12	58	47	5.27	3.91	6½	Grade Jersey,	Pasture (Nov.) hay,	4 qts. bran,	4 qts. meal and bran,	2	3	3
7	9	9	40	43	4.44	4.77	8	Grade Jersey, Durham, Hereford,	Pasture (Nov.), hay, oats, corn stover,	Meal and bran,	2 qts. meal and bran,	–	5	4
8	11	11	34	32	3.09	2.90	7	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	6 qts. meal and bran,	–	4	7
9	5	8	7	22	1.40	2.75	5½	Pure and grade Jersey, grade Durham,	Pasture (Nov.), hay, potatoes (Nov.),	4 qts. bran,	4 qts. meal and bran,	1	5	2
10	6	6	32	24	5.16	4	4	Grade Jersey, Durham,	Pasture (Nov.), hay, rowen,	None,	2 qts. meal and bran,	1	3	2
11	4	4	13	9	3.25	2.25	5	Grade Jersey, Ayrshire,	Pasture (Nov.), hay,	None,	2 qts. meal,	1	2	1

12	5	4	8	7	1.60	1.75	5	Natives,	Hay, corn fodder,	None,	None,	1	2	1
13	13	12	37	43	2.85	3.58	6	Grade Jersey, native,	Hay, corn fodder,	2 qts. cob meal,	4 qts. cob meal,	2	5	5
14	8	9	41	40	5.12	4.44	$6\frac{1}{2}$	Pure and grade Jersey, pure Durham, natives,	Rowen, hay, soft corn,	8 qts. meal and bran,	Same,	3	4	2
15	6	6	20	23	3.33	3.83	6	Grade Jersey,	Hay,	3 qts. meal and bran,	Same,	2	3	1
16	4	4	22	21	5.50	5.25	6	Pure and grade Jersey,	Oats and straw, hay,	Meal and bran,	Same,	3	1	–
17	3	3	19	17	6.33	5.67	4	Pure Jersey and grades,	Rowen,	6 qts. meal and bran,	Same,	–	3	–
18	11	11	39	34	3.54	3.09	$6\frac{1}{2}$	Grade Jersey, native,	Pasture (Nov.), hay,	None,	4 qts. meal and bran,	2	8	1
19	14	15	67	65	4.79	4.33	6	Grade Jersey, Durham, native,	Pasture (Nov.), hay, rowen, corn stover,	4 qts. $\frac{2}{3}$ meal, $\frac{1}{3}$ bran,	6 qts. $\frac{2}{3}$ meal $\frac{1}{3}$ bran,	13	1	–
20	4	6	18	18	4.50	3	6	Grade Jersey, native,	Pasture (Nov.), hay, corn stover, rowen,	None,	$1\frac{1}{2}$ qts. meal and rye,	2	2	–
21	22	16	61	33*	2.69	2.06	5	Grade Jersey,	Hay, corn fodder (Dec.),	4 qts. meal and bran,	Same,	5	9	2
22	6	7	19	26	3.16	3.71	6	Pure and grade Jersey,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	4	–
23	5	4	18	14	3.60	3.50	3	Grade Jersey, Holstein, native,	Hay, rowen, corn fodder,	1 qt. meal, 2 qts. bran,	Same,	1	3	–
24	6	3	10	12	1.66	4	5	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same,	–	2	1
25	17	16	72	74*	4.18	4.62	6	Grade Jersey, Devon,	Rowen, hay, barley, corn stover,	3 qts. meal, 2 qts. bran,	Same,	6	8	2
26	4	5	19	22	4.75	4.40	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	4 qts. cob meal and bran,	4	–	–
27	8	6	21	24	2.62	4	5	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	2 qts. corn and rye,	5	1	–
28	10	8	35	31	3.50	3.87	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	3 qts. meal and bran,	–	4	6
29	12	12	26	43	2.17	3.58	4	Grade Jersey, Holstein, Durham,	Pasture (Nov.), hay, corn fodder,	None,	3 qts. meal and bran,	–	5	7
30	13	10	42	31	3.23	3.10	$5\frac{1}{2}$	Grade Holstein,	Hay, corn fodder,	2 qts. cob meal,	4 qts. meal and bran,	–	5	5
31	4	4	11	21	2.75	5.25	4	Grade Jersey,	Hay, corn fodder,	2 qts. meal and bran,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery B — Concluded.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
32	7	7	31	22	4.43	3.14	6	Grade Jersey, Ayrshire,	Hay,	1½ qts. meal,	Same,	–	–	–
33	4	3	14	14	3.50	4.66	5½	Pure and grade Jersey,	Pasture (Nov.), hay,	1 qt. meal,	3 qts. meal,	3	1	–
34	2	4	15	26	7.50	6.50	6	Grade Durham,	Hay, corn stover,	None,	Corn,	3	1	–
35	2	2	9	7	4.50	3.50	5	Grade Jersey,	Hay,	Bran,	2 qts. meal, 1 qt. bran,	–	2	–
36	20	–	98	42	4.90	–	8	Grade and pure Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	–	–	–
37	18	20	72	82	4	4.10	6	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	15	3	2
38	7	8	24	34	3.43	4.25	6	Grade Holstein, Durham, native,	Pasture (Nov.), rowen, corn fodder,	8 qts. cob meal and bran,	Same,	2	6	–
39	14	14	42	45	3.00	3.21	5	Native,	Hay, corn fodder,	6 qts. meal and bran,	Same,	–	8	6
40	7	8	23	23	3.28	2.87	7	Grade Holstein, Jersey, Durham,	Pasture (Nov.), rowen,	None,	5 qts. cob meal and bran,	2	6	–
41	13	13	46	52	3.53	4	7	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	6 qts. meal and bran,	Same,	1	12	–
42	9	9	21	32	2.33	3.44	6	Pure and grade Jersey,	Pasture (Nov.), rowen, corn fodder,	4 qts. bran,	Same,	3	5	1
43	7	7	18	18	2.57	2.57	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	8 qts. meal and bran,	–	7	–
44	8	9	11	26	1.37	2.88	7	Grade Jersey, Holstein,	Hay,	Bran,	6 lbs. meal and bran,	5	2	2

45	7	7	16	20	2.28	2.85	6½	Grade Jersey, native,	Hay, corn stover,	None,	2 qts. meal,	1	3	3
46	6	6	18	14	3	2.33	6	Grade Jersey,	Hay, corn fodder,	7 qts. meal and bran,	Same,	2	1	3
47	7	7	14	24	2	3.42	6	Grade Durham, native,	Pasture (Nov.), hay, corn stover,	4 qts. bran,	4 qts. cob meal,	3	3	1
48	7	7	28	25	4	3.57	4½	Grade Jersey, Holstein,	Hay, corn fodder,	Meal and bran,	4 qts. meal and bran,	3	4	–
49	5	5	28	24	5.60	4.80	6½	Pure Jersey, grade Durham, Devon, Ayrshire,	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 2 qts. bran,	Same,	2	–	3
50	9	9	29	35	3.22	3.88	7	Grade Jersey, Holstein, Durham,	Hay,	6 qts. bran,	Same,	2	3	4
51	8	8	26	–	3.25	–	6	Grade Jersey, Durham, Guernsey, Devon, Ayrshire,	Grass (Nov.), hay,	3 qts. meal,	Same,	–	–	–
52	7	7	21	15	3	2.14	6	Grade Jersey, Ayrshire,	Hay, corn fodder,	Corn, oats, bran,	Same,	–	–	–
53	5	6	20	19	4	3.16	4½	Grade Jersey, Guernsey, native,	Hay, corn stover,	6 qts. meal and bran,	Same,	3	3	–
54	4	4	13	8	3.25	2	5½	Grade Jersey, Guernsey, Durham, Ayrshire,	Hay,	None,	None,	–	2	2
55	2	3	10	7	5	2.33	4½	Grade Jersey, native,	Hay, corn fodder, pumpkins (Nov.),	None,	Cob meal,	–	2	1
56	3	2	11	4	3.67	2	4½	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	3 qts. meal,	–	3	–
57	11	11	35	24	3.18	2.18	6½	Grade Jersey, Ayrshire,	Hay, oats, corn fodder,	4 qts. meal and bran,	Same,	–	11	–
58	6	6	10	–	1.67	–	4	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	None,	–	–	–	–
59	14	14	37	22	2.64	1.57	6½	Grade Jersey, Holstein,	Hay, oats, corn fodder,	None,	2 qts. meal,	2	6	3
60	3	3	12	20	4	6.67	6	Grade Durham,	Pasture (Nov.), hay,	8 qts. meal and bran,	Same,	2	1	–
61	5	4	16	13	3.20	3.25	4½	Grade Jersey,	Pasture (Nov.), hay, corn fodder, pumpkins (Nov.),	Meal and bran,	4 qts. meal and middlings,	–	4	–
62	–	6	–	41	–	6.83	5	Grade Jersey,	Hay,	–	3 qts. meal,	4	1	1

Summary.

	Creamery A.	Creamery B.
Number of farms contributing, .	131, ...	62
Total spaces of cream Nov. (1 day),	3,671, ...	1,668
Total spaces of cream Dec. (1 day),	3,470, ...	1,593
Total number of cows Nov. (1 day),	1,013, . . .	483
Total number of cows Dec. (1 day),	1,033, ...	456
Lowest space per cow,* . . .	1 (Farm Nos. 61 and 74),	1.40 (Farm No. 9).
Highest space per cow, . . .	7 75 (Farm No. 82), .	7.50 (Farm No. 34).
Average spaces per cow, . .	3.49, ...	3 42
Average age of cows, . . .	5¾ years, . . .	5½ years.
Average space per cow in station dairy, 5.25.		

* Excluding cases where milk is sold.

V. Feeding Experiments with Pigs.

The preceding annual report contains a summary of a series of feeding experiments with pigs, carried on at this station since 1884, for the purpose of ascertaining the cost of the feed required to produce a given quantity of dressed pork. Our first attention in this connection was directed towards a profitable disposition of two by-products of the dairy industry, — skim-milk and buttermilk from creameries. As the daily supply of these materials varies, for obvious reasons, widely on farms, it seemed advisable to devise economical fodder rations adapted to different conditions in that direction.

The daily diet in our earlier experiments contained a more liberal amount of milk than in our later ones. For several years past we have raised, the whole year around, for every cow on our farm, a pig for the meat market, to dispose of our skim-milk. This course necessitated, at times, additional resources of supply of nutritious food. To meet this requirement in an economical and profitable way, and by means which are in the reach of every farmer, has been our aim. How we have thus far succeeded in our endeavor, may be ascertained from a subsequent short review of our previous course of observation. A correct interpretation of our latest feeding experiment (X.), which forms the principal part of the subsequent communication, renders a brief restatement of the results of our earlier experiments advisable.

During our first and second experiments (1884), skim-milk or buttermilk or both and corn meal furnished the daily feed. In the first experiment, the relative proportions of skim-milk or of buttermilk and of corn meal remained the same from the beginning to the end of the trial; namely, three ounces of corn meal for every quart of skim-milk required to meet the increasing wants of the animals. The daily average consumption per head amounted at the close of the experiment to fourteen quarts of skim-milk and forty-two ounces of corn meal. The nutritive character of the daily diet remained practically the same during most of the time of observation. It was, in the case of the buttermilk diet, one part of digestible nitrogenous food constituents to from 2.84 to 3.38 parts of non-nitrogenous food constituents; and in case of that of the skim-milk, one of the former to from 2.50 to 2.90 of the latter; the variations being mainly due to the difference in the amount of solid matter in the two kinds of milk.

In the second feeding experiment (1885), the relative proportion between skim-milk or buttermilk and corn meal was different from that in the first one. During the first period of the second experiment, only two ounces of corn meal were added to each quart of milk required to satisfy the animal. As soon, however, as from six to seven quarts per head were consumed daily, four ounces of corn meal were fed for every quart of milk. Another increase in corn meal was made when ten quarts of milk were called for; and again, when twelve quarts were consumed per head. The experiment closed with a daily average ration per head of from ten to twelve quarts of milk, and from eighty to ninety-six ounces of corn meal. In consequence of this course of feeding, the nutritive character of the daily diet was changed from time to time. The periodical increase of corn meal in the daily fodder rations caused the introduction of a larger proportion of non-nitrogenous food constituents, as starch, sugar, fat, etc., in the diet, than of nitrogenous constituents. The experiment began with a diet which contained one part of digestible nitrogenous constituents to 2.7 of non-nitrogenous food constituents, and closed with 1 : 5 in case of skim-milk and 1 : 4.5 in case of buttermilk.

The expiration of a contract with a creamery in our vicinity deprived us, at that stage of our investigation, of a liberal supply of buttermilk. A limited supply of home-made skim-milk necessitated a modification of our feeding system, in case that at least six pigs should be engaged in the experiments at one time. It was therefore decided to feed the skim-milk from our herd of six cows, in equal quantities, to six growing pigs, and to supply the additional feed from other suitable sources, including corn meal in part. It seemed also of interest to learn whether the particular course pursued in the previously described experiments of feeding skim-milk from the home dairy with corn meal alone could be improved on; and, if so, in what direction. Gluten meal and wheat bran were chosen, for various reasons, to serve in connection with corn meal to furnish the additional ingredients of the diet, as soon as our milk supply became exhausted. This course promised to serve two distinct purposes: —

1. The rich nitrogenous character of gluten meal and of wheat bran offered a chance to secure any desired change in the nutritive character of the feed, as far as the relative proportion of the digestible nitrogenous and non-nitrogenous food constituents are concerned; and

2. To reduce the net cost of the feed, in case they proved to be an efficient substitute for larger quantities of corn meal, on account of the larger quantities of certain essential fertilizing constituents they contain.

The statement that an addition of gluten meal or of wheat bran or both, to a diet which previously consisted only of skim-milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

1. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

2. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potassium oxide, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that particular diet as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources of skim-milk.

The daily supply of skim-milk has not exceeded, at any period, eight quarts of milk during our later experiments, from the third to the ninth inclusive; most of the time it has been from four to five quarts per head. The relative proportion of corn meal, wheat bran and gluten meal has been frequently altered in case of different experiments, as well as at different stages of the same experiment, with varying results. The ninth experiment, which has been described in detail in our sixth annual report, has been, from an economical stand-point, thus far the most successful one. A brief abstract of that experiment may here suffice to show our late mode of compounding fodder rations for pigs at different stages of growth, in connection with the financial results we secured.

The summary includes our entire series of pig feeding described in previous reports, and also the last one, the tenth, which is for the first time published in detail in some succeeding pages.

Average of Daily Rations (Experiment IX.).

	Corn Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Corn and Cob Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, .	–	3	–	–	6.	I.	1 : 2.80
April 24 to May 1, .	–	6	–	–	12.		
May 2 to May 14, .	–	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, .	–	6	9.89	19 78	12.		
May 29 to June 4, .	–	6	10.67	21.34	12.		
June 5 to June 22, .	–	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, .	–	6	9.86	9.86	39.44		
July 4 to July 9, .	–	6	7.70	7.70	46.20	IV.	1 : 4.35
July 10 to July 25, .	56.10	6	9.35	9.35	–		
July 26 to Aug. 8, .	63.00	6	10.50	10.50	–		

Experiment IX.	Live Weight of Animal.	Nutritive Ratio.
Period I.,	20 to 90 pounds,	One digestible nitrogenous, 2.66 digestible non-nitrogenous, constituents
Period II.,	90 to 130 pounds,	One digestible nitrogenous, 3.62 digestible non-nitrogenous, constituents.
Period III.,	130 to 200 pounds,	One digestible nitrogenous, 4.35 digestible non-nitrogenous, constituents.

The calculations included in the following summary were based upon the following valuations per ton: —

	Cost.	Manurial Value.
Corn meal,	$24 00	$7 97
Barley meal,	30 00	6 21
Skim-milk (10 per cent. solids),	1.8 cts. gal.	2 25
Buttermilk (7 to 8 per cent. solids),	1.37 " "	1 74
Corn and cob meal,	$20 70	6 06
Wheat bran,	22 50	13 51
Gluten meal,	22 50	17 49

Summary of Experiments I. to X.

[Based on the same cost of feed and value of manurial refuse.]

EXPERIMENT.	Number of Pigs.	Average Weight of Pigs at Beginning of Experiment (Pounds)	Average Weight of Pigs at Close of Experiment (Pounds).	Articles of Fodder used.	Nutritive Ratio of Feed.	Pounds of Dry Matter consumed for the Production of One Pound of Dressed Pork.	Total Cost of Feed per Pound of Dressed Pork (Cents).	Manurial Value of Feed per Pound of Dressed Pork, after deducting Thirty Per Cent. taken by Pig (Cents).	Net Cost of Feed per Pound of Dressed Pork (Cents).
I. May 21 to Sept. 22, 1884, *a*,	3	48.8	239.0	Skim-milk, corn meal,	1 : 2.50 to 1 : 2.97	2.50 to 3.11; average 2.90	5.15	1.70	3.45
I. May 21 to Sept. 22, 1884, *b*,	3	47.6	253.9	Buttermilk, corn meal,	1 : 2.84 to 1 : 3.38	2.23 to 2.57; " 2.40	4.30	1.38	2.92
II. Nov. 5, 1884, to Mar. 21, 1885, *a*,	6	30.1	209.7	Buttermilk, corn meal,	1 : 3.5 to 1 : 4.8	3.34 to 4.17; " 3.67	5.91	1.80	4.11
II. Nov. 5, 1884, to Mar. 21, 1885, *b*,	6	28.7	227.0	Skim milk, corn meal,	1 : 2.7 to 1 : 5.00	2.97 to 3.48; " 3.31	5.51	1.69	3.82
III. April 1 to Sept. 16, 1885,	2	49.8	276.3	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 3.04 to 1 : 3.76	4.01 to 4.18; " 4.10	6.41	2.01	4.40
IV. Dec. 8, 1885, to May 31, 1886,	2	32.9	152.4	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.64 to 1 : 4.48	3.77 to 4.08; " 3.93	6.33	2.13	4.20
V. Sept. 15, 1886, to Jan. 19, 1887,	4	32.6	175.0	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.75 to 1 : 3.57	3.56 to 4.31; " 3.92	5.40	2.02	3.38
VI. Feb. 17 to May 2, 1887,	5	54.4	152.8	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.99 to 1 : 3.23	2.70 to 4.20; " 3.68	5.69	1.95	3.74
VII. June 28 to Oct. 26, 1887,	7	24.5	193.3	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.85 to 1 : 4.30	2.83 to 3.24; " 3.07	5.15	1.76	3.39
VIII. Nov. 8, 1887, to March 12, 1888,	6	25.2	186.4	Skim-milk, corn meal, Wheat bran, gluten meal, Corn and cob meal,	1 : 2.30 to 1 : 4.17	3.02 to 3.46; " 3.27	5.32	1.74	3.58
IX. April 12 to Aug. 8, 1888,	6	19.6	194.7	Skim-milk, corn meal, Wheat bran, gluten meal, Corn and cob meal,	1 : 2.53 to 1 : 4.35	2.81 to 3.17; " 3.00	4.89	1.62	3.27
X. April 26 to Aug. 28, 1889,	7	20.3	189.9	Skim-milk, barley meal, Wheat bran, gluten meal,	1 : 2.90 to 1 : 4.65	3.40 to 3.81; " 3.60	6.07	1.75	4.32

Our observations in this connection with the management of the above summarized ten feeding experiments, lead to the following suggestions regarding a proper course of raising pigs for the meat market: —

1. Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from eighteen to twenty pounds in live weight; in the colder seasons, when they weigh from twenty-five to thirty pounds.

2. The feed for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk, with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

3. Change the character of the diet, at certain stages of growth, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed. Begin, for instance, with two ounces of corn meal to one quart of skim-milk; when the animal has reached from sixty to seventy pounds, use four ounces per quart; and feed six ounces of meal per quart after its live weight amounts to from one hundred and twenty to one hundred and thirty pounds. The superior feeding effect noticed in case of one and the same diet during the earlier stages of growth, will not infrequently be found to decrease seriously during later stages.

4. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from one hundred and seventy-five to one hundred and eighty pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

5. It pays well, as far as the cost of feed is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

Weights taken at Time of killing of Pigs fattened at the Experiment Station (in Pounds).

[Age of pigs when killed, five to eight months.]

NUMBER AND BREED OF PIG.	Live Weight.	Dressed Weight.	Per Cent. of Live Weight lost by Dressing.	Heart.	Lungs.	Liver.	Heart, Lungs and Liver.	Stomach (empty).	Intestinal Fat.
1. Yorkshire — Berkshire,	231.25	194.50	15.89	–	–	–	4.25	1.25	4.50
2. " "	247.00	203.75	17.50	–	–	–	6.00	1.50	5.00
3. " "	218.50	183.25	16.13	–	–	–	4.50	1.25	5.00
4. Yorkshire — White Chester,	165.00	132.75	19.50	–	–	–	4.25	1.25	3.75
5. " " "	197.75	161.50	18.35	–	–	–	5.00	1.50	4.00
6. " " "	198.50	159.50	19.64	–	–	–	5.25	1.25	5.00
7. Yorkshire — Berkshire,	253.25	208.50	17.67	–	–	–	5.75	1.25	6.00
8. " "	243.25	205.25	15.60	–	–	–	5.25	1.50	4.00
9. " "	249.25	209.25	16.00	–	–	–	6.00	1.75	6.00
10. Yorkshire — White Chester,	209.00	168.50	19.40	–	–	–	6.00	1.50	4.50
11. " " "	191.00	158.50	17.02	–	–	–	5.50	1.25	5.25
12. " " "	216.25	173.50	19.77	–	–	–	5.50	1.25	6.00
13. Mixed,	196.00	167.50	14.54	–	–	–	4.25	1.25	1.75
14. "	306.00	258.00	15.69	–	–	–	6.50	1.50	5.50
15. "	178.50	150.50	15.69	–	–	–	3.75	1.00	2.50
16. "	246.50	210.00	14.81	–	–	–	5.00	1.25	4.75
17. "	164.00	137.00	16.46	.50	.75	2.25	3.50	–	2.50
18. "	193.25	163.00	15.65	.50	.75	2.75	4.00	–	2.25
19. "	178.25	153.00	14.16	.33	1.25	2.00	3.58	–	1.75
20. Berkshire — White Chester,	204.00	162.00	20.59	.63	1.25	3.75	5.63	–	2.38
21. " " "	184.00	145.00	21.20	.50	1.06	3.25	4.81	–	2.19
22. " " "	201.00	156.00	22.39	.50	1.21	3.75	5.46	–	3.38

23. Berkshire — White Chester,	193.00	158.00	18.13	.56	1.14	3.00	5.00	–	2.63
24. " " "	197.00	156.00	20.81	.53	1.13	3.75	5.41	–	2.88
25. " " "	184.50	144.00	21.95	.44	0.81	3.75	5.00	–	3.25
26. " " "	189.50	148.00	21.90	.50	1.00	3.75	5.25	–	3.13
27. Mixed,	189.00	154.00	18.52	.56	1.32	3.32	5.20	–	2.50
28. "	198.00	160.00	19.19	.50	1.50	3.00	5.00	–	3.81
29. "	187.00	151.00	19.25	.50	1.50	3.06	5.06	–	2.44
30. "	181.50	150.00	17.31	.44	1.19	3.44	5.07	–	2.50
31. "	184.50	150.00	18.70	.44	1.38	3.32	5.14	–	3.00
32. "	200.75	162.00	19.30	.69	1.56	3.63	5.88	–	3.38
33. "	185.75	152.00	18.17	.56	1.56	2.63	4.75	–	1.88
34. "	190.25	158.00	16.93	.50	1.13	3.00	4.63	–	2.69
35. "	188.75	154.00	18.15	.75	1.19	2.38	4.32	–	2.38
36. "	193.75	158.00	18.45	.75	1.75	2.88	5.38	–	2.25
37. "	203.50	168.50	17.20	.50	1.25	3.19	4.94	–	1.88
38. White Chester,	183.75	154.00	16.19	.25	1.50	2.13	3.88	1.00	2.25
39. " "	194.25	162.00	16.61	.25	1.38	2.63	4.26	1.13	3.38
40. Mixed,	207.50	172.50	16.87	.38	1.50	2.25	4.13	0.88	3.75
41. "	211.50	177.00	16.31	.38	1.25	2.50	4.13	0.88	3.63
42. Grade White Chester,	185.00	153.50	17.03	.50	0.94	4.00	5.44	1.19	1.94
43. " " "	199.00	163.00	18.09	.37	1.31	3.31	4.99	–	1.63
44. " " "	188.50	151.00	19.89	.44	1.13	3.56	5.13	1.25	1.94
45. " " "	200.00	162.00	19.00	.63	1.44	4.13	6.20	1.38	1.88
46. Mixed,	182.00	145.50	20.05	.56	1.50	3.69	5.75	1.50	2.81
47. "	177.00	141.00	20.34	.44	0.88	3.13	4.45	1.56	3.00
48. "	197.50	159.00	19.49	.53	1.38	3.50	5.41	1.50	1.50

Summary.

	Average Weight (Pounds).	Number of Pigs, averaged.
Live weight,	201.23	48
Dressed weight,	165.11	48
Per cent. of live weight lost by dressing,	17.95	48
Heart,	.50	32
Lungs,	1.26	32
Liver,	3.15	32
Heart, lungs and liver,	4.99	48
Stomach (empty),	1.30	26
Intestinal fat,	3.26	48

The intestinal fat, as may be seen from the preceding statement, varies from 1.75 to 6.00 pounds; its deposition, as a rule, has rapidly increased after the animals pass above 180 to 200 pounds of live weight.

Tenth Feeding Experiment (1889).

[Skim-milk, barley meal, wheat bran and gluten meal.]

The general course pursued in the management of this experiment is essentially the same as that adopted in the preceding ones (VII., VIII. and IX.). The main alteration consists in the circumstance that barley meal has been substituted for corn meal in the daily diet of the animals on trial.

Seven pigs, grades of White Chester and Berkshire, weighing from 14 to 23 pounds each at the beginning, served for our observation. The experiment began April 23, and closed August 28, lasting thus 127 days. The live weight gained during that period varied in case of different animals from 162 to 178¾ pounds. The average live weight gained of the whole lot was 169½ pounds per head, or 1.33 pounds per day. The amount of skim-milk consumed daily per head remained practically the same, after the first week,— five quarts. To every quart of milk required were added two ounces of barley meal. The additional feed subsequently needed consisted of a mixture of two weight parts of gluten meal and one of wheat bran. At the close of the second month of our trial, when the live weights of the various animals amounted to from 120 to 130 pounds each, the diet was changed; a mixture of four weight parts of barley meal and one weight part each of gluten meal and wheat bran was fed with the original quantity of skim-milk, — five quarts daily per head. The subsequent tabular statement shows more in detail the changes in the quantities of the daily fodder rations, and also their nutritive character at different stages of growth. The entire experiment might be divided practically into three feeding periods : —

	Live Weight.	Nutritive Ratio.
Period I., ...	20 to 90 pounds.	1 : 2.95
Period II., ...	90 to 130 pounds.	1 : 4.20
Period III., ...	130 to 200 pounds.	1 : 4.61

Average of Daily Rations (Experiment X.).

	Barley Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio.
1889.						
April 23 to May 1, . .	6.	3.	–	–	I.	1 : 2.90
May 2 to May 13, . .	10.	5.	–	–		
May 14 to May 28, . .	11.	5.5	4.00	8.00	II.	1 : 2.99
May 29 to June 4, . .	10.	5.	7.00	14.00		
June 5 to June 17, . .	10.	5.	11.90	23.80		
June 18 to July 8, . .	37.80	5.	9.47	9.47	III.	1 : 4 12
July 9 to July 22, . .	47.60	5.	11.90	11.90		
July 23 to Aug. 12, . .	58.80	5.	9.80	9.80	IV.	1 : 4.61
Aug. 13 to Aug. 27, . .	64.20	5.	10.70	10.70		

The amount of dry vegetable matter of the feed consumed per pound of dressed pork produced varies in case of different animals from 3.40 to 3.81 pounds, the mean being 3.6 pounds. This result is less favorable than those obtained in our ninth experiment, where the amount of dry vegetable matter consumed per pound of dressed pork obtained was noticed to vary from 2.61 to 3.17 pounds, with an average amount of 2.98 pounds. As both experiments were conducted during the same period of the year, — summer season, — the results apparently point towards a higher nutritive effect of the corn meal, as compared with that of barley meal, under conditions like ours. The final decision in this direction will be left to further trials.

The higher market price of the barley meal, as compared with that of corn meal, at present market rates, is an additional cause of a less favorable financial result than in most of our late experiments, from VI. to IX. inclusive. The average net cost per pound of dressed pork, in our tenth experiment, amounted to 4.29 cents. We received 5¾ cents per pound. For more details, see farther on.

Market Cost of Fodder Articles used.

Barley meal, .	$30.00 per ton.	Wheat bran, .	$18.50 per ton.
Skim-milk, .	1.8 cts. per gal.	Gluten meal, .	$22.00 per ton.

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

[Per cent.]

	Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture, ...	12.90	89.78	10.92	10.19
Nitrogen, ...	1.507	.52	2.447	4.230
Phosphoric acid, ...	.664	.19	2.900	.392
Potassium oxide, ...	.342	.20	1.637	.049
Valuation per 2,000 pounds, . .	$6 23	$2 17	$13 27	$14 90

(1)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13, .	11.63	93.00	–	–	1 : 2.90	23.00	41.50	14
May 14 to June 17, .	23.62	189.00	18.69	37.38	1 : 2.99	41.50	88.50	1 5
June 18 to July 22, .	95.64	175.00	23.91	23.91	1 : 4.17	88.50	135.00	1 5
July 23 to Aug. 28, .	133.08	184.00	22.18	22.18	1 : 4.56	135.00	185.00	1 6

Total Amount of Feed consumed from April 23 to August 28.

263.97 pounds barley meal, equal to dry matter,	229.92 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
64.78 pounds wheat bran, equal to dry matter,	57.71 pounds.
83.47 pounds gluten meal, equal to dry matter,	74.96 pounds.
Total amount of dry matter,	504.75 pounds.

Live weight of animal at beginning of experiment,	23.00 pounds.
Live weight of animal at time of killing,	185.00 pounds.
Live weight gained during experiment,	162.00 pounds.
Dressed weight at time of killing,	153.50 pounds.
Loss in weight by dressing,	31.50 pounds, or 17.03 per cent.
Dressed weight gained during experiment,	134.41 pounds.

Cost of Feed consumed during Experiment.

263.97 pounds barley meal, at $30.00 per ton,	$3 96
160.25 gallons skim-milk, at 1.8 cents per gallon,	2 88
64.78 pounds wheat bran, at $18.50 per ton,	60
83.47 pounds gluten meal, at $22.00 per ton,	92
	$8 36

3.12 pounds of dry matter fed yielded 1 pound of live weight, and 3.76 pounds of dry matter yielded 1 pound of dressed weight.
Cost of feed for production of 1 pound of dressed pork, 6.22 cents.

(2)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1 : 2.90	25.25	45.00	15
May 14 to June 17,	23.62	189.00	18.75	37.50	1 : 2.99	45.00	94.00	1 6
June 18 to July 22,	87.36	175.00	21.84	21.84	1 : 4.09	94.00	142.50	1 6
July 23 to Aug. 28,	137.88	184.00	22.98	22.98	1 : 4.60	142.50	199.50	1 8

Total Amount of Feed consumed from April 23 to August 28.

260.49 pounds barley meal, equal to dry matter,	226.89 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
63.57 pounds wheat bran, equal to dry matter,	56.63 pounds.
82.32 pounds gluten meal, equal to dry matter,	73.93 pounds.
Total amount of dry matter,	499.61 pounds.

Live weight of animal at beginning of experiment,	25.25 pounds.
Live weight of animal at time of killing,	199.00 pounds.
Live weight gained during experiment,	173.75 pounds.
Dressed weight at time of killing,	163.00 pounds.
Loss in weight by dressing, 36.00 pounds, or	18.09 per cent.
Dressed weight gained during experiment,	142.32 pounds.

Cost of Feed consumed during Experiment.

260.49 pounds barley meal, at $30.00 per ton,	$3 91
160.25 gallons skim-milk, at 1.8 cents per gallon,	2 88
63.57 pounds wheat bran, at $18.50 per ton,	59
82.32 pounds gluten meal, at $22.00 per ton,	91
	$8 29

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.51 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.82 cents.

(3)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1:2.90	19.75	38.50	14
May 14 to June 17,	23.40	187.00	15.87	31.76	1:2.99	38.50	84.00	1 5
June 18 to July 22,	84.88	175.00	21.22	21.22	1:4.06	84.00	127.50	1 4
July 23 to Aug. 28,	139.60	184.00	23.27	23.27	1:4.61	127.50	188.50	1 10

Total Amount of Feed consumed from April 23 to August 28.

259.51 pounds barley meal, equal to dry matter,	226.03 pounds.
639.00 quarts skim-milk, equal to dry matter,	141.71 pounds.
60.36 pounds wheat bran, equal to dry matter,	53.77 pounds.
76.25 pounds gluten meal, equal to dry matter,	68.48 pounds.
Total amount of dry matter,	489.99 pounds.

Live weight of animal at beginning of experiment,	19.75 pounds.
Live weight of animal at time of killing,	188.50 pounds.
Live weight gained during experiment,	168.75 pounds.
Dressed weight at time of killing,	151.00 pounds.
Loss in weight by dressing, 37.50 pounds, or	19.89 per cent.
Dressed weight gained during experiment,	135.19 pounds.

Cost of Feed consumed during Experiment.

259.51 pounds barley meal, at $30 00 per ton,	$3 89
159.75 gallons skim-milk, at 1.8 cents per gallon,	2 88
60 36 pounds wheat bran, at $18.50 per ton,	56
76.25 pounds gluten meal, at $22.00 per ton,	84
	$8 17

2.90 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.04 cents.

(4)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1 : 2.90	23.00	42.00	14
May 14 to June 17,	23.62	189.00	18.06	36.12	1 : 2.99	42.00	92.00	1 7
June 18 to July 22,	89.64	175.00	22.41	22.41	1 : 4.11	92.00	139 50	1 6
July 23 to Aug. 28,	141.42	184.00	23.57	23.57	1 : 4.62	139.50	200.00	1 10

Total Amount of Feed consumed from April 23 to August 28.

266.31 pounds barley meal, equal to dry matter,	231 96 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
64.04 pounds wheat bran, equal to dry matter,	57.05 pounds.
82.10 pounds gluten meal, equal to dry matter,	73.73 pounds.
Total amount of dry matter,	504.90 pounds.

Live weight of animal at beginning of experiment,	23.00 pounds.
Live weight of animal at time of killing,	200.00 pounds.
Live weight gained during experiment,	177.00 pounds.
Dressed weight at time of killing,	162.00 pounds.
Loss in weight by dressing,	38.00 pounds, or 19.00 per cent.
Dressed weight gained during experiment,	143.37 pounds.

Cost of Feed consumed during Experiment.

266.31 pounds barley meal, at $30.00 per ton,	$3 99
160.25 gallons skim-milk, at 1 8 cents per gallon,	2 88
64.04 pounds wheat bran, at $18 50 per ton,	59
82.10 pounds gluten meal, at $22.00 per ton,	91
	$8 37

2.85 pounds of dry matter fed yielded 1 pound of live weight, and 3.52 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.84 cents.

(5)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period. (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13, .	5.75	46.00	–	–	1 : 2.90	18.50	30.50	14
May 14 to June 17, .	21.88	175.00	17.38	34.75	1 : 2.99	30.50	83.00	1 8
June 18 to July 22, .	96.36	175.00	24.09	24.09	1 : 4.17	83.00	135.75	1 8
July 23 to Aug. 28, .	146.52	184.00	24.42	24.42	1 : 4.65	135.75	182.00	1 4

Total Amount of Feed consumed from April 30 to August 28.

270.51 pounds barley meal, equal to dry matter, . . 235.61 pounds.
580.00 quarts skim-milk, equal to dry matter, . . 128.63 pounds.
65.89 pounds wheat bran, equal to dry matter, . . 58.69 pounds.
83.26 pounds gluten meal, equal to dry matter, . . 74.78 pounds.

Total amount of dry matter, ... 497.71 pounds.

Live weight of animal at beginning of experiment, . 18.50 pounds.
Live weight of animal at time of killing, . . . 182.00 pounds.
Live weight gained during experiment, ... 163.50 pounds.
Dressed weight at time of killing, ... 145.50 pounds.
Loss in weight by dressing, . . 36.50 pounds, or 20.05 per cent.
Dressed weight gained during experiment, . . . 130.72 pounds.

Cost of Feed consumed during Experiment.

270.51 pounds barley meal, at $30.00 per ton, ... $4 06
145.00 gallons skim-milk, at 1.8 cents per gallon, . . . 2 61
65.89 pounds wheat bran, at $18.50 per ton, ... 61
83 26 pounds gluten meal, at $22.00 per ton, ... 92

$8 20

3.04 pounds of dry matter fed yielded 1 pound of live weight, and 3.81 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.27 cents.

(6)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13, .	5.75	46.00	–	–	1:2.90	14.00	25.75	13
May 14 to June 17, .	21.88	175.00	13.13	26.25	1:2.98	25.75	71.50	1 5
June 18 to July 22, .	89.55	175.00	22.37	22.37	1:4.11	71.50	121.00	1 7
July 23 to Aug. 28, .	140.46	184.00	23.41	23.41	1:4.61	121.00	177.00	1 8

Total Amount of Feed consumed from April 30 to August 28.

257.59 pounds barley meal, equal to dry matter, . . 224.36 pounds.
580.00 quarts skim-milk, equal to dry matter, . . 128.63 pounds.
58.91 pounds wheat bran, equal to dry matter, . . 52.48 pounds.
72 03 pounds gluten meal, equal to dry matter, . . 64.69 pounds.

Total amount of dry matter, ... 470.16 pounds.

Live weight of animal at beginning of experiment, . 14.00 pounds.
Live weight of animal at time of killing, . . . 177.00 pounds.
Live weight gained during experiment, ... 163.00 pounds.
Dressed weight at time of killing, ... 141.00 pounds.
Loss in weight by dressing, . . 36.00 pounds, or 20.34 per cent.
Dressed weight gained during experiment, . . . 129.85 pounds.

Cost of Feed consumed during Experiment.

257.59 pounds barley meal, at $30.00 per ton, ... $3 86
145.00 gallons skim-milk, at 1.8 cents per gallon, ... 2 61
58.91 pounds wheat bran, at $18.50 per ton, ... 54
72.03 pounds gluten meal, at $22.00 per ton, ... 79

$7 80

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.01 cents.

(7)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13,	5.75	46.00	–	–	1:2.90	18.75	30.25	13
May 14 to June 17,	21.88	175.00	16.44	32.88	1:2.99	30.25	79.75	1 7
June 18 to July 22,	96.12	175.00	24.03	24.03	1:4.17	79.75	134.50	1 9
July 23 to Aug. 28,	141.84	184.00	23.64	23.64	1:4.62	134.50	197.50	1 11

Total Amount of Feed consumed from April 30 to August 28.

265.59 pounds barley meal, equal to dry matter, . . 231.33 pounds.
580.00 quarts skim-milk, equal to dry matter, . . 128.63 pounds.
64.11 pounds wheat bran, equal to dry matter, . . 57.11 pounds.
80.55 pounds gluten meal, equal to dry matter, . . 72.34 pounds.

Total amount of dry matter, ... 489.41 pounds.

Live weight of animal at beginning of experiment, . 18.75 pounds.
Live weight of animal at time of killing, . . . 197.50 pounds.
Live weight gained during experiment, ... 178.75 pounds.
Dressed weight at time of killing, ... 159.00 pounds.
Loss in weight by dressing, . . 38.50 pounds, or 19.49 per cent.
Dressed weight gained during experiment, . . . 143.91 pounds.

Cost of Feed consumed during Experiment.

265.59 pounds barley meal, at $30.00 per ton, ... $3 98
145.00 gallons skim-milk, at 1.8 cents per gallon, . . . 2 61
64.11 pounds wheat bran, at $18 50 per ton, ... 59
80.55 pounds gluten meal, at $22.00 per ton, ... 89

$8 07

2.74 pounds of dry matter fed yielded 1 pound of live weight, and 3.40 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.61 cents.

Summary of Experiment (X.).

	Barley Meal (Pounds).	Skim-milk (Gallons).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	LiveWeight gained during Experiment (Pounds).	Dressed Weight gained during Experiment (Pounds).	Cost per Pound of Dressed Pork (Cents).
1, ...	263.97	160.25	64.78	83.47	162.00	134.41	6.22
2, ...	260.49	160.25	63.57	82.32	173.75	142.32	5.82
3, ...	259.51	159.75	60.36	76.25	168.75	135.19	6 04
4, ...	266.31	160.25	64.04	82.10	177.00	143.37	5.84
5, ...	270.51	145.00	65.89	83.26	163.50	130.72	6.27
6, ...	257.59	145.00	58.91	72.03	163.00	129.85	6.01
7, ...	265.59	145.00	64.11	80.55	178.75	143.91	5.61
	1,843.97	1,075.50	441.66	559.98	1,186.75	959.77	-

Total Cost of Feed consumed during the Above-stated Experiment.

1,843.97 pounds barley meal, at $30.00 per ton, . . .	$27 66
1,075.50 gallons skim-milk, at 1.8 cents per gallon, . .	19 36
441.66 pounds wheat bran, at $18.50 per ton, ...	4 08
559.98 pounds gluten meal, at $22.00 per ton, ...	6 16
	$57 26

Average cost of feed for production of 1 pound of dressed pork, 5.97 cents.

Manurial Value of Feed consumed during the Above-stated Experiment.

Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$5 74	$10 13	$2 93	$4 17	$22 97

Manurial value of feed for production of 1 pound of dressed pork, 2.39 cents

Net cost of feed for the production of 1 pound of dressed pork, 4.29 cents.

Barley Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.90	258.00	–	–	1 : 8.81
Dry matter,	87.00	1,742.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.30	46.00	–	–	
" cellulose,	7.11	142.20	17.06	12	
" fat,	1.94	38.80	26.38	68	
" protein (nitrogenous matter),	10.80	216.00	168.48	78	
Non-nitrogenous extract matter,	77.85	1,557.00	1,401.30	90	
	100.00	2,000.00	1,613.22	–	

Skim-milk (Average).

[One quart equals 2.17 pounds.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	89.78	1,795.60	–	–	1 : 2.13
Dry matter,	10.22	204.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.85	137.00	–	–	
" cellulose,	–	–	–	–	
" fat,	3.82	76.40	76.40	100	
" protein (nitrogenous matter),	31.60	632.00	632.00	100	
Non-nitrogenous extract matter,	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.92	218.40	–	–	1 : 3.99
Dry matter, . . .	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.00	140.00	–	–	
" cellulose, . . .	11 52	230.40	46.08	20	
" fat, ...	5.43	108.60	86.88	80	
" protein (nitrogenous matter), . .	17.17	343.40	302.19	88	
Non-nitrogenous extract matter, ...	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.19	203.80	–	–	1 : 2.86
Dry matter, . . .	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.57	11.40	–		
" cellulose, . . .	.56	11.20	3.81	34	
" fat, ...	6.40	128.00	97.28	76	
" protein (nitrogenous matter), . .	29.45	589.00	500.65	85	
Non-nitrogenous extract matter, ...	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

VI. Fodder Analyses. (1889.)

The majority of the analyses stated under the above heading are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

In presenting these analyses, it seems but proper to call the attention of farmers once more forcibly to a careful consideration of the following facts.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

The higher or lower commercial value of the manurial refuse left behind after the feed has accomplished its purpose in a satisfactory degree, decides its actual or net cost in farm industry. A disregard of this circumstance renders, in many instances, a remunerative dairying not less doubtful than a profitable feeding of live stock for the meat market.

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	16.44	328.80	–	–	1 : 7.92
Dry matter,	83.56	1,671.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.02	40.40	–	–	
" cellulose,	2.09	41.80	14.21	34	
" fat,	3.47	69.40	52.74	76	
" protein (nitrogenous matter),	12.27	245.40	208.69	85	
Non-nitrogenous extract matter,	80.15	1,603.00	1,506.82	94	
	100.00	2,000.00	1,782.46	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.13	242.60	–	–	1 : 9.68
Dry matter,	87.87	1,757.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.46	29.20	–	–	
" cellulose,	1.79	35.80	12.17	34	
" fat,	4.36	87.20	66.27	76	
" protein (nitrogenous matter),	10.44	208.80	177.48	85	
Non-nitrogenous extract matter,	81.95	1,639.00	1,540.66	94	
	100.00	2,000.00	1,796.58	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.71	214.20	–	–	1 : 10
Dry matter, . . .	89.29	1,785.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.00	20.00	–	–	
" cellulose, . . .	1.74	34.80	11.83	34	
" fat, ...	4.22	84.40	64.14	76	
" protein (nitrogenous matter), . .	10.19	203 80	173.23	85	
Non-nitrogenous extract matter, ...	82.85	1,657.00	1,557 60	94	
	100.00	2,000 00	1,806.80	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.98	239.60	–	–	1 : 8.47
Dry matter, . . .	88.02	1,760.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.56	31.20	–	–	
" cellulose, . . .	1.85	37.00	12.58	34	
" fat, ...	4.69	93.80	71.29	76	
" protein (nitrogenous matter), . .	11.79	235.80	200.43	85	
Non-nitrogenous extract matter, ...	80.11	1,602.20	1,506.07	94	
	100.00	2,000.00	1,790.37	–	

Corn Meal.

[Amherst Mill.]

92.34 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.36	–	–	–	1 : 9.17
Dry matter,	86.64	–	–	–	
	100.00	–	–	–	
Analysis of Dry Matter.					
Crude ash,	1.28	25.60	–	–	
" cellulose,	2 28	45.60	15.50	34	
" fat,	3.18	63.60	48.34	76	
" protein (nitrogenous matter),	10.82	216.40	183.94	85	
Non-nitrogenous extract matter,	82.44	1,648.80	1,549.87	94	
	100.00	2,000.00	1,797.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.51	310.20	–	–	1 : 8.54
Dry matter,	84.49	1,689.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.60	32.00	–	–	
" cellulose,	1.74	34.80	11.83	34	
" fat,	4.54	90.80	69.01	76	
" protein (nitrogenous matter),	11.69	233.80	198.73	85	
Non-nitrogenous extract matter,	80.43	1,608.60	1,512.08	94	
	100.00	2,000.00	1,791.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.32	226.40	–	–	1 : 9.89
Dry matter,	88.68	1,773.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.53	30.60	–	–	
" cellulose,	1.20	24.00	8.16	34	
" fat,	4.30	86.00	65.36	76	
" protein (nitrogenous matter),	10.26	205.20	174.42	85	
Non-nitrogenous extract matter,	82.71	1,654.20	1,554.95	94	
	100.00	2,000.00	1,802.89	–	

Corn Meal.

[Amherst Mill.]

88.50 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.05	201.00	–	–	1 : 9.14
Dry matter,	89.95	1,799.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.63	32.60	–	–	
" cellulose,	1.34	26.80	9.11	34	
" fat,	4.18	83.60	63.54	76	
" protein (nitrogenous matter),	10.98	219.80	186.66	85	
Non-nitrogenous extract matter,	81.87	1,637.40	1,539.15	94	
	100.00	2,000.00	1,798.46	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.57	191.40	–	–	1 : 4.06
Dry matter,	90.43	1,808.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.90	118.00	–	–	
" cellulose,	10.08	201.60	40.32	20	
" fat,	4.78	95.60	76.48	80	
" protein (nitrogenous matter),	17.06	341.20	302.26	88	
Non-nitrogenous extract matter,	62.18	1,243.60	994.88	80	
	100.00	2,000.00	1,413.94	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.34	226.80	–	–	1 : 3.70
Dry matter,	88.66	1,773.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.56	131.20	–	–	
" cellulose,	11.27	225.40	45.08	20	
" fat,	4.64	92.80	74.24	80	
" protein (nitrogenous matter),	18.13	362.60	319.09	88	
Non-nitrogenous extract matter,	59.40	1,188.80	950.40	80	
	100.00	2,000.00	1,388.81	–	

Wheat Bran.

[Amherst Mill.]

40.11 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.34	186.80	–	–	1 : 3.63
Dry matter,	90.66	1,813.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6 67	133.40	–	–	
" cellulose,	10.88	217.60	43.52	20	
" fat,	3.59	71.80	57.44	80	
" protein (nitrogenous matter),	18.13	362.60	319.09	88	
Non-nitrogenous extract matter,	60.73	1,214 60	971.68	80	
	100.00	2,000.00	1,391.73	–	

Wheat Bran.

[Amherst Mill.]

19.56 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.41	208.20	–	–	1 : 4.08
Dry matter,	89.59	1,791.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.99	139.80	–	–	
" cellulose,	12.02	240.40	48.08	20	
" fat,	5.46	119.20	95.36	80	
" protein (nitrogenous matter),	17.02	340.40	299.55	88	
Non-nitrogenous extract matter,	58.51	1,170.20	936.16	80	
	100.00	2,000.00	1,379.15	–	

Wheat Bran.

[Amherst Mill.]

17.97 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.42	228.40	–	–	1 : 3.97
Dry matter,	88.58	1,771.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
" cellulose,	11.03	220.60	44.12	20	
" fat,	5.40	108.00	86.40	80	
" protein (nitrogenous matter),	17.31	346.20	304.66	88	
Non-nitrogenous extract matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,383.34	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.85	177.00	–	–	1 : 4.23
Dry matter,	91.15	1,823.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.54	150.80	–	–	
" cellulose,	9.64	192.80	38.56	20	
" fat,	5.16	103.20	82.52	80	
" protein (nitrogenous matter),	16.45	329.00	289.52	88	
Non-nitrogenous extract matter,	61.21	1,224.20	979.36	80	
	100.00	2,000.00	1,389.96	–	

Wheat Bran.

[I. sent on by T. P. Root, Barre, Mass.; II. and III. sent on by E. D. Gibson, Ashburnham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.10	11.36	11.64
Dry matter,	91.90	88.64	88.36
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.89	6.98	7.42
" cellulose,	10.73	5.95	5.60
" fat,	5.40	7.49	9.43
" protein (nitrogenous matter),	16.73	17.97	16.13
Non-nitrogenous extract matter,	60 25	61.61	61.42
	100.00	100.00	100.00
Passed screen 144 meshes to square inch,	29.57	24.89	16.03

Gluten Meal.

[Springfield, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.49	189.80	–	–	1 : 2.84
Dry matter,	90.51	1,810.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.04	.80	–	–	
" cellulose,	.27	5.40	1.84	34	
" fat,	6.69	133.80	101.69	76	
" protein (nitrogenous matter),	29.87	597.40	507.79	85	
Non-nitrogenous extract matter,	63.13	1,262.60	1,186.84	94	
	100.00	2,000.00	1,798.16	–	

Gluten Meal.

[Springfield, Mass.]

50.24 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.50	210.00	–	–	1 : 2.93
Dry matter,	89 50	1,790.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.34	6.80	–	–	
" cellulose,	.41	8.20	2.79	34	
" fat,	7.08	141.60	107.62	76	
" protein (nitrogenous matter),	29.19	583.80	496.23	85	
Non-nitrogenous extract matter,	62.98	1,259.60	1,184.02	94	
	100.00	2,000.00	1,790.66	–	

Gluten Meal.

[Springfield, Mass.]

56.14 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.29	225.80	–	–	1 : 2.59
Dry matter,	88.71	1,774 20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.73	14.60	–	–	
" cellulose,	.69	13.80	4.69	34	
" fat,	4.08	81.60	62.02	76	
" protein (nitrogenous matter),	30.86	617.20	524.62	85	
Non-nitrogenous extract matter,	63.64	1,272.80	1,196.43	94	
	100.00	2,000.00	1,787.76	–	

Gluten Meal.

[Springfield, Mass.]

51.93 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.89	197.80	–	–	1 : 2.79
Dry matter, . . .	90.11	1,802.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.79	15.80	–	–	
" cellulose, . . .	.71	14.20	4.83	34	
" fat, ...	5.72	114.40	86.94	76	
" protein (nitrogenous matter), . .	29.73	594.40	505.24	85	
Non-nitrogenous extract matter, ...	63.06	1,261.20	1,185.53	94	
	100.00	2,000.00	1,782.54	–	

Gluten Meal.

[Sent on from Boston, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	7.85	157.00	–	–	1 : 1.99
Dry matter, . . .	92.15	1,843.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.82	36.40	–	–	
" cellulose, . . .	1.61	32.20	10.95	34	
" fat, ...	17.36	347 20	263.87	76	
" protein (nitrogenous matter), . .	41.10	822 00	698.70	85	
Non-nitrogenous extract matter, ...	38.11	762.20	716.47	94	
	100.00	2,000.00	1,689.99	–	

Gluten Meal.

[Sent on by W. H. Fairbanks, Sudbury, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.62	192.40	–	–	
Dry matter, . . .	90.38	1,807.60	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.95	19.00	–	–	
" cellulose, . . .	4.26	85.20	28.97	34	1 : 3.63
" fat, ...	7.82	156.40	118.86	76	
" protein (nitrogenous matter), . .	24.34	486.80	413.78	85	
Non-nitrogenous extract matter, ...	62.63	1,252.60	1,177.44	94	
	100.00	2,000.00	1,739.05	–	

Gluten Meal.

[Springfield, Mass.]

44.59 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.80	196.00	–	–	
Dry matter, . . .	90 92	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.25	25.00	–	–	
" cellulose, . . .	1.75	35.00	11.90	34	1 : 2.58
" fat, ...	7.00	140 00	106.40	76	
" protein (nitrogenous matter), . .	31.25	625.00	551.25	85	
Non-nitrogenous extract matter, ...	58 75	1,175.00	1,104.50	94	
	100.00	2,000 00	1,774.05	–	

Old Process Linseed Meal.

[Springfield, Mass.]

75.52 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.46	209.20	–	–	1 : 1.63
Dry matter,	89.54	1,790.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.08	141.60	–	–	
" cellulose,	8.51	170.20	44.25	26	
" fat,	7.98	159.60	145.24	91	
" protein (nitrogenous matter),	38.67	773.40	671.86	87	
Non-nitrogenous extract matter,	37.76	755.20	687.23	91	
	100.00	2,000.00	1,548.58	–	

Old Process Linseed Meal (Fine).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.48	149.60	–	–	1 : 1.76
Dry matter,	92.52	1,850.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.67	113.40	–	–	
" cellulose,	8.04	16.08	41.80	26	
" fat,	7.40	148.00	134.68	91	
" protein (nitrogenous matter),	37.15	743.00	646.41	87	
Non-nitrogenous extract matter,	41.74	834.80	759.67	91	
	100.00	2,000.00	1,582,56	–	

Fertilizing Constituents of Old Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	7.480
Calcium oxide,	.671
Magnesium oxide,	.827
Ferric oxide,	.060
Potassium oxide (4¼ cents per pound),	1.379
Phosphoric acid (6 cents per pound),	1.548
Nitrogen (17 cents per pound),	5.508
Insoluble matter,	.214
Valuation per ton,	$21 76

New Process Linseed Meal (Coarse).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.01	120.20	–	–	1 : 1.32
Dry matter,	93.99	1,879.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.04	120.80	–	–	
" cellulose,	9.23	184.60	48.00	26	
" fat,	3.14	62.80	57.15	91	
" protein (nitrogenous matter),	40.76	815.20	709.22	87	
Non-nitrogenous extract matter,	40.83	816.60	743.11	91	
	100.00	2,000.00	1,557.48	–	

Fertilizing Constituents of New Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	6.010
Calcium oxide,	.552
Magnesium oxide,	.534
Ferric oxide,	.047
Potassium oxide (4¼ cents per pound),	1.517
Phosphoric acid (6 cents per pound),	1.651
Nitrogen (17 cents per pound),	6.112
Insoluble matter,	.192
Valuation per ton,	$24 05

Linseed Meal.

[I., new process, sent on by T. P. Root, Barre, Mass.; II., old process, sent on by S. P. Puffer, North Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.58	10.43
Dry matter,	91.42	89.57
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.52	8.37
" cellulose,	10.31	9.69
" fat,	3.18	6 24
" protein (nitrogenous matter),	32.50	30.98
Non-nitrogenous extract matter,	46.49	44 72
	100.00	100.00

Fine Feed.

[Sent on by T. P. Root, Barre, Mass.]

	Per Cent.
Moisture at 100° C.,	7.76
Dry matter,	92.24
	100.00
Analysis of Dry Matter.	
Crude ash,	4.60
" cellulose,	5.81
" fat,	5.59
" protein (nitrogenous matter),	21.58
Non-nitrogenous extract matter,	62.42
	100.00

Barley Meal.

[Springfield, Mass.]

77.86 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.19	243.80	–	–	1 : 8.53
Dry matter,	87.81	1,756.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.82	36.40	–	–	
" cellulose,	7.37	147.40	17.69	12	
" fat,	2.19	43.80	29.78	68	
" protein (nitrogenous matter),	11.17	223.40	174.25	78	
Non-nitrogenous extract matter,	77.45	1,549.00	1,394.10	90	
	100.00	2,000.00	1,615.82	–	

Barley Meal.

[Springfield, Mass.]

57.71 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.61	272.20	–	–	1 : 9.11
Dry matter,	86.39	1,727.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.79	55.80	–	–	
" cellulose,	6.85	137.00	16.44	12	
" fat,	1.69	33.80	22.95	68	
" protein (nitrogenous matter),	10.42	208.40	162.55	78	
Non-nitrogenous extract matter,	78.25	1,565.00	1,408.50	90	
	100 00	2,000 00	1,610.44	–	

White Soja Beans.

[Bought in New York.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	5.85	117.00	–	–	
Dry matter, . . .	94.15	1,883.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	5.57	111.40	–	–	
" cellulose, . . .	5.15	103.00	14.94	14.5	1 : 1.97
" fat, ...	18 42	368.40	330.82	89.8	
" protein (nitrogenous matter), . .	35.98	719.60	647.64	90.0	
Non-nitrogenous extract matter, ...	34.88	697.60	432.51	62.0	
	100.00	2,000.00	1,425.91	–	

White Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	17.38	347.60	–	–	
Dry matter, . . .	82.62	1,652.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	5.22	104.40	–	–	
" cellulose, . . .	5.35	107 00	15.52	14.5	1 : 2.37
" fat, ...	21.89	437.80	393.74	89.8	
" protein (nitrogenous matter), . .	33.36	667.20	600.48	90.0	
Non-nitrogenous extract matter, ...	34.18	683.60	423.83	62.0	
	100.00	2,000.00	1,432.97	–	

Fertilizing Constituents of White Soja Beans.

	Per Cent.
Moisture at 100° C,	17.380
Calcium oxide,	.342
Magnesium oxide,	.869
Ferric oxide,	.231
Sodium oxide,	.166
Potassium oxide (4¼ cents per pound),	2.085
Phosphoric acid (6 cents per pound),	1.851
Nitrogen (17 cents per pound),	4.409
Insoluble matter,	.090
Valuation per ton,	$18 98

Black Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.27	385.40	–	–	1 : 2.28
Dry matter,	80.73	1,614.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.73	134.60	–	–	
" cellulose,	7.57	151.40	21.95	14 5	
" fat,	20.25	405.00	363.69	89.8	
" protein (nitrogenous matter),	32.58	651.60	586.44	90.0	
Non-nitrogenous extract matter,	32.87	657.40	407.59	62.0	
	100.00	2,000.00	1,379.67	–	

Fertilizing Constituents of Black Soja Beans.

	Per Cent.
Moisture at 100° C.,	19.270
Calcium oxide,	.495
Magnesium oxide,	.949
Ferric oxide,	.201
Sodium oxide,	.384
Potassium oxide (4¼ cents per pound),	1.896
Phosphoric acid (6 cents per pound),	1.886
Nitrogen (17 cents per pound),	4.208
Insoluble matter,	.095
Valuation per ton,	$18 18

Corn "Husks" or "Chaff."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.26
Dry matter,	86.74
	100.00

Analysis of Dry Matter.

Crude ash,	2.76
" cellulose,	18.91
" fat,	1.61
" protein (nitrogenous matter),	5.61
Non-nitrogenous extract matter,	71.11
	100.00

1.55 per cent. passed screen 144 meshes to square inch.

Corn "Germs."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.02
Dry matter,	86.98
	100.00

Analysis of Dry Matter.

Crude ash,	3.09
" cellulose,	2.25
" fat,	6.01
" protein (nitrogenous matter),	11.20
Non-nitrogenous extract matter,	77.45
	100.00

46.77 per cent. passed screen 144 meshes to square inch.

Low Meadow Hay.

[Sent on by S. N. Thompson, Southborough, Mass.]

	Per Cent.
Moisture at 100° C.,	8.01
Dry matter,	91.99
	100.00

Analysis of Dry Matter.

Crude ash,	6.75
" cellulose,	35.59
" fat,	1.88
" protein (nitrogenous matter),	9.51
Non-nitrogenous extract matter,	46.27
	100.00

Corn Stover.

[Sent on by J. C. Dillon, Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	15.60	17.22
Dry matter,	84.40	82.78
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	8.00	4.53
" cellulose,	38.24	28.41
" fat,	1.17	1.41
" protein (nitrogenous matter),	7.94	6.07
Non-nitrogenous extract matter,	44.65	60.08
	100.00	100.00

Ensilage.

[I. and II. sent on by J. N. Raymond, Beverly, Mass.; III. sent on by B. C. Haskell, Boston, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	80.77	78.98	79.73
Dry matter,	19.23	21.02	20.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5 08	4.71	3,19
" cellulose,	33.99	33.79	28.43
" fat,	2.71	1.94	3.60
" protein (nitrogenous matter),	10.26	7.74	7.49
Non-nitrogenous extract matter,	47.96	51.82	57.29
	100.00	100.00	100.00

Barley and Oat Chaff.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.49
Dry matter,	86.51
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	10.41
" cellulose,	24.30
" fat,	2.40
" protein (nitrogenous matter),	11.78
Non-nitrogenous extract matter,	51.11
	100.00

Fertilizing Constituents of Barley and Oat Chaff.

Moisture at 100° C.,	13.490
Calcium oxide,	.853
Magnesium oxide,	.346
Ferric oxide,	.072
Sodium oxide,	.035
Potassium oxide (4¼ cents per pound),	1.146
Phosphoric acid (6 cents per pound),	.409
Nitrogen (17 cents per pound),	1.650
Insoluble matter,	.272
Valuation per ton,	$7 07

Soja Bean (Entire Plant).

[Collected Aug. 26, 1889.]

	Per Cent.
Moisture at 100° C.,	6.48
Dry matter,	93.52
	100.00

Analysis of Dry Matter.

Crude ash,	8.55
" cellulose,	21.75
" fat,	6.35
" protein (nitrogenous matter),	15.10
Non-nitrogenous extract matter,	48.25
	100.00

In green material, moisture, 73.43 per cent.; dry matter, 26.57 per cent.

Fertilizing Constituents of Soja Bean.

Moisture at 100° C.,	6.480
Calcium oxide,	2.750
Magnesium oxide,	1.165
Ferric oxide,	.099
Sodium oxide,	.098
Potassium oxide (4¼ cents per pound),	1.546
Phosphoric acid (6 cents per pound),	.581
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	.987
Valuation per ton,	$9 69

Spanish or Long Moss (Tillandsia usneoides).

	Per Cent.
Moisture at 100° C.,	60.80
Dry matter,	39.20
	100.00

Analysis of Dry Matter.

Crude ash,	2.67
" cellulose,	32.61
" fat,	2.54
" protein (nitrogenous matter),	4.45
Non-nitrogenous extract matter,	57.73
	100.00

Fertilizing Constituents of Spanish Moss.

Moisture at 100° C.,	60.80
Calcium oxide,	.089
Magnesium oxide,	.122
Ferric and aluminic oxides,	.029
Sodium oxide,	.263
Potassium oxide (4¼ cents per pound),	.255
Phosphoric acid (6 cents per pound),	.030
Nitrogen (17 cents per pound),	.279
Insoluble matter,	.191
Valuation per ton,	$1 21

Palmetto Root.

[Sent on by C. D. Duncan, Mandarin, Fla.]

	Per Cent.
Moisture at 100° C.,	11.51
Dry matter,	88.49
	100.00

Analysis of Dry Matter.

Crude ash,	4.44
" cellulose,	21 26
" fat,	.53
" protein (nitrogenous matter),	3.82
Non-nitrogenous extract matter,	69.95
	100.00

Starch (in dry matter),	49.84
Sugar,	Trace.
Tannin,	Trace.

Fertilizing Constituents of Palmetto Root.

Moisture at 100° C.,	11.510
Ash,	3.930
Calcium oxide,	.045

	Per Cent.
Magnesium oxide,	.004
Ferric oxide,	.017
Sodium oxide,	.345
Potassium oxide (4¼ cents per pound),	1.380
Phosphoric acid (6 cents per pound),	.157
Nitrogen (17 cents per pound),	.540
Insoluble matter,	.410
Valuation per ton,	$3 20

Result of Examination of Fifty-pound Samples of the Corn entered by Competitors in This State for the American Agriculturist Prize.

1. Proportion of Moisture, Kernels and Cobs.

Name and Address of Competitors.	Per Cent. of Composition.			Per Cent. of Moisture.		Ratio of Cobs to Kernels.	
	Water.	Kernels	Cobs.	Kernels	Cobs.	As Received.	At 100° C.
1. W. S. Westcott, Amherst,	31.30	58.88	9.82	23.26	57.38	1 : 3.60	1 : 5.99
2. J. C. Dillon, Amherst,	40.74	52.30	6.96	33.50	67.40	1 : 3.96	1 : 7.51
3. F. Goodwin, Framingham,	32.59	59.17	8.24	29.87	46.12	1 : 4.23	1 : 7.06
4. J. S. Wells, Hatfield,	37.28	54.66	8.06	33.49	54.77	1 : 3.60	1 : 6.78
5. Henry Tillson, Sunderland,	32.02	58.46	9.52	28.75	46.96	1 : 5.61	1 : 6.17
6. G. P. Smith, Sunderland,	30.31	59.29	10.40	22.36	56.00	1 : 3.53	1 : 5.70
7. John Brooks, Princeton,	28.27	61.46	10.27	24.98	45.75	1 : 3.62	1 : 6.98
Averages,	33.22	57.74	9.03	28.15	53.48	1 : 4.02	1 : 6.60

2. Description of Ears.

Kind of Corn.	Number of Ears.	Average Weight of Ears (Grams).		Average Weight of Kernels (Grams).		Average Length of Ears (Inches).
		As Received.	At 100° C.	As Received	At 100° C.	
1. Yellow Flint,	125	177.4	121.9	.368	.281	8⅜
2. Yellow Dent,	96	222.9	132.1	.297	.197	7⅜
3. Yellow Flint,	102	209.8	141.8	.452	.317	9⅞
4. Yellow Dent,	67	319.4	200.3	.452	.300	8¼
5. Yellow Dent,	129	173.6	118.0	.384	.273	6⅜
6. Yellow and White Flint,	115	194.7	135.7	.457	.355	9⅛
7. White Flint,	135	167.9	120.5	.415	.312	8
Averages,	110	209.4	139.9	.404	.291	8¼

3. Fodder Constituents in Kernels (Per Cent.).

	Moisture at 100° C.	Dry Matter.	Analysis of Dry Matter.					Nutritive Ratio.
			Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	
1, ...	23.26	76.74	1.77	1.07	4.69	8.49	83.98	1 : 12.22
2, ...	33.50	66.50	1.65	1.40	4.42	9.37	83.16	1 : 10.93
3, ...	29.87	70.13	1.99	1.03	5.32	11.58	80.08	1 : 8.72
4, ...	33.49	66.51	1.95	1.51	5.45	11.14	79.95	1 : 9.08
5, ...	28.75	71.25	1.19	1.71	5.09	9.27	82.74	1 : 11.17
6, ...	22.36	77.64	1.44	1.36	4.96	13.36	78.88	1 : 7.40
7, ...	24.98	75.02	2.09	1.27	5.28	12.27	79.09	1 : 8.45
Averages, .	28.03	71.97	1.73	1.33	5.03	10.78	81.13	1 : 9.71

Per Cent. of Digestibility of Constituents.

Crude cellulose, ...	34
" fat, ...	76
" protein, ...	85
Non-nitrogenous extract matter, ...	94

4. Fertilizing Constituents in Dry Matter (Per Cent.).

	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Sodium Oxide.	Potassium Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per 2,000 Pounds Dry Matter.
1, ...	.028	.200	.017	.033	.274	.624	1.35	.040	$5 57
2, ...	.114	.193	.054	.025	.318	.845	1.49	.032	6 35
3, ...	.036	.222	.022	.038	.349	.772	1.85	.038	7 52
4, ...	.027	.169	.015	.023	.389	.492	1.78	.018	6 67
5, ...	.026	.164	.009	.028	.342	.457	1.49	.009	5 91
6, ...	.034	.231	.041	.028	.462	.638	1.97	.013	7 86
7, ...	.022	.264	.020	.031	.407	.859	1.96	.020	8 03
Averages, . .	.041	.206	.025	.029	.363	.670	1.70	.024	$6 85

Potassium oxide, 4¼ cents per pound; phosphoric acid, 6 cents; nitrogen, 17 cents.

ON FIELD EXPERIMENTS.

I. Field experiments to compare the influence of an addition of nitrogen in different combinations to the soil under cultivation, on the general character of the crop and on the annual yield.

II. Influence of fertilizers on the quantity and quality of prominent fodder crops.

III. Experiments with field and garden crops.

IV. Experiments with green crops for summer feed of milch cows.

V. Notes on miscellaneous field work.

VI. Prof. James E. Humphrey's report on fungi, etc.

I. Field Experiments to compare the Influence of an Addition of Nitrogen in Different Combinations to the Soil under Cultivation, on the General Character of the Crop and on the Annual Yield. (Field A.)

The area assigned to this investigation is the same which has been used in preceding years to study our lands with reference to the conditions of the inherent natural resources of potash. The previous system of subdivision into plats, one-tenth of one acre in size, is retained in all its details. The record of each plat, as far as modes of cultivation and of manuring are concerned, extends over more than five successive years. This circumstance served as one of the inducements to undertake the above-stated task.

Some plats had received during that period a supply of nitrogen for manurial purposes in but one and the same specified form, while others had received none in any form. This condition of the various plats was turned to proper account in our new plans. Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes, were retained in that state to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation ; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years, namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received, without an exception, a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid, and from 40 to 50 pounds of available nitrogen, were supplied per acre.

One plat, marked 0, received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate, and 18 pounds of dissolved bone-black.

Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 1 and 2 received nitrogen in form of sodium nitrate; plats 5, 6 and 8 received nitrogen in form of ammonium sulphate; plats 3 and 10 received nitrogen in form of dried blood; plat 0 received nitrogen in form of barn-yard manure.

For details, compare the following tables, containing the history of Field A: —

Composition of Manurial Substances applied.

	Per Cent.
Nitrate of soda = nitrogen,	16.00
Sulphate of ammonia = nitrogen,	20.91
Dried blood = nitrogen,	8.24
Muriate of potash = potassium oxide,	48.58
Sulphate of potash = potassium oxide,	37.54
Dissolved bone-black = available phosphoric acid,	21.80
Barn-yard manure = moisture,	73.04
phosphoric acid,	.688
potassium oxide,	.527
nitrogen,	.568

Field A.

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887, 1888, 1889, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.			YIELD OF DRY FODDER CORN.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1, .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
Plat 2, .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
Plat 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen) and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
Plat 4, .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
Plat 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen) and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
Plat 6, .	Fallow, ...	Fallow, ...	Fallow, ...	-	-	-
Plat 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), . .	280	255	730
Plat 8, .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
Plat 10, .	48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

Field A — Concluded.

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.	
	1888.	1889.	1888.	1889.
Plat 1,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	617	648
Plat 2,	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs. available phosphoric acid),	303	577
Plat 3,	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs. available phosphoric acid),	150	618
Plat 4,	Nothing,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	114	381
Plat 5,	97 lbs. magnesium sulphate,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	564	488
Plat 6,	Nothing,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	193	542
Plat 7,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	676	526
Plat 8,	50 lbs. ammonium sulphate (= 10 lbs. nitrogen),	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	146	359
Plat 9,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	553	476
Plat 10,	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	737	640

The entire field, eleven plats, was ploughed April 9. The fertilizer was applied broadcast to each plat, and subsequently slightly harrowed under, April 27. The final preparation of the soil for seeding, by ploughing and harrowing, took place May 9. The same variety of corn (Clark), a flint corn, was planted in drills in a similar manner as during preceding years, May 10. The crop on all plats was kept clean by means of the cultivator and hoe; it was cut September 3, when the kernels were fairly glazed over. The degree of progress in the growth of the corn upon different plats during the entire season may be noticed from the following tabular statement of periodical measurements of their average heights: —

Height of Corn on Plats, in Inches (1889).

	June 11.	June 19.	June 26.	July 3.	July 10.	July 17.	July 24.	July 31.	Aug. 7.	Aug. 14.	Aug. 21.	Aug. 28.
Plat 0, .	6	9	11	18	25	35	45	64	70	73	73	73
Plat 1, .	6	9	12	16	26	36	44	64	73	73	73	73
Plat 2, .	6	7½	10	15	25	33	42	62	68	70	70	72
Plat 3, .	6½	9	12	14	24	31	41	60	68	73	73	75
Plat 4, .	5½	7	10	13	20	27	33	49	62	65	65	67
Plat 5, .	5½	7½	10	13	23	34	41	55	67	70	70	70
Plat 6, .	6	8	9½	13	20	30	40	61	66	74	74	74
Plat 7, .	6	10	13	16	26	40	48	60	64	68	70	70
Plat 8, .	5	6½	8	10	17	21	30	45	54	60	62	68
Plat 9, .	6	9	10	16	22	33	41	60	63	68	69	69
Plat 10, .	7	11	14	19	27	46	54	69	75	76	76	76

The marked difference in the general appearance of the corn crop on different plats during the various stages of its growth was, however, not confined to their varying heights; they differed also at times much in regard to a more or less healthy color. The growth upon plats 7 and 9, in particular, was, during the entire season, of a light-green color; the same feature was noticeable to some degree, during the first half of the season, on plats 4, 5, 6 and 8. Upon the remaining plats the color was deep green, indicating a vigorous condition. Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 5, 6 and 8 received an addition of nitrogen in form of ammonium sulphate, and the remaining plats in form either of dried blood or of sodium nitrate. Not less noticeable is the difference in the character of the final crop. Those plats (4, 7 and 9) which received no nitrogen in the fertilizer applied, produced not only by far the smallest quantity of ears, but also the smallest number of well-developed ears. The yield in corn stover, on the other hand, is, in two of these cases (7 and 9) at least, equal to the highest on any of the other plats, as may be seen from the following record: —

Yield of Corn Stover and Ears on Plats (1889), at Forty-eight Per Cent. Moisture.

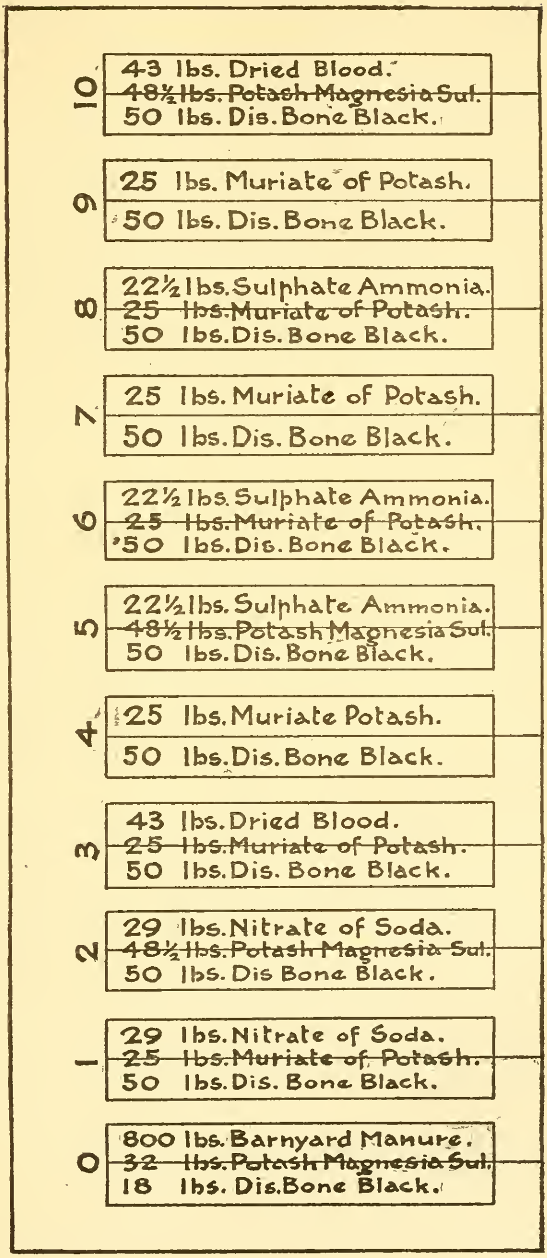
	Weight of Whole Crop.	Weight of Stover.	Weight of Ears.
	Lbs.	Lbs.	Lbs.
Plat 0,	500.62	342.35	158.27
Plat 1,	648.48	475.95	172.53
Plat 2,	576.91	375.75	201.16
Plat 3,	618.31	425.85	192.46
Plat 4,	381.18	283.90	97.28
Plat 5,	488.01	359.05	128.96
Plat 6,	541.95	367.05	174.90
Plat 7,	525.82	484.30	41 52
Plat 8,	359.12	237.98	121.14
Plat 9,	475.63	417.50	58.13
Plat 10,	639.55	467.60	171.95

Percentage of Well-developed and Undeveloped Ears on Plats (1889).

	Well-developed Ears.	Undeveloped Ears.
	Per Cent.	Per Cent.
Plat 0,	60.3	39.7
Plat 1,	48.5	51.5
Plat 2,	46.7	53.3
Plat 3,	28.3	71.7
Plat 4,	14.7	85.3
Plat 5,	18.7	81.3
Plat 6,	29.0	71.0
Plat 7,	41.6	58.4
Plat 8,	21.3	78.7
Plat 9,	24.4	75.6
Plat 10,	50.2	49.8

The results of our first season of observation regarding the influence of nitrogen-containing manurial substances on the character and on the quantity of the fodder corn raised under otherwise corresponding circumstances, although not without some interest, are not decisive enough to advise a detailed explanation of causes. The larger part of the late summer season with us was cold and wet, and for this reason of an exceptionally unfavorable character for the raising of fodder corn. How much this circumstance has affected our results, is difficult to decide. Not less difficult is it to decide, at this stage of observation, how much the special conditions of various plats may yet control the results. The experiment will be continued until a reliable basis for a final conclusion has been secured.

FIELD "A" 1889.



CORN PLATS WITH DRAINAGE SYSTEM. SCALE, 4 RODS TO 1 INCH.

II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops. (Field B.)

The field is located west of Field A, and has been used, like the latter, for several years previous to the establishment of the experiment station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and the same amount of fertilizer, — six hundred pounds of ground bones, and two hundred pounds of muriate of potash per acre. Since 1885 all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and, in the case of grasses, two feet. The space between the different plats has received, thus far, no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 were fertilized annually; plats 12, 14, 16, 18 and 20 have received no fertilizer until the present season, — 1889.

The details of the work carried on upon Field B are from year to year recorded in the annual report of the station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins, and the reports of the succeeding year.

The subsequent tabular statement of crops raised upon the different plats of Field B since 1886 may assist in a desirable understanding of its late history, and its condition at the beginning of the season of 1889. The single plats are, since 1886, each 175 feet long and 33 feet wide.

Statement of Crops raised on Field B.

PLATS.	1887.	1888.	1889.
Plat 11 (fertilized,)	Corn,	Kentucky blue-grass (*Poa prætensis*),	Kentucky blue-grass.
Plat 12 (unfertilized),	Corn,	Kentucky blue-grass,	Kentucky blue-grass (fertilized August, 1889).
Plat 13 (fertilized),	Italian rye-grass (*Lolium Italicum*), English rye-grass (*Lolium perenne*),	Italian rye-grass, English rye-grass,	Red-cob ensilage corn.
Plat 14 (unfertilized),	Italian rye-grass, English rye-grass,	Italian rye-grass, English rye-grass,	Red-cob ensilage corn (fertilized May, 1889).
Plat 15 (fertilized),	Five varieties Southern cow-pea,	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*). Sainfoin (*Onobrychis sativa*).
Plat 16 (unfertilized),	Five varieties Southern cow-pea,	Soja bean,	Bokhara clover (fertilized May, 1889). Sainfoin (fertilized May, 1889).
Plat 17 (fertilized),	Meadow fescue (*Festuca prætensis*),	Meadow fescue,	Meadow fescue.
Plat 18 (unfertilized),	Alsike clover (*Trifolium hybridum*), Medium red clover (*Trifolium pratense*),	Alsike clover, Medium red clover,	Red-cob ensilage corn (fertilized May, 1889).
Plat 19 (fertilized),	Alsike clover, Medium red clover,	Alsike clover, Medium red clover,	Alsike clover. Medium red clover.
Plat 20 (unfertilized),	Mammoth red clover (*Trifolium medium*), Alfalfa or lucerne (*Medicago sativa*),	Mammoth red clover, Alfalfa,	Red-cob ensilage corn (fertilized May, 1889).
Plat 21 (fertilized),	Mammoth red clover, Alfalfa,	Mammoth red clover, Alfalfa,	Corn (variety, Clark).

1889. — The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Kentucky blue-grass, Plat 11 (fertilized), was well preserved; the same circumstance was noticed on Plat 12 (unfertilized).

Perennial rye-grass, plats 13 and 14 (fertilized and unfertilized), was dead in the rows.

Italian rye-grass was fairly preserved in the rows on both plats.

Meadow fescue, Plat 17 (fertilized), was in a healthy and well-preserved condition.

Alsike clover, plats 18 and 19 (unfertilized and fertilized), had suffered somewhat on the unfertilized plat, but was well preserved upon the fertilized plat (19).

Medium red clover, raised on the same plats as the alsike, was in better condition upon the unfertilized plat (18) than the latter, yet fell behind on the fertilized plat (19).

Alfalfa, plats 20 and 21 (unfertilized and fertilized), was almost entirely winter-killed. The same feature was noticeable in regard to mammoth red clover, upon the unfertilized Plat 20, while upon Plat 21 (fertilized) a fair growth was noticed. The plats 15 and 16, which had been used in the preceding season for the production of Soja beans, were ploughed and prepared for seeding; the same course was pursued in regard to the grass and clover plats, where the growth had been seriously winter-killed, — plats 18, 20 and 21.

Plats 12, 14, 16, 18 and 20, which for five preceding years had not been fertilized, were treated, like all fertilized plats in this field, with eighty pounds of fine-ground bones and twenty-seven pounds of muriate of potash per acre.

Plats 15 and 16 were turned to account for the cultivation of Bokhara clover (*Melilotus alba*) and of sainfoin (*Onobrychis sativa*). Each plat was subdivided into two equal parts, and seeded down, one-half with Bokhara clover and the other half with sainfoin, May 8.

Plats 13, 14, 18 and 20 were planted, May 27, with red-cob ensilage corn, a dent variety sent on for trial by Messrs. D. J. Bushnell & Co. of St. Louis. Nine quarts of corn were used for that purpose. Plat 21 was planted on the same day with two and one-half quarts of Clark corn, a flint variety of medium size.

The grasses and clover varieties were kept clean from weeds by the use of the cultivator and the hoe; a similar attention was bestowed upon the corn-bearing plats.

The Kentucky blue-grass, seeded down in 1888, proved to be largely a mixture of other grasses, herd's grass in particular. The grass on both plats was cut for hay June 24. Plat 11 (fertilized) yielded 520 pounds of hay, or 3,921 pounds per acre; Plat 12 (unfertilized) yielded 280 pounds of hay, or 2,111 pounds per acre. The sod was subsequently turned under, and both plats re-seeded with Kentucky blue-grass, September, 1889.

Meadow fescue, Plat 17, began to head out May 30; it bloomed June 4; it was thirty-six inches high when in full blossom. The cutting had to be deferred, on account of rainy weather, to June 20, when it measured forty-four inches in height. The first cut of hay weighed 560 pounds, or 4,422 pounds per acre; the second cut (rowen) of hay, September 4, weighed 290 pounds, or 2,187 pounds per acre. This grass compares well in quality and quantity with herd's grass; seeded down close, it forms a compact, healthy-looking sod.

Bokhara clover, Plat 15, was seeded May 8; it appeared above ground May 16; was eight inches high July 3, and thirty-two inches August 7; it was cut for hay September 9, and yielded at the rate of 3,090 pounds per acre. The second year's growth is usually much heavier; the plant dies out with the end of the second year. The large yield of vegetable matter, in particular during the second year, renders further observation with this plant for feeding purposes advisable.

Sainfoin, Plat 15, was seeded May 8; the young plants appeared above ground May 18; it measured four inches

July 3. The growth of the plant was very slow during the entire season. The land was cleaned from weeds September 24, and the crop left for another year's observation. Whether a cold and wet season caused this slow progress in the growth of this reputed fodder crop, has to be left for the future to decide.

Alsike clover, Plat 19, started up well in May; it was in full bloom June 3, and was cut for hay July 2. The clover hay weighed 155 pounds, or 2,400 pounds per acre.

Medium red clover, Plat 19, began blooming June 17; the crop was cut for hay July 12. The latter weighed 180 pounds, or 2,900 pounds per acre.

In the interest of a due appreciation of the annual yield stated in connection with the above-described grasses and clovers, attention is here once more called to the fact that all were raised in rows, and not broadcast. The rows were, in case of the grasses, for stated reasons, two feet apart, and in case of clovers three feet. The numerical statements regarding their annual yield are therefore mainly of interest as far as relative quantities are concerned. Taking this circumstance into due consideration, it will be conceded that the yield in some instances has been remarkably large; as, for instance, in the case of meadow fescue, — 4,422 pounds of hay in the first cut and 2,187 pounds in the second cut, or 6,609 pounds of hay per acre. On a previous occasion it has been already stated that the cultivation of grasses in drills has been adopted in our experiments, on account of the chances this system of cultivation offers to keep individual varieties of grasses free from foreign growth. The introduction of drill cultivation in connection with the raising of grain crops is deservedly urged upon the attention of farmers, in the interest of clean cultivation.

Red-cob ensilage corn, plats 13, 14, 18 and 20, was planted in drills with nine quarts of seed corn, May 25. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with from four to six seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised. The young plants appeared above ground June 3. The crop looked vigorous and handsome throughout the entire season, yet was somewhat behind in its various stages of growth. The entire crop was cut for the silo September 6 and 7, although the ears were not yet as far advanced as desirable to secure the full benefit of the season. Early frosts oblige us to cut our corn crops at the beginning of the month of September. This feature of our local climate advises the selection of early-maturing varieties of corn. The green crop secured from the different plats varied widely in weight, — a result apparently largely due to the particular condition of the soil with reference to temporary available resources of plant food. The majority of plats (14, 18 and 20) had not been fertilized for several preceding years; Plat 13 was the only one, planted with the stated variety of corn, which for years had been fertilized with bone and potash. One year's treatment, spring of 1889, with a corresponding amount of these two manurial substances, did not raise their productiveness to its full capacity.

Plat	13	yielded	5,820	lbs.	green	fodder	corn,	or	43,884	lbs. per acre.
"	14	"	4,755	"	"	"	"		35,853	" "
"	18	"	3,230	"	"	"	"		24,354	" "
"	20	"	2,560	"	"	"	"		19,302	" "

Clark corn, Plat 21, was planted on the same date as the former, and treated alike in all particulars; it did well throughout the season; it showed tassels July 19, and was cut for the silo September 7. The crop was more matured than the red-cob ensilage corn, yet was the lowest in weight, — 2,365 pounds per plat, or 17,832 pounds per acre. The main difference in the weight of the crops secured from both varieties of corn does not express their relative food value; yet the difference in that direction is so great that it must be admitted that the Clark corn is not a success as an ensilage corn.

Analyses of Crops raised upon Field B during the Summer Season of 1888.

Italian Rye Grass (1888).

	Collected June 29, 1888 in Bloom.		Collected July 16, 1888, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.30	8.96	8.22	7.38
Dry matter,	90.74	91.04	91.78	92.62
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	7.44	7.50	8.58	6.55
" cellulose,	31.27	32.79	36 90	32 38
" fat,	2.04	1.39	1.90	2.07
" protein (nitrogenous matter),	9.75	7.13	9.53	6.20
Non-nitrogenous extract matter,	49.50	51.19	43.09	52.80
	100.00	100.00	100.00	100.00

Fertilizing Constituents of Italian Rye Grass.

	Collected June 29, 1888, in Bloom.		Collected July 16, 1888, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.300	8.960	9.204	7.380
Calcium oxide,	.644	.639	.983	1.160
Magnesium oxide,	.357	.316	.328	.284
Ferric oxide,	.045	.042	.065	.130
Sodium oxide,	.151	.463	.795	.395
Potassium oxide (4¼ cts. per lb),	1.922	1.184	2.086	.940
Phosphoric acid (6 cts. per lb.),	.546	.572	.539	.564
Nitrogen (17 cts. per lb.),	1.415	1.039	1.381	.919
Insoluble matter,	1.922	2.602	2.290	3.507
Valuation per ton,	$7 10	$5 22	$6 24	$4 59

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Alsike Clover (1888).

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13.52	13 10	6.08
Dry matter,	86.48	86.90	93.92
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	15.91	9.90	8.26
" cellulose,	26 79	24.03	32.34
" fat,	2.19	1 88	3 07
" protein (nitrogenous matter),	16.48	17 55	14.77
Non-nitrogenous extract matter,	38.63	46.64	41.56
	100.00	100.00	100 00

Fertilizing Constituents of Alsike Clover.

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13 520	13 100	6 080
Calcium oxide,	2.119	2 608	2 838
Magnesium oxide,	.330	.705	.304
Ferric oxide,	.141	.202	.064
Sodium oxide,	.299	.273	.209
Potassium oxide,	4.308	1.087	2.602
Phosphoric acid,	.716	.704	.496
Nitrogen,	2.280	2.440	2.214
Insoluble matter,	.744	1.102	.420
Valuation per ton,	$12 27	$10 06	$10 34

Medium Red Clover (1888).

[Collected July 6, 1888, in bloom, fertilized.]

Moisture at 100° C.,	6.02
Dry matter,	93.98
	100.00

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Analysis of Dry Matter.

Crude ash,	8.90
" cellulose,	29.97
" fat,	2.62
" protein (nitrogenous matter),	14 63
Non-nitrogenous extract matter,	43 88
	100.00

Fertilizing Constituents of the Above Medium Red Clover.

Moisture at 100° C.,	6.020
Calcium oxide,	1.932
Magnesium oxide,	.423
Ferric oxide,	.064
Sodium oxide,	.201
Potassium oxide,	2.315
Phosphoric acid,	.459
Nitrogen,	2.198
Insoluble matter,	.267
Valuation per ton,	$9 99

Mammoth Red Clover (1888).

	Collected June 21, 1888, in Bloom.		Collected July 13, 1888, in Seed.
	Fertilized.	Unfertilized	Unfertilized.
Moisture at 100° C.,	17.53	9.36	7.34
Dry matter,	82 47	90 64	92 66
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.50	10.50	8.53
" cellulose,	33 72	20.16	28.65
" fat,	2.25	1.86	2.25
" protein (nitrogenous matter),	14.69	18.50	14.06
Non-nitrogenous extract matter,	38.84	48.98	46 51
	100.00	100 00	100 00

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Fertilizing Constituents of Mammoth Red Clover.

	COLLECTED JUNE 21, 1888, IN BLOOM.		COLLECTED JULY 23, 1888, IN SEED.
	Fertilized.	Unfertilized.	Unfertilized.
Moisture at 100° C.,	17.530	9.360	7.340
Calcium oxide,	2.732	3.978	2.712
Magnesium oxide,	.312	.792	.735
Ferric oxide,	.057	.144	.133
Sodium oxide,	.512	.558	.098
Potassium oxide,	2 430	.726	.513
Phosphoric acid,	.504	.704	.421
Nitrogen,	1.938	2.680	2.075
Insoluble matter,	.261	.908	1.168
Valuation per ton,	$9 26	$10 57	$8 00

Alfalfa (1888).

	COLLECTED JUNE 29, 1888, IN BLOOM.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	4.68	4.60
Dry matter,	95.32	95.40
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.97	7.10
" cellulose,	34.39	32 41
" fat,	1.12	1.04
" protein (nitrogenous matter),	16.27	14.41
Non-nitrogenous extract matter,	40.25	45.04
	100.00	100.00

ANALYSES OF CROPS RAISED UPON FIELD B — *Concluded.*

Fertilizing Constituents of Alfalfa.

	Collected June 29, 1888, in Bloom.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	4.680	4.600
Calcium oxide,	1.944	2.855
Magnesium oxide,	.279	.513
Ferric oxide,	.050	.070
Sodium oxide,	.079	1.156
Potassium oxide,	2.038	.891
Phosphoric acid,	.556	.645
Nitrogen,	2.481	2.200
Insoluble matter,	.140	.508
Valuation per ton,	$10 84	$9 00

Soja Bean (Entire Plant, Dry).

[Collected Aug. 30, 1888, unfertilized.]

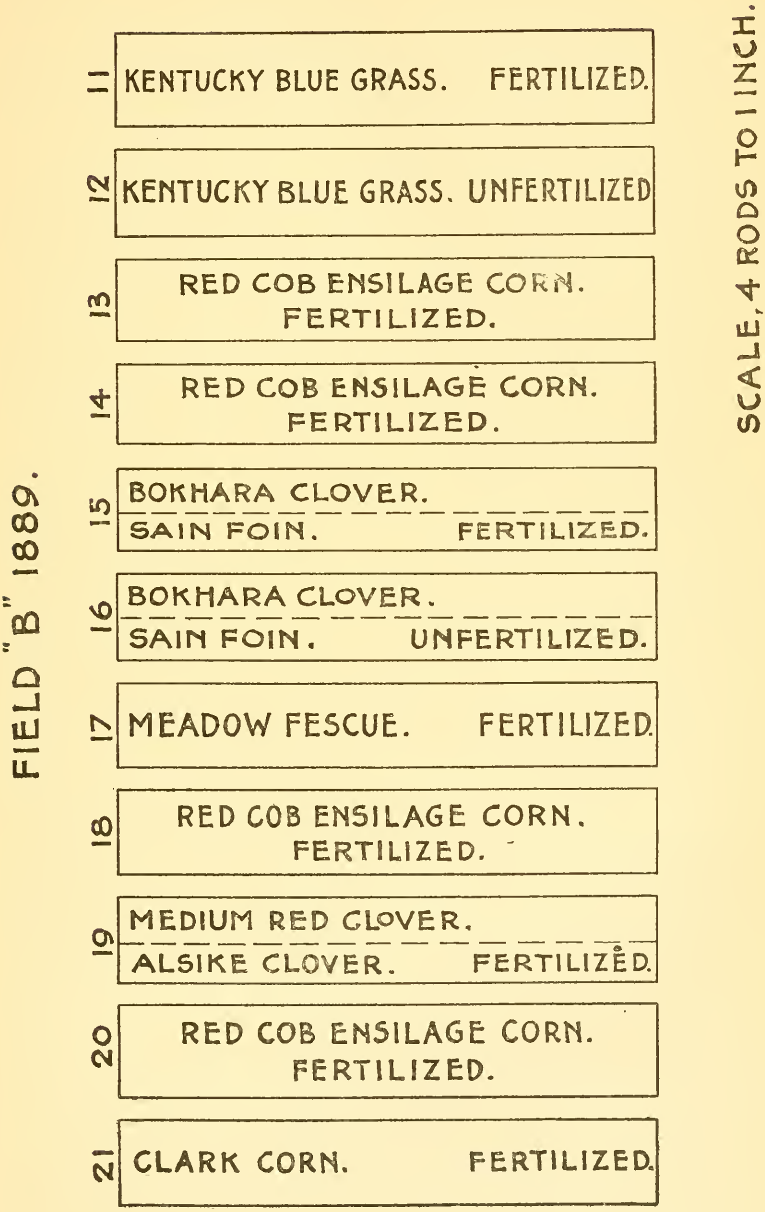
Moisture at 100° C.,	6.12
Dry matter,	93.88
	100.00

Analysis of Dry Matter.

Crude ash,	6.47
" cellulose,	20.76
" fat,	5.62
" protein (nitrogenous matter),	15.87
Non-nitrogenous extract matter,	51.28
	100.00

Fertilizing Constituents of the Above Soja Bean.

Moisture at 100° C,	6.120
Calcium oxide,	2.770
Magnesium oxide,	1.190
Ferric oxide,	.131
Sodium oxide,	.198
Potassium oxide,	.617
Phosphoric acid,	.753
Nitrogen,	2.380
Insoluble matter,	.967
Valuation per ton,	$9 51


FIELD "B" 1889.
SCALE, 4 RODS TO 1 INCH.
11 KENTUCKY BLUE GRASS. FERTILIZED.
12 KENTUCKY BLUE GRASS. UNFERTILIZED
13 RED COB ENSILAGE CORN. FERTILIZED.
14 RED COB ENSILAGE CORN. FERTILIZED.
15 BOKHARA CLOVER.
SAIN FOIN. FERTILIZED.
16 BOKHARA CLOVER.
SAIN FOIN. UNFERTILIZED.
17 MEADOW FESCUE. FERTILIZED.
18 RED COB ENSILAGE CORN. FERTILIZED.
19 MEDIUM RED CLOVER.
ALSIKE CLOVER. FERTILIZED.
20 RED COB ENSILAGE CORN. FERTILIZED.
21 CLARK CORN. FERTILIZED.

III. Experiments with Field and Garden Crops. (Fields C and D, 1889.)

A short description of the work carried on upon these fields during the preceding year, 1888, may serve as an introduction to a brief statement of the course adopted in 1889.

Field C, 1888. — This field comprises an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passageway three feet wide. The northern half of the field is 70 feet wide and 328 feet long; the southern half is the same length, but 109 feet wide.

The latter was again subdivided into three equal parts, each 111 by 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and oats (variety Western). The middle division was planted the same day with serradella and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart.

The northern half of Field C was occupied by a series of crops in rows, running north and south, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning at the east end : —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.

Teosinte (*Euchlæna luxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture. (For details, see sixth annual report, pages 115 to 120.)

Field C, 1889. — The entire area of both divisions of this field was carefully prepared in a similar manner as in the preceding spring. It was ploughed and harrowed April 20, and fertilized broadcast with fine-ground bone and muriate of potash, at the rate of six hundred pounds of the former and two hundred pounds of the latter. The entire southern half of the field was planted with roots, while the northern half was used for raising a variety of fodder and garden crops. The majority of the seeds used in this connection were sent on by the United States Department of Agriculture; others came from parties more or less directly interested in the particular variety sent on for trial; some were bought of reliable parties. Most of these seeds were planted merely for the purpose of studying their particular degree of adaptation to our climate and soil, to secure suitable material for analysis, and to ascertain their relative proportion of essential nutritive constituents. As this part of our work requires exceptional accommodation for analytical work, it has to be largely deferred to a more favorable part of the year. This circumstance must serve as our excuse for publishing some analyses of the crops raised in 1888 for the first time on the present occasion.

Description of the Principal Crops raised on the Southern Division of Field C, beginning at the West End.

American ruta-baga turnips of Delano Moore, Presque Isle, Me., two rows, 109 feet long and 2 feet apart, were planted May 3. The young plants appeared above ground May 11; they were thinned out in the rows to eight inches of space between them, July 1, and subsequently kept clean from weeds by a periodical use of the cultivator and the hoe. A blight which appeared during the first week of August on the leaves did considerable injury to the earlier foliage; the later leaves suffered less seriously. The crop was harvested October 22; the roots weighed 170 pounds. Photographs representing fair specimens of the roots will be found farther on. An analysis stating the composition of a medium-sized root is reported at the close of this chapter.

Lane's Sugar Beet. — The seeds used in this case were sent on by C. H. Lane of Middlebury, Vt. The area occupied by the plant measured 1,090 square feet. The seeds were planted in rows two feet apart, May 3; the young plants appeared above ground May 11; they were thinned out in the rows to six inches space between them, June 18, and kept clean from weeds by cultivator and hoe in the same manner as the previously described crop. The first growth of leaves suffered seriously from a blight, the later leaves were entirely free from blight, and made a vigorous growth. The crop was harvested October 19; it weighed 610 pounds, without the leaves. A photograph of different sizes of the roots, and an analysis stating the composition of a medium-sized root, will be found farther on.

Saxony Sugar Beet. — This crop occupied an area of 15,587 square feet. The seed was sown in rows two feet apart, to admit the use of a one-horse cultivator, May 3. The seeding was heavy; five and one-half ounces of seed were used. The young plants were thinned out and treated like the previously stated crop. The unfavorable, cold, wet weather during the fore part of the summer season affected this crop in a similar way as the preceding root crops. Insects and a blight destroyed almost entirely the first leaf growth. The later leaves were vigorous, and apparently free from blight. The roots were harvested October 19; they weighed 6,450 pounds, or nine tons per acre, which is about one-half an average crop. Photographs and a chemical analysis accompany these statements.

Carrots, Danvers. — The land occupied by this crop measured 18,420 square feet; the seed was sown in rows, leaving fourteen inches of space between, May 13; fourteen ounces of seed were used for that purpose. The plants came up May 21; they were thinned out by hand in the rows from two to three inches apart. The crop was kept clean by weeding with the hand and the hoe. The leaves suffered somewhat from blight during the earlier part of the month of August. The roots were harvested October 17; they weighed 11,390 pounds, or 13⅓ tons per acre.

The serious influence of an unfavorable season on the yield of the root crops has been a marked one. The roots were much smaller than in preceding years; this circumstance applies with particular force to the different varieties of sugar beets on trial. The crops have fallen behind in these cases more than fifty per cent. of a fair average yield. The yield of carrots is one-third less than that obtained in preceding years.

Statement of Crops raised on the Northern Division of Field C.

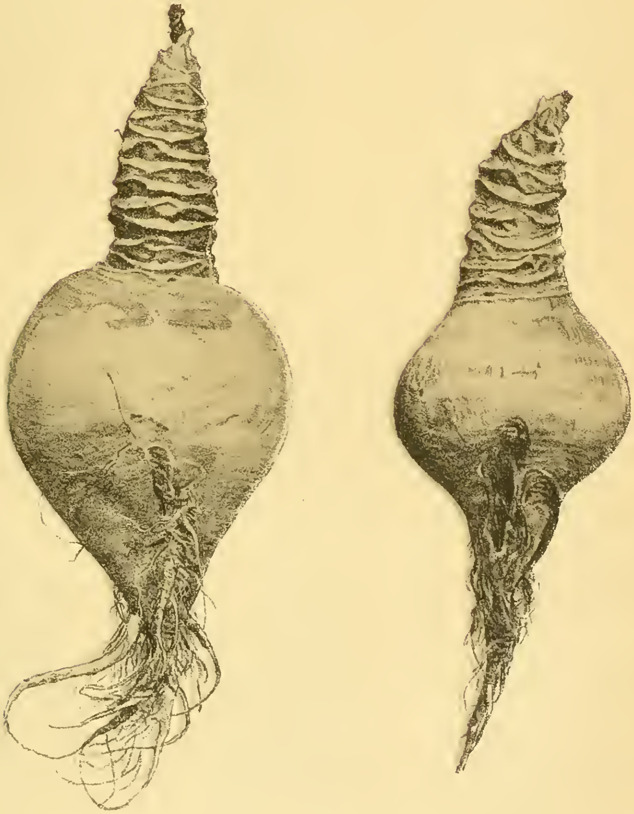
This section of Field C is 70 feet wide and 328 feet long, and laid out in rows from two to three feet apart, as circumstances may advise. Most of the crops raised here are merely on trial, to study their general adaptation to our soil and climate; a few rows represent in most instances the extent of the area occupied by each of them. In many instances merely a sufficient amount is raised to secure suitable samples for chemical examination. Wherever the results in the field and in the laboratory are encouraging, as far as fodder crops new to our section of the country are concerned, larger fields will be devoted subsequently, to test their respective agricultural merits on a becoming scale.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crops (aside from the products of pastures and meadows), — the fodder corn and corn stover.

A more detailed discussion of this important question may be found in our fifth annual report, page 88, and sixth annual report, page 115.

The crops were arranged in the following order, beginning at the west end: —

Erfurt earliest cauliflower, two rows.
Early snowball cauliflower, two rows.
Haines No. 64 tomato, two rows.
Honduras sorghum, seven rows.
New orange sorghum, seven rows.
Kansas orange sorghum, seven rows.
Price's new hybrid sorghum, seven rows.
Early Tennessee sorghum, seven rows.
Bokhara clover (*Melilotus alba*), three rows.
Bokhara clover (*Melilotus cæruleus*), three rows.
Lotus villosus, two rows.
Pyrethrum roseum, one row.
Sulla (*Hedysarum coronaria*), one row.
Pease, one row.
Dwarf Lima beans, one-half row.
Early cow-pea, one and one-half rows.
Black soja bean, five rows.
Blue lupine, two rows.
Cow-pea, three rows.
Horse bean, three rows.
Japan clover (*Lespideza striata*), five rows.
Chapman honey plant, three rows.
New Japanese buckwheat, seventeen rows.
Common barley, fifteen rows.
Hulless black barley, fifteen rows.



American Ruta Baga Turnips.

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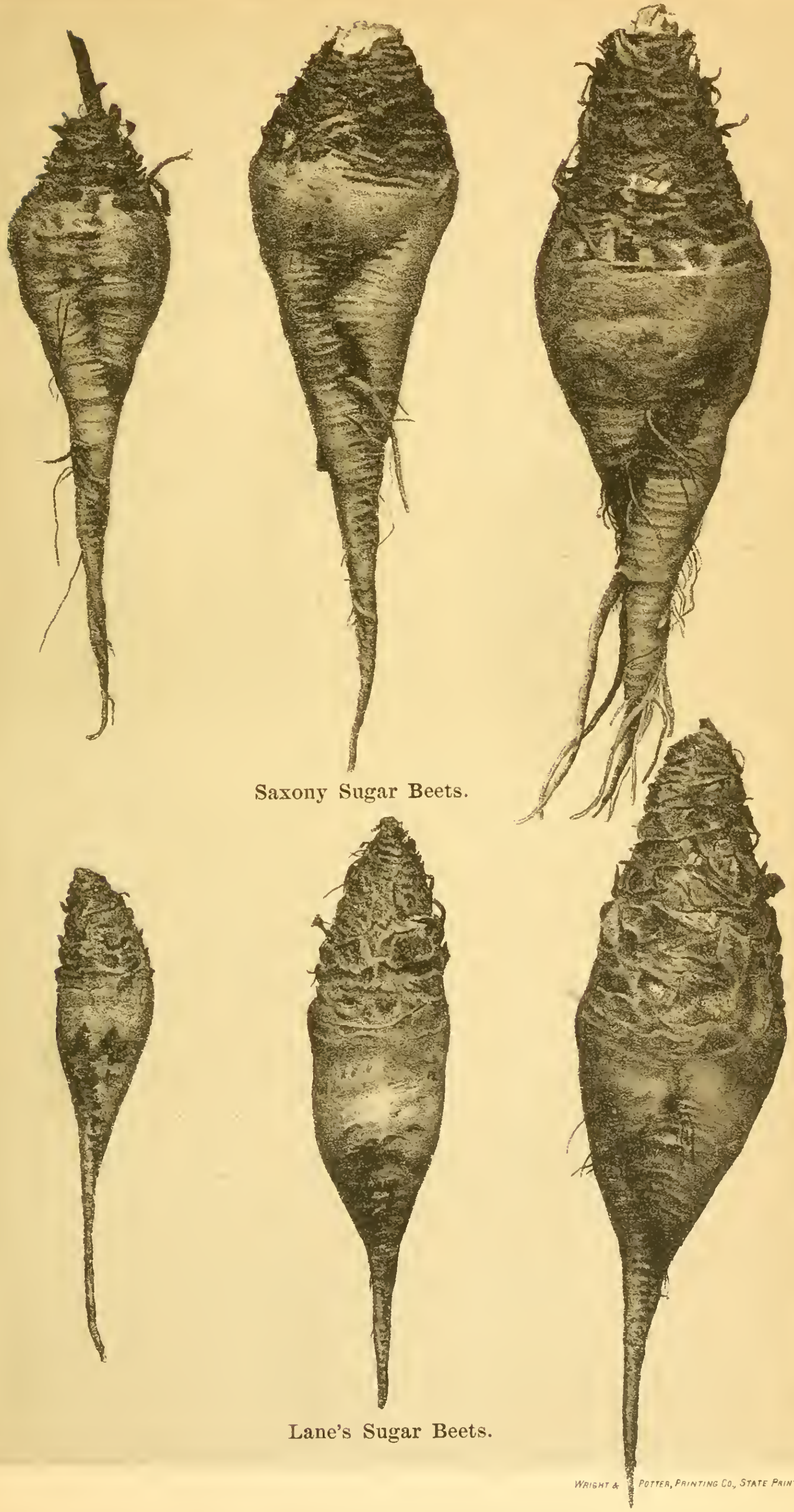

Saxony Sugar Beets.

Lane's Sugar Beets.

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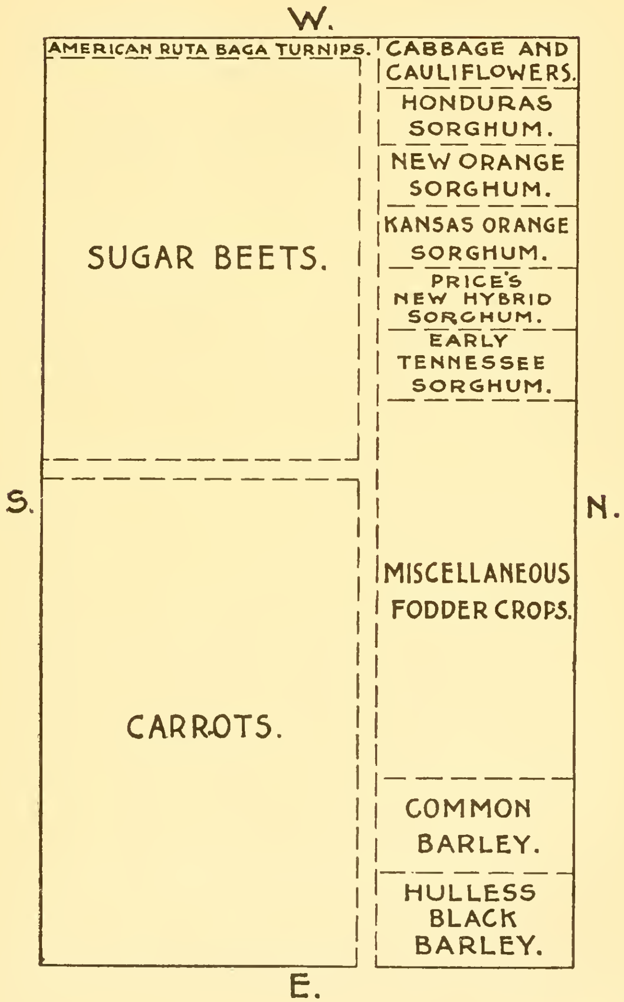
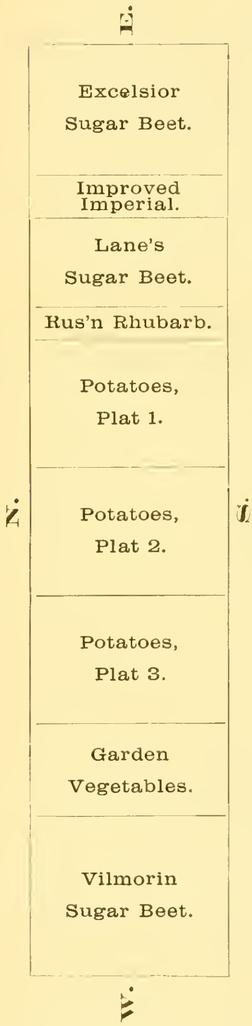
FIELD "C" 1889.



SCALE, 4 RODS TO 1 INCH.

Field D, 1888. — This field is 328 feet long and 70 feet wide, covering an area of 22,960 square feet. It has been used during previous years for the raising of a variety of garden and field crops, on a larger or smaller scale. The soil has been usually ploughed late in the fall and early in the succeeding spring. The manure has been applied in every instance early in the spring, after ploughing, and subsequently slightly harrowed under. With the exception of the potato plats used for studying the causes of the scab on potatoes, but one fertilizer, consisting of fine-ground bones with muriate of potash, six hundred pounds of the former and two hundred pounds of the latter per acre, has been used upon this field. The distribution of the crops raised during the year 1888 may be seen from the accompanying sketch. Some analyses of crops raised during that year are for stated reasons published farther on for the first time, in connection with analyses made of crops raised during the present year.

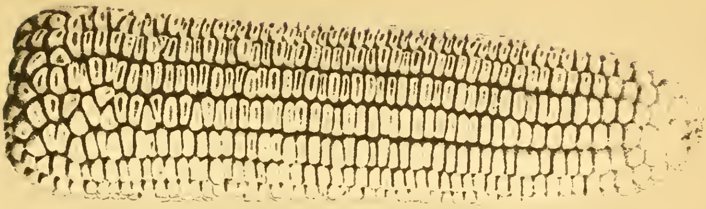
FIELD D, 1888.*



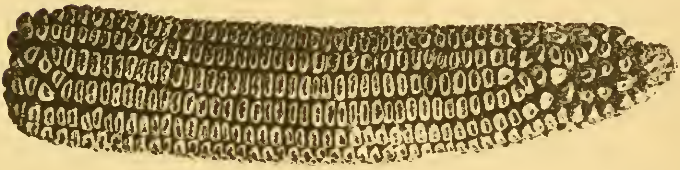
* Scale, 4 rods to 1 inch.

1889. — The preparation of the soil, as well as the system of manuring, was in all its details the same as in the preceding years. The crops were planted in rows, and kept clean by the timely use of the cultivator and the hoe. They were arranged in the following order, beginning at the west end of the field: —

Red-cob Ensilage Corn. — The seed was sent on, with a request for a trial, by D. I. Bushnell & Co., St. Louis, Mo. An area of 5,460 square feet was assigned in this field for our observation. The seed was planted May 7; the young plants appeared above ground in



1. Red Cob Ensilage Corn.



2. Pride of the North Corn.

3. Minnesota King Corn.

4. Clark Corn.

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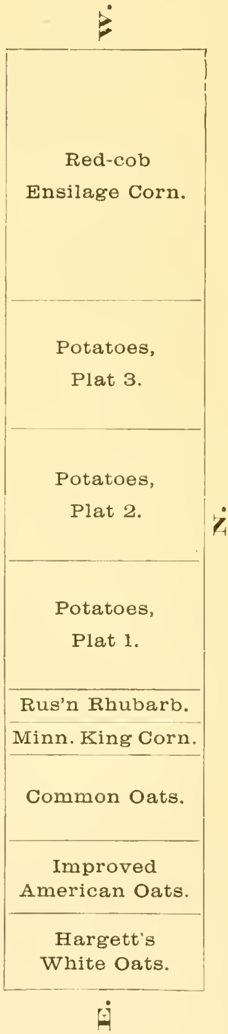
May; tassels were first noticed July 30. The growth measured at this time 70 inches in height; it was 105 inches high at the appearance of silk. The field looked extremely vigorous and handsome at this stage of the growth, — middle of August. The leaves died, however, soon, largely beginning at the lower end of the stalks. Most of the foliage up to the middle of the stalks was dead before the kernels began to glaze over. The plants measured 10½ feet in height when cut, October 2. The ears were at this late date not yet fully matured; they were also to a considerable degree imperfect in their general development. We obtained 475 pounds of ears and 2,550 pounds of stover.

FIELD D, 1889.*



* Scale, 4 rods to 1 inch.

The exceptionally cool and wet weather during the months of July and August has no doubt largely contributed to the unsatisfactory termination of our trial for a matured crop. Late maturing varieties of corn offer but little chance with us for a successful curing. Our trial for ensilage has been referred to in some preceding pages (Field B). The general character of a well-matured ear of this handsome corn may be judged from a description and photograph of an ear sent on to the station, which occur farther on.

Potatoes (Beauty of Hebron). — Three plats for several years assigned to this crop to study the causes of scab were prepared and manured in exactly the same manner as in previous years. They were planted with healthy tubers, May 1; the young crop showed itself pretty uniformly over the entire field, May 16. A blight appeared at the close of the month of July; it spread so rapidly that it killed within a week the entire vines. The crop was harvested without delay, yet proved a total failure; the tubers, almost without an exception, were full of scab and soon rotted.

The experiments regarding the cause of scab on potatoes, which for several years past have been carried on upon this part of our field, have been transferred to Field E; they have been placed, since the beginning of 1889, under the special direction of Prof. J. E. Humphrey. His elaborated report regarding his studies of scab and other plant diseases, which forms a part of this report, cannot fail to engage the attention of all parties interested in the subject discussed.

Minnesota King Corn. — Two samples were sent on by Northrup, Braslan & Goodwin of Minneapolis, Minn. Two rows were planted May 14; the plants reached a height of 66 inches and matured during the first week of September. They compared well with other medium-sized varieties current in our vicinity; no special merits were noticed. The general character of the corn may be judged from a short description and photograph which may be found farther on.

Oats. — Three varieties were planted. The seeds of two varieties — "Hargett's White" (Seizure) and "Improved American" — were sent by the United States Department of Agriculture; the third variety, commonly called "Connecticut Valley Oats," was secured from a farmer in our vicinity. The latter, one of the most prominent home varieties of oats, was included in our observation for the purpose of comparing the individual merits, if any, of the different varieties on trial, as far as practicable under corresponding circumstances. The seeds were planted, each fifteen rows, two feet apart. The main difference in the advancing growth consisted in a deep-green color of the Improved American. The latter exceeded the other varieties by three inches in height at the close of the season. All matured about the same time, and were cut on the same day, July 19. When harvested, July 23, the entire crop of the Hargett's White weighed 360 pounds; of the home variety, weighed 350 pounds; of the Improved American, weighed 390 pounds.

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Russian Rhubarb Roots.

Most of our grain crops suffered more or less from smut. The season was evidently not favorable for comparative trial of grain crops.

Russian Rhubarb. — Some years ago a small sample of seeds of this plant was sent on to the station by the Secretary of the American Retail Druggist Association, with the request to experiment with them upon our fields. The seed was represented as genuine by an officer of the Russian government, who procured it for the association. Several plants raised from this seed have been for a number of years cultivated very successfully on our ground. Well-matured seed has been collected every year, and some of it was sown two years ago. Quite a number of roots have been collected for trial by druggists. Parties interested in the question of their fitness for medicinal purposes can secure a specimen for trial, if early applied for. An attempt has been made to give a correct picture of the roots in different positions by the photographs accompanying this chapter. Photographs of the same kind of crop have in every instance been taken at equal distance from the camera, that their relative sizes might be observed.

Description of the Ears of Corn illustrated by the Following Photographs.

1. Red-cob ensilage corn, a dent variety mentioned in this chapter.
2. Pride of the North corn, a dent variety largely grown upon the station grounds.
3. Minnesota king corn, a dent corn mentioned in this chapter.
4. Clark corn, a flint corn which has served for our observations on Field A.

	Number of Rows.	Number of Kernels per Row.	Length of Ear (Inches).	Weight of Ear (Grams).*	Weight of Kernels (Grams).	Weight of Cob (Grams).	Ratio of Cob to Kernels.	Average weight of Kernels (Grams).
1, . . .	16	54	8½	396	339	57	1 : 5.95	.97
2, . . .	16	46	8	205	178	27	1 : 6.59	.25
3, . . .	8	44	7½	157	110	47	1 : 2.34	.31
4, . . .	8	48	8½	159	128	31	1 : 4.13	.336

* One ounce equals about thirty grams.

Teosinte (Euchlœna luxurians).

[Collected Sept. 7, 1888, in full bloom]

	Per Cent.
Moisture at 100° C.,	6.06
Dry matter,	93.94
	100.00

Analysis of Dry Matter.

Crude ash,	6.95
" cellulose,	28.88
" fat,	1.28
" protein (nitrogenous matter),	9.71
Non-nitrogenous extract matter,	53.18
	100.00

In green material, moisture 89.42 per cent.; dry matter, 10.58 per cent.

Fertilizing Constituents of Teosinte.

Moisture at 100° C.,	6.060
Calcium oxide,	1.597
Magnesium oxide,	.458
Ferric oxide,	.021
Sodium oxide,	.109
Potassium oxide (4¼ cents per pound),	3.696
Phosphoric acid (6 cents per pound),	.546
Nitrogen (17 cents per pound),	1.460
Insoluble matter,	.315
Valuation per ton,	$8 76

Lotus villosus (Second Year's Growth).

[Collected June 21, 1889, in full bloom.]

	Per Cent.
Moisture at 100° C.,	10.68
Dry matter,	89.32
	100.00

Analysis of Dry Matter.

Crude ash,	8.23
" cellulose,	24.48
" fat,	3.00
" protein (nitrogenous matter),	13.49
Non-nitrogenous extract matter,	50.80
	100.00

In green material, moisture 83.37 per cent.; dry matter, 16.63 per cent.

Lotus villosus (First Year's Growth).

[Collected Sept. 7, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	12.36
Dry matter,	87.64
	100.00

Analysis of Dry Matter.

Crude ash,	8.30
" cellulose,	15.07
" fat,	2.69
" protein (nitrogenous matter),	16.12
Non-nitrogenous extract matter,	57.82
	100.00

In green material, moisture 88.63 per cent; dry matter, 11.37 per cent.

Fertilizing Constituents of Lotus villosus.

Moisture at 100° C.,	12.360
Calcium oxide,	2.861
Magnesium oxide,	.615
Ferric oxide,	.148
Sodium oxide,	.633
Potassium oxide (4¼ cents per pound),	1.550
Phosphoric acid (6 cents per pound),	.500
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	1.053
Valuation per ton,	$9 60

Sulla (Hedysarum coronaria).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	10.46
Dry matter,	89.54
	100.00

Analysis of Dry Matter.

Crude ash,	8.77
" cellulose,	12.38
" fat,	3.16
" protein (nitrogenous matter),	17.03
Non-nitrogenous extract matter,	58.66
	100.00

In green material, moisture 74.21 per cent.; dry matter, 25.79 per cent.

Fertilizing Constituents of Sulla.

	Per Cent.
Moisture at 100° C.,	10.460
Calcium oxide,	2.791
Magnesium oxide,	.378
Ferric oxide,	.147
Sodium oxide,	.362
Potassium oxide (4¼ cents per pound),	1.872
Phosphoric acid (6 cents per pound),	.424
Nitrogen (17 cents per pound),	2.441
Insoluble matter,	.987
Valuation per ton,	$10 40

Hairy Vetch (Vicia villosa).

[Collected Sept. 3, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	7.44
Dry matter,	92.56
	100.00

Analysis of Dry Matter.

Crude ash,	8.37
" cellulose,	31.88
" fat,	1.22
" protein (nitrogenous matter),	19.58
Non-nitrogenous extract matter,	38.95
	100 00

In green material, moisture 78.01 per cent ; dry matter, 21 99 per cent.

Bokhara or Sweet Clover (Melilotus alba).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	6.36
Dry matter,	93.64
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	28.08
" fat,	1.85
" protein (nitrogenous matter),	11.81
Non-nitrogenous extract matter,	51.36
	100.00

In green material, moisture 76.52 per cent.; dry matter, 23.48 per cent.

Fertilizing Constituents of Bokhara Clover.

	Per Cent.
Moisture at 100° C.,	6.360
Calcium oxide,	1.938
Magnesium oxide,	.373
Ferric oxide,	.028
Sodium oxide,	.077
Potassium oxide (4¼ cents per pound),	1.673
Phosphoric acid (6 cents per pound),	.436
Nitrogen (17 cents per pound),	1,770
Insoluble matter,	.013
Valuation per ton,	$7 96

Melilotus cœruleus.

[Collected Aug. 6, 1889, somewhat past blooming.]

	Per Cent.
Moisture at 100° C.,	8.22
Dry matter,	91.78
	100.00

Analysis of Dry Matter.

Crude ash,	14.87
" cellulose,	27.17
" fat,	1.67
" protein (nitrogenous matter),	13.07
Non-nitrogenous extract matter,	43.22
	100 00

Fertilizing Constituents of Melilotus cœruleus.

Moisture at 100° C.,	8.220
Calcium oxide,	1.449
Magnesium oxide,	.260
Ferric oxide,	.349
Sodium oxide,	.270
Potassium oxide (4¼ cents per pound),	2.796
Phosphoric acid (6 cents per pound),	.544
Nitrogen (17 cents per pound),	1.919
Insoluble matter,	4.008
Valuation per ton,	$9 55

Danvers Carrots.

[Grown on Field C, 1888.]

	Per Cent.
Moisture at 100° C.,	90.05
Dry matter,	9.95
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	8.28
" cellulose,	10.20
" fat,	1.67
" protein (nitrogenous matter),	7.98
Non-nitrogenous extract matter,	71.81
	100.00

Nutritive ratio, 1 : 9.17.

Carrot Tops (Danvers).

[Collected Oct. 31, 1889, two weeks after harvesting.]

	Per Cent.
Moisture at 100° C.,	9.76
Dry matter,	90.24
	100.00

Analysis of Dry Matter.

Crude ash,	13.87
" cellulose,	13.61
" fat,	2.01
" protein (nitrogenous matter),	20.12
Non-nitrogenous extract matter,	50.39
	100.00

In green material, moisture, 76.79 per cent.; dry matter, 23.21 per cent.

Sugar Tests of Sorghum (1889).

[Per Cent.]

	Moisture at 100° C.	Glucose.	Sucrose.	Total Sugar.
Early Tennessee (over-ripe),	77.43	1.79	3.21	5.00
Price's New Hybrid (ripe),	77.80	2.92	3.78	6.70
Kansas Orange (green),	80.67	2.38	3.63	6.01
New Orange (green),	78.30	2.96	3.85	6.81
Honduras (green),	77.55	3.08	4.01	7.09

Beets, Field D (1888).

[I. Excelsior Sugar Beet; II. Improved Imperial; (?) III. Vilmorin Sugar Beet.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.95	90.60	86.73
Dry matter,	13.05	9.40	13.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	3.21	10.09	5.70
" cellulose,	5.83	7.83	4.82
" fat,	.72	1.80	.73
" protein (nitrogenous matter),	8.74	12.78	8.45
Non-nitrogenous extract matter,	81.50	67.50	80.30
	100.00	100.00	100.00
Sugar,	9.84	3.45	7.24

Fertilizing Constituents of the Above Beets.

	Per Cent.	
	II.	III.
Moisture at 100° C.,	90.600	86.730
Calcium oxide,	.045	.056
Magnesium oxide,	.030	.037
Ferric oxide,	.005	.009
Sodium oxide,	.104	.170
Potassium oxide,	.462	.170
Phosphoric acid,	.086	.028
Nitrogen,	.192	.181
Insoluble matter,	.015	.090
Valuation per ton,	$1 14	$0 79

Beets, Field D (1888).

[IV. Lane's Sugar Beet; V. New Market Gardener Beet; VI. Eclipse Beet; VII. Osborn's Selected Beet.]

	Per Cent.			
	IV.	V.	VI.	VII
Moisture at 100° C.,	84.56	89.65	90 25	88.80
Dry matter,	15.44	10.33	9.75	11.20
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	6.87	7.21	9.77	7.87
" cellulose,	6.17	7.56	7.22	6.71
" fat,	.66	.59	.74	.64
" protein (nitrogenous matter),	10.63	14.29	15.40	14.46
Non-nitrogenous extract matter,	75.67	70.35	66.87	70 32
	100.00	100.00	100.00	100.00

Fertilizing Constituents of the Above Beets.

	Per Cent.		
	V.	VI.	VII.
Moisture at 100° C.,	89.650	90.250	88.800
Calcium oxide,	.032	.044	.064
Magnesium oxide,	.022	.032	.028
Ferric oxide,	.003	.005	.002
Sodium oxide,	.060	.110	.156
Potassium oxide,	.481	.467	.313
Phosphoric acid,	.085	.091	.069
Nitrogen,	.236	.240	.259
Insoluble matter,	.009	.016	.010
Valuation per ton,	$1 41	$1 33	$1 23

Determination of Albuminoid Nitrogen (1888).

	Per Cent. in Dry Matter.		
	Albuminoid Nitrogen.	Non-albuminoid Nitrogen.	Total Nitrogen.
Root, No. 1,	.58	.82	1.40
" 2,	.85	1.19	2.04
" 3,	.50	.85	1.35
" 4,	.67	1.03	1.70
" 5,	.76	1.53	2 29
" 6,	.84	1.63	2.47
" 7,	.78	1.53	2.31

Potatoes (1887).

[I. Polaris, healthy tubers; II. Beauty of Hebron, healthy tubers; III. Beauty of Hebron, healthy tubers; IV. Beauty of Hebron, scabby tubers.]

	Per Cent.			
	I.	II.	III.	IV.
Original moisture,	80.20	80.73	81.53	82.15
Original dry matter,	19.80	19.27	18.47	17.85
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	5.17	5.17	6.27	6.35
" cellulose,	1.91	3.32	3.22	3.55
" fat,	0.62	0.57	0.52	0.58
" protein (nitrogenous matter),	10.74	9.58	9.73	10.70
Non-nitrogenous extract matter,	81.56	81.36	80.26	78.80
	100.00	100.00	100.00	100.00
Albuminoid nitrogen, in dry matter,	.91	.73	.77	.92
Non-albuminoid nitrogen, in dry matter,	.80	.80	.79	.79
Total nitrogen, in dry matter,	1.71	1.53	1.56	1.71

Tabular Statement, showing the Loss in Weight, by Evaporation of Moisture, of Two Potatoes (Beauty of Hebron) kept in a Dry Cellar.

[Weight of potatoes Sept. 13, 1887: No. 1, 108.1210 grams; No. 2, 90.5225 grams.]

DATE OF WEIGHING.	PER CENT. OF ORIGINAL WEIGHT LOST SINCE PRECEDING WEIGHING.		PER CENT. OF ORIGINAL WEIGHT LOST SINCE SEPT. 13, 1887.	
	Potato No. 1.	Potato No. 2.	Potato No. 1.	Potato No. 2.
1887.				
September 26, . . .	1.43	1.43	1.43	1.43
October 10, . . .	.74	.72	2.17	2.15
October 24, . . .	.67	.66	2.84	2.81
November 7, . . .	.55	.53	3.39	3.32
November 21, . . .	.50	.48	3.89	3.80
December 5, . . .	.52	.51	4.41	4.31
December 19, . . .	.55	.52	4.96	4.83
1888.				
January 2, . . .	.55	.53	5.51	5.36
January 16, . . .	.66	.68	6.17	6.04
January 30, . . .	.66	.70	6.83	6.74
February 13, . . .	.89	.93	7.72	7.67
February 27, . . .	1.47	1.41	9.19	9.08
March 12, . . .	1.71	1.78	10.90	10.86
March 28, . . .	2.23	2.20	13 13	13.06
April 9, . . .	2.01	1.88	15.14	14.94

Both potatoes began to sprout Jan. 7, 1888.

American Ruta-baga Turnips (1889).

	Per Cent.
Moisture at 100° C.,	91.75
Dry matter,	8.25
	100.00

Analysis of Dry Matter.

Crude ash,	11.89
" cellulose,	13.12
" fat,	1.26
" protein (nitrogenous matter),	11.46
Non-nitrogenous extract matter,	62.27
	100.00

Fertilizing Constituents of American Ruta-baga Turnips.

Moisture at 100° C.,	91.750
Calcium oxide,	.083
Magnesium oxide,	.030
Ferric oxide,	.005
Sodium oxide,	.009
Potassium oxide,	.468
Phosphoric acid,	.106
Nitrogen,	.151
Insoluble matter,	.015
Valuation per ton,	$1 04

Lane's Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	90.13
Dry matter,	9.87
	100.00

Analysis of Dry Matter.

Crude ash,	14.54
" cellulose,	9.69
" fat,	.83
" protein (nitrogenous matter),	13.01
Non-nitrogenous extract matter,	61.93
	100.00

Fertilizing Constituents of Lane's Sugar Beet.

Moisture at 100° C.,	90.130
Calcium oxide,	.062
Magnesium oxide,	.043
Ferric oxide,	.007
Sodium oxide,	.006
Potassium oxide,	.720
Phosphoric acid,	.134
Nitrogen,	.205
Insoluble matter,	.038
Valuation per ton,	$1 47

Saxony Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	88.38
Dry matter,	11.62
	100.00

Analysis of Dry Matter.

Crude ash,	9.14
" cellulose,	6.70
" fat,	.59
" protein (nitrogenous matter),	10.06
Non-nitrogenous extract matter,	73 51
	100.00

Fertilizing Constituents of Saxony Sugar Beet.

Moisture at 100° C.,	88.380
Calcium oxide,	.052
Magnesium oxide,	.044
Ferric oxide,	.009
Sodium oxide,	.004
Potassium oxide,	.617
Phosphoric acid,	.103
Nitrogen,	.187
Insoluble matter,	.022
Valuation per ton,	$1 28

IV. Experiments with Green Crops for Summer Feed of Milch Cows. (Field F.)

The field selected for the raising of green fodder crops for experiments with milch cows (see second feeding experiment, page 48 of this report), had been used for a series of years as a meadow for the production of hay. During the fall of 1887, a piece of land, 300 feet long and 137 feet wide, was ploughed, and the succeeding spring, 1888, after a proper mechanical condition was secured, seeded down with Hungarian grass. After this crop was removed into a silo, the soil was turned, and left in that state for the following year.

1889. — In working out our plans for future experiments upon this field, it was decided to turn the still existing resources of available plant food to account for the raising of Southern cow-peas, serradella, and a mixture of vetch and oats. This decision was made for the following reasons: these crops had given much satisfaction in preceding years, when fed as green fodder to milch cows; they promised, judging from our own experience in adjoining fields, a fair yield when following grass and corn without any use of manure; and they would each reach in a desired succession a stage of growth best adapted for their profitable use as green fodder. The field was ploughed and harrowed early in the season (April, 1889), and subsequently subdivided into three equal parts, 300 feet long and 43 feet wide, with four feet unoccupied space between the plats (see sketch, Field F).

The plat along the north side of the field, 12,900 square feet, was seeded broadcast with twenty-five pounds each of vetch and oats, April 26.

The middle subdivision was sown in drills three feet apart, with eleven pounds of serradella seed. May 8.

The plat along the south side of the field was sown in drills three feet apart, with twenty-five pounds of Southern cow-peas (Clay variety), April 8.

Vetch and Oats. — The oats appeared first above ground; the vetch followed, May 6. The crop was eleven inches high, June 11; it measured twenty-five inches, June 19. The oats began to head out, June 24, and the vetch to bloom, June 25; the entire growth was, on an average, thirty inches high, June 28, when the cutting for the daily feed began. The last of the crop was cut July 17; it had reached a height of forty inches. The average moisture of the green fodder for the entire period was 78.26 per cent., which makes the solid vegetable matter 21.74 per cent. The entire yield of the green crop was 5,440 pounds, or $8\frac{1}{2}$ tons per acre. This result is not as good, as far as quantity is concerned, as that secured during the preceding year, when a mixture of 25 pounds of vetch and 50 pounds of oats were used as seed; the rate of yield per acre in that year was $9\frac{1}{2}$ tons of green fodder. The area occupied by vetch and oats was not large enough to answer fully our purpose, to cover the time until the cow-pea is fit to be used advantageously. We shall hereafter double the area, and seed one-half down, as we did before, towards the close of April, and the other half from two to three weeks later.

Serradella. — The young plants were out May 16. The crop was kept clean with the cultivator and hoe. It is a peculiar feature of this crop, that its growth is very slow until it begins to bloom, when it rapidly branches out, and causes finally a compact, bulky green mass, filling out completely the three feet of space between the rows. The seed was sown, May 8; the plants appeared above ground, May 16; they were but one inch high, June 11; two inches, June 19; two and one-half inches, June 26; and four inches, July 3; began blooming, July 6; ten inches high, July 24; began spreading, July 31; reached thirteen inches in height, August 21. The first feed was cut September 11, when it formed a dense mass, several feet wide; the last feed was cut September 27. The green crop harvested amounted to 8,350 pounds, or $13\frac{1}{2}$ tons per acre. The average moisture was 83.65 per cent., and the solid vegetable matter 16.35 per cent.

Southern Cow-pea. — The young plants were seen six days after planting. The crop was cultivated and kept clean in common with the preceding one; its leaves were slightly injured by frost, May 29. The growth was three inches high, June 11; five and one-half inches, June 26; eight inches, July 3; seventeen inches, July 17; twenty-four inches, August 21, when blossoms appeared. The first cut for fodder was made September 1, and the last, September 10. The entire yield of green fodder amounted to 6,125 pounds, or 10 tons per acre. The average moisture of the crop when fed was 83.07 per cent., leaving, for the solid vegetable matter, 16.93 per cent. The frequent rains during the late summer and the autumn have apparently favored an increase in the yield of green fodder. Whether their composition has suffered, will be learned from a comparison of our analyses of past years.

The general characteristics of the crops above mentioned have been stated in previous reports, and their good services in the dairy are confirmed by our own observations. We can only repeat in this connection the views advanced in previous reports.

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at the same time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen-containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

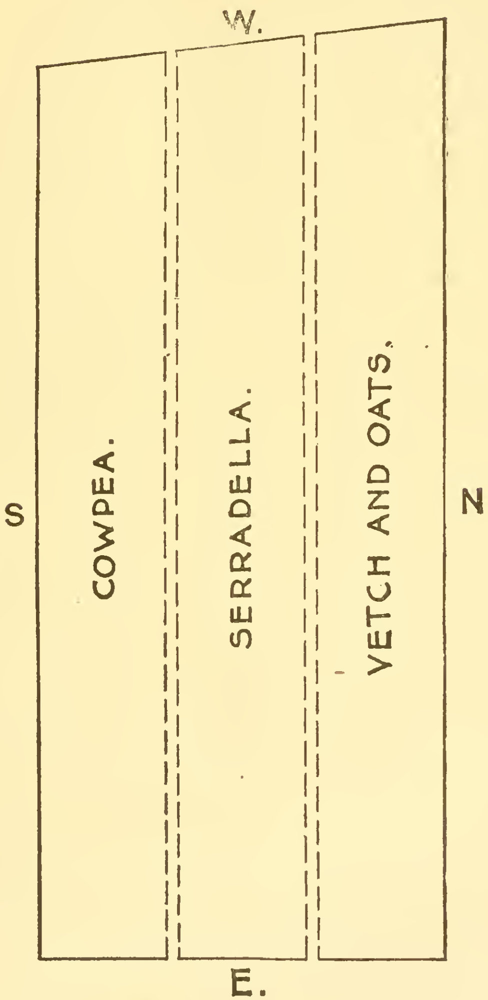
Our prominent fodder crops may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1.	Leguminous plants, clovers, vetches, etc., . .	1 : 2.2 to 1 : 4.5
2.	Grasses, ...	1 : 5.0 to 1 : 8.0
3.	Green corn, roots and tubers, ...	1 : 6.0 to 1 : 15.0

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, pease, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the economical systems of rotations, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops. Although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

FIELD "F" 1889.



SCALE, 4 RODS TO 1 INCH.

V. Notes on Miscellaneous Field Work.

Although the entire farm land of the station has been placed under a careful supervision, as far as records of manuring, modes of cultivation and proper selection of crops for cultivation are concerned, a considerable part of it is not yet engaged in a strictly experimental work. The course adopted in the management of some fields aims at a timely preparation for some definite experiment contemplated in the near future; in others, to fit them for an economical production of fodder crops for the support of farm live stock. The fields designed for the cultivation of fruit-bearing trees and shrubs, to study the causes and the character of the diseases they are frequently heir to, are subdivided, and each plat subjected to a systematic treatment with different kinds and forms of manurial substances. The outlines of the area selected for permanent meadows are better defined, and the condition of the lands improved, by underdraining and ditching; different portions of the meadows are stocked with different varieties of grasses, to test their adaptation and their economical value. The ploughed lands are subjected periodically, whenever practicable, to drill cultivation, in the interest of a clean culture.

As the work accomplished in this direction can be better appreciated when stated later on in connection with the different results secured, a mere enumeration of the principal field crops raised during the past season may suffice here.

Hay,	37 tons.
Rowen,	15 tons.
Corn for ensilage,	19 tons.
Carrots,	5½ tons.
Sugar-beets,	4 tons.
Barley, grain and straw,	5,750 pounds.
Oats, grain and straw,	5,350 pounds.
Corn on the cob,	5,250 pounds.
Fodder corn,	7,000 pounds.
Corn stover,	7,000 pounds.
Sorghum fodder,	2,000 pounds.
Vetch and oats (green),	5,450 pounds.
Cow-pease (green),	6,600 pounds.
Serradella (green),	8,350 pounds.

VI. Department of Vegetable Physiology.

1. — Report by Prof. James Ellis Humphrey.

The first year of my work in this department has been largely one of organization and equipment. Beginning without equipment and in limited quarters, no elaborate work has been possible. The liberality of the last Legislature has removed this difficulty, however, and the new building and green-house provided for the department are just completed and occupied. Views of the new accommodations are given with this report.

Our equipment for certain lines of work, especially for the study of fungous diseases of plants, is now fairly good, and reference collections are well begun.

My report for 1889 comprises the following divisions: —

1. A general account of the *Fungi*, with special reference to those which cause diseases of cultivated plants.
2. A report on studies of the potato scab, carried on during the year.
3. Notes on various diseases of plants, which have been more or less prevalent on the station farm the past season.
4. Notes on specimens from other sources, referred to the department for examination and report.

1. *General Account of the Fungi.*

The past few years have been marked, in the United States, by a rapidly increasing interest in the relations of the *fungi* to the plants which they attack, and by a growing appreciation of the dreaded *rusts*, *smuts*, *mildews*, *blights* and other fungous diseases, and of their economic importance. These troubles, once regarded as mysterious, unavoidable, "Providential" visitations, are coming to be generally understood to be simple, direct effects of natural causes, and, as such, open to study and amenable to treatment. With this understanding comes, naturally, a comprehension of the value and practical utility of the scientific investigation of fungous diseases in all their phases.

The writer on *fungi* for popular information, meets at the outset a difficulty not experienced by all scientific writers, in the very nature of the *fungi* themselves. It is not easy to comprehend that organisms so small and so inconspicuous can possess such power for harm; and it is not easy for the layman to understand that, in spite of their minuteness, they pass through life-cycles as constant and as definite as those of the plants on which they grow. It seems, therefore, worth while to attempt a general sketch of the growth and classification of those organisms of a vegetable nature, which attack and cause diseases of plants cultivated for useful products or for ornament. This account may serve as an introduction to the present as well as to future publications of this station on the subject of plant diseases, and to familiarize the reader, once for all, with the use of certain technical terms which are essential to exactness of statement. For the use of such terms no apology is needed. Their seeming difficulty lies simply in their unfamiliarity, which, as with all new words, soon wears away through use; while their advantage over words already familiar is that they convey precise ideas, unmodified by preconceptions, and so greatly aid in clearness and definiteness of thought. The words printed in SMALL CAPITALS on the following pages may serve, also, as a general reference-list of technical or semi-technical terms, whose use is essential in treating of plant diseases, and whose meaning, here explained, will be assumed for the future to be understood by the readers of the publications of this station.

Any plant consists of one or more of the elementary plant-units, known as CELLS. A cell consists essentially of a mass of the semi-fluid living substance which is the basis of all life, usually surrounded by a firm membrane, known as the CELL-WALL. The simplest plants consist of a single cell each; but the higher plants, on the other hand, are made up of immense numbers of cells, intimately united. Every living plant requires, for the renewal of worn-out parts and the growth of new parts, a supply of the materials necessary to such renewal and growth. Since both the living matter and the wall of the cell consist of compounds of a highly complex chemical constitution, the plant must be furnished with substances which contain the necessary chemical elements, in such form as to be readily convertible by it into vegetable tissue. Such substances constitute the real *food* of plants, in the same sense that what an animal eats constitutes its food; and both plants and animals find available food-supply only in *organic* substances. Inorganic materials can no more serve plants than they can serve animals as food; and just here a distinction must be made between the true food of plants and "plant food," so called in the discussion of fertilizers. We shall see later what is the relation to the plant of the latter, which consists essentially of inorganic substances.

Now, we know that an animal must obtain its food materials ready formed; that is, it cannot prepare the organic nutriment it requires from inorganic substances, but must obtain it from plants or from other animals. Here lies the important distinction between animals and *green* plants; for, in spite of the fact that, to most persons, the word *plant* carries with it the idea of greenness, it is by no means true that all plants are green. Green plants owe their color to the presence in their leaves and other green parts of a special pigment, known as leaf-green or CHLOROPHYLL. It may be added that some plants which are not green to the eye, yet contain chlorophyll, whose presence is hidden by some other masking pigment. The term "green plants" is here used, then, to designate all *chlorophyll-containing* plants, whatever their external appearance.

In chlorophyll we have the remarkable substance which bridges the gap between the inorganic and the organic. It is the one substance in nature on whose activity the continuance of all life depends. It alone has the power of forming organized food materials out of the elements of inorganic substances, but only under certain definite conditions. The green tissues of land plants receive water from the soil by way of their roots and stems, and absorb from the atmosphere the carbonic acid gas, or *carbon-dioxide*, which it contains in small proportion. These two simple inorganic compounds, water and carbon-dioxide, furnish the elements, *carbon*, *hydrogen* and *oxygen*, for the formation of certain organic compounds; and it is the peculiar property of chlorophyll, that, in its presence, and in its presence *only*, these elements are freed from their original combinations, and recombined into such organic compounds; though these changes can take place only when the chlorophyll is exposed to light of sufficient intensity, and when the water supplied to it holds in solution suitable inorganic compounds containing *nitrogen*, *potassium*, *phosphorus*, *calcium*, *magnesium*, *iron* and *sulphur*. Under natural conditions, waters from any soil in which plants will grow will be found to contain all these substances; but, in consequence of repeated cultivation and removal of the crops, the supply of these materials in a soil becomes greatly reduced, or, as we say, the soil becomes "exhausted." It then becomes necessary to supply the lacking constituents to the soil in the form of manures or fertilizers; and it is these necessary elements which are commonly spoken of as "plant food." Being inorganic, they cannot serve as food to the plant; but, as we have seen, their presence is indispensable to the elaboration of the true food of the plant from the materials furnished by water and carbon-dioxide. The precise relation of most of these elements to the life of the plant is hardly at all understood; but it is easy to show that, in the absence of either of them, there can be no permanently healthy activity. Their relation to the elaboration of organic food material from inorganic compounds has been compared, perhaps aptly, to that of oil to the smooth running of a steam-engine.

The necessary conditions being fulfilled, then, there occurs a recombination of the constitutents of water and carbon-dioxide into organic substance, excepting a part of the *oxygen*, which is set free into the atmosphere. Whatever temporary combinations they may pass through, the first visible and stable form in which these recombined elements appear is usually that of *starch*, which is the commonest form of organic food material that occurs in plants. After it is thus provided, by the activity of its chlorophyll, with an organized food supply, the plant utilizes it, as it needs, for the formation of tissue, either in repairing waste or in new growth.

But not all plants contain chlorophyll. Very many resemble animals in being entirely unable to provide their own nourishment, and in being, therefore, wholly dependent on external sources of food supply. Since their food supply consists of organic substances, it is evident that it must come from one of two sources; either from living organisms, animal or vegetable, or from dead organisms in a more or less advanced state of decomposition. Among flowering plants there are a few which are thus dependent, the best known of which are the white "Indian pipe" *(Monotropa)* of our woods, and the "Dodder," which twines its yellow or orange-colored leafless stems about our golden-rods and similar plants. But nearly all of the chlorophyll-less plants are of much simpler structure. They are mostly very small, and show no distinction of separate organs, like the stem and leaf of higher plants.

These simple plants may best be grouped under three heads, the true *Fungi*, the *Bacteria*, and the *Slime Moulds*. Many of them live on decaying organic matter, the remains of dead organisms of various sorts, and are known as SAPROPHYTES, or corpse-plants. Others, on the contrary, resemble the dodder in drawing their nourishment directly from living plants or animals, on which they are said to be PARASITES. The plant or animal at whose expense the parasite lives is called its HOST. It is this latter class of plants which has special interest to all who cultivate the higher plants, since its members cause the numerous and frequent plant diseases ordinarily known as *fungous* diseases. As we have seen, they attack their host-plants for the purpose of obtaining the organic food supply necessary to their growth, which they are unable, from lack of chlorophyll, to provide for themselves.

The effects of different parasites on their host plants vary greatly. It is evident that the host plant must always be weakened by being robbed of a part of its food; but the amount taken seems, in some cases, to be insignificant, so that no serious damage results. On the other hand, the destruction of the host is sometimes so rapid and so complete that there can be no doubt that the parasite exercises a more positively fatal influence than merely that of turning the food supply of the plant from its proper channels. Between these extremes one may observe all degrees of harmfulness on the part of the various parasites; and the harm done by any particular one may vary widely in different cases, being largely controlled by varying conditions.

The great majority of parasitic fungi develop and vegetate within the tissues of their hosts; but some forms live and grow superficially, merely sending small branches into the cells of their hosts, for the purpose of absorbing nourishment. These *external* parasites are, as a rule, much less injurious to the plants they attack than are *internal* parasites.

A striking influence is often exerted on the habit of growth of a plant by the attacks of a parasite. Thus, it is often possible to tell which among a number of plants are infected, by their appearing taller or shorter, or slenderer or stouter, than the healthy plants; or they may appear of a lighter or darker shade of color; or, as frequently happens, the development of a fungus in the tissues of a plant may cause the affected parts to become abnormally developed and distorted to such an extent as to attract the attention of even the casual observer.

Just here should be noted an important fact for the student of parasitic fungi. As a rule, a given parasite is able to live on only a single host species, or on a few closely related species, seeming to require for its development the special chemical and other conditions afforded by some particular plant or particular group of similar plants. But, on the other hand, closely related parasites may attack widely different plants. For example, there is a very common "rust" which attacks the Canada thistle, and another which is equally common on grasses and grains. The two rusts are very closely related, while the relationship between the thistles and the grasses is very remote. Neither of these rusts can live on the host plant of the other.

The distinction between parasites and saprophytes, while very useful, must not be made too strict; for there are numerous fungi which, while naturally saprophytes, can assume the role of parasites under certain conditions, and others which may live as saprophytes, for a time at least, though ordinarily obtaining their nourishment parasitically. Many fungi, also, are probably parasites in some and saprophytes in other parts of the life-cycle.

We may pass now to a more particular account of the groups of chlorophyll-less plants already mentioned.

The Slime Moulds comprise a comparatively small number of plants, most of which are strictly saprophytic in their mode of life. A few of the simpler ones, however, are parasites, and their life history may be briefly sketched. They pass the winter or other unfavorable period in a so-called resting state, in which condition they appear as tiny globular bodies, each consisting of a mass of living matter, surrounded by a tough, firm coat. When warmth and moisture return, these outer coats crack open, and the living masses escape and begin to actively creep about, seeking for the plants on which they are able to live. Failing in this search, one of these tiny creeping masses soon dies; but, if successful, it penetrates the cells of the host plant, and proceeds to grow and mature at its expense. Toward the end of the growing season, the masses of living substance, which have greatly increased in size and now occupy the interiors of cells of the host whose contents they have absorbed, break up into many very small portions, each of which enters the resting state by becoming surrounded with a tough coat, and so awaits the next season. These organisms are clearly of the simplest nature, and it would perhaps be better to call them simply *organisms*, than to try to assign them a place on either side of the shadowy and indefinite line which separates the lowest plants and animals. By nearly universal consent, however, their study is assigned to the botanists. The most important member of this group, economically, is perhaps the parasite which causes the "club-foot" of cabbages and turnips, incidentally described in the article on "Potato Scab," in the report of this station for 1888.

The Bacteria, or "germs," include the smallest known organisms, with both saprophytic and parasitic forms, and perhaps many which can live in either way. They consist of minute spheres, rods and threads, whose vital activity is the cause of many most remarkable phenomena. Among those which live saprophytically, one form produces the putrefaction of dead organic matter; another causes the souring of milk; another, the change of alcohol into acetic acid, which occurs when cider is converted into vinegar; another produces the rancidity of butter; and so on, through a long list. Many of the parasitic bacteria live in the bodies of men or other animals, and produce the most dreaded and dreadful contagious or *zymotic* diseases, like small-pox, anthrax or splenic fever, diphtheria, Asiatic cholera, hog cholera, Southern cattle fever, chicken cholera, pleuro-pneumonia, and many others. A few, also, produce diseases of plants, especially the rotting of bulbs and tubers. It is also claimed by careful investigators that the "fire blight" of pear and apple trees is due to the attacks of one of the bacteria.

These plants reproduce themselves chiefly by *fission*, a process which consists in the elongation of the organism up to a certain point, and the formation of a cross-wall dividing it into halves, which then separate and become independent. In its essentials the process is evidently a simple cutting in two.

The bacteria are universally disseminated, since their extreme smallness and consequent lightness render them easily transportable by the lightest breezes. When it is remembered that all putrefactive changes are due to their activity, their omnipresence begins to be realized.

The true FUNGI show greater complexity of structure than either of the groups just described. With a very few exceptions, they have a distinct *plant body* or vegetative portion, on which are developed the reproductive organs, or fruiting portion. The plant body consists of fine colorless threads, often branched, which spread over or through the substance from which the fungus draws its nourishment. These active, absorbing, vegetative threads of the plant body constitute the MYCELIUM of the fungus. From these are ultimately produced others, which are the fruiting or reproductive threads of the plant, and bear the reproductive bodies whose function is similar to that of the seeds of the higher plants, namely, the perpetuation of the species. Though produced in widely different ways, and varying among themselves far more than do the seeds of flowering plants, they may be, for convenience, all included under the general name SPORES. They are much simpler in structure than true *seeds*, and are usually microscopic in size.

In the simplest cases, the spores of a fungus are produced directly on the ends of separate and independent fruiting threads ; in other cases they are the products of sexual processes, involving the union of distinct male and female threads ; and, in the more complicated forms, numerous reproductive threads become intimately interlaced and compacted into a fruiting structure, often of considerable size, which bears spores in an interior cavity or cavities, or on some part of its surface. These spore-bearing structures reach their greatest development and conspicuousness in the "toadstools" and related fungi. In the modes in which spores are developed from the fruiting threads, we may distinguish two chief types. In one case, the end of a thread is simply cut off to form a spore ; while, in the other, the end of the thread swells, and spores are formed free in the swollen portion. Those of the former type may be called *naked*, those of the latter, *enclosed*, spores. There is another classification of the spores of fungi, which is of special importance in the study of plant diseases. The majority of fungus spores can germinate at once and produce new fungi, under favorable conditions for vegetation. Of these there are some which live but a short time, and, unless they very soon find such conditions, fail to develop. They are produced in great numbers, however, may develop rapidly, and serve especially to spread the fungus by the infection of new hosts during the growing season. They may therefore be designated SUMMER SPORES. A familiar example is offered by the spores developed in red-brown streaks on the leaves and stalks of grain, in midsummer, and known as the "red rust." Other spores can live for a long time, awaiting suitable conditions, and ready to improve the first opportunity for germination. Still others, on the contrary, require a greater or less period of rest or quiescence before germination can take place. Such spores are usually able to withstand great extremes of temperature and dryness, and serve to perpetuate the plant through the winter or other unfavorable period ; in contrast to the summer spores, which spread it rapidly at favorable seasons. They may be distinguished as RESTING

SPORES, and well illustrated by the spores which compose the black streaks which follow the red rust on the stalks of grain, and are known as "black rust."

A few fungi form peculiar bodies, which serve the purpose of resting spores, although they are of a very different nature. These are dark-colored masses of closely compacted mycelium, which can retain their vitality for a long time under circumstances unfavorable to growth, and finally, when favorable conditions recur, produce spore-bearing structures and spores. These special resting mycelia are known as SCLEROTIA, and are well illustrated by the *ergot* of grain, often known as "spurred rye."

A given species of fungus may produce, not merely one but two or several forms of spores and spore-bearing structures. These various forms may be produced at the same time or at nearly the same time, on the same mycelium; and, when this is the case, their connection and relations to each other are comparatively easy to make out. For instance, the streaks of rust on the culms of grain may often be found, at the proper season, with both red and black spores arising from the same mycelium, showing that the red and black rusts are only different spore-forms of the same fungus. But so simple a condition as this is the exceptional rather than the usual one. In very many fungi, the spores produced on one mycelium develop other mycelia essentially indistinguishable from the first, on which spores very unlike the first are formed; and these may, in their turn, give rise to a mycelium bearing spores like the first. For example, the mycelium developed next spring from the spores of many black rusts of the present season will produce, not new rust spores, but chains of wholly different spores, arranged in the form of tiny circular masses, each surrounded by a fringed or ragged border. From this characteristic structure, and the fact that they usually grow in close groups, these peculiar forms of fructification have received their name of *cluster cups*. On the mycelium arising from their spores are developed again rust spores like those which gave rise to the cluster-cup mycelium. Or again, the same mycelium may produce two or more forms of spores at quite different times, so that their connection is not directly traceable except by keeping the mycelium under long-continued observation. The spores and spore-bearing organs in the different stages of the same fungus may represent wholly different types of structure; so that the different forms have been, and, in the great majority of cases, still are, described and known under different names, as distinct fungi. This diversity of form, characteristic of the life-cycle of so many fungi, is known as PLEOMORPHISM. The subject is but just beginning to be understood, and its study is only begun. Consequently our knowledge of the whole matter is extremely fragmentary and unsatisfactory.

The fungi, like other plants, exhibit among themselves widely different types of structure, and may be separated into very distinct groups; while, within the limits of these groups, they show in greater or less degrees that similarity of organization and development which indicates descent from common ancestors, and consequent near relationship. These likenesses and differences enable us to arrange the fungi for convenience of study and discussion in a more or less natural order, though our knowledge is still very far from being sufficiently complete to afford us an arrangement which at all fully represents their relationships. It will be a great convenience, in future discussions, to have a general outline of the classification of the fungi and related groups; and the following is presented with a view to meeting this need. It is hoped that it may prove useful for reference, and sufficiently full, taken in connection with the preceding general account, to facilitate an intelligent understanding of discussions of particular fungous diseases. If any reader should feel, after reading this necessarily very brief and imperfect sketch, a desire for more detailed information concerning any fungi, the writer will be glad to render all possible assistance. In the following brief accounts of the various groups, attention has been given especially to those which include parasites on cultivated plants. The best available English name has been given to each group, and after the English name will be found, in each case, the name, in parentheses, by which the group is known to botanists.

I. Slime Moulds (*Myxomycetes*). — See above, p. 201.

II. Bacteria (*Schizomycetes*). — See above, p. 201.

III. Fungi. — These may be conveniently divided, for our purpose, into about seventeen groups, all but the last composed of quite closely related plants, as follows: —

1. *Downy mildews* and *white rusts* (*Peronosporeæ*) are internal parasites in the herbaceous parts of plants. Most of them produce summer spores, on threads which break through the surface of the plant into the air; and resting spores, in the interior of the host. The latter are set free by the decay, during the winter, of the tissues in which they are imbedded, and then germinate in spring. The former are scattered by the currents of air, and rapidly infect new hosts.

Among diseases caused by attacks of members of this group of fungi are the potato rot, downy mildews of the grape, lettuce, onion, etc., and "damping off" of seedlings.

2. *Water moulds* (*Saprolegniaceæ*) are chiefly saprophytes on animal substances (dead insects, etc.) in water; but one of them can attack living fish, notably the salmon, destroying the skin, commonly of the head region, by its gradual spread, and finally killing its victim.

3. *Leaf-gall fungi* (*Chytridiaceæ*) are very small and simple parasites, some of which form pustule-like swellings of herbaceous parts of flowering plants, and so merit the name here given. A majority of the members of the group, however, are parasites on the lower water plants, and of no present interest.

4. *True moulds* (*Mucorini*) comprise fungi which are saprophytes on common vegetable substances, and others which are parasites on the mycelia of the former. They are of no special interest in the present connection.

5. *Insect fungi* (*Entomophthoreæ*) are nearly all parasites of insects, and cause the death of their hosts. Their only economic interest is in the possibility which has been suggested that they may be artificially propagated for use in destroying insect pests. The cheme however is one of very doubtful practicability.

6. *Smuts* (*Ustilagineæ*) are internal parasites of flowering plants, and develop both mycelium and spores in the

tissues of their hosts. The mycelium is largely used up in the formation of spores, so that, at maturity, little is to be found but a dark-brown or black powdery mass of spores. In most cases these latter can germinate at once under certain conditions; but they may live for a very long time ready to germinate when favorable conditions occur. The spores of some smuts seem to be true resting spores; and those of many other species approach that condition, in that they germinate much more readily after a period of rest than when just mature. The smuts of corn, of wheat and other grains, and of the onion, are only too well known.

7. *Rusts* (*Uredineæ*) are especially interesting for their striking and remarkable pleomorphism, already referred to. They are very common parasites of flowering plants, and the typical species produce three chief spore forms. Individual variations within the group make it difficult to give a general account, but the following will apply to most of the rusts. Early in the season the fungus appears in its first or *cluster-cup* stage, described above, and shown in the yellow patches so common on barberry leaves in June. The spores of this form produce fresh mycelia, which give rise to the second, and later to the third, spore form. These second and third forms, are, as has been already stated, the *red* and *black* rusts, respectively. This is the typically complete condition, but in very many cases one or even two of the forms are unknown. The spores of the *cluster-cup* and *red-rust* forms are summer spores, while those of the *black-rust* are usually resting spores, though not always so.

Frequently the various forms of a rust fungus follow each other on the same host plant; but the difficulty of a complete knowledge of many of them is further complicated by the fact that the *cluster-cup* form occurs on one host, and the other two on a widely different one. For example, the cluster-cup of the barberry is the first stage of the fungus whose second and third stages are the red and black rusts of wheat and various other grains and grasses, as has been shown by careful and repeated cultures. This form of pleomorphism, in which the different spore forms of a parasitic fungus occur on different hosts, is known as HETERŒCISM.

A few closely related plants belonging to the group of rusts constitute important exceptions to the typical life history, outlined above. These are *heterœcismal* fungi, whose second form is unknown, and probably does not exist. Their cluster-cup forms cause the familiar "rusting" of the leaves, and sometimes of the fruits, of apple trees, hawthorns and related woody plants, in summer; and their third forms are the "cedar apples," whose gelatinous fruiting masses are equally common on our red cedars or "savins" and junipers, in spring. It will be seen from the above that the "cedar apples," which correspond to the *black-rust* stage of other rusts, appear *earlier* in the season than the *cluster-cup* stage; naturally, then, their spores are not resting spores, the fungi being carried through the winter by their mycelia, which live in the branches of the hosts.

Among important isolated forms, whose other stages are unknown, may be named the orange-colored rust which covers the lower surfaces of the leaves of blackberries and raspberries in spring and summer.

8. *Jelly fungi* (*Tremellini*) are very interesting botanically, since they show distinct relationships with both the rusts and the toadstools; but they are saprophytes, and require no further notice here, beyond the statement that they form gelatinous masses of various colors, from white to black, on dead wood, and are most abundant in late fall and early spring.

9. *Toadstools* (*Hymenomycetes*) are perhaps the most abundant of fungi, besides comprising more species than any other group. They are nearly all saprophytes, and many grow in places where the presence of organized food material would hardly be suspected. Their spores are borne free at the ends of spore-producing threads, which are usually packed closely together, and form a fruiting surface. In the simplest members of the group this surface is the only one exposed to the air; but in the more elaborate forms, popularly known as toadstools, there are upper and under surfaces distinguishable on the fruiting structure, and of these the latter is the spore-producing surface.

A few forms are of present interest. One of the simplest members of this group causes the leaves and fruits of the blueberry, cranberry, and related plants, to become swollen and covered by a white "bloom," composed of the spores of the fungus, and often does considerable damage. The mycelia of several toadstools grow in the wood or between the wood and bark of trees, and may do much harm to timber. In the case of some species, the mycelia may form long, brown, branching *sclerotia*, somewhat resembling roots, which are not uncommon beneath the bark of decaying logs. This group includes the mushrooms, the chantarelle, and many other valuable food fungi.

10. *Puff-balls* (*Gasteromycetes*) are nearly related to the last group, and, like most of its members, are saprophytes. A few of the species are edible, but otherwise the group has no economic importance, although including many familiarly known forms.

11. *Yeasts* (*Saccharomycetes*) are very simple fungi, in which the plant is reduced to a single elliptical cell, and reproduces itself chiefly by a process of budding. A slight projection grows out from the cell, and gradually increases in size until it reaches dimensions not much less than those of its parent cell, from which it then becomes detached, and begins to lead an independent life, budding in its turn. Although saprophytes, these fungi are of great interest economically, from their producing the alcoholic fermentation, and their consequent practical application in baking and brewing. The change known as alcoholic fermentation consists in the separation of the chemical elements composing *sugar*, and their recombination into other compounds, chiefly alcohol and carbon-dioxide; and the power to produce this change is possessed in a remarkable degree by some of the yeasts.

12. *Leaf-curls* (*Exoasceæ*) are parasitic fungi of very simple structure. They cause a swelling and curling of the parts attacked, which are commonly the leaves, though sometimes the fruits. The distortions are covered by a "bloom" composed of tiny club-shaped sacs, projecting from between the surface cells of the host, and containing minute spores. The "curl" of peach leaves and the swelling of unripe plums into "plum pockets" are caused by these fungi.

13. *Powdery mildews* (*Perisporiaceæ*) are external parasites of herbaceous parts of plants. The white threads of the mycelium spread over the surface, sending absorbing organs into the tissues, and bear abundantly the fruiting structures, which are recognizable by the naked eye as tiny black bodies, when ripe. Each of these bodies consists of a hard shell, surrounding from one to several somewhat egg-shaped sacs, in which the spores are contained. The best-known of these fungi are the powdery mildews of the grape and the gooseberry.

14. *Black fungi* (*Pyrenomycetes*) may be so called from the fact that a large majority of them produce a blackened, carbonized appearance of the leaves or branches which they attack, making them look as though burned. Sometimes, however, they are of a light or bright color, so that the name is not entirely appropriate. In cavities in these black or colored fruiting structures are contained the spores, enclosed in oblong or club-shaped sacs, which escape into the air through tiny pores connecting with the exterior. Many of these fungi also produce summer spores, on threads which cover the outer surface with a "bloom," or line cavities similar to those which contain the spores in sacs. Most of these plants are saprophytes, but a few attack hosts still living. Of them there are a few which are too well known, notably those which cause the "black-knot" of plum and cherry trees, and the "black-rot" of the grape.

15. *Saucer fungi* (*Discomycetes*) are so called from the form of the fruiting portion of many members of the group, though, on account of their wide variations, no single descriptive term is applicable to all. They are chiefly saprophytes, and the larger forms sometimes strikingly recall the toadstools in habit and place of growth. The spores are contained, as in the last two groups, in closed sacs, which, in the saucer fungi, stand erect and closely packed together on the upper or inner face of the saucer, which they cover with a distinct spore-bearing layer. A few of these fungi live, at least under certain conditions, as parasites, and develop small *sclerotia* in the tissues of their hosts, thus producing the so-called "sclerotia diseases" of clover, onions, hemp, etc.

16. *Truffles* (*Tuberaceæ*) are a small group of subterranean saprophytes, some of which are highly prized as articles of food.

17. *Imperfect fungi* is a general term to include an immense number of forms supposed to be mostly early stages in the development of members of some of the groups already described, especially various summer-spore forms of fungi belonging to groups 13, 14 and 15. Here are comprised the very different forms known under the names *Sphæropsideæ*, *Melanconieæ*, *Hyphomycetes*, etc. The spores are usually borne naked on the ends or sides of spore-producing threads, and germinate at once, as a rule. These fungi are, in large proportion, parasites, and produce diseases of widely differing external appearance, known variously by the names "anthracnose," "blight," "spot," "scab," "rot," etc.

A fuller account of these fungi is impossible, except by subdividing them into several groups, because of the very heterogeneous character of the contents of this general *catch-all* for forms not placed elsewhere. The fact that such a miscellaneous and enormous collection of "imperfect" form-species must form a part of any enumeration of fungi, is the best evidence of the incompleteness of our knowledge. In proportion as that knowledge increases, the extent of this collection must diminish.

The above outline covers the principal fungi, and will, it is hoped, to some extent subserve the purposes for which it has been prepared. Being now in possession of some general facts concerning fungi, we may attempt to deduce from them some of those principles which must guide us in attempts to lessen or prevent the ravages of diseases caused by these plants.

Since parasitic fungi develop, for the most part, within the tissues of their hosts, it is evident that there is little possibility of saving a plant once fairly infected; for what would kill the parasite would ordinarily be fatal to the host. The powdery mildews, being external parasites, may perhaps be killed after they are well developed. Our chief aim, however, must be to protect the plant by the thorough application to its exposed surfaces of some preparation which shall, without injuring the plant, kill or at least prevent the germination of fungus spores which may alight upon it, and which would, under natural conditions, germinate there and infect the plant. Many such preparations have been proposed and tested, a few with encouraging results. While this whole subject is but little developed as yet, two formulæ may be given which promise to be quite generally useful : —

Copper Mixture of Gironde or Bordeaux Mixture.

A. Dissolve six pounds sulphate of copper (blue stone) in sixteen gallons water.

B. Slake four pounds quicklime with six gallons water.

C. When cool, mix *A* and *B*, stirring thoroughly.

Blue Water or Eau Celeste.

Dissolve one pound sulphate of copper in four gallons warm water ; when cool, add one pint commercial ammonia and eighteen gallons water.

The latter of these may be applied by means of any apparatus which thoroughly distributes it ; but the former requires the use of a spraying pump, with a special agitating nozzle to keep it evenly and thoroughly mixed, since the lime is simply held in suspension, without being dissolved.

It seems hardly necessary to point out that a vigorously healthy plant will be far less subject to the attacks of fungi, and will suffer far less from such attacks, than a poorly nourished one. Both theory and experience point to this obvious conclusion.

After a plant is too far gone to be saved, measures should be taken to prevent the infection of neighboring plants, still intact, and of plants of the same kind, in the following season. With the latter object in view, one should destroy the affected parts, and especially any dead or fallen parts or refuse, which may harbor the spores of the fungus during the winter. In dealing with fungi which produce resting spores, these precautions should be taken with especial thoroughness. The destruction of infectious material should be as complete as *burning* can make it, for nothing less than this will assure the death of all the spores contained in it. In dealing with any fungous disease, one of the secrets of success may be summed up in the word, *thoroughness.*

Numerous cases can be cited of common weeds or wild plants, each of which is so closely related to some species of cultivated plants that it is liable to attack by the same fungi that infest its cultivated relative. Where this is true, the wild plant may serve equally with the cultivated one to perpetuate the fungus, and may keep it alive during a time when the latter is not grown, or may become a source of infection for a cultivated field, previously free. For example, the "black-knot" fungus grows on our wild cherries, as well as on cultivated cherries and plums; the lettuce mildew occurs on several species of "wild lettuce;" and the grape-vine mildew, besides occurring on wild grape vines, has been found on the Virginia creeper. The bearing of these facts on questions of preventing and checking the various diseases is obvious.

Finally, it is clear that epidemic diseases cannot be successfully combated without general co-operation throughout an infected region. The attempts of half a dozen intelligent men to protect their crops may be almost of no avail, if one lazy or "conservative" neighbor refuses to join in the attempt, and allows his adjacent field to afford a breeding-place for the very fungus our progressive friends are fighting.

Successful dealing with diseases caused by parasitic fungi may be said, then, to be based on the following essentials: *promptness*, *thoroughness*, *cleanliness*, *intelligent treatment*, *co-operation*.

The writer wishes to come into much more general communication with the farmers, market gardeners, horticulturists, florists, and all who cultivate plants, in the State. He especially and urgently requests that specimens be sent him of plants affected by any disease, not caused by insects, which may come to the attention of any reader of this report.

Very much aid to a fuller knowledge of many diseases can be afforded if those who are the losers by them will co-operate to render all possible assistance, even to the extent of going to some trouble, to those engaged in their study. Without such co-operation and assistance, our work must necessarily be far less effective and our studies far less complete in their results.

2. *The Potato Scab.*

In the report of this station for 1888, pages 131 to 138, was given an account of the disease of potatoes known as "scab," with a summary of the views held up to that time as to its nature and cause. It was shown that, while the characters of the disease are sufficiently marked and far too familiar, its cause is still to be explained. On this point three principal theories are held, which may be stated briefly as follows: (1) the theory of W. G. Smith and others, that the trouble is caused by the irritating action of foreign substances in the soil; (2) the view that it is due to peculiar soil conditions; and (3) Brunchorst's claim that it is caused by the attacks of a parasite belonging to the slime moulds. Various American experiments were quoted, bearing on the effects of the presence or absence of manure, excess or deficiency of water, use of smooth or scabby "seed," use of fungicides, and cultivation of light or dark skinned potatoes.

In the spring of 1889, arrangements were made for experiments on the same plot on which the scab had appeared for several years, — Field E, containing about three-tenths of an acre. This plot, which had been ploughed the previous fall, was ploughed again in the spring, and divided into twenty-eight sections of three rows each, the section being regarded ás the unit, and each section being treated, as nearly as possible, in a uniform manner.

The whole plot, excepting section 1, at the south end, was dressed with an application of ground bone and potash-magnesia sulphate, at the rate of 600 pounds of the former and 290 pounds of the latter per acre. In addition to suggestions for the details of experiments drawn from current theories and previous experiments, two were adopted from other sources; namely, to test the effect of tobacco applied in the drill in the form of ground tobacco refuse, and to observe the results, as to the development of scab, of deep planting. Arrangements were made to facilitate the irrigation of a part of the sections; but, owing to the extreme rainfall of the season, no use was made of the means provided, and no comparison of the effects of excess and deficiency of moisture on the development of the scab can be instituted, as the whole field received the same liberal natural watering.

The first five columns of the following table show the details of the planting of each section. It will be seen that the plan affords material for the following comparisons of results, as to the development of scab : 1. Deep *vs.* shallow planting ; 2. Susceptibility to attack of light and dark skinned varieties ; 3. Barn-yard manure *vs.* commercial fertilizers ; 4. Effect of tobacco dust in drill ; 5. Scabby *vs.* smooth "seed."

Number of Sect.	Quality of Seed.	Variety of Seed.	How Fertilized.	How Planted.	Scabbiness of Crop.
1	Smooth,	Beauty of Hebron,	Barn-yard manure,	In hills,	Very badly scabbed.
2	"	" "	Bone and potash,	In drill,	Considerably scabbed.
3	"	" "	" "	"	Considerably scabbed.
4	"	" "	" "	"	Badly scabbed.
5	"	" "	Bone, potash and tobacco,	"	Badly scabbed.
6	Scabby, except bl'k,	1st and 2d rows, Beauty of Hebron; 3d row, ½ white, ½ black,	Bone and potash,	"	Badly scabbed, except bl'k.
7	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	" "	In trench (deep),	Considerably scabbed.
8	Smooth,	Beauty of Hebron,	" "	In trench,	Somewhat scabbed.
9	"	" "	" "	In drill,	Badly scabbed.
10	"	" "	" "	"	Considerably scabbed.
11	"	" "	" "	"	Considerably scabbed.
12	"	" "	" "	In trench,	Considerably scabbed.
13	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	" "	In drill,	Considerably scabbed.

14	Smooth,	Beauty of Hebron,	Bone, potash and barn-yard manure,	In hills,	Very badly scabbed.
15	"	" "	Bone and potash,	In drill,	Badly scabbed.
16	"	" "	" "	"	Badly scabbed.
17	"	" "	Bone, potash and tobacco,	"	Badly scabbed.
18	"	" "	Bone and potash,	"	Considerably scabbed.
19	"	Polaris,	" "	"	Considerably scabbed.
20	"	"	" "	"	Badly scabbed.
21	"	Beauty of Hebron,	" "	"	Considerably scabbed.
22	"	" "	" "	"	Considerably scabbed.
23	"	Polaris,	" "	"	Considerably scabbed.
24	"	"	" "	"	Considerably scabbed.
25	"	"	" "	In trench,	Somewhat scabbed.
26	"	"	" "	In drill,	Somewhat scabbed.
27	"	"	" "	"	Considerably scabbed.
28	"	Beauty of Hebron,	" "	"	Considerably scabbed.

The scabby "white" potatoes planted on sections 6, 7 and 13 were of a very light-skinned sort, much resembling the Gregory, though not certainly of that variety. Those called "black," planted on section 6, were a very few small, elongated, dark-purple tubers, found in the station barn; the "tops" showed the same dark color which marked the tubers, and produced the only entirely smooth potatoes on the field. The plot was planted May 4, and the first shoots broke through the soil on the 17th. A week later they were well up, and a marked backwardness of sections 1 and 14 was observed, as compared with the rest. The retarding effect of planting directly on manure continued to be distinctly noticeable for three weeks longer. Various explanations may be offered, however, for this fact, which, by itself, has no special significance. The field was cultivated and hoed at sufficiently frequent intervals, and the plants grew well, being kept fairly free from the potato beetle by two light applications of Paris green, combined with hand-picking.

On the 4th of June young tubers were found, of the size of a pea, and from this time their size and number rapidly increased. On July 22 the first indications of the *rot* made their appearance on the leaves of some plants near the south end of the plot, and had soon spread over almost the entire field. As soon as possible, namely, on the 29th of July, the potatoes were dug, in order to avoid the loss of results from the scab experiments to which the rotting of the tubers would lead. The potatoes from each section were kept distinct, and carefully examined with reference to their relative scabbiness. The result in each case is briefly stated in terms of a scale of five grades, running from "generally smooth" to "very badly scabbed," in the last column of the foregoing table. A compilation of the results there given, with regard to their bearing on the points before indicated, shows that: 1. Deep planting appears to tend to diminish the development of scab, though further experiments in this direction are very desirable. 2. While the very dark potatoes were wholly free from scab, little or no difference was to be noticed in the susceptibility of the three light varieties planted; it is to be regretted that none of the best red varieties were available for the comparison. 3. The potatoes raised on barn-yard manure were markedly more scabby and more deeply scabbed than the rest. 4. Tobacco dust in the drill had no appreciable effect in increasing or diminishing the scab. 5. Scabby "seed" produces a crop neither better nor worse than that grown from smooth potatoes. None of these results are new, but they may serve as further material on which to base general conclusions, and as confirmatory of the results of most previous similar experiments. But all such results are comparatively without significance, so long as the *cause* of the trouble remains unknown, and we are as much as ever in the dark, so far as any basis of rational experimentation or treatment is concerned; therefore the most attention has been given to the study of the development of the scab.

From the time when tubers began to be formed till the crop was dug, plants were taken up at intervals, and carefully examined. The first suspicious spots were found on some small tubers June 20, and the first unmistakable scab was noticed on the 28th. After this time abundant specimens were obtainable. It is worthy of note that the first examples of affected tubers were obtained from sections 1 and 14, on which barn-yard manure was used, and that they always furnished the most and scabbiest material.

The scab always begins in very small spots, and spreads from these. When quite small, the spots usually show dark-brown centres from which the lighter marginal portions seem to have spread. These dark central spots mark the position of the *lenticels* of the tuber, in which the disease originates. The microscopic structure of the diseased spots is the same at all stages of their development. The first suspicious spots, detected June 20, on very young tubers, proved, on microscopic examination, to be young scab-spots, and could not be distinguished in minute structure from the large patches on a full-grown tuber. The characteristic change which produces the appearance and condition known as *scab* consists in the browning, drying and shrivelling of the walls of a few layers of the surface cells of the tuber, which produces a hard and rough crust. The difference between a very small spot and a large patch of scabby surface is wholly one of kind, the latter developing from the former by the simple extension of the pathological condition described, over a greater surface. In this way is produced what may be described as the *superficial* form of the disease, illustrated by the lower specimen in Fig. 1, opposite page 136 of our report for 1888, and by Fig. 1, accompanying the present paper. The drying and browning sometimes penetrates to a considerable depth, and causes the death of masses of tissue of some volume, which finally become destroyed by decay, frequently with the assistance of worms and other animals. Their presence in this form of the disease has apparently led to the belief, held by many persons, that such animals are the cause of the trouble. This may be called the *deep* form of the scab, and shows, in its completest development, extensive cavities in the tubers, where tissue has died and decayed. It is illustrated by the upper specimen in Fig. 1 of last year's report, and by the accompanying Fig. 2. Both forms of the disease coexist under various conditions to such a degree that the causes determining the development of the deep form are wholly indefinable.

Very careful examinations were made, to determine whether the present disease is caused by any plant or animal, either as a true parasite or otherwise; but no organism of any sort was found constantly or even frequently present at any stage of its progress, and there can be no doubt that it is *not* the result of the activity or development of any living thing other than the potato plant. Various experiments, referred to in the paper in last year's report, above mentioned, have pointed to this conclusion, and their results would be very puzzling had the present investigations resulted otherwise. The search for some organism standing in causal relation to the trouble, has, however, been conducted with much care, in deference to the claims and theory of Brunchorst, quoted above, and to be discussed later.

Since the scientific name of an organism indicates always a definite and determinable thing, one can always be sure, in the study of a disease plainly caused by a plant or animal, as to the validity of his comparisons of his results with those of others who have studied the same disease. But the words "scab," "Schorf" and "Skurv" are not terms which mean only definite things, but are of popular and general application; and the assumption that they are used in different countries to designate the same disease, remains merely an assumption until it is proved by direct comparison to be correct. Indeed, the assumption that the word "scab" is used, throughout our own country, for the same affection, is, perhaps, hardly justified; but, as it is borne out by specimens from various parts of New England, its correctness for the whole country is taken for granted. In order, however, to settle the uncertainty whether the three words above quoted are synonymous, two leading writers on the subject were requested to furnish material for comparison with American *scabby* potatoes. Dr. Sorauer, director of the experiment station at Proskau, Germany, was asked to send potatoes affected with the disease known in Germany as "Schorf" or "Grind," and Dr. Brunchorst of Bergen, Norway, to send potatoes attacked by the disease known in that country as "Skurv," and said by him to be caused by a species of slime mould. Both very kindly responded, and the writer wishes here to extend to both botanists his very sincere thanks for their interest and assistance.

Dr. Sorauer sent several tubers affected with what, to the naked eye, resembles in all respects our *superficial* form of scab; and microscopic examination fully establishes its identity with our disease. The accompanying Fig. 3 is made from a photograph of one of the potatoes sent by Dr. Sorauer. The German "Schorf" and the English "scab" are, then, synonyms, as applied to diseases of the potato.

From Dr. Brunchorst, a photograph of tubers attacked by "Skurv" has been received; but, unfortunately, the specimens of such tubers, promised by him, have failed to arrive, and it is impossible to accurately compare the disease with our own. Such comparisons as are rendered possible by Dr. Brunchorst's descriptions and figures and by the photograph he has had the goodness to send, point, however, to the conclusion that he is dealing with a disease very distinct from the *scab*, and that his assumption that the American and German diseases are identical with the Norwegian, is incorrect.

Fig. 4 is a reproduction of Brunchorst's photograph. Until more positive evidence can be obtained from the study of specimens, it seems safest to assume that the "Skurv" studied by him is quite different from the other diseases, and of different origin. This view removes difficulties not readily explained otherwise.

Bulletin No. 34 of this station, published last June, contained a series of questions concerning potato scab, addressed to farmers, especially those of this State, which they were requested to answer from their experience, for the assistance of this department in the study of the disease. Some ten thousand copies of this bulletin were sent out, and some agricultural journals showed their interest by printing and calling attention to them. The replies to this widely circulated request were *six* in number, and, of these, *four* came from neighboring States. It is fair to ask the farmers of Massachusetts to imagine how great is the encouragement derived from such a result by those who are working in their interest, and wish their co-operation and assistance. The facts stated require no comment.

In conclusion, it may be remarked that the results of the year are more negative than positive. It is certain that our disease is the same as that discussed by German writers, and that it is not caused by any parasitic organism.

Several years' observations at this station point, also, to the correctness of the view that the cause of our trouble is to be sought in peculiar physical or chemical conditions of the soil, though the opinion that excessive moisture is a sufficient controlling cause seems hardly tenable.

It seems to be generally conceded that potatoes become most scabby in heavy, close soil, and least so in light, loose soil; that worse crops in this respect are raised on land which has been cultivated for some time than on freshly broken ground. Indeed, the belief is quite general that new soil will give a smooth crop. This was not the case, however, at this station, the past season, when land broken for the first time in years gave a badly scabby crop. It should be added that this was on a stiff, heavy, poorly drained soil.

FIG. 1.

"Surface" Scab, from Station Plots.

FIG. 2.

"Deep" Scab, from Station Plots.

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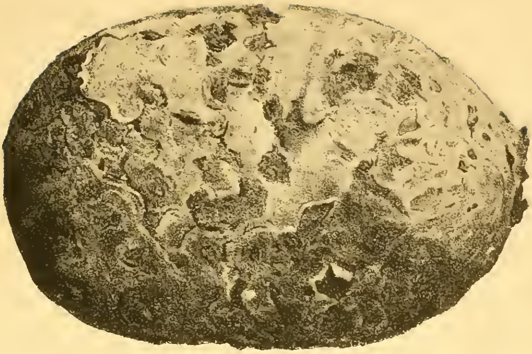

FIG. 3.
German *Schorf* (="Surface" Scab.)

FIG. 4.
Norwegian *Skurv.*

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It seems at present probable that excess of moisture tends to produce the scab, rather through its influence in rendering the soil heavy and clinging, than in any more direct way; and it is recommended that, to secure a smooth crop, potatoes be planted in light, porous soil, kept well stirred.

Observations will be continued next season, in the light of past experience.

3. Fungous Diseases on Station Farm.

The following notes include only such diseases as attacked crops grown on the station farm during the past season with sufficient violence to produce results of economic importance. Many fungi, of course, were found, whose presence was of no practical importance to the various plants on which they occurred; but a few produced striking results by their abundance and vigor. The meteorological conditions of the season were peculiarly favorable to the development of fungi.

1. The *smut* of barley and oats (*Ustilago segetum* Pers.*) attacked both of those grains on the east fields and on the experimental plats to such an extent that the "smutted" heads formed a very appreciable portion of the whole. Even were the affected heads but a small fraction of one per cent. of the whole, the loss on a large field would be sufficient to justify attempts to save it, as a little calculation will show. The parasite under consideration appears on the fruiting heads of the small grains, and, when ripe, presents only the mass of black spores characteristic of the *smuts*, which completely replaces the substance of the seed. The enclosing seed coats burst open, and the spores are carried in all directions by the wind, finding lodgement on the surrounding plants and soil. Although the smut spores ripen considerably earlier than does the grain in the sound heads, grain from a smutted field is sure to have them adhering to its surface and entangled in the tuft of hairs at its end, especially if smutted heads have been mixed with the sound ones in threshing. Unless they are present in very large numbers,

* It may be explained that the scientific name of a plant consists of three parts, the name of the *genus* or group of closely related plants to which it belongs, the name of its particular kind or *species*, and the name (in full or abbreviated) of the person or persons to whom it owes the name.

they cannot be detected by the unaided eye. These spores remain unchanged during the winter, and are ready for germination with the seed, when it is planted in the spring. Experiments have shown that the germinating tubes of the smut fungus can penetrate and infect the plants of grain only when they are very young seedlings, with very tender and easily penetrable tissues. Having once gained entrance to the interior of such a plant, however, the fungus grows with the plant, invading the new tissues as they are formed, and finally reaching its complete development by producing its reproductive bodies in the place of the destroyed reproductive bodies of its host. If the grain, with adhering smut spores, be fed to horses or cattle, the spores pass through the body and are voided unharmed. And not merely unharmed; their passage through the animal body seems to cause them to germinate more readily than before, and they produce, in the manure heap, tiny bodies which increase rapidly by a process of budding similar to that of the yeast fungi. Thus a few spores may produce, in a short time, a multitude of these tiny buds, each of which can infect a grain seedling with the smut parasite.

Since the infection of neighboring plants cannot be caused by a "smutty" plant, the problem of dealing with the present trouble is much simpler than similar problems concerning the numerous fungi which spread rapidly by summer spores. It is evident that it is useless to attempt to save a plant once attacked by smut; but the facts just stated concerning the fungus under discussion point to three lines of defence against its attacks: (1) The conditions for the germination of the seed and the growth of the seedling should be as favorable as possible, in order that the period of susceptibility to infection may be made as short as possible. To this end, well-matured seed should be sown on well-prepared and well-drained soil, in favorable "growing" weather. (2) Suitable commercial fertilizers should replace animal manures, on fields to be sown to grain. This will eliminate from the problem an important complication. (3) The seed grain should be treated, before being sown, with a preparation which will kill the adhering spores, with the least damage to the seed. The best for this purpose seems to be a one-half per cent. solution of sulphate of copper, prepared by dissolving it in water in the proportion of one pound to twenty-five gallons. The grain should be thoroughly wet with this solution, and allowed to soak in it for from twelve to twenty-four hours. It may then be spread out for a few hours, till dry enough to be readily sown. This treatment is very efficacious and inexpensive.

2. The *spot disease* of sugar beets appeared on the leaves of that crop about the end of June, in the form of dead, dry, circular patches, from one-eighth to three-eighths of an inch in diameter. These patches are the result of the death of the leaf tissues, caused by their invasion by a fungus mycelium. While a few patches would do little harm on the large leaf of a beet, they often become so abundant, as in the present case, as to destroy a large part of the tissue of the leaves. Since, as we have seen, the leaves, being the chlorophyll-containing organs, are those on which the plant depends for its supply of organic food material, it is evident how serious for the plant must be the loss, during its time of active growth, of a large fraction of its working leaf surface. In the case under notice, the spots gradually extended and increased, until, in August, the leaves died completely from the violence of the attack. By this time, however, the roots were so well grown that they were able to put out promptly a fresh growth of leaves, which continued through the rest of the season, though themselves affected somewhat by the *spot*. Clearly, the production of new leaves must have involved the conversion, for that purpose, of a considerable amount of stored material from the root, which ought to have remained there. This loss, with that due to the diminution of active surface on both sets of leaves, must very materially reduce the amount of solid matter in the roots, and lessen their feeding value in proportion.

Two fungus forms appeared on the spots on the station beets, both of them belonging to the *Imperfect Fungi*. Up to about the 10th of July, the most abundant form was that known to botanists as *Septoria Betæ* West., while after that time the chief form, and, late in the season, apparently the only form, was that known as *Cercospora beticola* Sacc. In view of their appearance on the same spots, and in the relations described, it is pertinent to inquire if they may not be forms of the same pleomorphic fungus. Direct proof, either for or against this hypothesis, is, however, still wanting.

No very definite directions for combating this trouble can be given, in the absence of more complete knowledge of the accompanying fungus forms than we yet have. As both *Septoria* and *Cercospora* spores quickly germinate and infect new hosts, that is, are summer spores, it is probable that spraying the crop as soon as the spots begin to appear may check its spread. It is probable that the "Eau Celeste" would give good results. Leaves badly attacked should be burned; all refuse should be cleared from the field at the end of the season, and burned; and the same crop should not be planted on the same ground or in its immediate neighborhood, the following year.

3. The *rot* of potatoes has been unusually serious on the station plots, as throughout the State, during the season just past. This disease, known as *blight* when it attacks the tops, and as *rot* when the tubers are affected, is due to a fungus of the downy mildew group, *Phytophthora infestans* deBary. Its abundance and destructiveness in 1889 have called out so many descriptions and recommendations concerning the fungus and means for checking it, that an extended account is superfluous here. The fungus spreads very rapidly by means of summer spores, but, so far as is known, does not, like most of the downy mildews, produce resting spores. Its only known mode of passing the winter is by the hibernation of its mycelium in the host tubers. Special care should be taken, then, to avoid planting "seed" potatoes which contain this hibernating mycelium, whose presence is commonly indicated by dark-brown sunken spots on the surface of the tuber, beneath which the tissues are more or less "rotted." A fuller account of this very fatal disease, by the present writer, may be found in Bulletin No. 6 of the Hatch Experiment Station of the Massachusetts Agricultural College.

The blight which appeared on the leaves of potatoes on the plot devoted to *scab* experiments, as previously mentioned, spread rapidly, but not with perfect regularity. When the leaves and stems were mostly killed by the fungus, the fourth day after its appearance, those on sections 1 and 14, the third row of section 6, and the second and third rows of both 7 and 13, were still fresh and comparatively unharmed. Comparison with the table given above shows that the sections which suffered least were those in which the potatoes were planted directly on manure, and the rows which were planted with the varieties designated as *white* and *black*. That some varieties are less susceptible than others to attacks of the rot, has been repeatedly shown; but why planting on manure should give protection against it, as seems here to have been the case, is not easy to see; yet there was no other difference in conditions between plots 1 and 14, on one hand, and 2–4, 9–11, and 15–16, on the other hand. Yet all the latter suffered equally and very severely. The attack was not of the most violent sort, and, even on the worst-affected plants, there was not the complete collapse into a slimy, putrescent mass, which is the result of the extreme form of the disease. Nothing now remained to be done but to harvest the potatoes as quickly as possible. Press of other farm work prevented immediate attention, but they were all harvested before the end of the month, in very good condition, so far as the *rot* was concerned. Later potatoes, on other fields, which received less prompt attention, were an almost total loss.

Notes on other fungous diseases are reserved until more complete data can be accumulated concerning them.

4. Notes on Material referred to the Department.

Some of the examinations which have been made by the department, of specimens referred to it, may be of sufficient general interest to warrant a brief discussion here.

1. *Fungus in Cellar.* — In December, 1888, a quantity of a white, flocculent substance, mixed with gravel from the cellar bottom on which it had grown, was sent in for examination. The house from whose cellar the material was taken was a tenement-house, and the white growth in question was a source of alarm to the tenants, who threatened to

leave, fearing that its appearance was an indication of the unhealthfulness of the premises.

It was evident to the unaided eye, and microscopic examination confirmed the opinion, that the white material was the sterile mycelium of some fungus. As there was no trace of spore formation, it was impossible to say to what fungus the mycelium belonged, though more probably to some member of the toadstool group.

The only conditions necessary to the development of such mycelia are the presence of spores, and of certain degrees of temperature and moisture. The latter conditions are afforded by even the best of cellars, which receive no artificial heat, and fungus spores penetrate every crevice with the air in which they float. Not only are such growths perfectly harmless in themselves, but their occasional appearance is no indication of unhealthful conditions; although their very constant or luxuriant appearance is often an accompaniment of extreme dampness. For the sake of neatness, it is best to remove them with rake or broom, and prevent their reappearance on the same surface by the free application of lime, either dry or in the form of whitewash.

A report to this effect was made in the present case, but it was afterwards learned that the tenants had already left, victims to their superstitious fears and dread of the "mysterious."

It should be remarked here that the appearance of white fungus mycelia, followed by the development, on the surface of the mass, of a rusty-brown spore layer, with the exudation of watery drops at its margin, should receive prompt attention. The fungus which answers to this description belongs to the toadstool group, and appears on woodwork or even on cellar bottoms. It produces a very rapid and destructive "dry rot" of timber, and is known in Germany as the "house fungus." It should be thoroughly destroyed, and all woodwork in its vicinity painted or well whitewashed.

2. *Black Spot of Rose Leaves.* — A disease affecting the leaves of roses growing in the Durfee plant-house of the Massachusetts Agricultural College was referred by Prof. S. T. Maynard to this department for examination and

report, in December, 1888. The leaves showed the dark, cloudy and dendritic patches, and the small, slightly raised pustules characteristic of the "black spot" of the rose; and the microscope showed the presence of an abundant mycelium in the spots, producing at certain points masses of the spores of the "black-spot" fungus, *Actinonema rosæ* Fr. The spore-bearing spots are indicated by the pustules, which are formed by the elevation of the surface layer or *epidermis* of the leaf by the developing spore masses. As the internal tissue of the leaf is invaded by the mycelium, it is gradually killed, and loses its green color; so arise the discolored spots, which give the disease its name, and which, at first small, spread radially in all directions from the point of infection. The fungus which causes this trouble is one of the imperfect fungi, and its relation to other forms remains still undetermined.

The same disease appeared abundantly on leaves of roses cultivated out of doors in the garden of a very successful amateur in Amherst, last summer.

Infected leaves should be carefully collected and destroyed, to prevent the dissemination of spores; and it is probable that spraying with some fungicide will prove efficacious in checking the disease, if done early and frequently enough. For fuller details and recommendations, reference may be had to the report of the mycologist of the United States Department of Agriculture, for 1887, p. 366, and to Bulletin No. 6 of the Hatch Experiment Station, before referred to.

3. *Nematode Disease of Cucumbers.* — A disease seriously affecting cucumbers raised under glass came to my attention in July last, through Mr. H. T. Fernald of Amherst. It manifests itself first in the yellowing of the foliage, which is followed by the death of the plant. But the real seat of trouble is in the roots, on which are formed rough, tubercle-like swellings or *galls*, in which the tissues are loose and spongy, and easily crumble. Examination showed the presence in these galls of very numerous microscopic worms and their eggs. The worms measure perhaps one-fiftieth of an inch in length, and belong to the group known as thread-worms or *nematodes*, which attack the roots of many plants with fatal results.

This nematode disease of cucumbers is known in England, and is said to have been successfully treated by watering the soil in which the diseased plants were growing, with a weak solution of permanganate of potash, which appears to be fatal to the worms, without injuring the plants. It is suggested that the sulphate of manganese would probably be as efficient as the permanganate of potash, while it is much cheaper. The writer will be glad to communicate with anyone who is troubled by this disease, and wishes to experiment in combating it.

2. — Communication by C. A. Goessmann.

The investigations concerning the effect of various modes of cultivation and of manuring on the general character and composition of fruits and garden crops will be resumed, as far as practicable, during the coming year. The circumstances which some years ago obliged me to discontinue that work as outlined in our first and second annual reports, under the heading "Chemistry in Fruit Culture," are not existing now. The late permanent assignment of suitable fields, as well as the recent erection of buildings designed with a view to offer to growing plants the necessary protection against objectionable features of climate and weather, promise to favor our plans of operation. The co-operation of our experiments in the field and in the vegetation house cannot fail to assist materially in drawing correct conclusions from our results.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers: —

1. General introduction.
2. Laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

I. Communication on Commercial Fertilizers.

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1. *General Introduction.*

The new duties assigned to the director of the station render it necessary to discriminate, in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers, and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition, and to such additional information as relates to the latter. The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents, has, therefore, to be discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage, — a circumstance not unfrequently overlooked.

The approximate market value of the different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage, requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food — *i.e*, phosphoric acid, nitrogen and potash — which they contain. To ascertain, by this mode of valuation, the approximate market value of a fertilizer (*i.e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid, and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility and the more or less rapid diffusion of the different articles of plant food throughout the soil. The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration, at the same time, their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals. (1889.)

	Cents per Pound.
Nitrogen in ammoniates,	19
Nitrogen in nitrates,	17
Organic nitrogen in dry and fine-ground fish, meat and blood,	19
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,	7½

Trade Values of Fertilizing Ingredients — Concluded.

	Cents per Pound.
Phosphoric acid in dry ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarse bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in form free from muriates or chlorides; ashes, etc.,	6
Potash as kainite,	4½
Potash as muriate,	4½

The organic nitrogen in superphosphates, special manures and mixed fertilizers of a high grade, is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, nineteen cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. For similar reasons, the insoluble phosphoric acid is valued in this connection at three cents; it being assumed, unless found otherwise, that it is from bone or similar source, and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound.

The above trade values are the figures at which, in the six months preceding March, 1889, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials, which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1, plus twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect, at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary character of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guaranty of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale in our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing circumstances. Requests for analyses of substances, as fodder articles, fertilizers, etc., coming through officers of agricultural societies and farmers' clubs within the State, will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without charge for the services rendered. Applications of private parties for analyses of substances, free of charge, will receive a careful consideration, whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent on to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

2. *Laws for the Regulation of the Trade in Commercial Fertilizers.*

[Chap. 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizers or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

Sect. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

Sect. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

Instructions issued at the Beginning of the Season, to Dealers in Commercial Fertilizers.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide, guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers, but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the 1st of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers, are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the director of the Massachusetts State Agricultural Experiment Station.

3. *List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year, and the Brands Licensed by Each.*

Forest City Wood Ash Company, London, Ontario, Canada: —
Canada Unleached Wood Ashes.

Bowker Fertilizer Company, Boston, Mass : —
Stockbridge Manures.
Bowker's Hill and Drill Phosphate
Bowker's Ammoniated Bone Fertilizer.
Bowker's Lawn and Garden Fertilizer.
Bowker's Fish and Potash.
Bowker's Dry Ground Fish.
Gloucester Fish and Potash.
Fine-ground Bone.
Plain Superphosphate.
Kainite.
Nitrate of Soda.
Dried Blood.
Dissolved Bone-black.
Muriate of Potash.
Sulphate of Potash.

National Fertilizer Company, Bridgeport, Conn.: —
Chittenden's Complete Fertilizer
Chittenden's Fish and Potash.
Chittenden's Phosphate.

Hargrave Manufacturing Company, Fall River, Mass.: —
Hargrave's Bone.

William E. Fyfe & Co., Clinton, Mass.: —
Canada Unleached Wood Ashes.

Edmund Hersey, Hingham, Mass.: —
Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Read Fertilizer Company, Syracuse, N. Y.: —
Farmer's Brand.
Lion Brand.
High-grade Farmer's Friend Special.
Sampson or Lion Special.

E. Frank Coe, New York, N. Y.: —
E. Frank Coe's Gold Brand Excelsior Guano.
Fish and Potash.
Potato Fertilizer.
Alkaline Bone.
E. Frank Coe's High-grade Ammoniated Bone Superphosphate.

Cumberland Bone Company, Portland, Me.: —
Seeding-down Fertilizer.
Cumberland Superphosphate.

Williams & Clark Company, New York, N. Y.: —
Americus Ammoniated Bone Superphosphate.
Potato Phosphate.

Great Eastern Fertilizer Company, Rutland, Vt.: —
Great Eastern General for Grain and Grass.
Great Eastern Vegetable, Vine and Tobacco Fertilizer.
Great Eastern General Oats, Buckwheat and Seeding-down Phosphate.

Joseph Church & Co., Tiverton, R. I.: —
Fish and Potash.
Church's Special.
Church's Standard.
Dried and Ground Fish.

Thompson & Edwards Fertilizer Company, Chicago, Ill.: —
World of Good Tobacco Guano.

J. A. Tucker & Co., Boston, Mass.: —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.

Edw. F. Jennison, Lancaster, Mass.: —
Jennison's Complete Animal Fertilizer.

Orient Guano Manufacturing Company, New York, N. Y.: —
Suffolk County.
Orient Complete Manures.
Fish and Potash.

Davidge Fertilizer Company, New York, N. Y.: —
Davidge's Potato Manure.
Davidge's Vegetator.
Davidge's Special Favorite.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Lister's Standard Superphosphate of Lime.
Lister's Ammoniated Dissolved Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

J. M. Butman, Lowell, Mass.: —
Lowell Bone Fertilizer.

Adams & Thomas, Springfield, Mass.: —
Adams Market Bone Fertilizer.

Whittemore Brothers, Wayland, Mass.: —
Whittemore's Complete Manure.

Mayo & Hix, Boston, Mass.: —
Mayo Superphosphate.

John C. Dow & Co., Boston, Mass.: —
Dow's Ground Bone Fertilizer.

J. E. Soper & Co., Boston, Mass.: —
Cotton-seed Hull Ashes.

F. C. Sturtevant, Hartford, Conn.: —
Tobacco Stems.

E. H. Smith, Northborough, Mass.: —
Smith's Steamed Bone.

A. L. Ames, Peabody, Mass.: —
Ames' Bone Fertilizer.

The Mapes Formula and Peruvian Guano Company, New York, N. Y.: —
The Mapes Bone Manures.
Peruvian Guanos.
The Mapes Superphosphate.
The Mapes Special Corn Manures.

C. A. Bartlett, Worcester, Mass.: —
C. A. Bartlett's Pure Ground Bone.
Animal Fertilizer.

Bradley Fertilizer Company, Boston, Mass.: —
Bradley's XL Phosphate.
B. D. Sea-fowl Guano.
Coe's Superphosphate.
Fish and Potash.
Pure Fine-ground Bone.
Bradley's Complete Manures: —
For Potatoes and Vegetables.
For Corn and Grain.
For Top-dressing Grass and Grain.
Bradley's Grass Manure for Top-dressing.
Bradley's Potato Manure.
Nitrate of Soda.
Sulphate of Ammonia.
Muriate of Potash.
Dissolved Bone-black.

Cleveland Dryer Company, Cleveland, Ohio: —
Cleveland Potato Phosphate.
Cleveland Superphosphate.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

American Manufacturing Company, Boston, Mass.: —
The Allen Fertilizer.

G. E. Holmes, New Worcester, Mass.: —
Fine-ground Bone.

Wm. J. Brightman & Co., Tiverton, R. I.: —
Fish and Potash.
Superphosphate.
Dry Ground Fish.

S. Winter, Brockton, Mass.: —
S. Winter's Pure Ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y.: —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.

Standard Fertilizer Company, Boston, Mass.: —
Standard Superphosphate.
Breck's Lawn and Garden Dressing.

Munroe, Judson & Stroup, Oswego, N. Y.: —
Unleached Canada Wood Ashes.

Benj. Randall, Boston, Mass.: —
Randall's Market-garden Fertilizer.
Randall's Combined Bone.

The Le Page Company, Boston, Mass.: —
The Red Star Brand 203 Fertilizer.
The Red Star Brand Special Potato Fertilizer.

Pacific Guano Company, Boston, Mass.: —
Soluble Pacific Guano.
Fish and Potash.
Special Potato Manure.

The Quinnipiac Company, New London, Conn.: —
Quinnipiac Phosphate.
Quinnipiac Potato Manure.
Quinnipiac Dry Ground Fish.
Quinnipiac Fish and Potash.

A. Lee & Co., Boston, Mass.: —
Lawrence Fertilizer.
Ground Bone.

3. *List of Dealers who have secured Certificates, etc.* — Concluded.

H. J. Baker & Bros., New York, N. Y.: —
- A. A. Ammoniated Superphosphate.
- Pelican Bone Fertilizer.
- Potato Manure.

John G. Jefferds, Worcester, Mass.: —
- Jefferds' Animal Fertilizer.
- Jefferds' Fine-ground Bone.

N. Ward Company, Boston, Mass.: —
- N. Ward Company's High-grade Animal Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
- Darling's Animal Fertilizer.
- Extra Bone Phosphate.
- Darling's Potato and Root Crop Manure.
- Darling's Pure Bone.
- Muriate of Potash.
- Sulphate of Potash.

Butler, Breed & Co., Boston, Mass.: —
- Economic No. 1 Fertilizer for Grass.
- Economic No. 2 Fertilizer for Pasture.
- Economic No. 3 Fertilizer for Corn.
- Economic No. 4 Fertilizer for Potatoes.
- Economic No. 7 Fertilizer for Garden.

Stearns' Fertilizer Company, New York, N. Y.: —
- Stearns' Ammoniated Bone Superphosphate.
- Stearns' American Guano.

Thos. Hersom & Co., New Bedford, Mass.: —
- Pure Fine-ground Bone.

H. L. Phelps, Southampton, Mass.: —
- H. L. Phelps' Complete Manure.

Prentiss, Brooks & Co., Holyoke, Mass.: —
- Dry Fish.
- Dissolved Bone-black.
- Muriate of Potash.
- Nitrate of Soda.

4. Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
7	High-grade Farmer's Friend Special,	Read Fertilizer Company, New York,	Pittsfield.
8	Farmer's Friend,	Read Fertilizer Company, New York,	Pittsfield.
9	Lion Brand,	Read Fertilizer Company, New York,	Pittsfield.
11	Quinnipiac Phosphate,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
12	Quinnipiac Fish and Potash,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
13	Quinnipiac Potato Manure,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
17	Vegetator,	Davidge Fertilizer Company, New York,	Amherst.
18	Bowker's Potato Grower,	Bowker Fertilizer Company, Boston,	Sunderland.
23	Chittenden's Universal Phosphate,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
24	Chittenden's Tobacco Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
33	Mapes' Potato Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
	Bones and Tankage.		
2	Hargrave's Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
3	Steamed Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
4	Steamed Bone,	Edward H. Smith, Northborough, Mass.,	Amherst.
38	Holmes' Steamed Bone,	G. E. Holmes, Worcester, Mass.,	Worcester.
43	Bartlett's Steamed Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
7	High-grade Farmer's Friend Special.	14.20	4.24	3.3—4.5	3.38	2.02	2.38	7.78	6—7	5.40	5—6	9.84	10—12
8	Farmer's Friend,	14.10	2.72	2.06—2.88	7.24	2.33	2.81	12.38	11—13	9.57	9—11	2.32	- *
9	Lion Brand,	12.54	1.08	.82—1.65	6.40	2.43	2.07	10.90	10—12	8.83	8—10	3.66	- *
11	Quinnipiac Phosphate,	18.49	2.70	2.5—3.25	3.74	6.75	2.46	12.95	10—16	10.49	9—13	2.05	2—3*
12	Quinnipiac Fish and Potash,	18.28	4.28	3.25—4.25	0.48	5.82	4.03	10.33	5—7	6.30	3—5	4.48	3—5*
13	Quinnipiac Potato Manure,	16.67	2.96	2.5—3.25	3.33	3.38	1.43	8.14	6—12	6.71	5—9	5.34	5—6*
17	Vegetator,	6.75	3.20	3.3—4.12	4.91	0.51	1.51	6.93	-	5.42	5—7	4.08	- *
18	Bowker's Tobacco Grower,	6.05	3.36	3.25—4.25	6.94	1.38	3.55	11.87	-	8.32	8—10	5.52	4—5
23	Chittenden's Universal Phosphate,	13.12	2.86	2.—2.9	6.24	3.72	2.53	12.49	11—12	9.96	9—11	2.86	2—3
24	Chittenden's Tobacco Fertilizer,	9.44	3.28	3.3—4.9	7.04	2.16	2.89	12.09	8—10	9.20	6—8	5.56	- *
33	Mapes' Potato Manure,	6.45	3.72	3.71—4.12	6.27	4.13	2.24	12.64	8—10	10.40	6—8	6.56	6—8*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones and Tankage.														
2	Hargrave's Bone,	6.61	3.02	-	0.28	10.01	15.67	25.96	-	10.29	-	-	-	-	-
3	Steamed Bone,	2.65	3.18	-	0.31	8.39	10.87	19.57	-	8.70	-	34.41	21.03	21.96	22.60
4	Steamed Bone,	5.46	4.48	4.—4.5	0.38	8.72	12.78	21.98	21.5—22.5	9.10	6.6—9.1	39.45	36.35	22.95	1.25
38	Holmes' Steamed Bone,	10.87	3.27	2.5—3.5	0.32	11.37	10.56	22.25	22—24	11.69	-	25.79	47.72	26.49	-
43	Bartlett's Steamed Bone,	5.75	3.15	2.39	0.42	13.03	12.79	26.24	27.35	13.45	7.59	39.87	39.98	20.15	-

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
5	Lowell Bone Fertilizer,	J. M. Butman, Lowell, Mass.,	Lowell.
10	Sampson Brand or Lion Special,	Read Fertilizer Company, New York,	Pittsfield.
15	Special Favorite,	Davidge Fertilizer Company, New York,	Amherst.
19	Stockbridge's Tobacco Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
25	Cumberland Bone Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
32	Mapes' Complete Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
39	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
42	Jefferds' Animal Fertilizer with Potash,	J. G. Jefferds, Worcester, Mass.,	Worcester.
44	Americus Brand Ammoniated Superphosphate,	Williams & Clark Company, New York,	Worcester.
54	Church's Fish and Potash,	Joseph Church & Co., Tiverton, R.I.,	Springfield.
55	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
57	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
58	Bradley's Fish and Potash, "A" Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
68	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Chelsea.
69	Imperial Bone Superphosphate,	J. A. Tucker & Co , Boston, Mass ,	Chelsea.
83	Ames' Bone Fertilizer,	A. L Ames, Peabody, Mass.,	Ipswich.
84	Dow's Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Ipswich.
88	Darling's Pure Dissolved Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
111	Extra Bone Phosphate,	Darling Fertilizer Company, Pawtucket, R. I.,	Taunton.
30	Cotton-hull Ashes,	Quinnipiac Company, New London, Conn.,	Northampton.
29	Muriate of Potash,	Quinnipiac Company, New London, Conn ,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
5	Lowell Bone Fertilizer,	7.28	2.35	2.0—2.5	5.41	8.12	2.01	15.54	14.5—17.5	13.53	12.5—14.5	3.63	3—3.5
10	Sampson Brand or Lion Special,	14.04	2.76	2.47—3.30	6.14	2.58	2.51	11 23	10—12	8.72	8—10	3.96	–*
15	Special Favorite,	10.32	1.32	1.24—2.06	7.84	1.53	2.28	11 65	12—14	9.37	10—12	1.45	1.5—2.5
19	Stockbridge's Potato Manure,	4.87	5.62	5.75—6.75	3.40	1.84	2.78	8.02	5—7	5.24	4—5	10.26	10—12*
25	Cumberland Bone Superphosphate,	12.44	2.32	2—3	6.04	6.40	4.04	16.48	13—14	12.44	9—13	2.72	2—3
32	Mapes' Complete Manure,	10.72	3.12	3.30—4.12	3.89	3.24	3.97	11.10	10—12	7.13	–	4.17	4—5
39	Bradley's XL Superphosphate of Lime,	14.52	3.52	2.50—3.25	8.09	2.56	1.89	12.54	11—14	10.65	9—11	2.24	2—3
42	Jefferds' Animal Fertilizer with Potash,	3.88	3.12	4.12—5.77	0.28	9.63	11.33	21.24	14—16	9.91	–	4.83	5—7
44	Americus Brand Ammoniated Superphosphate,	16.59	2.37	2—3	8.92	1.73	0.28	10.93	11—16	10.65	10—12	1.82	2—3*
54	Church's Fish and Potash,	18.82	3.74	3.3—4.12	2.02	2.62	1.12	5.76	5—6	4.64	–	4.18	3—5
55	Adams' Market Bone Fertilizer,	11.66	3.08	2.5—3.5	1.92	5.57	3.10	10.59	8—10	7.49	6—8	5.60	3—5
57	Dry Fish Guano,	9.22	9.00	8.24—9.89	0.46	4.45	2.48	7.39	6—8	4.91	–	–	–
58	Bradley's Fish and Potash, "A" Brand,	16.46	3.25	2—3	2 57	1.98	1.45	6.00	–	4.55	4—6	4.99	4—6
68	Original Bay State Bone Superphosphate,	16.91	2.77	2.47—2.88	5.97	1.67	2.26	10.90	10—12	7.64	9—9.5	2.27	2—3
69	Imperial Bone Superphosphate,	20.10	2.38	2.06—2.47	5.53	2.50	2.75	10.78	9—10	8.03	8—9	1.85	2.5—3
83	Ames' Bone Fertilizer,	11.29	2.66	1.65—2.47	6.08	3.29	0.32	9.69	8—12	9.37	8—10	1.39	1—3
84	Dow's Nitrogenous Superphosphate,	11.16	2.65	2.06—2.88	3.34	7.11	2.37	12.82	–	10.45	8—10	3 78	3—4
88	Darling's Pure Dissolved Bone,	4.67	2.01	2.06—2.88	7.04	8.95	2.56	18.55	16—18	15.99	14—16	–	–
111	Extra Bone Phosphate,	10.81	2.60	2.47—3.30	5.76	2.91	2.33	11.00	10—12	8.67	7—9	3.28	3—5
30	Cotton-hull Ashes,	8.11	–	–	–	–	–	9.62	–	–	–	22.80	
29	Muriate of Potash,	2 05	–	–	–	–	–	–	–	–	–	49.67	–†

* Sulphate of potash the source of potash. † Guaranteed eighty per cent. muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
16	Potato Fertilizer,	Davidge Fertilizer Company, New York,	Amherst.
20	Animal Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
49	Ammoniated Bone Superphosphate, Americus Brand,	Williams & Clark Co., New York,	Springfield.
52	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	Springfield.
108	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	New Bedford.
53	Potato Manure,	H. J. Baker & Bro., New York.	Springfield.
59	Chittenden's Complete Fertilizer for Grass,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
61	Mapes' Complete Manure for Light and Sandy Soils,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
65	Red Brand, Special Fertilizer for Potatoes, Cabbage and Pease,	Le Page Company, Boston, Mass.,	Boston.
76	Randall Market Garden Fertilizer,	Benj. Randall, Boston, Mass ,	Boston.
98	Crocker's New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
102	Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
110	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Taunton.
124	Jennison's Animal Fertilizer,	Edward F. Jennison, Lancaster, Mass.,	South Lincoln.
129	Lister's Ammoniated Dissolved Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
132	Sea-fowl Guano,	Bradley Fertilizer Company, Boston, Mass.,	Turner's Falls.
134	Orient Complete Manure,	Orient Guano Company, Orient, L. I.,	Sheffield.
135	Great Eastern Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
137	Potato Fertilizer,	E. Frank Coe, New York,	Westfield.
	Bones and Tankage.		
123	Hersom's Tankage,	Thomas Hersom & Co., New Bedford.	New Bedford.
95	Bowker's Fine-ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
118	Hargrave's Fine-ground Bone,	Hargrave Manufacturing Company, Fall River,	Fall River.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen: Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total: Found.	Total: Guaranteed.	Available: Found.	Available: Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide: Guaranteed.
	Compound Fertilizers.												
16	Potato Fertilizer, ...	12.37	3.08	2.88—3.71	8.10	1.06	1.32	10.18	10—12	9.16	9.5—11	3.02	–*
20	Animal Fertilizer, ...	9.93	2.97	–	6.14	1.96	6.40	14.50	10—12	8.10	6—8	3.34	–†
49	Ammon. Bone Superphos., Americus Brand,	16.86	2.66	2—3	9.03	1.65	0.23	10.91	10—16	10.68	10—12	1.98	2—3
52 } 108 }	A. A. Ammoniated Superphosphate, . .	13.32	3.42	2.47—3.3	10.09	1.36	1.13	12.58	–	11.45	10—12	2.58	2—3
53	Potato Manure, ...	9.89	4.17	3.30	5.95	1.34	0.81	8.10	–	7.29	5.75	9.33	10.
59	Chittenden's Complete Fertilizer for Grass, .	12.86	3.62	4.12—4.94	5.88	3.43	2.91	12.22	6—8	9.31	4—6	5.56	5—7
61	Mapes' Com. Manure for Light and Sandy Soil,	11.40	5.66	4.94—6.59	5.50	1.19	2.30	8.99	8—10	6.69	8.	6.46	6—8
65	Red Star Brand, Spec. Fert. for Potatoes, etc.,	15.37	3.01	3—4	4.16	2.35	3.26	9.77	8—10	6.51	6—8	3.34	–*
76	Randall's Market Garden Fertilizer, . .	11.22	3.36	2.88—3.71	5.28	2.51	1.66	9.45	–	7.79	8.5—11	3.68	4—5
98	Crocker's New Rival Ammo. Superphosphate,	15.57	1.43	1.23—2.06	7.94	1.72	1.33	11.05	–	9.66	10—12	2.08	–*
102	Lawrence Fertilizer, ...	15.37	1.78	2.06—2.88	9.86	1.34	0.95	12.15	10—12	11.20	–	1.61	2—3
110	Potato and Root Crop Manure, ...	12.57	3.12	2.88—4.12	4.81	1.91	3.81	10.53	10—12	6.72	–	8.96	7—9
124	Jennison's Animal Fertilizer, ...	3.59	5.40	3—4	0.08	5.93	6.78	12.79	11—12.5	6.01	6—8	8.94	7—8
129	Lister's Ammoniated Dissolved Bone, . .	14.84	2.09	1.65—2.06	7.14	2.07	3.39	12.60	10—13	9.21	8—10	1.67	1—2
132	Sea-fowl Guano, ...	13.61	2.60	2.06—2.68	7.38	2.84	3.19	13.41	11—14	10.22	9—11	2.42	2—3
134	Orient Complete Manure, ...	13.84	2.20	1.65—2.47	8.71	0.18	1.41	10.30	–	8.89	8—12	2.28	2—4
135	Great Eastern Tobacco Fertilizer, . . .	14.12	2.31	1.65—2.47	7.54	1.58	1.56	10.68	–	9.12	8—12	4.51	6—8
137	Potato Fertilizer, ...	13.21	2.06	2—2.5	7.48	1.53	1.66	10.67	–	9.01	8—11	5.52	–*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen: Found.	Nitrogen: Guaranteed.	Soluble.	Reverted.	Insoluble.	Total: Found.	Total: Guaranteed.	Available: Found.	Available: Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones and Tankage.														
123	Hersom's Tankage, ...	3.42	4.24	2.08	–	6.73	12.79	19.52	29.42	6.73	13.62	–	–	–	–
95	Bowker's Fine-ground Bone, ...	9.15	3.48	2.5—3.25	1.66	7.27	14.66	23.59	18—22	8.93	–	50.80	28.77	11.18	9.25
118	Hargrave's Fine-ground Bone, . . .	10.28	3.25	3.93	.37	12.01	13.19	25.57	18.80	12.38	4.12	43.43	23.01	14.20	19.36

* Sulphate of potash the source of potash.   † Guaranteed as muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
1	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass ,	Peabody.
28	Stockbridge's Manure for Top Dressing,	Bowker Fertilizer Company, Boston, Mass ,	Springfield.
46	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
71	Standard Superphosphate,	Standard Fertilizer Company, Duxbury, Mass ,	Boston.
78	Economic No. 1, for Grass,	Economic Fertilizer Company, Boston, Mass.,	Boston.
105	Church's Dry Ground Fish,	Joseph Church & Co., Tiverton, R. I.,	New Bedford.
127	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Worcester.
144	Cumberland Seeding-down Fertilizer,	Cumberland Bone Company, Portland, Me.,	Dighton.
115	The Allen Fertilizer,	The American Manufacturing Company, Boston, Mass.,	Woburn.
146	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Waltham.
147	Davidge's Potato Manure,	Davidge Fertilizer Company, New York,	Belchertown.
148	Special Favorite,	Davidge Fertilizer Company, New York,	Belchertown.
14	Sulphate of Potash,	Quinnipiac Company, Agents, New London, Conn.,	North Amherst.
	Bones.		
41	Jefferds' Steamed Bone,	J. G. Jefferds, Worcester, Mass.,	Worcester.
73	Standard Pure Ground Bone,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
87	Darling's Pure Ground Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
103	Lawrence Bone Meal,	Lee & Co., Lawrence, Mass.,	Lawrence.
143	S. Winter's Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
1	Ames' Bone Fertilizer,	14.05	2.88	1.65—2.47	6.81	2.04	1.51	10.36	8—12	8.85	8—10	2.10	1—3
28	Stockbridge's Manure for Top Dressing,	11.93	3.82	5—6	5.35	5.10	0.24	10.69	6—7	10.45	3—4	6.19	5—6
46	Chittenden's Ammon. Bone Superphosphate,	12.17	2.56	1.65—2.47	8.93	0.80	3.83	13.56	9—11	9.73	7—9	2.63	2—4
71	Standard Superphosphate,	19.22	2.86	2.5 —3.5	4.51	3.66	2.17	10.34	11—14	8.17	9—13	3.13	3—4
78	Economic No. 1, for Grass,	11.61	1.36	1—2	-	0.45	4.63	5.08	2—4	0.45	-	0.36	-
105	Church's Dry Ground Fish,	11.81	9.12	-	0.59	5.64	2.34	8.57	-	6.23	-	-	-
127	Cumberland Superphosphate,	14.17	2.60	2—3	6.88	4.43	4.48	15.79	8—14	11.31	6—10	2.56	2—3
144	Cumberland Seeding-down Fertilizer,	18.50	2.12	1.65	2.97	5.15	11.26	19.38	18—20	8.12	5—9	0.98	1
145	The Allen Fertilizer,	16.80	2.56	2.06—2.47	4.66	1.84	2.97	9.47	6—8	6.50	5—8	4.36	4—6
146	Mayo's Superphosphate,	18.80	2.88	2.5—3.	6.50	3.05	0.84	10.39	11.5—13.5	9.55	10.5—11.5	3.16	3—4
147	Davidge's Potato Manure,	20.43	3.88	2.47—3.71	7.45	3.27	1.43	12.15	-	10.72	9.5—11	3.89	4—6
148	Special Favorite,	9.42	1.56	1.24—2.06	7.06	2.82	2.25	12.13	12—14	9.88	10—12	1.61	1.5—2.5
14	Sulphate of Potash,	1.58	-	-	-	-	-	-	-	-	-	21.92	-

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
41	Jefferds' Steamed Bone,	1.50	3.28	2.47—3.30	0.46	7.60	21.75	29.81	27—30	8.06	-	57.88	31.32	10.80	-
73	Standard Pure Ground Bone,	5.60	1.36	-	0.23	7.97	19.56	27.76	-	8.20	-	42.92	23.54	12.65	10.89
87	Darling's Pure Ground Bone,	2.07	3.80	3.30	0.67	8.36	15.10	24.13	24—26	9.03	-	50.65	31.02	18.33	-
103	Lawrence Bone Meal,	15.49	2.12	-	0.20	4.40	16.35	20.95	-	4.60	-	41.69	29.49	15.92	12.90
143	S. Winter's Pure Ground Bone,	7.93	3.28	4.20	0.33	12.93	11.58	24.84	23.66	13.26	12.85	55.85	23.59	10.19	10.37

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
21	Stockbridge's Vegetable and Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
22	Ammoniated Bone Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
31	Dry Ground Fish,	Quinnipiac Company, New London, Conn.,	Northampton.
34	Mapes' Complete Manure, "A" Brand,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
45	Potato Phosphate,	Williams & Clark Company, New York,	Worcester.
50	Potato Phosphate,	Williams & Clark Company, New York,	Springfield.
51	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
56	Bradley's Fish and Potash, Anchor Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
64	203 Fertilizer for General Crops,	Le Page Company, Boston, Mass.,	Boston.
70	Breck's Lawn and Garden Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
77	Randall's Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
86	Cleveland Superphosphate,	Cleveland Dryer Company, Cleveland, Ohio,	Ipswich.
92	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
97	Crocker's Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
99	Crocker's Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
104	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
114	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Fall River.
115	Brightman's Dry Ground Menhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
116	Brightman's Ammoniated Bone Supherphosphate,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
119	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Hatfield.
125	Americo Guano, the Standard Potato Manure,	Stearns Fertilizer Company, New York,	Worcester.
133	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York,	No. Adams.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Stockbridge's Vegetable and Potato Manure,	17.58	3.32	3.25—4.25	6.97	1.52	2.10	10.59	8—10	8.49	7—8	5.34	5—6
22	Ammoniated Bone Fertilizer,	11.70	2.12	2.00—3.00	7.43	2.80	3.38	13.61	10—12	10.23	8—10	1.71	2—3
31	Dry Ground Fish,	10.86	7.76	7.5—10.0	1.10	2.97	3.38	7.45	7—10	4.07	4—6	–	–
34	Mapes' Complete Manure, "A" Brand,	10.96	2.75	2.47—3.30	5.16	1.40	6.19	12.75	–	6.56	10—12	3.33	2.5—3.5
45, 50	Potato Phosphate,	17.35	2.11	2.0—3.0	6.15	1.33	0.37	7.85	8—10	7.48	7—10	7.42	–*
51	Bradley's Potato Manure,	12.87	2.73	2.5—3.5	5.85	2.52	2.14	10.51	8—11	8.37	6—8	5.76	5—6
56	Bradley's Fish and Potash, Anchor Brand,	10.33	3.60	3.25—4.25	2.70	1.31	1.71	5.72	5	4.01	–	3.97	3
64	203 Fertilizer for General Crops,	13.73	2.59	3—4	3.03	2.83	3.53	9.39	10—12	5.86	8—10	5.40	3—4
70	Breck's Lawn and Garden Dressing,	7.40	4.80	4.12—4.91	5.17	1.41	1.97	8.55	–	6.58	8—9	5.10	4—6
77	Randall's Bone and Potash,	10.88	2.81	1.6—2.5	7.96	3.77	1.86	13.59	13—16	11.73	5—7	3.90	2
86	Cleveland Superphosphate,	12.40	2.72	2.05—2.85	1.60	9.47	1.47	12.47	11—14	11.07	9—11	2.16	2—3
92	Bowker's Hill and Drill Phosphate,	11.27	2.51	2.5—3.25	7.77	1.53	4.84	14.14	11—14	9.30	10—12	1.83	2—3
97	Crocker's Vegetable Bone Superphosphate,	9.91	4.60	5—6	3.43	2.49	2.49	8.41	7—10	5.92	6—8	7.15	6—8
99	Crocker's Ammoniated Wheat and Corn Phosphate,	12.43	2.66	2—3	8.54	3.10	0.80	12.44	11—15	11.64	10—13	4.44	1.75—2.93
104	Lowell Bone Fertilizer,	5.40	2.96	2—2.5	4.91	6.94	2.17	14.02	14.5—17.5	11 85	12.5—14.5	3.24	3—3.5
114	Soluble Pacific Guano,	12.16	3.44	2.25—3	7.29	2.79	1.41	11.49	10.5—16.0	10.08	8.5—12	3.95	2—3.5
115	Brightman's Dry Gr'nd Menhaden Fish Guano,	9.49	9.96	8.24—9.89	0.18	4.35	4.43	8.96	–	4.53	–	–	–
116	Brightman's Ammoniated Bone Superphosp'te,	11.24	3.16	2.47—4.12	4.73	1.02	4.48	10.23	8.25—10	5.75	8—10	4.14	3—5
119	Darling's Animal Fertilizer,	15.33	3.46	3.30—4.91	4.19	3.07	2 94	10.20	10—12	7 26	–	4.44	4—6
125	Americo Guano, the Standard Potato Manure,	10.55	4.29	4.12—5.77	1.27	8.04	3.66	13.07	8—12	9.31	–	8.60	6—8
133	High-grade Ammoniated Bone Superphosphate,	12.10	2.53	2—2.5	7.98	2.39	2.05	12.42	11—13	10.37	9—12	2.18	–*

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
27	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
35	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
47	Chittenden's Complete Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
48	Flamingo Guano,	Liebig & Gibbons, Baltimore, Md.,	Fitchburg.
63	Mapes' Tobacco Manure, Conn. Brand,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
66	Red Star Brand Special Fertilizer for Onions and Tobacco,	LePage Company, Boston, Mass ,	Boston.
67	Red Star Brand, The Perfect Lawn Dressing,	LePage Company, Boston, Mass.,	Boston.
72	Breck's Top Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
81	Economic No. 4, for Potatoes,	Economic Fertilizer Company, Boston, Mass.,	Boston.
85	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, O.,	Ipswich.
91	Stockbridge's Manure for Seeding-down,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
96	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Haverhill.
100	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
101	Crocker's Ammoniated Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
113	Pacific Guano Company's Special Potato Manure,	Glidden & Curtis, Boston. Mass.,	Plymouth.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
120	World of Good Potato Grower,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
126	Stearns' High-grade Ammoniated Bone Superphosphate,	Stearns Fertilizer Company, New York,	Worcester.
136	Great Eastern Grain and Grass Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
138	H. L. Phelps' Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
139	H. L. Phelps' Potato Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
140	H. L. Phelps' Complete Manure for Corn and Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
27	Lawn and Garden Dressing,	11.17	3.28	3.30—4.12	9 92	1.66	2.69	14.27	-	11.58	5—6	3.60	3—4
35	Mapes' Corn Manure,	12.73	4.12	3.71—4.12	5.12	3.81	3.20	12.13	10—12	8.93	-	6.29	6—7
47	Chittenden's Complete Fertilizer,	12.01	2.98	3.30—4.12	4.10	6.56	3.29	13.95	8—10	10.66	6—8	5.11	6—8
48	Flamingo Guano,	12 35	0.80	.62—1.03	0	13 25	6.27	19.52	13—19	13.25	10—14	0.70	.25—.75
63	Mapes' Tobacco Manure, Conn. Brand,	4.52	4 48	4.74	4.67	3.65	4.22	12.54	7.75	8.32	-	5.89	7.75
66	Red Star Brand, Special Fertilizer for Onions and Tobacco,	15.46	3.32	2.47—3.30	3.74	2.46	4.13	10.33	6—8	6.20	-	4.02	-*
67	Red Star Brand, The Perfect Lawn Dressing,	6.82	3.88	4—5	6.45	1.20	3.15	10.80	10—12	7.65	8—10	4.12	4—5
72	Breck's Top Dressing,	8.40	5.96	5 77—6.59	4.80	2.04	0.26	7.10	6—8	6.84	5—6	2.60	2.5—3.5
81	Economic No. 4, for Potatoes,	11.74	0.93	.25— .75	0	0	6.41	6.41	2—4.5	0	-	Trace.	-
85	Cleveland Potato Phosphate,	8.15	4.36	2.06—2.88	6.73	2.47	3.53	12.73	10—13	9.20	8—10	3.26	3.25—4.25
91	Stockbridge's Manure for Seeding-down,	10.93	2.81	2.47—3.30	5.68	2.21	5.98	13.87	12—14	7.89	6—8	2.94	3—4
96	Bradley's XL Superphosphate of Lime,	15.82	2.74	2.50—3.25	8.82	1.62	1.90	12.34	11—14	10.44	9—11	1.86	2—3
100	Crocker's Potato, Hop and Tobacco Phosphate,	13.50	3.23	2—3	8 70	1.72	0.74	11.16	9—14	10.42	8—12	3.46	3.5—4.5
101	Crocker's Ammoniated Bone,	12.10	3.96	2.88—3.71	6.74	2.87	0.77	10.38	11—14	9 61	10—12	1.27	-*
113	Pacific Guano Co.'s Special Potato Manure,	13.22	3.66	3.30—4.12	5 53	2 40	1.82	9.75	8—12	7.93	5—8	5 57	5.5—7
117	Brightman's Fish and Potash,	26.80	3.88	2.47—4.12	0 80	7.47	2 89	11.16	-	8.27	-	2.67	2—3
120	World of Good Potato Grower,	8.44	2.14	2.47—3.30	3.04	5.44	5.24	13.72	-	8.48	6—8	3.06	-*
126	Stearns' High-grade Am. Bone Superphosphate,	12.50	2.68	2.26—2.88	2.84	3.10	6.26	12.20	10.5—14	5.94	8.5—11	3.12	3—4
136	Great Eastern Grain and Grass Fertilizer,	19.47	2.56	2.88—3.71	6.52	1.73	3.20	11.45	9—15	8.25	8—12	2.67	2—4
138	H. L. Phelps' Phosphate,	13.35	2.92	2.47—3.30	12.72	0.24	0.24	13.20	8—10	12.96	-	3.71	3—4
139	H. L. Phelps' Potato Manure,	8.59	4.13	4 12—4.94	5.45	3.83	1.63	10.91	8—10	9.28	5—7	9 45	8—10
140	H.L.Phelps' Complete Manure, Corn and Grass,	8.12	4.12	4.12—4.94	5.69	2.72	1.25	9.66	8—10	8.41	8—10	9.86	7—8

* Sulphate of potash the source of potash.

A. Analyses of Commercial Fertilizers, etc. — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
36	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
40	Lawn Fertilizer, Tobacco and Sulphur,	F. C. Sturtevant, Hartford, Conn.,	Worcester.
60	Chittenden's Complete Fertilizer for Potatoes,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
74	Peruvian Guano,	Mapes Formula and Peruvian Guano Company, New York,	Boston.
75	Animal Fertilizer for Lawn and Garden,	Darling Fertilizer Company, Pawtucket, R. I.,	Boston.
80	Economic No. 3, for Corn,	Economic Fertilizer Company, Boston, Mass.,	Boston.
89	The Economic Fertilizer for All Crops,	Baugh & Sons, Philadelphia and Baltimore,	Newburyport.
93	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
94	Stockbridge's Manure for Grapes, Raspberries, etc.,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
107	Baker's Special Corn Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
109	Special Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
112	N. Ward & Co.'s High-grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
121	World of Good Raw Bone Superphosphate,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
130	Lister's Celebrated Onion Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
141	Fish and Potash,	Prentiss, Brooks & Co , Holyoke, Mass.,	Holyoke.
142	Lawn Dressing,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
149	Whittemore Bros.' Bone Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
26	Cotton-hull Ashes,	H. L. Phelps, Southampton, Mass., Agent,	Sunderland.
37	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
36	Stockbridge's Manure for Onions,	10.29	4.00	3.25—4.25	7.37	2.37	1.90	11.64	8—10	9.74	7—8	4.85	5—6
40	Lawn Fertilizer, Tobacco and Sulphur,	22.46	2 60	–	–	–	–	0.014	–	–	–	7.12	–
60	Chittenden's Compound Fertilizer for Potatoes,	11.41	3.40	3.30—4.12	5.95	1.64	6 31	13.87	8—10	7.59	6—8	5.78	6—8
74	Peruvian Guano,	14.65	8.44	–	4 35	6.64	5.10	16.09	–	10.99	–	2.75	–
75	Animal Fertilizer for Lawn and Garden,	12.00	3.58	4—6	2.38	3.41	7.68	13.47	10—12	5.79	–	3.84	4—6
80	Economic No. 3, for Corn,	12 88	1 10	.25—.75	0.00	2 59	8.22	10.81	6—9	2 59	–	0.21	–
89	Economic Fertilizer for all Crops,	20.35	1.60	1.65—2.06	4 39	1.69	3 04	9.12	–	6.08	5—6	1.95	–*
93	Stockbridge's Manure for Strawberries,	13.37	2.18	2.50—3.25	6 06	1 06	6.56	13.68	7—9	7.12	6—7	3.92	–*
94	Stockbridge's Manure for Grapes, etc.,	13.70	3.18	2.50—3.25	7.16	1.15	3.29	11.60	8—10	8.31	6—8	3.58	4—5
107	Baker's Special Corn Manure,	8.04	4.58	4.12	4.89	1.56	2.07	8.52	7.50—9.50	6.45	6.50	7.32	7
109	Special Grass Manure,	15.12	3.68	3.30	4.16	0.62	2.00	6 82	–	4.78	5	5.80	7
112	N. Ward & Co., High-grade Animal Fertilizer,	14.86	3.69	2.88—3.70	5.46	6.22	0.50	12.18	–	11.68	12—14	4.15	4—5
121	World of Good Raw Bone Superphosphate,	4.72	3.04	1.65—2.47	5.14	4.29	6.28	15.71	12—14	9.43	8—10	2.10	–*
130	Lister's Celebrated Onion Fertilizer,	10 11	4 52	3 30—4 12	4.34	3.10	0.32	7.76	–	7 44	8—10	5.75	7—8
141	Fish and Potash,	7.60	3.65	3.30—4.12	2.12	1.63	1.48	5.23	5—6	3.75	–	5.12	4—6
142	Lawn Dressing,	15.21	2.92	3.30—4.12	5.94	1.22	0.50	7.66	6—8	7.16	–	8.09	7—9
149	Whittemore Bros ' Bone Fertilizer,	13.13	3.70	–	5.62	6.53	1.47	13.62	–	12.15	–	3.63	–
26	Cotton-hull Ashes,	10.70	–	–	–	–	–	10.08	–	–	–	26.04	–
37	Nitrate of Soda,	1.32	16.04	–	–	–	–	–	–	–	–	–	–

* Sulphate of potash the source of potash.

5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

Wood Ashes.

[I., II. and III. sent on from Amherst, Mass.; IV. sent on by E. C. Smith, Rowley, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.49	9.30	0.44	7.03
Calcium oxide,	38.36	38.58	24.62	32.31
Magnesium oxide,	2.74	2.72	4.70	4.03
Sodium oxide,	2.29	1.89	–	–
Potassium oxide,	4.53	4.84	5.69	4.36
Phosphoric acid,	2.48	2.99	4.61	2.38
Insoluble matter (before calcination),	17.54	18.08	41.92	19.53
Insoluble matter (after calcination),	14.51	15.36	37.22	13.99

Wood Ashes.

[I. and II. sent on by C. H. Thompson & Co., Boston, Mass.; III. sent on by J. C. Comins, N. Amherst, Mass.; IV. sent on by Chas. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.03	0.55	6.98	7.72
Calcium oxide,	22.69	33.58	37.28	42.39
Magnesium oxide,	6.15	3.74	5.13	2.65
Potassium oxide,	6.52	1.91	5.56	5.38
Phosphoric acid,	1.66	1.32	2.30	1.15
Insoluble matter (before calcination),	27.92	3.64	13.91	9.26
Insoluble matter (after calcination),	23.75	2.03	11.50	6.37

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Frank Wheeler, Concord, Mass.; III. and IV. sent on by E. W. McGarvey, London, Ont.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C, ...	16.55	15.58	7.53	11.88
Calcium oxide, ...	36.59	34.20	39.61	34.87
Magnesium oxide, ...	3.01	2.86	2.42	3.20
Potassium oxide, ...	4 29	4.82	6.39	5.29
Phosphoric acid, ...	2.44	1 76	1.28	2 00
Insoluble matter (before calcination),	15.15	20.75	11.14	11 66
Insoluble matter (after calcination), .	12.42	18.35	8.32	7.68

Wood Ashes.

[Sent on by Frank Goodwin, Framingham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C, ...	20.33	15.54	.10	14.34
Calcium oxide, ...	31.21	32.77	40.01	33.82
Magnesium oxide, ...	3.51	3.21	3.73	3.04
Potassium oxide, ...	3.57	3.75	9.80	4.43
Phosphoric acid, ...	2.90	1.45	2.16	2.72
Insoluble matter (before calcination),	13.31	12.56	15.54	21.13
Insoluble matter (after calcination), .	10.51	10 06	11.94	8.69

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. sent on by Frank Goodwin, Framingham, Mass.; II. sent on by Chas. W. Jenks, Bedford, Mass.; III. sent on by Frank E. Kimball, Danvers, Mass.; IV. sent on by C. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.15	20.40	15.64	14.46
Calcium oxide,	44.59	30.98	31.56	32.14
Magnesium oxide,	7.24	3.14	3.27	2.59
Potassium oxide,	4.27	4 26	4.12	4.36
Phosphoric acid,	3.73	1.54	1.28	2.71
Insoluble matter (before calcination),	11.70	13.53	24.10	16.48
Insoluble matter (after calcination),	10.42	10.49	13.50	13.26

Wood Ashes.

[I. sent on from Amherst, Mass.; II. sent on by Urbane Derby, Concord, Mass.; III. sent on by W. E. Allen, Lancaster, Mass.; IV. sent on by E. F. Manchester, Fall River, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	19.30	7.08	.25	4.77
Calcium oxide,	30.54	39.54	27.48	32.52
Magnesium oxide,	2.75	4.64	4.41	4.60
Potassium oxide,	5.16	3.60	5.07	4.23
Phosphoric acid,	1.77	1.95	2.28	2.07
Insoluble matter (before calcination),	14.50	14.74	39.10	24.76
Insoluble matter (after calcination),	10.20	12.53	37.75	20.04

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by J. A. Merriam, Framingham, Mass.; III. sent on by R. L. Day, South Framingham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	19.04	21.47	14.52
Calcium oxide,	36.35	32.66	40.31
Magnesium oxide,	2.82	2.36	2.91
Potassium oxide,	4.63	3.26	2.70
Phosphoric acid,	1.65	1.70	1.47
Insoluble matter (before calcination),	8.07	8.25	7.77
Insoluble matter (after calcination),	7.15	7.86	6.78

Wood Ashes.

[I. sent on by W. H. Davis, Littleton, Mass.; II. and III. sent on by A. H. Turner, Harvard, Mass.; IV. sent on by Flagg & Russell, Warnersville, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.42	15.72	13.88	11.45
Calcium oxide,	36.94	28.61	34.03	27.17
Magnesium oxide,	3.24	3.00	3.07	3.37
Ferric oxide,	2.74	1.03	.49	–
Potassium oxide,	7.82	8.72	5.59	5.77
Phosphoric acid,	.51	.32	.54	1.31
Insoluble matter (before calcination),	16.43	18.49	13.51	7.08
Insoluble matter (after calcination),	12.18	12.12	11.33	5.85

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Coolidge Bros., South Sudbury, Mass ; III. and IV. sent on by James Logan, Worcester, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C ,	15.73	11.86	24.96	15.97
Calcium oxide,	37.18	43.13	15.83	39.76
Magnesium oxide,	3.56	1.80	2.14	1.82
Potassium oxide,	5.22	3.66	3.74	2.40
Phosphoric acid,	1.57	3.84	1.89	6.10
Insoluble matter (before calcination),	6.44	7.06	16.20	8.39
Insoluble matter (after calcination),	5.61	6.41	12.50	5.93

Cotton-seed Hull Ashes.

[I. sent on by Lyman A. Crafts, Whately, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.; III. sent on by A. W. Field, North Hadley, Mass.; IV. sent on by J. Comins, Sunderland, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.24	9.97	.86	11.96
Calcium oxide,	8.89	9.59	9.80	4.41
Magnesium oxide,	12.61	13.58	16.05	12.29
Ferric oxide,	1.14	1.54	1.92	–
Potassium oxide (6 cents per pound),	28.44	25.17	22.58	29.36
Phosphoric acid (6 cents per pound),	10.28	9.16	8.02	12.99
Insoluble matter (before calcination),	–	–	10.73	7.38
Insoluble matter (after calcination),	6.11	.96	6.50	3.68
Valuation per ton,	$46 46	$41 20	$36 72	$50 82

5. *Analyses, etc.* — Continued.

Cotton-seed Hull Ashes.

[I. and II. sent on by S. G. Hubbard, Hatfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.13	8.13
Calcium oxide,	7.26	11.34
Magnesium oxide,	10.99	11.58
Ferric oxide,	1.25	1.96
Potassium oxide (6 cents per pound),	25.35	22.66
Phosphoric acid (6 cents per pound),	10.68	8.69
Insoluble matter (before calcination),	13.59	12.70
Insoluble matter (after calcination),	11.61	9.73
Valuation per ton,	$43 24	$37 62

Sulphate of Potash.

[I. sent on from Amherst, Mass.; II. and III. sent on from Feeding Hills, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.87	7.54	8.46
Potassium oxide (6 cents per pound),	37.54	25.81	17.43
Sulphuric acid,	45.96	46.96	50.11
Insoluble matter,	.94	–	–
Valuation per ton,	$45 05	$30 97	$20 92

5. *Analyses, etc.* — Continued.

Muriate of Potash.

[Sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.01	2.22	2.41
Sodium oxide,	2.88	12.44	11.50
Potassium oxide ($4\frac{1}{2}$ cents per pound),	45.16	47.30	49.86
Chlorine,	45.67	52.00	52.00
Insoluble matter,	1.01	Trace.	Trace
Valuation per ton,	$40 64	$42 57	$44 87

Gypsum.

[I. sent on from Wellesley Hills, Mass.; II. sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	38.47	14.05
Calcium oxide,	16.21	32.65
Sulphuric acid,	21.43	41.90
Insoluble matter,	11.30	2.22

No. I. is a factory refuse article.

Lime.

[Sent on from Amherst, Mass.]

	Per Cent.
Calcium oxide,	74.79
Insoluble matter,	.77

5. *Analyses, etc.* — Continued.

South Carolina Phosphate.

[Sent on from Amherst, Mass. I., finely ground "Floats;" II., Apatite.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.39	.09
Calcium oxide,	46.76	–
Ferric and aluminic oxides,	5.78	–
Total phosphoric acid,	27.57	36.08
Soluble phosphoric acid,	0.00	–
Reverted phosphoric acid (7½ cents per pound),	4.27	–
Insoluble phosphoric acid (2 cents per pound),	23.30	–
Insoluble matter,	9.04	9.55
Valuation per ton,	$15 73	–

Mona Island Guano.

[Sent on by J. Campbell & Co., New York, N. Y.]

	Per Cent.
Moisture at 100° C.,	12.52
Ash,	75.99
Total phosphoric acid,	21.88
Soluble phosphoric acid,	.00
Reverted phosphoric acid (7½ cents per pound),	7.55
Insoluble phosphoric acid (3 cents per pound),	14.33
Calcium oxide,	37.49
Potassium oxide,	Trace.
Nitrogen (17 cents per pound),	.76
Insoluble matter,	2.45
Valuation per ton,	$22 50

5. *Analyses, etc.* — Continued.

Dissolved Bone-black.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	16.84	17.41
Ash,	56.83	56 19
Total phosphoric acid,	22.18	21.70
Soluble phosphoric acid,	14.27	15.60
Reverted phosphoric acid,	7.53	6.02
Insoluble phosphoric acid,	.38	.08
Insoluble matter,	3.92	3.99
Valuation per ton,	$34 59	$34 10

Bone Coal.

[Sent on by Chas. S. Young, Wellesley Hills, Mass.]

	Per Cent.
Moisture at 100° C.,	18 16
Ash,	72.24
Total phosphoric acid,	25.58
Soluble phosphoric acid (8 cents per pound),	.38
Reverted phosphoric acid (7½ cents per pound),	5.18
Insoluble phosphoric acid (5 cents per pound),	20.02
Insoluble matter,	.69
Valuation per ton,	$28 40

5. *Analyses, etc.* — Continued.

Ground Bones.

[I., II. and III. sent on by Geo. Frost, Boston, Mass.; IV. sent on by L. B. Smith, Eastham, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	28.96	56.50	33.25	50.78
Fine medium, smaller than $\frac{1}{25}$ inch,	59.98	38.18	28.65	49.22
Medium, smaller than $\frac{1}{12}$ inch,	11.06	5.32	21.78	–
Coarser than $\frac{1}{12}$ inch,	–	–	16.32	–
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	5.59	5.85	4.18	5.34
Ash,	58.07	38.79	49.80	64.17
Total phosphoric acid,	20.08	19.90	19.32	27.22
Soluble phosphoric acid,	.30	.17	.37	.54
Reverted phosphoric acid,	5.46	7.86	9.36	9.34
Insoluble phosphoric acid,	14.32	12.67	9.59	17.34
Nitrogen,	3.88	5.90	4.72	–
Insoluble matter,	1.48	.48	.40	.46

5. *Analyses, etc.* — Continued.

Bones.

[I. sent on by Edward H. Smith, Northborough, Mass.; II. sent on by Franklyn Howland, New Bedford, Mass.; III. sent on by Edmund Hersey, Hingham, Mass.; IV. sent on by S. Winter, Brockton, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	37.90	46.00	62.29	57.33
Fine medium, smaller than $\frac{1}{25}$ inch,	38.30	36.52	30.81	24.13
Medium, smaller than $\frac{1}{12}$ inch,	19.50	17.48	6.28	9.74
Coarser than $\frac{1}{12}$ inch,	4.30	–	.62	8.80
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	4.33	4.21	5.07	8.03
Ash,	57.06	74.04	55.04	60.60
Total phosphoric acid,	22.40	29.42	25.19	23.66
Soluble phosphoric acid,	.43	.45	.14	.51
Reverted phosphoric acid,	6.17	13.17	10.80	12.18
Insoluble phosphoric acid,	15.80	15.80	14.25	10.97
Nitrogen,	4.04	2.08	3.07	4.20
Insoluble matter,	1.65	.31	.55	.72

Dried Blood.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	15.02
Nitrogen (19 cents per pound),	8.24
Valuation per ton,	$31 31

5. *Analyses, etc.* — Continued.

Sulphate of Ammonia.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.43
Nitrogen (19 cents per pound),	20.91
Sulphuric acid,	57.26
Valuation per ton,	$79 46

Nitrate of Soda.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.22	1.98
Sodium oxide,	53.44	59.56
Nitrogen (17 cents per pound),	15.30	16.00
Insoluble matter,	.19	.05
Valuation per ton,	$52 02	$54 40

Saltpetre Waste (from Gunpowder Works).

[Sent on by A. N. Stowe, Hudson, Mass.]

	Per Cent.
Moisture at 100° C.,	2.12
Calcium oxide,	.22
Magnesium oxide,	.16
Sodium oxide,	50.54
Potassium oxide (4½ cents per pound),	1.85
Sulphuric acid,	.71
Nitrogen (17 cents per pound),	.59
Chlorine,	59.00
Insoluble matter,	.18
Valuation per ton,	$3 68

5. *Analyses, etc.* — Continued.

Wool Waste.

[I. sent on by F. D. Barker, South Acton, Mass.; II. sent on by C. W. Mann, Methuen, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.53	3.46
Ash,	–	59.41
Potassium oxide (4¼ cents per pound),	Trace.	3.08
Phosphoric acid (6 cents per pound),	.115	.29
Nitrogen (8 cents per pound),	10.195	1.18
Insoluble matter,	3.480	49.57
Valuation per ton,	$16 45	$4 86

"*Mud Crab.*"

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	7.67
Ash,	6.71
Total phosphoric acid (6 cents per pound),	1.25
Soluble phosphoric acid,	.28
Reverted phosphoric acid,	.62
Insoluble phosphoric acid,	.35
Nitrogen (17 cents per pound),	8.84
Insoluble matter,	.91

Tobacco Dust.

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	12.98
Potassium oxide (4¼ cents per pound),	9.04
Phosphoric acid (6 cents per pound),	2.09
Nitrogen (17 cents per pound),	3.00
Insoluble matter,	.40
Valuation per ton,	$20 39

5. *Analyses, etc.* — Continued.

Cotton-seed Meal.

[Sent on from Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.77	6.27	8.44
Calcium oxide,	.38	.42	.378
Magnesium oxide,	.98	1.07	1.200
Potassium oxide (4¼ cents per pound),	.87	.96	2 017
Phosphoric acid (6 cents per pound),	1.42	1.57	3.165
Nitrogen (15 cents per pound),	5.96	6.56	7.220
Insoluble matter,	.59	.73	.121
Valuation per ton,	$20 32	$22 37	$27 17

Gluten Meal.

[Sent on by W. E. Dennis, Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	7.850
Calcium oxide,	.045
Magnesium oxide,	.042
Ferric oxide,	.090
Sodium oxide,	.111
Potassium oxide (4¼ cents per pound),	.030
Phosphoric acid (6 cents per pound),	.501
Nitrogen (17 cents per pound),	6.060
Insoluble matter,	1.680
Valuation per ton,	$21 23

5. *Analyses, etc.* — Continued.

Linseed Refuse.

[Sent on by John King, South Framingham, Mass.]

	Fine.	Coarse.
Moisture at 100° C.,	6.440	6.230
Ash,	7.370	5.330
Potassium oxide (4¼ cents per pound),	.679	.802
Phosphoric acid (6 cents per pound),	1.525	1.188
Nitrogen (15 cents per pound),	7.080	4.680
Insoluble matter,	.495	.112
Valuation per ton,	$28 84	$22 29

Cotton-seed Fertilizer.

[Sent on by Geo. W. Wright, Concord, Mass.]

	Per Cent.
Moisture at 100° C.,	7.950
Calcium oxide,	.429
Magnesium oxide,	.672
Ferric oxide,	.066
Potassium oxide (4¼ cents per pound),	1.194
Phosphoric acid (6 cents per pound),	1.241
Nitrogen (15 cents per pound),	8.000
Insoluble matter,	1.187
Valuation per ton,	$26 50

Oak Leaves.

[Sent on by W. H. Hillman, Forestdale, Mass.]

	Per Cent.
Moisture at 100° C.,	9.601
Ash,	6.840
Calcium oxide,	.548
Magnesium oxide,	.267
Ferric oxide,	.027
Potassium oxide (4¼ cents per pound),	.058
Phosphoric acid (6 cents per pound),	.549
Nitrogen (17 cents per pound),	.930
Soluble silica,	.018
Insoluble silica,	4.333
Valuation per ton,	$3 87

5. *Analyses, etc.* — Continued.

Chaff from Grain Elevator.

[Sent on by S. H. Pierce, Lincoln, Mass.]

	Per Cent.
Moisture at 100° C.,	9.89
Ash,	10.74
Potassium oxide (4¼ cents per pound),	.76
Phosphoric acid (6 cents per pound),	5.00
Nitrogen (17 cents per pound),	1.62
Insoluble matter,	6.49
Valuation per ton,	$12 16

Jute Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	10.847
Ash,	23.610
Calcium oxide,	1 496
Ferric oxide,	.671
Potassium oxide (4¼ cents per pound),	.080
Phosphoric acid (6 cents per pound),	.720
Nitrogen (13 cents per pound),	1.794
Insoluble matter,	19.090
Valuation per ton,	$5 59

Hemp Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	12.272
Ash,	6.340
Calcium oxide,	1.654
Ferric oxide,	.307
Potassium oxide (4¼ cents per pound),	.232
Phosphoric acid (6 cents per pound),	.242
Nitrogen (13 cents per pound),	1.095
Insoluble matter,	2.481
Valuation per ton,	$3 26

Cranberry Vines.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	13.070
Ash,	2.450
Calcium oxide,	.404
Magnesium oxide,	.253

5. *Analyses, etc.* — Continued.

	Per Cent.
Ferric oxide,	.087
Sodium oxide,	.080
Potassium oxide (4¼ cents per pound),	.329
Phosphoric acid (6 cents per pound),	.268
Nitrogen (17 cents per pound),	.770
Insoluble matter,	.834
Valuation per ton,	$3 22

Salt Hay.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	5.360
Calcium oxide,	.371
Magnesium oxide,	.335
Ferric oxide,	.028
Sodium oxide,	.017
Potassium oxide (4¼ cents per pound),	.718
Phosphoric acid (6 cents per pound),	.248
Nitrogen (17 cents per pound),	1.180
Valuation per ton,	$4 92

Compound Fertilizers.

[I. sent on by H. D. Graves, Sunderland, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.17	8.92
Total phosphoric acid,	15.79	6.86
Soluble phosphoric acid,	6 88	4.77
Reverted phosphoric acid,	4.43	1.58
Insoluble phosphoric acid,	4.48	.51
Potassium oxide,	2.56	10.31
Nitrogen,	2.60	6.82
Insoluble matter,	5.44	3.67

5. *Analyses, etc.* — Continued.

Compound Fertilizers.

[I. sent on by C. A. Bartlett, Worcester, Mass.; II. sent on by E. C. Smith, Rowley, Mass.; III. sent on by W. H. Porter, Agawam, Mass; IV. sent on by F. W. J. Gerrish, North Worcester, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	17.92	8.71	6.41	18.97
Ash,	56.65	60.15	72.65	48.25
Total phosphoric acid,	7.87	16 71	15.04	11.03
Soluble phosphoric acid,	3.55	4.53	5.44	7.16
Reverted phosphoric acid,	1.99	3.67	4.29	3.42
Insoluble phosphoric acid,	2.33	8.51	5.31	.45
Potassium oxide,	3.78	4.70	2.16	3.56
Nitrogen,	2.06	3.12	2.42	2.24
Insoluble matter,	9.93	5.55	7.50	5.30

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	73.470	73.520	76.160	73.470
Organic and volatile matter,	85.900	93.087	95.915	96.671
Ash,	14.100	6.913	4.085	3.329
Calcium oxide,	.264	.185	.302	.322
Magnesium oxide,	.182	.158	.180	.124
Potassium oxide (4½ cents per pound),	.615	.487	.804	.484
Phosphoric acid (6 cents per pound),	.133	.189	.218	.247
Nitrogen (17 cents per pound),	.362	.338	.570	.471
Insoluble matter,	12.657	6.038	2.131	2.285
Valuation per ton,	$1 94	$1 82	$2 92	$2 34

5. *Analyses, etc.* — Concluded.

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	70.160	56.710	72.810
Organic volatile matter,	86.553	87.526	95.809
Ash,	13.447	12.474	4.191
Calcium oxide,	.323	.386	–
Magnesium oxide,	.271	.223	–
Potassium oxide (4½ cents per pound),	.614	.486	.562
Phosphoric acid (6 cents per pound),	.553	.399	.745
Nitrogen (17 cents per pound),	.486	.419	.672
Insoluble matter,	11.991	9.873	2.250
Valuation per ton,	$2 86	$2 34	$3 68

No. III. From State Experiment Station.

6. *Miscellaneous Analyses.*

Ensilage Liquor.

[Sent on by James Cheesman, Boston, Mass. Specific gravity, 1.015; temperature, 17° C.]

	Per Cent.
Acidity (calculated to acetic acid),	2.66
Moisture at 100° C.,	96.21
Dry matter,	3.79
Ash,	.91
Calcium oxide,	.015
Magnesium oxide,	.003
Ferric oxide,	.227
Sodium oxide,	.001
Potassium oxide,	.155
Phosphoric acid,	.001
Nitrogen as ammoniates,	.023
Nitrogen as nitrates,	.008
Nitrogen as albuminoids,	.002
Nitrogen, total,	.056

6. *Miscellaneous Analyses* — Concluded.

"*Nicotinia*" (*Insecticide*).

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	10.00
Ash,	27.37
Calcium oxide,	4.45
Magnesium oxide,	.90
Potassium oxide ($4\frac{1}{4}$ cents per pound),	9.15
Phosphoric acid (6 cents per pound),	.67
Nitrogen (17 cents per pound),	2.49
Insoluble matter,	2.12
Valuation per ton,	$17 05

Hellebore (*Insecticide*).

[Sent on by Joseph Breck & Son, Boston, Mass.]

	Per Cent.	
	I.	II.
Ash,	6.97	41.36
One hundred parts of ash contained: —		
Ferric and aluminic oxides,	–	7.11
Insoluble matter,	33.65	92.16

No. II. was evidently adulterated with ground clay.

Peroxide of Silicate (*Insecticide*).

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.65
Calcium oxide,	41.18
Sulphuric acid,	49.66
Arsenious oxide,	.57
Copper oxide,	.33
Insoluble matter,	2.31

Gypsum, with a trace of Paris green.

II. Analyses of Water sent on for Examination.

[Parts per million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1,	.03	.06	Trace.	41.00	11.00	1.11	None.	Upton.
2,	.02	.07	5.00	45.00	10 00	1.27	None.	Amherst.
3,	.10	.14	13.00	157.00	89.00	3.25	None.	Amherst.
4,	.04	.15	32.00	203.00	118.00	3.25	None.	Amherst.
5,	.02	.04	11 00	96.00	24.00	1.27	Present.	Framingham.
6,	.05	.08	12.00	108.00	30.00	2.60	None.	Framingham.
7,	.02	.01	10.00	72.00	44.00	2.73	–	Hinsdale.
8,	.03	.07	9.00	160.00	85.00	3.25	None.	Amherst.
9,	.02	.04	24.00	146.00	46.00	3.12	None.	Amherst.
10,	.68	.18	Trace.	45.00	5.00	1.27	None.	Amherst.
11,	.12	.04	6.00	25.00	5.00	0.00	–	Ashfield.
12,	.08	.04	Trace.	68.00	28.00	2.86	–	Ashfield.
13,	.03	.06	7.00	58.00	40.00	0.00	None.	Bedford.
14,	.04	.28	22.00	135.00	70.00	3.38	None.	Westford.
15,	.05	.18	20.00	85.00	20.00	3.38	–	Westford.
16,	.99	.15	96.00	558.00	325.00	13.01	None.	South Deerfield.
17,	.03	.07	Trace.	70.00	45.00	1.56	None.	North Amherst.
18,	.03	.07	30.00	85.00	18.00	2.60	Present	Amherst.
19,	.04	.07	Trace.	93.00	30.00	3.90	None.	Amherst.
20,	.04	.12	Trace.	60.00	30.00	0.00	None.	Ashby.
21,	.03	.09	4.00	130.00	68.00	2.73	None.	East Amherst.
22,	.03	.05	7.00	91.00	43.00	.79	None.	North Leverett.
23,	01	.05	10.00	60.00	15.00	.32	Present.	Shutesbury.
24,	.52	1.80	40.00	765.00	410.00	9.71	–	Amherst.
25,	.40	.12	7.00	92.00	22.00	6.43	Present.	Amherst.
26,	.01	.01	78.00	389.00	139.00	7.83	–	Amherst.
27,	.46	.07	Trace.	57.00	12.00	2.60	None.	Amherst.
28,	.33	.08	Trace.	74.00	27.00	2.34	Present.	Amherst.
29,	.03	.06	12.00	135.00	70.00	3.64	None.	Amherst.

II. Analyses of Water — Continued.

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
30,	.01	.06	Trace.	112.00	42.00	2.47	None.	East Amherst.
31,	.04	.05	Trace.	46.00	10.00	.47	None.	Amherst.
32,	.13	.10	6.00	147.00	92.00	4.57	None.	South Amherst.
33,	.17	.06	6.00	111.00	66.00	4.57	None.	Amherst.
34,	.84	.10	34.00	370.00	137.00	6.71	None.	Sunderland.
35,	·05	.05	6.00	88.00	42.00	2.21	–	Amherst.
36,	.01	.03	8.00	180.00	80.00	3.90	None.	Leverett.
37,	.01	.01	Trace.	30.00	00.00	1.11	None.	Amherst.
38,	.01	.10	12.00	95.00	5.00	1.95	–	Amherst.
39,	.01	.16	Trace.	49.00	10.00	2.34	None.	South Boston.
40,	.05	.12	Trace.	47.00	9.00	2.34	None.	South Boston.
41,	.03	.03	7.00	93.00	51.00	2.73	None.	Amherst.
42,	.21	.07	3.00	61.00	25.00	2.21	None.	North Amherst.
43,	.02	.07	22.00	168 00	78 00	4.57	None.	Amherst.
44,	.03	.16	Trace.	52.00	12.00	.32	–	Amherst.
45,	.05	.03	Trace.	74.00	18.00	1.95	None.	South Amherst
46,	.06	.13	8.00	128.00	68.00	2.60	Present.	Amherst.
47,	.01	.12	Trace.	40.00	6.00	.32	–	Amherst.
48,	.03	.10	Trace.	42.00	20.00	.32	–	Amherst.
49,	.03	.11	10.00	158.00	90.00	2.34	–	Amherst.
50,	.01	.04	Trace.	50.00	38.00	1.27	None.	Amherst.
51,	.03	.24	Trace.	50.00	8.00	.16	–	Amherst.
52,	.14	.22	Trace.	140.00	86.00	4.57	–	Amherst.
53,	.01	.06	5.00	110.00	90.00	2.34	None.	Amherst.
54,	.10	.26	6.00	74.00	42.00	4.16	None.	Hudson.
55,	.72	.16	13.00	156.00	98.00	5.29	–	Amherst.
56,	.06	.26	7.00	68.00	22 00	.79	None.	Ashburnham.
57,	.12	.08	10.00	90.00	30.00	2.60	–	Bedford.
58,	.08	.08	35.00	210.00	160.00	5.29	Present.	Bedford.
59,	.00	.04	8.00	77.00	47.00	2.21	–	Bedford.

II. Analyses of Water — Concluded.

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
60,	.01	.03	8.00	70.00	35.00	1.95	None.	Bedford.
61,	.01	.06	6.00	75.00	40.00	.48	None.	East Deerfield.
62,	.00	.03	4.00	20.00	00.00	.00	None.	East Deerfield.
63,	.01	.02	8.00	75.00	40.00	2.21	None.	North Amherst.
64,	.02	.07	7.00	138.00	78.00	1.56	None.	Deerfield.
65,	.01	.03	21.00	178.00	150.00	2.60	None.	Amherst.
66,	.09	.05	19.00	68.00	50 00	2.60	None.	Amherst.
67,	01	.05	7.00	78.00	18.00	.48	None.	North Hadley.
68,	.08	.06	11.00	114 00	56.00	2.86	None.	East Buckland.
69,	.03	.10	10.00	96.00	68.00	2.99	–	Buckland.
70,	.05	.07	17.00	280.00	190.00	2.86	–	Sunderland.
71,	.06	.05	20.00	236.00	146.00	4.57	None.	Amherst.
72,	Trace.	.02	10.00	88.00	26.00	1.95	None.	North Amherst.
73,	.01	.05	6.00	40.00	18.00	1.43	None.	North Amherst.
74,	Trace.	.03	4.00	16.00	6 00	.16	None.	North Amherst.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per

* One gallon equals 70,000 grains.

million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

The American Association of Official Chemists has appointed a committee to investigate the subject of analyses of water for family use, and to advise upon some uniform method of investigation and of reporting the results. As soon as their recommendation shall be endorsed by the association, we propose to be guided by that decision.

An examination of the previously stated results of analyses, indicate that Nos. 3, 5, 10, 11, 16, 18, 23, 24, 25, 27, 28, 32, 33, 34, 42, 46, 52, 54, 57 and 58, ought to be condemned as unfit for family use, while Nos. 12, 56, 66 and 68 must be considered suspicious. From this record it will be seen that over one-fourth of the entire number of well waters tried proved unfit for drinking. Heating well waters to the boiling point removes, not unfrequently, immediate danger. Seven samples gave unmistakable evidence of the presence of lead.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by W. H. Beal.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1890.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse Salts, Ashes, etc.																							
Muriate of potash,	45	2.00	-	-	-	-	58.98	45.94	**52.46**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.60	.75
Sulphate of potash,	15	1.25	-	-	-	-	51.28	21.36	**38.60**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	13	4.75	-	-	-	-	27.77	18.92	**23.50**	-	-	-	-	-	-	6.25	2.57	12.25	-	44.25	-	2.60	1.41
Kainite,	3	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.12	10.25	-	21.05	-	34.32	1.27
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.57	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (*Kieserite*),	9	22.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	14	1.40	-	16.01	15.30	**15.75**	-	-	-	-	-	-	-	-	-	35.25	-	-	-	-	-	.50	.50
Sulphate of ammonia,	23	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	trace
Saltpetre waste,	8	2.75	-	3.30	.59	**2.43**	30.94	1.85	**15.50**	-	-	-	-	-	-	34.25	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	116	12.00	-	-	-	-	7.95	2.93	**5.25**	4.61	.51	**1.75**	-	-	-	-	34.80	3.25	.83	-	-	-	12.50
Cotton-seed hull ashes,	20	7.33	-	-	-	-	42.12	17.34	**23.80**	13.67	2.89	**8.50**	-	-	-	-	9.50	11.25	1.60	-	-	-	11.79
Ashes of spent tan-bark,	3	6.31	-	-	-	-	2.87	1.14	**2.04**	2.77	.13	**1.61**	-	-	-	-	33.46	3.55	-	-	-	-	24.33

Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue-works,	1	12.74	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	.86	3.16	.36	1.18	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	5	18.18	-	-	-	-	-	-	-	2.72	.06	1.05	-	-	-	-	40.07	.64	.69	-	28.51	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.43	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano, from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	.67	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (*Orchilla*),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.08	-	-	1.27
South Carolina rock phosphate,	4	1.50	-	-	-	-	-	-	-	30.51	25.81	28.03	.27	.33	27.43	-	41.87	3.03	4.80	-	-	-	11.61
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	34.27	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	35.21	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	3	1.45	-	-	-	-	-	-	-	30.51	18.91	23.49	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc. — Concluded.																							
Bone-black,	5	4.60	–	–	–	–	–	–	–	30.54	16.56	**28.28**	–	–	–	–	–	–	–	–	–	–	3.64
South American bone-ash,	1	7.00	–	–	–	–	–	–	–	–	–	**35.89**	–	–	–	–	44.89	–	–	–	–	–	4.50
III. Refuse Substances.																							
Dried blood,	12	12.50	6.37	13.55	8.10	**10.52**	–	–	–	6.23	1.53	**1.91**	–	–	–	–	–	–	–	–	–	–	–
Ammonite,	1	5.88	–	–	–	**11.33**	–	–	–	–	–	**3.43**	–	–	–	–	–	–	–	–	–	–	1.38
Oleomargarine refuse,	1	8.54	14.42	–	–	**12.12**	–	–	–	–	–	**.88**	–	–	–	–	–	–	–	–	–	–	.96
Felt refuse,	1	29.24	33.53	–	–	**5.26**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.44
Sponge refuse,	1	7.25	–	–	–	**2.43**	–	–	–	–	–	**3.19**	–	–	–	–	3.94	1.27	–	–	–	–	39.05
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	**13.25**	–	–	–	2.30	1.36	**1.83**	–	–	–	–	–	–	–	–	–	–	.24
Raw wool,	1	6.95	7.54	–	–	**12.88**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.63
Wool waste,	5	9.27	–	10.20	1.18	**5.64**	3.08	.54	**1.30**	–	–	**.29**	–	–	–	–	.07	.07	–	–	–	–	4.60
Wool washings (water),	1	–	–	–	–	–	–	–	**3.92**	–	–	–	–	–	–	.49	.28	–	–	–	–	–	–
Wool washings (acid),	1	–	–	–	–	–	–	–	**4.20**	–	–	–	–	–	–	.40	.61	.20	–	–	–	–	–
Wool washings (alkaline),	1	92.03	3.28	–	–	**.09**	–	–	**1.09**	–	–	–	–	–	–	.92	.04	–	–	–	–	–	.22

Meat mass, ...	5	12.09	13.60	11.50	9.69	10.44	–	–	–	3.58	.56	2.07	–	–	–	–	–	–	–	–	–	–	.58
Bone soup, ...	1	82.92	7.07	–	–	1.14	–	–	–	–	–	1.26	–	–	–	–	–	–	–	–	–	–	–
Dried soup from meat and bone, . . .	1	14.80	8.40	–	–	9.97	–	–	–	–	–	.53	–	–	–	–	–	–	–	–	–	–	.61
Dried soup from rendering cattle feet, .	1	10.80	7.50	–	–	14.47	–	–	–	–	–	.46	–	–	–	–	–	–	–	–	–	–	.26
Dried soup from horse rendering, . .	1	92.14	–	–	–	1.12	–	–	–	–	–	.14	–	–	–	–	–	–	–	–	–	–	–
Soap-grease refuse, ...	2	29.25	51.39	4.20	2.21	3.21	–	–	–	15.37	11.04	13.21	–	–	–	–	–	–	–	–	–	–	1.29
Bones, ...	106	7.47	56.07	4.70	1.62	4.12	–	–	–	27.76	18.58	23.50	.43	7.85	15.22	–	–	–	–	–	–	–	1.25
Tankage, ...	13	13.20	28.75	8.07	4.60	6.82	–	–	–	16.94	8.76	11.25	.27	4.75	6.23	–	–	–	–	–	–	–	1.23
Fish with less than 20 per cent. water, .	49	12.75	21.50	11.40	6.81	7.25	–	–	–	11.26	5.50	8.25	.55	2.50	5.10	–	–	–	–	–	–	–	2.20
Fish with between 20 and 40 per cent. water,	9	29.34	19.14	7.41	4.22	5.81	–	–	–	8.32	4.68	7.25	.82	2.87	3.56	–	–	–	–	–	–	–	1.85
Fish with over 40 per cent. water, . .	10	45.46	15.50	7.60	2.43	4.97	–	–	–	8.56	2.94	5.08	1.17	1.33	2.58	–	–	–	–	–	–	–	1.35
Whale meat, raw, ...	1	44.50	1.04	–	–	4.86	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lobster shells, ...	1	7.27	–	–	–	4.50	–	–	–	–	–	3.52	–	–	–	–	22.24	1.30	–	–	–	–	.27
Castor-bean pomace, ...	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	–	–	–	–	.87	.29	–	–	–	–	1.75
Cotton-seed meal, ...	7	6.80	5.77	7.26	4.02	6.66	2.09	.89	1.62	3.16	1.26	1.45	–	–	–	–	.39	.99	–	–	–	–	.60
Rotten brewer's grain, ...	1	78.77	–	–	–	.72	–	–	.04	–	–	.43	–	–	–	–	.26	.15	–	–	–	–	.59
Tobacco stems, ...	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	–	–	–	.34	3.89	1.23	–	–	–	–	.82
Cotton waste (wet), ...	1	34.69	–	–	–	1.30	–	–	.80	–	–	1.54	–	–	–	–	2.45	1.13	–	–	–	–	41.33
Cotton waste (dry), ...	2	6.89	–	2.09	1.32	1.71	1.62	.89	1.26	.84	.83	.84	–	–	–	–	1.99	.77	–	–	–	–	34.89
Cotton dust, ...	1	34.46	50.93	–	–	.50	–	–	.19	–	–	.21	–	–	–	–	.90	.90	–	–	–	–	47.46
Glucose refuse, ...	1	8.10	–	–	–	2.62	–	–	.15	–	–	.29	–	–	–	–	.18	.02	–	–	–	–	.07
Hop refuse, ...	1	8.98	–	–	–	.98	–	–	.11	–	–	.20	–	–	–	–	.27	.10	–	–	–	–	.63

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances—Concluded.																							
Sumac waste,	1	63.06	6.80	–	–	1.19	–	–	3.25	–	–	–	–	–	–	–	1.14	3.25	–	–	–	–	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	–	–	–	1.63	2.13	.11	–	–	–	–	1.06
Rockweed, green,	1	68.50	23.70	–	–	.62	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rockweed, dry,	1	10.68	35.75	–	–	1.45	–	–	4.89	–	–	2.75	–	–	–	7.90	7.66	.21	–	–	–	–	10.40
Wet kelp,	1	88.04	2.26	–	–	.26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mussel mud, wet,	1	60.01	27.29	–	–	.21	–	–	6.17	–	–	.10	–	–	–	.70	.93	.14	3.48	–	–	–	–
Mussel mud, dry,	1	2.24	72.02	–	–	.72	–	–	–	–	–	.35	–	–	–	–	23.39	–	8.26	–	–	–	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	–	–	–	–	–	–	.94	.91	.37	4.13	–	–	–	34.88
Fresh-water mud,	1	40.37	–	–	–	1.37	–	–	.22	–	–	.26	–	–	–	–	1.27	.29	1.80	–	–	–	18.26
Black mud,	1	56.55	39.60	–	–	1.64	–	–	.38	–	–	–	–	–	–	.86	.91	.66	4.26	–	–	–	31.84
Muck,	12	55.13	13.75	2.54	.26	1.12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Peat,	9	61.50	7.71	1.40	.41	.75	–	–	–	–	–	–	–	–	–	–	.50	–	–	–	–	–	.38
Turf,	1	19.29	6.36	1.97	1.9[illegible]	1.94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Soot,	1	5.54	77.10	–	–	–	–	–	1.83	–	–	–	–	–	–	–	–	–	–	–	–	–	35.34

IV. Animal Excrement.																							
Barn-yard manure, ...	7	73.27	8.36	.67	.34	**.47**	.80	.48	**.58**	.75	.13	**.36**	–	–	–	–	.30	.19	–	–	–	–	6.75
Poudrette, dry, ...	1	5.25	35.45	–	–	**3.58**	–	–	**.49**	–	–	**5.74**	–	–	–	–	–	–	–	–	–	–	4.65
Hen manure, fresh, ...	1	45.73	–	–	–	**.79**	–	–	**.18**	–	–	**.47**	–	–	–	–	.97	–	–	–	–	–	39.32
Hen manure, dry, ...	1	8.35	–	–	–	**2.13**	–	–	**9.94**	–	–	**2.02**	–	–	–	–	2.22	.62	–	–	–	–	34.64

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1890.

Prepared by W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN — FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	23	30.53	10.34	**19.14**	17.19	8.04	**10.33**	6.10	1.42	**2.42**	63.13	42.02	**55.30**	31.53	19.26	**25.97**	5.98	1:7.99
Fodder corn (ensilaged),	16	28.40	13.12	**20.30**	12.58	6.91	**8.64**	6.07	1.94	**3.84**	65.69	42.99	**56.44**	35.25	17.67	**26.29**	4.99	1:10.22
Sorghum,	6	23.18	12.38	**17.41**	11.84	7.46	**8.74**	2.00	1.21	**1.55**	64.93	47.65	**56.15**	29.27	22.00	**26.73**	6.83	1:11.62
White kibi,*	2	24.26	22.85	**23.56**	15.14	10.79	**12.97**	1.61	1.50	**1.56**	53.66	52.30	**52.91**	31.70	23.03	**27.37**	5.19	–
Mochi millet,*	3	42.27	30.07	**37.42**	11.90	6.11	**9.94**	1.94	1.74	**1.81**	67.08	49.06	**55.69**	29.80	20.01	**25.56**	7.00	–
Mix,*	3	31.36	18.17	**24.45**	16.70	9.81	**13.53**	2.48	1.35	**1.86**	52.30	47.75	**51.27**	27.44	26.82	**27.06**	6.28	–
Green oats,	5	28.82	15.51	**20.03**	20.47	7.05	**13.85**	3.32	2.02	**2.68**	50.69	40.81	**45.90**	33.12	25.2	**29.70**	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	**34.63**	8.83	8.20	**8.52**	2.07	1.95	**2.01**	51.33	51.23	**51.27**	33.23	32.50	**32.87**	5.33	1:10.96
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	**25.93**	–	–	**9.38**	–	–	**1.01**	–	–	**57.80**	–	–	**24.66**	7.15	1:6.86
Vetch and oats (1 part vetch, 9 parts oats),	2	24.04	13.89	**18.97**	10.76	10.59	**10.68**	2.74	2.29	**2.52**	43.75	40.10	**41.91**	35.81	34.20	**35.01**	9.88	1:6.85
Horse bean (*Vicia faba* L.),	1	–	–	**15.17**	–	–	**16.68**	–	–	**2.31**	–	–	**47.09**	–	–	**28.17**	5.75	1:2.71
Cow-pea vines,	3	21.19	18.15	**19.63**	17.93	11.24	**14.59**	2.99	1.81	**2.48**	60.62	46.13	**52.42**	25.88	21.87	**23.59**	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	**17.41**	17.75	12.17	**14.96**	2.65	2.09	**2.37**	41.54	35.45	**38.49**	38.76	26.21	**32.49**	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	–	–	**14.65**	–	–	**18.71**	–	–	**2.41**	–	–	**42.67**	–	–	**31.18**	5.03	–
Spanish moss (*Tillandsia usneoides* L.),	1	–	–	**39.20**	–	–	**4.45**	–	–	**2.54**	–	–	**57.73**	–	–	**32.61**	2.67	–

II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	5	91.94	89.11	**90.28**	10.13	9.02	**9.54**	2.65	2.09	**2.49**	54.43	47.11	**49.26**	35.55	29.21	**32.28**	6.43	1:11.85
Rowen (of mixed hay),	4	91.16	80.29	**86.10**	14.70	11.63	**13.45**	5.03	2.60	**3.91**	53.52	41.92	**45.48**	31.50	25.11	**28.88**	8.28	1:6.36
Timothy hay (*Phleum pratense* L.),	4	92.76	89.45	**91.43**	9.02	7.24	**8.32**	2.65	1.95	**2.20**	54.43	50.01	**51.73**	36.59	29.21	**32.90**	4.85	1:11.44
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	**92.30**	8.40	6.41	**7.88**	1.69	1.50	**1.60**	54.74	50.32	**52.63**	34.11	31.12	**32.92**	4.97	1:12.06
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	**91.17**	11.29	7.57	**8.99**	3.56	2.40	**2.91**	47.34	43.50	**46.15**	35.79	34.12	**34.89**	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	4	92.60	87.84	**90.18**	7.27	5.89	**6.49**	2.17	1.65	**1.84**	49.18	43.95	**47.37**	39.90	34.46	**36.26**	8.04	1:14.32
Perennial rye grass (*Lolium perenne* L.),	4	93.64	90.50	**92.60**	16.56	6.59	**11.71**	3.15	1.59	**2.37**	55.77	38.82	**48.14**	30.86	26.79	**29.64**	8.14	1:7.40
Italian rye grass (*Lolium Italicum* A Br.),	4	92.62	90.70	**91.54**	9.75	6.20	**8.15**	2.07	1.39	**1.85**	52.80	43.09	**49.14**	36.90	31.27	**33.34**	7.52	1:10.90
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	**92.55**	–	–	**9.45**	–	–	**2.22**	–	–	**50.64**	–	–	**31.96**	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	**93.35**	–	–	**15.27**	–	–	**1.95**	–	–	**38.24**	–	–	**33.72**	10.82	1:2.94
Low meadow hay,	1	–	–	**91.99**	–	–	**9.51**	–	–	**1.88**	–	–	**46.27**	–	–	**35.59**	6.75	–
Millet,	5	93.85	91.90	**93.00**	8.11	7.09	**7.59**	2.67	.89	**1.74**	55.80	49.62	**51.64**	35.91	29.80	**33.54**	5.49	1:7.78
Oats in blossom,	1	–	–	**93.57**	–	–	**6.58**	–	–	**2.92**	–	–	**50.03**	–	–	**34.06**	6.41	1:14.23
Oats in milk,	1	–	–	**90.45**	–	–	**10.89**	–	–	**2.69**	–	–	**46.02**	–	–	**34.32**	6.08	1:7.90
Oats, ripe,	1	–	–	**91.30**	–	–	**6.05**	–	–	**2.61**	–	–	**48.92**	–	–	**36.31**	6.11	1:15.03
Winter rye, in bloom,	1	–	–	**91.45**	–	–	**10.66**	–	–	**2.57**	–	–	**47.40**	–	–	**32.97**	6.40	1:8.28
Barley, in milk,	1	–	–	**89.75**	–	–	**10.26**	–	–	**2.76**	–	–	**52.91**	–	–	**29.12**	4.95	1:9.59
Corn fodder,	3	93.35	91.17	**92.62**	8.63	6.17	**7.21**	2.06	1.11	**1.53**	55.68	53.86	**54.98**	33.75	29.05	**31.40**	4.88	1:11.85
Corn stover,	11	94.23	49.87	**81.08**	12.15	6.04	**7.92**	2.63	1.17	**1.65**	63.05	44.65	**53.38**	38.24	20.93	**32.02**	5.03	1:10.88

* Japanese fodder plants.

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodder — Concluded.																		
Teosinte (*Euchlœna luxurians* Dur. and Asch.),	1	–	–	93.94	–	–	9.71	–	–	1.28	–	–	53.18	–	–	28.88	6.95	–
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	1	–	–	93.98	–	–	14.63	–	–	2.62	–	–	43.88	–	–	29.97	8.90	1:5.63
Alsike clover (*Trifolium hybridum* L.),	5	93.92	86.48	90.07	17.55	14.77	16.22	3.26	1.88	2.66	46.64	38.03	43.27	32.34	21.44	26.18	11.67	1:3.37
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.30	34.39	25.42	29.72	8.11	1:4.09
Sand lucerne, in bloom (*M. media* Pers.),	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	1	–	–	93.64	–	–	11.81	–	–	1.85	–	–	51.36	–	–	28.08	6.90	–
Blue melilot (*Melilotus cærulea* Desr.),	1	–	–	91.78	–	–	13.81	–	–	1.67	–	–	43.22	–	–	27.17	14.87	–
Sulla (*Hedysarum coronarium*),	1	–	–	89.54	–	–	17.03	–	–	3.16	–	–	58.66	–	–	12.38	8.77	–
Hairy lotus (*Lotus villosus* Thuill.),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.49	15.07	19.78	8.27	–
Soja bean,	2	93.88	93.52	93.70	15.87	15.10	15.49	6.35	5.62	5.99	51.28	48.25	49.75	21.75	20.76	21.26	7.51	1:4.52
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.59	19.06	21.67	9.29	1:4.82
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.2	44.49	48.18	25.92	24.37	25.15	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	–	–	92.56	–	–	19.58	–	–	1.22	–	–	38.95	–	–	31.88	8.37	–
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.6	2.30	2.50	44.34	43.29	43.80	30.69	30.05	30.37	8.24	1:3.87
Vetch and oats,	1	–	–	87.47	–	–	7.72	–	–	2.53	–	–	49.00	–	–	36.22	4.53	1:11.26

Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55
White daisy (*Chrysanthemum Leucanthemum* L.),	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Dry carrot tops,	1	-	-	90.24	-	-	20.12	-	-	2.01	-	-	50.39	-	-	13.61	13.87	-
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	1:8.24
Beets, sugar,	9	19.53	13.05	15.62	17.44	7.32	10.84	.83	.58	.65	81.50	72.79	77.87	6.98	4.82	6.00	4.64	1:12.15
Beets, yellow fodder,	1	-	-	9.40	-	-	12.78	-	-	1.80	-	-	67.50	-	-	7.83	10.09	1:8.33
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	1:9.94
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	3	12.52	9.95	10.82	9.63	7.98	8.84	3.94	1.67	2.50	73.96	67.24	70.99	10.76	7.55	9.53	8.14	1:9.81
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn kernels and cobs (corn and cob meal),	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.62	9.77	5.39	7.34	1.67	1:8.63
Wheat grain,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18	1:6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans (*Soja hispida* Mönch.),	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans (*Vicia faba* L.),	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24

A. Analyses of Fodder Articles — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver	Max.	Min.	Aver.		
V. Flour and Meal.																		
Corn meal,	18	89.95	82.96	**87.24**	16.08	10.19	**11.26**	5.08	3.10	**4.35**	83.24	73.20	**80.34**	3.60	1.20	**2.42**	1.63	1:8.94
Hominy meal,	3	91.89	89.30	**90.75**	11.88	11.20	**11.61**	12.22	4.89	**9.33**	78.07	68.00	**72.55**	4.78	3.69	**4.08**	2.43	1:8.82
Ground barley,	2	87.81	86.39	**87.10**	11.17	10.42	**10.80**	2.19	1.69	**1.94**	78.25	77.45	**77.79**	7.37	6.85	**7.11**	2.36	1:9.72
Broom-corn meal,	1	–	–	**86.46**	–	–	**11.14**	–	–	**4.13**	–	–	**74.30**	–	–	**8.00**	2.43	–
Pea meal,	1	–	–	**91.15**	–	–	**20.95**	–	–	**1.67**	–	–	**55.02**	–	–	**19.42**	2.94	–
VI. By-products and Refuse.																		
Linseed cake, old process,	4	92.52	89.54	**90.82**	38.67	30.98	**36.26**	7.98	5.69	**6.83**	44.72	37.76	**41.02**	9.69	8.04	**8.73**	7.16	1:1.67
Linseed cake, new process,	2	93.99	91.42	**92.71**	40.76	32.50	**36.63**	3.18	3.14	**3.16**	46.49	40.83	**42.66**	10.31	9.23	**9.77**	6.78	1:1.45
Cotton-seed meal,	7	93.16	90.11	**91.92**	47.04	18.17	**42.22**	14.72	5.22	**13.48**	54.55	25.03	**28.02**	14.80	6.28	**8.22**	8.06	1:1.45
Wheat bran,	20	91.90	86.30	**89.30**	20.24	15.67	**17.56**	6.08	2.80	**4.83**	62.18	56.89	**59.87**	14.26	7.49	**10.83**	6.91	1:3.85
Wheat middlings,	3	90.75	89.45	**90.45**	19.21	17.23	**18.21**	6.46	3.19	**4.63**	74.30	61.62	**69.60**	8.40	1.40	**4.11**	3.45	1:4.10
Wheat shorts,	2	91.13	89.67	**90.40**	17.28	16.71	**17.00**	5.86	5.52	**5.69**	61.71	58.03	**59.86**	11.21	8.58	**9.90**	7.55	1:4.09
Rye bran,	2	91.82	86.30	**89.06**	18.98	16.52	**17.75**	3.03	2.07	**2.55**	73.56	69.24	**71.70**	4.54	3.46	**4.00**	4.30	1:4.88
Rye middlings,	1	–	–	**87.46**	–	–	**13.15**	–	–	**5.61**	–	–	**73.52**	–	–	**3.70**	4.02	1:7.28
Gluten meal,	17	92.15	88.32	**90.36**	39.28	28.24	**31.58**	9.34	3.92	**6.59**	66.26	48.84	**60.19**	4.74	.41	**1.12**	.59	1:2.39
Refuse from starch works,	1	–	–	**42.96**	–	–	**22.41**	–	–	**10.17**	–	–	**58.98**	–	–	**7.54**	.90	–

Spent brewer's grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	1:3.06
Cocoa dust, from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.2	72.56	16.58	13.15	14.86	1.46	-
Apple-pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar-beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles, with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
I. Green Fodders.												
Corn fodder,	4	72.64	.564	1.64	.620	.102	.312	.132	.042	.281	.703	$2 78
Corn fodder, ensilage,	1	71.60	.360	1.32	.330	.050	.100	.090	.020	.140	.040	1 68
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	2 09
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 65
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 38
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	2 14
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 58
Horse bean,	1	74.71	.675	1.45	1.370	.090	1.370	.620	.200	.330	2.040	3 87
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 51
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 92
White lupine,	1	85.35	.440	.74	1.730	.680	3.070	.730	.170	.350	.900	3 39
Spanish moss (*Tillandsia*),	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 20
II. Hay and Dry Coarse Fodders.												
English hay (mixed hays),	3	11.26	1.370	6.34	1.541	.077	.401	.197	.045	.352	.890	6 38
Rowen,	2	12.48	1.746	9.57	1.966	.168	.814	.250	.064	.464	1.920	8 16

Timothy hay,	2	7.52	1.260	4.93	1.530	.220	.710	.100	–	.460	1.170	6 14
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.362	1.736	5 20
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 55
Meadow fescue,	4	9.79	.942	7.88	2.005	.225	.566	.160	.030	.343	1.883	5 31
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	6 16
Italian rye grass,	2	8.29	1.150	6.89	.992	.595	1.072	.306	.098	.552	2.899	5 41
Salt hay,	1	5.36	1.180	–	.718	.017	.371	.335	.028	.248	–	4 92
Corn fodder,	4	–	1.800	4.91	.760	.010	.600	.690	.070	.510	1.650	7 38
Corn stover,	2	28.24	1.118	3.74	1.320	.794	.524	.257	.056	.303	.811	5 28
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 72
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	9 38
Medium red clover,	1	10.72	2.089	8.36	2.201	.192	1.838	.402	.061	.436	.254	9 49
Alsike clover,	5	9.93	2.331	11.11	2.008	.317	2.209	.537	.216	.703	1.746	10 46
Lucerne (*alfalfa*),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 92
Bokhara clover,	1	6.36	1.770	6.46	1.673	.077	1.938	.373	.025	.436	.013	7 96
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	9 55
Sulla,	1	10.46	2.441	7.85	1.872	.362	2.791	.378	.147	.424	.987	10 40
Lotus villosus,	1	12.36	2.259	7.32	1.550	.633	2.861	.615	.148	.500	1.053	9 50
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	9 54
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 96
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	10 64
Vetch and oats,	2	11.98	1.368	10.96	.903	.199	.539	.253	.137	.525	.212	6 05

B. Analyses of Fodder Articles, with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	$2 54
Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	15 52
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	1 31
Beets, sugar,	2	84.65	.250	.80	.285	.151	.056	.037	.018	.083	.066	1 19
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 14
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 06
Ruta-bagas,	2	87.82	.210	1.10	.500	.160	.090	.030	.003	.131	.010	1 30
Turnips,	1	87.20	.221	1.01	.412	.133	.117	.033	.009	.116	.072	1 22
Carrots,	1	90.02	.140	.88	.540	.110	.070	.020	.010	.100	.010	1 06
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	1 03
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	49
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	6 37
Corn kernels and cobs (cob meal),	4	10.00	1.460	1.45	.441	.121	.057	.162	.004	.603	.091	6 05
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	21 96

V. Flour and Meal.												
Corn meal,	2	13.52	**2.05**	1.42	**.435**	.064	.034	.187	.015	**.707**	.005	7 85
Hominy feed,	1	8.93	**1.63**	2.21	**.490**	–	.180	.280	–	**.980**	–	6 14
Ground barley,	1	13.43	**1.55**	2.06	**.341**	.169	.091	.173	.013	**.660**	.669	6 25
Wheat flour,	1	9.83	**2.21**	1.22	**.540**	–	.170	.050	–	**.570**	–	8 65
Pea meal,	1	8.85	**3.08**	2.68	**.993**	.618	.302	.302	.027	**.820**	.122	11 31
VI. By-products and Refuse.												
Linseed cake, old process,	3	7.79	**6.021**	7.13	**1.162**	–	.656	.799	.060	**1.646**	.355	23 44
Linseed cake, new process,	2	6.12	**5.396**	5.33	**1.160**	–	.552	.534	.047	**1.420**	.152	21 02
Cotton-seed meal,	6	8.36	**6.41**	6.27	**1.620**	.190	.710	1.100	.190	**2.090**	.501	25 68
Wheat bran,	4	11.01	**2.88**	6.44	**1.620**	.180	.200	.900	.020	**2.870**	.130	14 77
Wheat middlings,	1	9.18	**2.63**	2.30	**.630**	.110	.200	.210	–	**.950**	–	10 63
Rye middlings,	1	12.54	**1.84**	3.52	**.810**	.030	.090	.320	.020	**1.260**	.170	8 46
Gluten meal,	4	8.53	**5.43**	.65	**.045**	.018	.050	.035	.069	**.425**	–	19 01
Spent brewer's grain,	1	6.98	**3.05**	6.15	**1.550**	.347	.296	.286	.159	**1.260**	1.770	12 14
Cocoa dust,	1	7.10	**2.299**	6.35	**.630**	–	.630	–	–	**1.340**	–	11 22
Broom-corn waste (stalks),	1	10.37	**.870**	4.70	**1.858**	–	.242	.170	–	**.460**	1.000	5 09
Cotton hulls,	3	10.63	**.750**	2.61	**1.080**	–	.200	.260	–	**.180**	.060	3 74
Apple pomace,	2	80.50	**.227**	.271	**.134**	.026	.037	.028	.008	**.018**	.009	90
Corn cobs,	8	12.09	**.504**	.815	**.598**	.071	.025	.045	.009	**.063**	.190	2 44
Palmetto root,	1	11.51	**.540**	3.93	**1.380**	.345	.045	.004	.017	**.157**	.410	3 20

NOTE. — Basis of valuation, nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4¼ cents per pound.

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12—15	3.09	–	–	–
Apple (Baldwin), ...	Oct. 9,	19.66	1.065	12—15	6.25	–	–	–
Apple (Baldwin), ...	Nov. 27,	–	1.075	12—15	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	–	–	–
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	–	–	–
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	–	–	–
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	12—15	4.77	–	–	–
Pear (Bartlett), ...	Sept. 7,	16.55	1.060	12—15	5.68	–	–	–
Pear (Bartlett), ...	Sept. 20,	–	1.065	12—15	8.62	–	–	–
Pear (Bartlett),‡	Sept. 22,	–	1.060	12—15	8.93	–	–	–
Cranberries, ...	–	10.71	1.025	15	1.35	–	–	–§
Cranberries, ...	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), . .	–	–	1.045	25	–	1.92	6.09	45
Early York Peach (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe), .	–	–	1.050	18	–	2.19	7.02	85.6
Crawford Peach (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
Crawford Peach (not mellow), .	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C. C.
Concord, ...	July 17,	1.0175	31	8.30	.645	7.77	–
Concord, ...	July 20,	1.0150	31	8.10	.625	7.72	216
Concord, ...	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord, ...	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord, ...	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord, ...	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord, ...	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape, . . .	July 19,	1.020	31	9.00	.714	7.93	204
Purple Wild Grape, . . .	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Purple Wild Grape, . . .	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Purple Wild Grape, . . .	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape, . . .	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific, ...	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seeding, ...	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona, ...	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed), ...	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam, ...	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder, ...	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware, ...	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak, ...	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella, ...	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling, ...	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack, ...	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba, ...	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder, ...	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak, ...	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord, ...	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord, ...	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan, ...	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape, . . .	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled), .	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled), .	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2CO_3 in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	*Soda Solution required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled, .	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled, . .	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled, . . .	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled, ...	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled, . . .	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled, ...	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled, . . .	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled, ...	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled, ...	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled, ...	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled, . . .	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled, ...	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled, . . .	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled, ...	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled, . . .	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled, ...	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained —			Soda Solution required for 100 parts of Grapes.
		Ash.	Moisture.	Grape Sugar.	
	1889.				
Concord, not girdled, . . .	Sept. 23,	–	84.69	6.24	75
Concord, girdled, ...	Sept. 23,	.42	83.00	8.13	85.4
Concord, not girdled, . . .	Oct. 8,	.53	84.51	6.09	48
Concord, girdled, ...	Oct. 8,	.37	82.69	8.50	50

* One part Na_2 CO_3 to 100 parts of water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Grape Sugar.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	–	–	13.51	–	Fertilized.
Wild Purple Grape Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	–	–	–	–	Unfertilized.
Wild White Grape Berries, .	"	21.65	–	–	–	–	Fertilized.
Wild White Grape Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, . .	"	–	–	–	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. *Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 PARTS OF ASH CONTAINED —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches, *	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine, †	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63 54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit), ‡	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit), §	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased, ‖	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased, ‖	–	15.67	–	64.23	10.28	1.45	8.37	–
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,*	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	Saxony, .	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial, ...	Saxony, .	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	Saxony, .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, ...	Saxony, .	$1\frac{1}{2}$ to 2	13.10
II. White Magdeburg, ...	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . . .	12.55	13.24	10.50
Kainite and superphosphate, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

LOCALITY OF BEET-FIELD.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872–73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2 50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 14 lbs.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

WHERE GROWN.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs.	15.4°	64° F.	11.38
Reviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,* . .	4.2	27	2.48	None	6.8	7.93
Aug. 16, .	No flower stalks in sight,* . .	5.8	24	4.06	None	9.0	11.10
Aug. 20, .	Flower stalks developed,* . .	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,* . . .	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* .	13.2	22	3.57	7.65	–	–
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18, .	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18, .	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21, .	Juice from the above,* . . .	13.0	21	–	–	–	–
Sept. 23, .	Juice from the above,* . . .	15.0	18	–	–	–	–
Sept. 25, .	Left on field 3 weeks,† . . .	19.8	21	11.91	6.27	–	–
Sept. 28, .	Left on field 3 weeks,† . . .	17.8	12	16.60	–	–	–
Oct. 4, .	Left on field 3 weeks,† . . .	16.1	17	8.62	6.16	12.0	–
Oct. 7, .	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8, .	Freshly cut. Stripped 2 weeks,† .	12.8	17	5.16	5.27	7.0	–
Oct. 9, .	Freshly cut. Stripped 2 weeks,† .	18.4	17	7.57	–	10.6	–
Oct. 14, .	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18, .	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19, .	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22, .	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23, .	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24, .	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 Parts of Cane contained —				
		Moisture.	Grape Sugar.	Cane Sugar.	Total Sugar.	
1879.						
October, .	Early Tennessee sorghum, mature, .	77.43	1.79	3.21	5.00	Grown on station grounds.
October, .	Price's new hybrid, ripe, . . .	77.80	2.92	3.78	6.70	
October, .	Kansas orange, green, . . .	80.67	2.38	3.63	6.01	
October, .	New orange, green, ...	78.30	2.96	3.85	6.81	
October, .	Honduras, green, ...	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4.85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon, ¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon, **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	50	16.70	11.96	13.60	5.45	2.48	3.95	–	–	3.20	–	–	–	.70
Skim-milk,	–	–	–	10.19	–	–	.37	–	–	3.53	–	–	–	.80
Buttermilk,	–	–	–	8.16	–	–	.21	–	–	2.79	–	–	–	.80
Cream,	54	28.51	22.65	25.03	20.90	13.74	16.99	–	–	–	–	–	–	.62
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	–
Whole-milk cheese (Jersey),*	1	–	–	62.84	–	–	37.32	–	–	22.13	–	–	–	3.39
Whole-milk cheese,*	1	–	–	64.17	–	–	34.34	–	–	26.69	–	–	–	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	–	–	62.70	–	–	27.81	–	–	30.37	–	–	–	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	–	–	57.76	–	–	23.42	–	–	31.99	–	–	–	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	–	–	56.05	–	–	17.67	–	–	33.24	–	–	–	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	–	–	54.59	–	–	15.77	–	–	34.94	–	–	–	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	–	–	51.62	–	–	18.35	–	–	28.63	–	–	–	4.64
Genuine oleomargarine cheese,*	1	–	–	62.10	–	–	31.66	–	–	25.94	–	–	–	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	3.16	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3 000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine sâlt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98 520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97 650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98 202	.877	.168	.046	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	

METEOROLOGY.

1889.

Our weather observations have been conducted on the same general plan as in previous years, being essentially the same as that recommended to voluntary observers of the United States Signal Service. Besides this, we have during the summer months forwarded to a signal officer at Cambridge, Mass., a weekly report of temperature, rainfall and sunshine, and their effects as observed on the growth of crops in this vicinity. This report was for use of the New England Meteorological Society and the United States Signal Service in preparing a weekly weather and crop bulletin.

The winter months of 1889 were exceptionally mild. Our lowest temperature during that time was nine degrees below zero. Ice did not form thick enough to be cut until the first part of February. There was no snow on the ground until the 20th of January. Sleighs were in use from that date until the last week in February; most of the time, however, hardly enough snow for good sleighing. A snow-storm, amounting to 4.5 inches, occurred on March 31 and April 1. This snow quickly disappeared.

On account of the warm and dry weather during the spring, the ground was prepared and planted somewhat earlier than usual. Heavy frosts occurred May 4 and 29; the latter touched our more tender crops, but apparently did not affect corn or potatoes.

February, March and April were our driest months; less than three inches of water fell during February and March. The rains of May were abundant and well distributed. During June, July and the first part of August, an unusual number of rainy days interfered seriously with farm work; considerable damage was done in our vicinity to partially cured hay and grain.

The average temperature of July and August was lower than usual. The cool weather during those two months retarded the ripening of corn, and was evidently injurious to most crops, judging from the unusual prevalence of fungous diseases.

The first frost occurred September 23; the first snow-fall occurred November 27, and the first snow-storm, December 5, amounting, in the latter case, to an inch and a half of snow. The severest snow-storm, amounting to 6.5 inches of snow, occurred December 14. Both of these snows disappeared soon.

During eight months of the year the prevailing wind was north-west; during March, September and October, the prevailing direction was north-east; and during June, south-west.

The rainfall during the year amounted to 43.72 inches, which is slightly below the average. The number of days on which an appreciable quantity of water fell was 128. The largest number occurring in one month was 15, in July; the smallest, 7, in August. The largest rainfall for one month was 8.35 inches, in July; the smallest, 1.45 inches, in February.

During the first seven months of the year there were fifty-four days during which the sky was more than seven-tenths overcast by clouds at each observation. During the last five months, when a more detailed system of taking the observation was used, sixty-six days were noticed "cloudy;" twenty cloudy days occurred in September. On twenty-three days during the first seven months, the sky was found less than four-tenths overcast at each observation. April and June had each but one "clear" day; during the last five months there were but twenty-four clear days.

The mean annual temperature was 47.78 degrees, which is nearly 1 degree above the average. The highest temperature for the year was 89 5 degrees, occurring May 9; the lowest, — 9 degrees, occurring February 24. The maximum for 1888 was 94.5 degrees, on July 23; the minimum, — 21.5 degrees, January 23. The absolute range of temperature for 1889 was 98.5 degrees, against 116 for 1888, 115.2 for 1887, and 117 for 1886.

Summary of Meteorological Observations, 1889.

	Temperature, Degrees Fahrenheit.											Relative Humidity, Per Ct.				Precipitation, Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	25.5	35.2	30.2	30.3	49.1	16.1	33.0	58.0	9th	0.5	23d	-	-	-	-	3.29	9th
February,	15.6	25.8	20.8	20.8	37.9	1.9	36.0	42.0	17th	—9.0	24th	-	-	-	-	1.45	18th
March,	30.7	42.5	35.3	35.9	49.9	27.6	22.3	63.5	24th	14 0	1st	-	-	-	-	1.46	31st
April,	42.0	56.4	45.4	47.4	63.9	32.9	31.0	78.0	19th	25.0	23d	80.7	49.1	71.7	67.2	2.42	1st
May,	53.4	69.2	58.0	59.8	72.6	45.5	27.1	89.5	9th	31.0	4th	83.9	53.6	75.9	71.1	4.15	27th
June,	61.6	73.9	64.9	66.4	76.4	53.6	22.8	88.5	30th	38.0	7th	89.2	61.0	84.0	78.0	3.85	11th
July,	65.0	75.0	66.2	68.1	74.1	58.5	15.6	86.0	8th	46.5	16th	89.2	66.9	85.7	80.6	8.35	29th–31st
August,	58.7	74.0	62.5	64.4	74.7	58.1	16.6	84.0	31st	40.5	29th	94.4	61.2	88.0	81.2	2.69	14th
September,	56.3	67.9	59.7	60.9	72.6	46.1	26.5	82.5	6th	34.5	23d	92.0	67.6	84.7	81.4	2.90	17th–19th
October,	39.8	53.2	44.0	45.2	60.8	32.7	28.1	69 5	1st	21.0	24th	-	-	-	-	4.10	27th
November,	37.0	45.8	39.8	40.6	51.1	24.1	27.0	62.5	3d	14.5	17th	-	-	-	-	6.21	27th–28th
December,	29.6	38.9	32.8	33.5	48.9	11.1	37.8	64.0	25th	3.5	4th	-	-	-	-	2.85	8th–9th
Sums,	515.2	657.8	559.6	573.3	732.0	408.2	323.8	868.0	-	260.0	-	529.4	359.4	490.0	459.5	43.72	-
Means,	42.94	54.82	46.63	47.78	61.00	34.02	20.98	72.33	-	21.67	-	88.23	59.90	81.67	76.58	3.64	-

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Solar Halos.	Lunar Halos.
January, .	4, 5, 13, 15, 26,	20, 21, 27, 28,	5, 6, 7, 9, 16, 17,	–	–	15.
February, .	11,	6, 8, 9, 11, 12, 18, 27.	5, 16, 17,	–	–	–
March, .	1, 13, 15,	31,	4, 5, 6, 16, 17, 28, 29.	28,	–	–
April, . .	7, 10, 11, 15, 23,	1,	1, 3, 20, 25, 26, 27, 28.	20,	–	11, 15, 16.
May, . .	4, 29,	–	10, 11, 13, 14, 20, 21, 25, 26, 27, 30, 31.	10, 14, 25,	–	–
June, . .	7,	–	1, 2, 4, 6, 8, 10, 11, 12, 15, 17, 22, 26.	10, 11, 15,	3,	–
July, . .	–	–	2, 3, 4, 8, 9, 10, 11, 14, 15, 20, 27, 29, 30, 31.	7, 8, 29, 30,	–	–
August, .	–	–	1, 3, 5, 9, 13, 14, 15,	3, 14,	–	–
September, .	23,	–	11, 12, 13, 17, 18, 19, 20, 25, 26, 30.	17,	–	–
October, .	3, 5, 8, 9, 11, 12, 16, 17, 19, 22, 24.	–	1, 6, 7, 10, 12, 13, 20, 21, 22, 26, 27, 28, 29, 31.	–	–	–
November, .	4, 11, 16, 17, 18,	–	2, 3, 9, 10, 11, 13, 19, 20, 21, 22, 23, 27, 28.	–	–	1, 8.
December, .	5, 10, 22, 24, 29, 31.	5, 14,	8, 9, 10, 11, 18, 19, 22, 24, 29.	–	–	–

Record

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter, beginning with the year 1836.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23 026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720*	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24 510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25 276	1867, . . .	67.920

Record of Temperature, etc. — Concluded.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30.506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24.220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893
1888–89, . .	27.170	1889, . . .	66.300

C. A. GOESSMANN,
Director.

James P. Lynde, *Treasurer*, *in account with* Massachusetts Agricultural Experiment Station.

1889.	Received.		1889.	Expended.	
	From State Treasurer, ...	$10,000 00		Transferred to Hatch funds, ...	$705 33
	Dr. C. A. Goessmann, director, receipts at station, ...	991 75		Salaries, ...	5,057 52
	Dr. C. A. Goessmann, director, fees for certificates of analysis of commercial fertilizers, . .	1,530 00		Laboratory supplies, ...	927 48
				Printing and postage, ...	509 40
				Office expenses, ...	126 53
				Farmer and labor, ...	2,600 92
				Farm supplies, ...	610 72
				Stock, ...	363 52
				Feed, ...	354 02
				Miscellaneous expenses, ...	598 37
				Construction and repairs, ...	464 64
				Expenses Board of Control, . . .	188 30
				Cash in bank, ...	15 00
		$12,521 75			$12,521 75

Examined, compared with the vouchers, found correct and approved. Wm. R. Sessions, *Auditor*.

INDEX.

INDEX

TO SEVENTH ANNUAL REPORT, 1889.

PUBLIC DOCUMENT. No. 33.

EIGHTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

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MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

BOARD OF CONTROL, 1890.

STATION STAFF.

C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*, . Amherst.
J. E. Humphrey, S.B., *Vegetable Physiologist (Mycologist)*, Amherst.

Assistants.

W. H. Beal, A B., M.E , . .	*General and Analytical Chemistry.*
E. R. Flint, B S.,* . . .	" " " "
R. B. Moore, B.S., . . .	" " " "
C. S. Crocker, B.S., . .	" " " "
B. L. Hartwell, B.S., . .	" " " "
H. D. Haskins, B S., . .	" " " "
C. H. Jones, B S., . . .	" " " "
W. A. Parsons, B S., . .	*Field Experiments and Stock Feeding.*
David Wentzell, . . .	*Farmer.*

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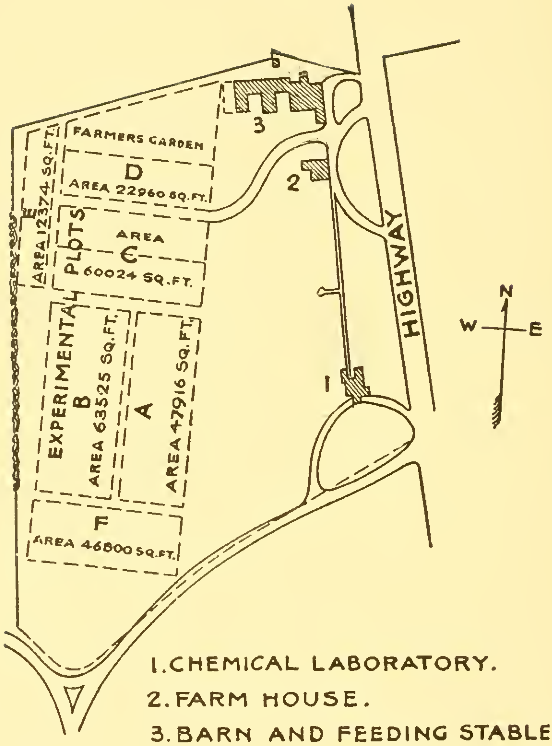
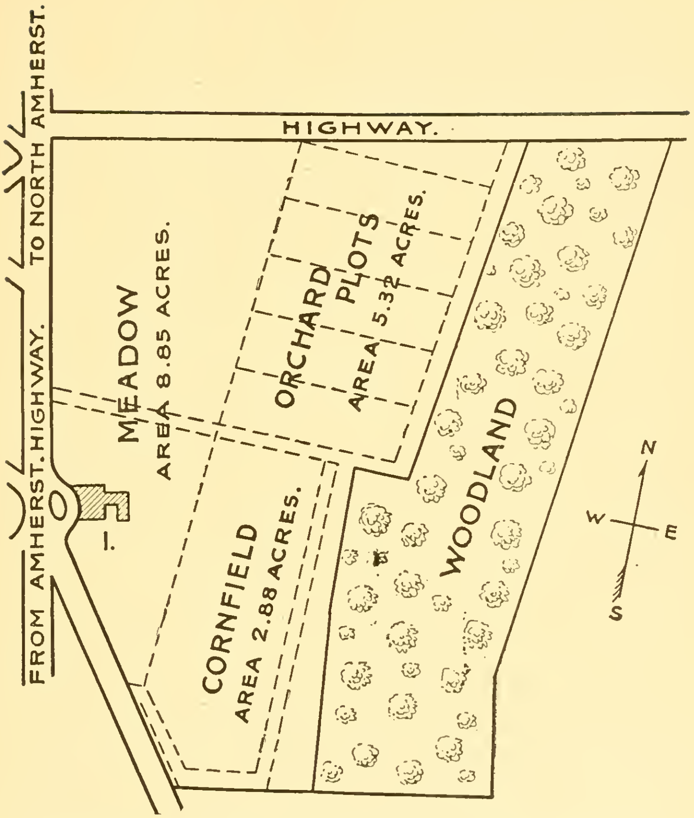
* Resigned July 1, 1890.



1. CHEMICAL LABORATORY.
2. FARM HOUSE.
3. BARN AND FEEDING STABLES.

·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·



I. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP·OF·LAND·LEASED·TO·THE
MASSACHUSETTS·EXPERIMENT·STATION
·FROM·THE·
AGRICULTURAL·COLLEGE·FARM
EAST·OF·THE·HIGHWAY
AREA·TAKEN·30.52·ACRES

Boston, Jan. 9, 1891.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Eighth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
Secretary.

EIGHTH ANNUAL REPORT

OF THE

DIRECTOR OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The present condition of the State Agricultural Experiment Station may be considered a satisfactory one, as far as buildings and general outfit are concerned. The older buildings are in a good state of repair, and the new ones are well equipped for the purpose they are to serve.

The experimental work of the past year has been extensive, and in various directions. A favorable season has materially assisted in a successful termination of the work in the field.

No material changes have been made in regard to different lines of observation, decided upon at the beginning of the year. The details of the management have been carried out, as far as practicable, according to the plans from time to time presented for your consideration. Investigations in the laboratory, the vegetation house, the field and the barn, have received their due share of attention.

Professor Humphrey has continued his study of fungoidal diseases of plants, in various directions. A detailed description of his work in that connection forms a chapter in the annual report.

A series of field experiments, inaugurated at the close of the past season (1890), for the purpose of studying the effect of different forms of nitrogen and of phosphoric acid on the growth of winter rye and winter wheat, has been supplemented by control observations in pots in the vegetation house.

A number of reputed fodder crops, more or less new to the soil of Massachusetts, have been studied with regard to their adaptation to our climate and soil. Some of these have been raised in sufficient quantity to test their services as green fodder or hay for milk production.

Feeding experiments with milch cows with reference to an economical production of milk, and with young pigs for a remunerative production of pork, have been continued.

Considerable attention has been paid to the cost of the feed for the production of mutton and beef.

The work in the chemical laboratory has been, as usual, quite large, and for different purposes. The chemical analyses made at the station laboratory during the entire year, aside from four hundred analyses for the Hatch Station of the Agricultural College, number some nine hundred. Of these, from three hundred to four hundred were made at the special request of farmers in the State. They include analyses of fertilizers, fodder articles, well water, milk, etc.

The details of the work carried on in the directions previously stated are recorded in the subsequent pages of the annual report for 1890, under the following headings: —

Feeding Experiments.

I. Two feeding experiments with milch cows.

1. Some general remarks on our previous feeding experiments with milch cows.
2. Feeding experiment with milch cows, to compare the value of old-process linseed meal with that of new-process linseed meal.
3. Feeding experiment with milch cows, to compare the economical value of reputed fodder crops, — vetch and oats, and soja bean, — when fed as green fodder in part or in whole for English hay.
4. Creamery record for 1889 and 1890.

II. Feeding experiments with lambs, to ascertain the cost of feed when fattening lambs, by means of winter fodder rations, for the meat market.

III. Feeding experiments with pigs, — skim-milk, corn meal, corn and cob meal, wheat bran and gluten meal, serving as fodder ingredients of the daily diet.

IV. Fodder analyses, 1890.

Field Experiments.

V. Some suggestions regarding the question, How can we improve in an economical way the productiveness of our farm lands?

VI. Experiments to ascertain the effect of different combinations of nitrogen on oats.

VII. Field experiments with prominent grasses and leguminous plants, to study their composition and general economical value.

VIII. Field experiments with reputed field and garden crops, to ascertain their adaptation to our soil and climate.

IX. Field experiments to study the economy of using different commercial sources of phosphoric acid for manurial purposes in farm practice, — potatoes.

X. Experiments with grass land.

XI. Report on general farm work.

XII. Professor Humphrey's report.

Special Work in the Chemical Laboratory.

XIII. Analyses of licensed commercial fertilizers.

XIV. Miscellaneous analyses of material sent on for examination.

XV. Water analyses.

XVI. Compilation of fodder analyses, with reference to fodder constituents and fertilizing constituents; analyses of industrial products, garden crops, fruits, etc., made at Amherst, Mass.

XVII. Meteorological observations.

The periodical publications of the station have been as numerous as in previous years. The circulation of bulletins and annual reports is steadily increasing.

In closing, it becomes a pleasing duty to acknowledge that the successful termination of the work carried on at the station during the past year is largely due to the industry and faithful execution of the various tasks assigned to all parties associated with me for that purpose.

With the assurance of my sincere thanks for your kind indulgence, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

Amherst, Mass., Jan. 9, 1891.

ON FEEDING EXPERIMENTS.
1890.

I. Two Feeding Experiments with Milch Cows.
II. One Feeding Experiment with Lambs.
III. Two Feeding Experiments with Pigs.
IV. Fodder Analyses.

I.

1. Some general remarks on our previous feeding experiments with milch cows. 2. Feeding experiments with milch cows, to compare the value of old-process linseed meal with that of new-process linseed meal, when fed pound for pound under otherwise corresponding conditions. 3. Feeding experiments with milch cows, to compare the economical value of reputed fodder crops, — vetch and oats, and soja bean, — when fed as green fodder in part or in whole as substitutes for English hay. 4. Creamery record for 1889 and 1890.

1. Some General Remarks on our Previously Reported Feeding Experiments with Milch Cows.

A careful examination of our last annual report cannot fail to show that our feeding experiments with milch cows, previous to the close of 1889, were chiefly instituted for the purpose of securing a satisfactory answer to the following questions: —

1. What is the comparative feeding effect of dry fodder corn, of dry corn stover, and of a good corn ensilage, when used in part or in the whole as a substitute for English hay (upland meadow hay), in the daily diet of milch cows, and also that of a good root crop in place of corn ensilage; the amount and kind of grain feed remaining, for obvious reasons, the same under otherwise corresponding circumstances?

2. What is the *total cost*, as well as the *net cost*, of the *daily feed* per head in case of the different fodder combinations used; making in all cases alike an allowance of a loss of twenty per cent. of the fertilizing constituents contained in the feed consumed, in consequence of the sale of the milk?

3. What is the commercial value, at current market rates, of the manurial refuse obtainable in the case of different fodder combinations used as daily diet for the support of cows, assuming that eighty per cent. of the value of the fertilizing constituents contained in the fodder consumed can be secured to the farm by a careful management?

The results of these experiments, which extend over a period of five successive years, 1885–89, were summed up in the following statements: —

1. The high nutritive value of fodder corn, corn stover and good corn ensilage, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animal on trial, as well as the quality and the quantity of the milk obtained, point in that direction.

2. To produce one quart of milk, using the same quantity and quality of grain feed, required in every instance a larger quantity of perfectly dried hay than of either fodder corn, corn stover or corn ensilage, in a corresponding state of dryness, — corn stover leading.

3. The net cost of feed in the case of the same ration of grain feed is from one-third to one-half less per quart of milk, when fodder corn, corn stover or corn ensilage serve as substitutes for English hay in the daily diet of milch cows; corn fodder, as a rule, leading, while corn stover leads the corn ensilage in four out of six cases.

4. Sugar beets, as well as carrots, when fed pound for pound of dry matter in place of part of the hay ration, with the same kind and quantity of grain feed, have raised almost without an exception the temporary yield of milk; exceeding, as a rule, the corn ensilage in that direction.

5. Corn ensilage, as well as roots, proved best when fed in place of one-fourth to one-half of the full hay ration. From twenty-five to twenty-seven pounds of roots, or from

thirty-five to forty pounds of corn ensilage per day, with all the hay called for to satisfy the animal in either case, seems, for various reasons, a good proportion, allowing the stated kind and quantity of grain feed.

6. The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids.

The valuation of the fodder ingredients is based in this connection on the average of the local market price per ton of each article for the entire period of observation : —

Corn meal,	$22 75	Fodder corn,	$5 00
Wheat bran,	21 00	Corn stover,	5 00
Gluten meal,	24 50	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices : *i. e.*, nitrogen (per pound), 17 cents ; phosphoric acid, 6 cents ; and potassium oxide, 4¼ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management, while twenty per cent. is assumed to be sold with the milk.

For further details, see seventh annual report of station, pages 37–47, and 73–84.

It will be apparent, from the above statements, that it was the main aim of our feeding experiments with milch cows, during the years 1885–89, to compare the relative feeding value of our *current coarse fodder articles* with each other, — as, English hay, rowen, fodder corn, corn stover, corn ensilage and roots. To do this judiciously required in all cases the use of the same quantity and quality of grain feed. It is for this reason chiefly that the latter was confined to the same quantity of corn meal, corn and cob meal, wheat bran and gluten meal.

These articles were at any time at our disposal in our local market; all of them could claim a fair reputation for milk production.

During the past year *we have changed the object of our feeding experiments* with milch cows. Having made ourselves, as far as practicable, familiar with the feeding effect and general economical value of our current *coarse home-raised fodder articles*, it was decided to compare the feeding value of our prominent concentrated fodder articles (grains, brans, oilcakes, gluten meal, starch feed, etc.) with each other, under otherwise corresponding circumstances.

Some experiments with the two kinds of linseed meal (old and new process) are described within a few subsequent pages.

2. *Feeding Experiments with Milch Cows.*

Old-process linseed meal *vs.* new-process linseed meal, Dec. 11, 1889–July 2, 1890.

The feeding experiments subsequently described were instituted chiefly for the purpose of comparing the effect of new-process linseed meal with that of old-process linseed meal, on the *quantity* and *quality* of milk produced, and on *the cost of feed* consumed, when fed *in equal weights* as an ingredient of an otherwise corresponding daily diet of milch cows. This inquiry into the respective merits of both kinds of linseed meal for dairy purposes has been undertaken in response to frequent inquiries regarding that point on the part of dairymen in our State. The old-process linseed meal is sold, in our local markets, at $27 per ton of 2,000 pounds, and the new-process linseed meal of the Cleveland Linseed Oil Company at $26 for the same weight. The first-named article is obtained when the seed is subjected to the action of a powerful press to secure its oil; while the latter is produced by the aid of a new process, owned by the Cleveland company. The new process favors a more thorough abstraction of the oil, and involves, it is stated, a boiling of the seeds. The difference in the treatment of the seed, for the separation of the oil, explains one of the most characteristic differences in the composition of both kinds of linseed meal; for old-process linseed meal contains, as a rule, a larger percentage of oil or fat, and a smaller one of organic-nitrogen-containing matter, than the new-process linseed meal. Aside from the stated causes of differences in their composition, there are various other circumstances which not unfrequently contribute towards serious variations in the composition of individual samples of both kinds. Among these is most prominent a more or less advanced state of maturity of the plant when harvested. Our inquiry into the comparative value of both kinds of meal as a fodder ingredient of the daily diet for milch cows has been carried on with articles of the following average composition : —

COMPOSITION OF LINSEED MEAL USED.	New-process Linseed Meal.	Old-process Linseed Meal.
	Per Cent.	Per Cent.
Moisture at 100° C., ...	5.06	9.88
Dry matter, ...	94.94	90.12
	100.00	100.00
Analysis of Dry Matter.		
Crude ash, ...	6.34	7.39
" cellulose, ...	8.93	8.74
" fat, ...	2.17	7.24
" protein (nitrogenous matter), ...	41.02	36.97
Non-nitrogenous extract matter, ...	41.54	39.66
	100.00	100.00

Fertilizing Constituents.

	Per Cent.	Per Cent.
Moisture at 100° C., ...	5.06	9.88
Nitrogen, ...	6.25	5.33
Phosphoric acid, ...	1.42	1.64
Potassium oxide, ...	1.16	1.16
Valuation per ton of 2,000 pounds, ...	$24 00	$21 50

Five cows, grades of various description, all of fair milking qualities, were selected for the trial. Two had dropped their last calves one month before the beginning of the observation, one five months, and two from eleven to twelve months. They differed but one year in their respective ages, which were from six to seven years.

English hay, rowen, fodder corn, corn stover, corn ensilage, carrots and sugar beets furnished at different times the main bulk of the daily fodder ration; while corn meal, wheat bran and both kinds of linseed meal alternately served as supplementary feed stuffs to secure a desired high nutritive character for the entire diet. The daily quantity of the grain feed, of roots and of hay, in case corn ensilage furnished largely the coarse feed, was in each case a definite one, decided upon before; it was in each case entirely consumed. The daily consumption of the coarse portion of the particular fodder combination on trial, as hay when fed alone, rowen, fodder corn, corn stover and corn ensilage, depended on the appetite of each individual animal. It varied usually somewhat in quantity in case of different cows. Care was taken to offer to each a liberal quantity. The unconsumed portion was weighed back each day, and subsequently accounted for in the daily feeding record.

The fodder corn, corn ensilage and corn stover were obtained from the same variety of corn, "Pride of the North," a dent corn. The ensilage corn and the fodder corn were of a corresponding stage of growth; *i.e.*, with kernel beginning to glaze. The corn stalks were in every case cut into pieces from one and one-half to two inches in length before being fed.

The entire experiment extended over six successive months, and was subdivided into nine distinct periods. The changes in daily diet were made gradually, as customary in well-conducted feeding experiments. The weekly weights of the animals on trial were taken on the same day, in the morning, before milking and feeding.

The adopted valuation of the different fodder articles is based on their local market price per ton of 2,000 pounds, at Amherst: —

Corn meal, per ton,	$19 00
Wheat bran,	17 50
Old-process linseed meal,	27 00
New-process linseed meal,	26 00
Carrots,	7 00
Sugar beets,	5 00
Hay,	15 00
Rowen,	15 00
Fodder corn,	5 00
Corn stover,	5 00
Corn ensilage,	2 75

A few subsequent pages contain an abstract of the results of the experiment, closing with a detailed feeding record of every cow on trial : —

I. — *Statement of the Average of the Daily Fodder Combinations used during the Different Successive Feeding Periods.*

I.		II.	
Corn meal (pounds),	3.25	Corn meal (pounds),	3.25
Wheat bran,	3.25	Wheat bran,	3.25
Old-process linseed meal,	3.25	Old-process linseed meal,	3.25
Hay,	18.50	Hay,	5.00
Total cost (cents),	24.18	Corn ensilage,	45.00
Net cost,	14.06	Total cost (cents),	20.25
Manurial value obtainable,	10.12	Net cost,	10.79
Nutritive ratio,	1 : 5.73	Manurial value obtainable,	9.46
		Nutritive ratio,	1 : 6.27

III.		IV.	
Wheat bran (pounds),	3.25	Wheat bran (pounds),	3.25
Old-process linseed meal,	3.25	Old-process linseed meal,	3.25
Carrots,	20.00	Carrots,	20.00
Fodder corn,	13.75	Corn stover,	16.00
Total cost (cents),	17 65	Total cost (cents),	18.21
Net cost,	9.58	Net cost,	9.20
Manurial value obtainable,	8.07	Manurial value obtainable,	9.01
Nutritive ratio,	1 : 5.16	Nutritive ratio,	1 : 5.15

I. — *Daily Fodder Combinations* — Concluded.

V.		VI.	
Wheat bran (pounds),	3.25	Corn meal (pounds),	3.25
New-process linseed meal,	3.25	Wheat bran,	3.25
Carrots,	20.00	New-process linseed meal,	3.25
Fodder corn,	16.25	Sugar beets,	20.00
Total cost (cents),	18.06	Hay,	16.00
Net cost,	9.12	Total cost (cents),	27.16
Manurial value obtainable,	8.94	Net cost,	16.38
Nutritive ratio,	1 : 4.96	Manurial value obtainable,	10.78
		Nutritive ratio,	1 : 5.23

VII.		VIII.	
Corn meal (pounds),	3.25	Corn meal (pounds),	3.25
Wheat bran,	3.25	Wheat bran,	3.25
Old-process linseed meal,	3.25	Old-process linseed meal,	3.25
Sugar beets,	20.00	Rowen,	20.75
Hay,	16.00	Total cost (cents),	25.86
Total cost (cents),	27.30	Net cost,	13.48
Net cost,	16.96	Manurial value obtainable,	12.38
Manurial value obtainable,	10.34	Nutritive ratio,	1 : 5.04
Nutritive ratio,	1 : 5.63		

IX.	
Corn meal (pounds),	3.25
Wheat bran,	3 25
New-process linseed meal,	3.25
Rowen,	20.75
Total cost (cents),	25.72
Net cost,	13.05
Manurial value obtainable,	12.67
Nutritive ratio,	1 : 4.73

II. — *Summary of the Cost of the Daily Fodder Rations (Cents).*

	PERIODS.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Total cost,	24.18	20.25	17.65	18.21	18.06	27.16	27.30	25.86	25.72
Net cost,	14.06	10.79	9.58	9.20	9.12	16.38	16.96	13.48	13.05
Manurial value obtainable,	10.12	9.46	8.07	9.01	8.94	10.78	10.34	12.38	12.67

II. — *Daily Fodder Rations* — Concluded.

Valuation of Essential Fertilizing Constituents in the Various Fodder Articles used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Corn Meal.	Wheat Bran.	Old-process Oil Meal.	New-process Oil Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.
Moisture,	11.67	9.27	9.88	5.06	9.72	72.95	20.42	22.50	90.47	90.02	13.53
Nitrogen,	1.479	2.545	5.331	6.254	1.379	0.33	1.058	1.211	0.149	0.184	1.790
Phosphoric acid,	0.713	2.900	1.646	1.420	0.359	0.138	0.510	0.303	0.100	0.086	0.464
Potassium oxide,	0.430	1.637	1.162	1.160	1.572	0.301	0.760	1.320	0.540	0.462	1.966
Value per 2,000 lbs.,	$6 27	$13 60	$21 15	$24 00	$6 53	$1 56	$4 89	$5 67	$1 12	$1 14	$8 42

III. — *Amount of Dry Vegetable Matter of the Feed required to produce One Quart of Milk during the Experiment.*

NAME.	Average Yield of Milk per Day (Quarts).	Average Amount of Dry Matter consumed to produce One Quart of Milk.
Juno,	9.53	2.57
Flora,	7.46	3.17
Jessie,	7.40	3.09
Roxy,	12.55	1.99
Pink,	10.99	2.09

IV. — *Cost of Feed consumed for the Production of One Quart of Milk during the Different Feeding Periods (Cents).*

Feeding Periods, 1889-1890.		Juno.	Flora.	Jessie.	Roxy.	Pink.
I. Dec. 11 to Dec. 31,	Total cost,	2.54	2.88	3.08		
	Net cost,	1.48	1.68	1.79		
	Obtainable manure,	1.06	1.20	1.29		
II. Jan. 6 to Feb. 16,	Total cost,	2.20	2.52	2.83		
	Net cost,	1.17	1.34	1.51		
	Obtainable manure,	1.03	1.18	1.32		

IV. — *Cost of Feed, etc.* — Concluded.

Feeding Periods, 1889-1890.		Juno.	Flora	Jessie.	Roxy.	Pink.
III. Feb. 23 to March 13,	Total cost,	2 19	3.00	2.85	1.37	1.61
	Net cost,	1.15	1 65	1.57	.72	.87
	Obtainable manure,	1.04	1.35	1.28	0.65	0.74
IV. March 18 to April 5,	Total cost,	2 24	2.81	2.72	1.63	1.76
	Net cost,	1.13	1.43	1.39	.81	.87
	Obtainable manure,	1.11	1.38	1.33	0.82	0.89
V. April 9 to April 18,	Total cost,	2.19	2.47	2.37	1.60	1.68
	Net cost,	1.11	1.25	1.21	.79	.85
	Obtainable manure,	1.08	1.22	1.16	0.81	0.83
VI. April 25 to May 13,	Total cost,	2.72	3.36	3.36	2.12	2.45
	Net cost,	1.64	2.02	2.02	1.60	1.48
	Obtainable manure,	1.08	1.34	1.34	0.52	0.97
VII. May 18 to May 27,	Total cost,	2.71	3.48	3.45	2.24	2 46
	Net cost,	1 69	2.16	2.14	1.39	1.53
	Obtainable manure,	1.02	1.32	1.31	0.85	0.93
VIII. June 1 to June 19,	Total cost,	2.38	3.19	3.10	2.10	2.17
	Net cost,	1.25	1.67	1.62	1.11	1.10
	Obtainable manure,	1.13	1.52	1.48	0.99	1.07
IX. June 23 to July 2,	Total cost,	2.49	3.59	3.09	2.12	2.24
	Net cost,	1.26	1 82	1.57	1.11	1.14
	Obtainable manure,	1.23	1.77	1.52	1.01	1.10

V. — *Average Quantity of Milk per Day* (*Quarts*).

	Feeding Periods, 1889-1890.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Juno,	9.67	9.40	8.47	8.18	8.30	10.01	10.06	11.05	10.61
Flora,	8.64	8.41	5.73	6.45	7.26	7.86	7.64	7.89	7.29
Jessie,	7.87	7.16	6.05	6.57	7.44	7.75	7.48	8.19	8.09
Roxy,			13.52	11.46	11.64	13.18	12.67	12.84	12.22
Pink,			10.09	10.59	10.65	11.30	11.05	12.06	11.19

V. — *Average Quantity of Milk, etc.* — Concluded.

I. — Variations in daily production of milk during the entire feeding experiment (quarts).

II. — Average quantity of milk per day for the entire feeding experiment (quarts).

	I.	II.
Juno,	8.18 — 11.05	9.53
Flora,	5.73 — 8.64	7.46
Jessie,	6.05 — 8.19	7.40
Roxy,	11.46 — 13.52	12.55
Pink,	10.09 — 12.06	10.99

VI. — *Statement of the Average of Analyses of Milk made during the Different Feeding Periods.*

Periods.		Juno.	Flora.	Jessie.	Roxy.	Pink.
I.,	Solids, per cent.,	12.84	13.47	14.72		
	Fat, per cent.,	3.89	3.72	5.21		
II.,	Solids, per cent.,	12.97	13.86	14.93		
	Fat, per cent.,	3.93	4.33	5.86		
III.,	Solids, per cent.,	13.68	15.44	15.61	13.27	14.86
	Fat, per cent.,	4.33	6.00	6.45	4.21	5.73
IV.,	Solids, per cent.,	13.80	13.62	14.14	13.18	13.61
	Fat, per cent.,	4.31	4.27	4.78	3.51	4.72
V.,	Solids, per cent.,	13.34	12.59	13.79	12.48	13.65
	Fat, per cent.,	4.24	3.96	5.17	4.30	4.74
VI.,	Solids, per cent.,	14.37	13.30	14.93	13.21	14.45
	Fat, per cent.,	4.76	3.71	5.57	3.91	5.02
VII.,	Solids, per cent.,	13.90	13.19	15.76	12.74	14.40
	Fat, per cent.,	4.28	3.85	6.22	3.75	5.11
VIII.,	Solids, per cent.,	13.62	12.82	14.80	12.59	14.20
	Fat, per cent.,	4.59	3.73	5.70	3.73	5.04
IX.,	Solids, per cent.,	13.85	12.93	14.43	12.81	14.40
	Fat, per cent.,	4.45	3.52	5.13	3.68	3.93

VII. — *Creamery Record for the Different Feeding Periods.*

Feeding Periods.		Quarts of Milk set for Cream.	Spaces of Cream produced.	Average Number of Spaces per Day.	Quarts of Milk produced One Space of Cream.
	1889-1890.				
I.	Dec. 11 to Dec. 31, .	933.50	657	31.29	1.42
II.	Jan. 6 to Feb. 16, .	2,013.40	1,367	32.55	1.47
III.	Feb. 23 to March 13,	913.74	602	31.68	1.52
IV.	March 18 to April 5,	1,002.75	627	33.00	1.60
V.	April 9 to April 18, .	559.50	336	33.60	1.67
VI.	April 25 to May 13, .	1,159.50	665	35.00	1.74
VII.	May 18 to May 27, .	599.20	347	34.70	1.73
VIII.	June 1 to June 19, .	1,201.50	676	35.58	1.76
IX.	June 23 to July 2, .	601.25	333	33.30	1.81

VIII. — *Live Weights of Animals during the Feeding Periods (Pounds).*

Name.	Feeding Periods.									Gain at Close.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	
Juno, ...	1,070	1,030	1,018	1,025	1,042	1,095	1,095	1,142	1,125	55
Flora, ...	1,000	990	960	984	1,005	1,047	1,050	1,084	1,080	80
Jessie, ...	888	870	827	830	838	901	897	932	928	40
Roxy, ...			834	849	864	898	915	955	938	104
Pink, ...			800	814	818	860	860	852	859	59

IX. — *Conclusion.*

An examination of the previously recorded results of the inquiry into the respective particular claims of both kinds of linseed meal as food constituents for dairy purposes shows that, *at stated market prices*, under *otherwise corresponding circumstances* and when *used in equal-weight parts*, they may serve in place of each other without materially affecting the financial side of the operation one way or the other. In case the new-process linseed meal is used, the net cost of the milk is somewhat less, on account of the larger amount of fertilizing elements it contains, which increases somewhat the value of obtainable manure (see rations 6, 7, 8 and 9). This advantage is, however, in the majority of instances, to some extent compensated for by a somewhat more liberal yield of milk, in case old-process linseed meal has been fed. As the old-process linseed meal has a well-established reputation as a suitable food constituent for dairy cows, the new-process linseed meal may claim a similar position in the front rank of concentrated feed stuffs for dairy purposes. A careful selection of suitable associated fodder constituents is, however, in both instances, necessary to show their real economical value. A comparison of the yield of milk obtained, in the majority of cases, during feeding periods III., IV., with those of periods VI., VII., VIII. and IX., cannot fail to render that point prominent.

X. — *Detailed Statement of the Feeding Record of the Different Cows on Trial.*

1. JUNO: *Age, seven years; grade, Ayrshire; last calf, June 22, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.											Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.					
1889 - 1890.																
Dec. 11 to Dec. 31,	3 25	3 25	3.25	–	18 95	–	–	–	–	–	–	25.84	9.67	2.67	1 : 5.76	1,070
Jan. 6 to Feb. 16,	3.25	3.25	3.25	–	5.00	47.81	–	–	–	–	–	26.17	9.40	2.78	1 : 6.36	1,030
Feb. 23 to March 13,	–	3.25	3.25	–	–	–	17.53	–	20.00	–	–	21.72	8.47	2.56	1 : 5.51	1,018
March 18 to April 5,	–	3.25	3.25	–	–	–	–	16.32	20.00	–	–	20.42	8.18	2.50	1 : 5.17	1,025
April 9 to April 18,	–	3 25	–	3.25	–	–	16.75	–	20.00	–	–	21.26	8.30	2 56	1 : 5.01	1,042
April 25 to May 13,	3.25	3.25	–	3.25	16.11	–	–	–	–	20.00	–	25.43	10.04	2.53	1 : 5.24	1,095
May 18 to May 27,	3.25	3.25	3.25	–	16.00	–	–	–	–	20.00	–	25.17	10.06	2 50	1 : 5.63	1,095
June 1 to June 19,	3.25	3 25	3.25	–	–	–	–	–	–	–	21.34	27.18	11.05	2.46	1 : 5.08	1,142
June 23 to July 2,	3 25	3 25	–	3.25	–	–	–	–	–	–	21.70	27.65	10.61	2.61	1 : 4.77	1,125

2. FLORA: *Age, six years; grade, Durham; last calf, Dec. 22, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Dec. 11 to Dec. 31,	3.25	3.25	3.25	–	19.43	–	–	–	–	–	–	26.27	8.64	3.04	1 : 5.79	1,000
Jan. 6 to Feb. 16,	3.25	3.25	3.25	–	5.00	51.17	–	–	–	–	–	27.08	8.41	3.22	1 : 6.44	990
Feb. 23 to March 13,	–	3.25	3 25	–	–	–	11 95	–	20.00	–	–	17.28	5.73	3.02	1 : 4.96	960
March 18 to April 5,	–	3.25	3.25	–	–	–	–	15 74	20.00	–	–	19.97	6.45	3.09	1 : 5.13	984
April 9 to April 18,	–	3.25	–	3.25	–	–	15.70	–	20.00	–	–	20.42	7.26	2.81	1 : 4.91	1,005
April 25 to May 13,	3.25	3.25	–	3.25	15.00	–	–	–	–	20.00	–	24.43	7.86	3.11	1 : 5.16	1,047
May 18 to May 27,	3.25	3.25	3 25	–	15.00	–	–	–	–	20.00	–	24.27	7.64	3.18	1 : 5.55	1,050
June 1 to June 19,	3.25	3.25	3.25	–	–	–	–	–	–	–	19.79	25.84	7.89	3.28	1 : 5.01	1,084
June 23 to July 2,	3.25	3 25	–	3.25	–	–	–	–	–	–	21.40	27.39	7.29	3.76	1 : 4.75	1,080

FEEDING RECORD — *Continued.*

3. JESSIE: *Age, six years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.											Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.					
1889 - 1890.																
Dec. 11 to Dec. 31,	3.25	3.25	3.25	–	18.43	–	–	–	–	–	–	25.37	7.87	3.22	1 : 5.72	888
Jan. 6 to Feb. 16,	3.25	3.25	3.25	–	5.00	45.02	–	–	–	–	–	25.42	7.16	3.55	1 : 6.27	870
Feb. 23 to March 13,	–	3.25	3.25	–	–	–	12.21	–	20.00	–	–	17.49	6.05	2.89	1 : 5.00	827
March 18 to April 5,	–	3.25	3 25	–	–	–	–	14.47	20.00	–	–	18.98	6.57	2.89	1 : 5.02	830
April 9 to April 18,	–	3.25	–	3.25	–	–	14.30	–	20.00	–	–	19.31	7.44	2 60	1 : 4.78	838
April 25 to May 13,	3 25	3 25	–	3.25	14.53	–	–	–	–	20.00	–	24.01	7.75	3.10	1 : 5.12	901
May 18 to May 27,	3.25	3 25	3.25	–	14.00	–	–	–	–	20.00	–	23.37	7.48	3.12	1 : 5.47	897
June 1 to June 19,	3.25	3 25	3 25	–	–	–	–	–	–	–	20.16	26.16	8.19	3.19	1 : 5.02	932
June 23 to July 2,	3.25	3 25	–	3.25	–	–	–	–	–	–	19.90	26.09	8.09	3.22	1 : 4.69	928

4. ROXY: *Age, seven years; grade, Ayrshire; last calf, Feb. 5, 1890.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Feb. 23 to March 13,	–	3.25	3.25	–	–	–	17.21	–	20 00	–	–	21.47	13.52	1.59	1 : 5.48	834
March 18 to April 5,	–	3 25	3.25	–	–	–	–	18.11	20 00	–	–	21.81	11.46	1.90	1 : 5.30	849
April 9 to April 18,	–	3 25	–	3.25	–	–	18.30	–	20.00	–	–	22.49	11.64	1.93	1 : 5.15	864
April 25 to May 13,	3.25	3.25	–	3.25	17.05	–	–	–	–	20.00	–	26.28	13.18	1.99	1 : 5.31	898
May 18 to May 27,	3.25	3.25	3.25	–	17.40	–	–	–	–	20.00	–	26.44	12.67	2.09	1 : 5.73	915
June 1 to June 19,	3.25	3 25	3.25	–	–	–	–	–	–	–	22.16	27.89	12.84	2.17	1 : 5.11	955
June 23 to July 2,	3.25	3.25	–	3.25	–	–	–	–	–	–	21.90	27.83	12.22	2.28	1 : 4.81	938

FEEDING RECORD — *Concluded.*

5. Pink : *Age, six years; native; last calf, Jan. 23, 1890.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Feed consumed (Pounds) per Day.															
1890.																
Feb. 23 to March 13,	–	3.25	3.25	–	–	–	11.05	–	17.90	–	–	16.36	10.09	1.62	1 : 4.87	800
March 18 to April 5,	–	3.25	3.25	–	–	–	–	17.74	20.00	–	–	21.52	10.59	2.03	1 : 5.27	814
April 9 to April 18,	–	3.25	–	3.25	–	–	15.60	–	20.00	–	–	20.34	10.65	1.91	1 : 4.90	818
April 25 to May 13,	3.25	3.25	–	3.25	16.79	–	–	–	–	20.00	–	26.05	11.30	2.31	1 : 5.29	860
May 18 to May 27,	3.25	3.25	3.25	–	15.80	–	–	–	–	20.00	–	24.99	11.05	2.26	1 : 5.61	860
June 1 to June 19,	3.25	3.25	3.25	–	–	–	–	–	–	–	20.37	26.34	12.06	2.18	1 : 5.02	852
June 23 to July 2,	3.25	3.25	–	3.25	–	–	–	–	–	–	20.00	26.18	11.19	2.34	1 : 4.69	859

6. Nancy : *Age, seven years; native; last calf, March 16, 1890.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	New-process Linseed Meal.	Hay.	Corn Ensilage.	Fodder Corn.	Corn Stover.	Carrots.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 25 to April 5,	–	3.25	3.25	–	–	–	–	13.50	20.00	–	–	18.23	12.70	1.44	1 : 4.94	860
May 18 to May 27,	3.25	3.25	3.25	–	15.80	–	–	–	–	20.00	–	24.99	13.02	1.92	1 : 5.61	875
June 1 to June 19,	3.25	3.25	3.25	–	–	–	–	–	–	–	19.76	25.82	13.21	1.95	1 : 5.01	900
June 23 to July 2,	3.25	3.25	–	3.25	–	–	–	–	–	–	19.70	25.93	12.74	2.04	1 : 4.67	889

Total Cost of Feed per Quart of Milk.

1. Juno.

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1889-1890.															
Dec. 11 to Dec. 31,	203.02	9.67	68.25	68.25	68.25	–	398.00	–	–	–	–	–	–	$5 16	2.54
Jan. 6 to Feb. 16,	394.88	9.40	136.50	136.50	136.50	–	210.00	2,008.00	–	–	–	–	–	8 68	2.20
Feb. 23 to March 13,	160.93	8.47	–	61.75	61.75	–	–	–	333.00	–	380.00	–	–	3 53	2.19
March 18 to April 5,	155.35	8.18	–	61.75	61.75	–	–	–	–	310.00	380.00	–	–	3 48	2.24
April 9 to April 18,	83.02	8.30	–	32.50	–	32.50	–	–	167.50	–	200.00	–	–	1 82	2.19
April 25 to May 13,	190.70	10.04	61.75	61.75	–	61.75	306.00	–	–	–	–	380.00	–	5 18	2.72
May 18 to May 27,	100.58	10.06	32.50	32.50	32.50	–	160.00	–	–	–	–	200.00	–	2 73	2.71
June 1 to June 19,	209.88	11.05	61.75	61.75	61.75	–	–	–	–	–	–	–	405.50	5 00	2.38
June 23 to July 2,	106.05	10.61	32.50	32.50	–	32.50	–	–	–	–	–	–	217.00	2 64	2.49

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

2. *Flora.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1889-1890.															
Dec. 11 to Dec. 31,	181.50	8 64	68 25	68.25	68.25	–	408.00	–	–	–	–	–	–	$5 23	2.88
Jan. 6 to Feb. 16,	353.02	8.41	136.50	136.50	136.50	–	210.00	2,149.00	–	–	–	–	–	8 88	2.52
Feb. 23 to March 13,	108.84	5.73	–	61.75	61.75	–	–	–	227.00	–	380.00	–	–	3 27	3 00
March 18 to April 5,	122 56	6.45	–	61.75	61.75	–	–	–	–	299 00	380.00	–	–	3 45	2.81
April 9 to April 18,	72.56	7.26	–	32 50	–	32.50	–	–	157.00	–	200.00	–	–	1 79	2.47
April 25 to May 13,	149 32	7.86	61.75	61.75	–	61.75	285.00	–	–	–	–	380.00	–	5 02	3.36
May 18 to May 27,	76.40	7.64	32.50	32 50	32.50	–	150.00	–	–	–	–	200.00	–	2 66	3.48
June 1 to June 19,	150.00	7.89	61.75	61.75	61.75	–	–	–	–	–	–	–	376.00	4 78	3.19
June 23 to July 2,	72.91	7.29	32.50	32 50	–	32.50	–	–	–	–	–	–	214.00	2 62	3.59

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

3. *Jessie.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1889-1890.															
Dec. 11 to Dec. 31,	165.25	7.87	68.25	68.25	68.25	–	387.00	–	–	–	–	–	–	$5 07	3.08
Jan. 6 to Feb. 16,	300.70	7.16	136.50	136.50	136.50	–	210.00	1,891.00	–	–	–	–	–	8 52	2.83
Feb. 23 to March 13,	115.00	6.05	–	61.75	61.75	–	–	–	232.00	–	380.00	–	–	3 28	2.85
March 18 to April 5,	124.75	6.57	–	61.75	61.75	–	–	–	–	275.00	380.00	–	–	3 39	2.72
April 9 to April 18,	74.40	7.44	–	32.50	–	32.50	–	–	143.00	–	200.00	–	–	1 76	2.37
April 25 to May 13,	147.25	7.75	61.75	61.75	–	61.75	276.00	–	–	–	–	380.00	–	4 95	3.36
May 18 to May 27,	74.77	7.48	32.50	32.50	32.50	–	140.00	–	–	–	–	200.00	–	2 58	3.45
June 1 to June 19,	155.70	8.19	61.75	61.75	61.75	–	–	–	–	–	–	–	383.00	4 83	3.10
June 23 to July 2,	80.93	8.09	32.50	32.50	–	32.50	–	–	–	–	–	–	199.00	2 50	3.09

4. *Roxy.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Feb. 23 to March 13,	256.86	13.52	–	61.75	61.75	–	–	–	327.00	–	380.00	–	–	$3 52	1.37
March 18 to April 5,	217.75	11.46	–	61.75	61.75	–	–	–	–	344.00	380.00	–	–	3 56	1.63
April 9 to April 18,	116.40	11.64	–	32.50	–	32.50	–	–	183.00	–	200.00	–	–	1 86	1.60
April 25 to May 13,	250.35	13.18	61.75	61.75	–	61.75	324.00	–	–	–	–	380.00	–	5 31	2.12
May 18 to May 27,	126.74	12.67	32.50	32.50	32.50	–	174.00	–	–	–	–	200.00	–	2 84	2 24
June 1 to June 19,	243.95	12.84	61.75	61.75	61.75	–	–	–	–	–	–	–	421.00	5 12	2.10
June 23 to July 2,	122.21	12.22	32.50	32.50	–	32.50	–	–	–	–	–	–	219.00	2 65	2.17

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

5. Pink.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890.															
Feb. 23 to March 13,	191.74	10.09	–	61.75	61.75	–	–	–	210.00	–	340.00	–	–	$3 09	1 61
March 18 to April 5,	201.16	10.59	–	61.75	61.75	–	–	–	–	337.00	380.00	–	–	3 54	1.76
April 9 to April 18,	106.51	10.65	–	32.50	–	32 50	–	–	156.00	–	200.00	–	–	1 79	1 68
April 25 to May 13,	214.75	11.30	61.75	61.75	–	61.75	319.00	–	–	–	–	380.00	–	5 27	2.45
May 18 to May 27,	110.47	11.05	32 50	32.50	32.50	–	158.00	–	–	–	–	200.00	–	2 72	2.46
June 1 to June 19,	229.07	12 06	61.75	61.75	61.75	–	–	–	–	–	–	–	387.00	4 86	2.12
June 23 to July 2,	111.86	11.19	32.50	32.50	–	32.50	–	–	–	–	–	–	200.00	2 51	2.24

6. Nancy.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Amount of Carrots consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
March 25 to April 5,	152.44	12.70	–	39.00	39.00	–	–	–	–	162.00	240.00	–	–	$2 12	1.39
May 18 to May 27,	130.23	13.02	32.50	32.50	32.50	–	158.00	–	–	–	–	200.00	–	2 72	2.09
June 1 to June 19,	250.93	13.21	61.75	61 75	61.75	–	–	–	–	–	–	–	375.50	4 78	1.90
June 23 to July 2,	127.35	12.74	32.50	32.50	–	32.50	–	–	–	–	–	–	197.00	2 49	1.96

Net Cost of Milk and Manurial Value of Feed.

1. *Juno.*

Feeding Periods.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889 - 1890.					Cents.	Pounds.
Dec. 11 to Dec. 31, .	$5 16	$2 69	$2 15	$3 01	1.48	1,034
Jan. 6 to Feb. 16, .	8 68	5 06	4 05	4 63	1.17	1,045
Feb. 23 to Mar. 13, .	3 53	2 10	1 68	1 85	1.15	1,030
Mar. 18 to Apr. 5, .	3 48	2 16	1 73	1 75	1.13	1,034
Apr. 9 to Apr. 18, .	1 82	1 13	90	92	1.11	1,071
Apr. 25 to May 13, .	5 18	2 57	2 06	3 12	1.64	1,115
May 18 to May 27, .	2 73	1 29	1 03	1 70	1.69	1,095
June 1 to June 19, .	5 00	2 97	2 38	2 62	1.25	1,145
June 23 to July 2, .	2 64	1 62	1 30	1 34	1.26	1,130
Total, . .	$38 22	$21 59	$17 28	$20 94	–	–

2. *Flora.*

Dec. 11 to Dec. 31, .	$5 23	$2 72	$2 18	$3 05	1.68	1,015
Jan. 6 to Feb. 16, .	8 88	5 17	4 14	4 74	1.34	1,004
Feb. 23 to Mar. 13, .	3 27	1 84	1 47	1 80	1.65	960
Mar. 18 to Apr. 5, .	3 45	2 13	1 70	1 75	1.43	980
Apr. 9 to Apr. 18, .	1 79	1 10	88	91	1.25	1,030
Apr. 25 to May 13, .	5 02	2 50	2 00	3 02	2.02	1,050
May 18 to May 27, .	2 66	1 26	1 01	1 65	2.16	1,065
June 1 to June 19, .	4 78	2 84	2 27	2 51	1.67	1,088
June 23 to July 2, .	2 62	1 61	1 29	1 33	1.82	1,085
Total, . .	$37 70	$21 17	$16 94	$20 76	–	–

3. *Jessie.*

Dec. 11 to Dec. 31, .	$5 07	$2 65	$2 12	$2 95	1.79	875
Jan. 6 to Feb. 16, .	8 52	4 96	3 97	4 55	1.51	865
Feb. 23 to Mar. 13, .	3 28	1 85	1 48	1 80	1.57	850
Mar. 18 to Apr. 5, .	3 39	2 06	1 65	1 74	1.39	820
Apr. 9 to Apr. 18, .	1 76	1 07	86	90	1.21	870
Apr. 25 to May 13, .	4 95	2 47	1 98	2 97	2.02	913
May 18 to May 27, .	2 58	1 23	98	1 60	2.14	910
June 1 to June 19, .	4 83	2 87	2 30	2 53	1.62	940
June 23 to July 2, .	2 50	1 54	1 23	1 27	1.57	935
Total, . .	$36 88	$20 70	$16 57	$20 31	–	–

Net Cost of Milk and Manurial Value of Feed — *Concluded.*

4. *Roxy.*

Feeding Periods.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890.					Cents.	Pounds.
Feb. 23 to Mar. 13, .	$3 52	$2 08	$1 66	$1 86	.72	840
Mar. 18 to Apr. 5, .	3 56	2 25	1 80	1 76	.81	853
Apr. 9 to Apr 18, .	1 86	1 17	94	92	.79	875
Apr. 25 to May 13, .	5 31	1 63	1 30	4 01	1.60	906
May 18 to May 27,	2 84	1 34	1 07	1 77	1.39	925
June 1 to June 19, .	5 12	3 03	2 42	2 70	1.11	958
June 23 to July 2, .	2 65	1 63	1 30	1 35	1.10	940
Total, . .	$24 86	$13 13	$10 49	$14 37	–	–

5. *Pink.*

Feb. 23 to Mar. 13, .	$3 09	$1 77	$1 42	$1 67	0.87	773
Mar. 18 to Apr. 5, .	3 54	2 23	1 78	1 76	0.87	820
Apr. 9 to Apr. 18, .	1 79	1 10	88	91	0.85	825
Apr. 25 to May 13, .	5 27	2 61	2 09	3 18	1.48	878
May 18 to May 27, .	2 72	1 29	1 03	1 69	1.53	862
June 1 to June 19, .	4 86	2 89	2 31	2 55	1.11	855
June 23 to July 2, .	2 51	1 55	1 24	1 27	1.14	859
Total, . .	$23 78	$13 44	$10 75	$13 03	–	–

6. *Nancy.*

Mar. 25 to Apr. 5, .	$2 12	$1 27	$1 02	$1 10	0.72	840
May 18 to May 27, .	2 72	1 29	1 03	1 69	1.30	882
June 1 to June 19, .	4 78	2 84	2 27	2 51	1.00	898
June 23 to July 2, .	2 49	1 54	1 23	1 26	0.99	889
Total, . .	$12 11	$6 93	$5 55	$6 56	–	–

Composition of Fodder Articles fed during the Previously Described Feeding Experiments.

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.67	233.40	–	–	
Dry matter,	88.33	1,766.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,					
" cellulose,	1.89	37.80	–	–	1 : 9.65
" fat,	1.44	28.80	9.79	34	
" protein (nitrogenous	4.44	88.80	67.49	76	
matter),	10.46	209.20	177.82	85	
Non-nitrogenous extract matter,	81.77	1,635.40	1,537.28	94	
	100.00	2,000.00	1,792.38	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.27	185.40	–	–	
Dry matter,	90.73	1,814.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.47	149.40	–	–	
" cellulose,	9.75	195.00	39.00	20	1 : 3.94
" fat,	5.48	109.60	87.68	80	
" protein (nitrogenous matter),	17.53	350.60	308.53	88	
Non-nitrogenous extract matter,	59.77	1,195.40	956.32	80	
	100.00	2,000.00	1,391.53	–	

Composition of Fodder Articles, etc. — Continued.

Old-process Linseed Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.88	197.60	–	–	1 : 1.70
Dry matter,	90.12	1,802.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.39	147.80	–	–	
" cellulose,	8.74	174.80	45.45	26	
" fat,	7.24	144.80	131.77	91	
" protein (nitrogenous matter),	36.97	739.40	643.28	87	
Non-nitrogenous extract matter,	39.66	793.20	721.81	91	
	100.00	2,000.00	1,542.31	–	

New-process Linseed Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.06	101.20	–	–	1 : 1.26
Dry matter,	94.94	1,898.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.34	126.80	–	–	
" cellulose,	8.93	178.60	46.44	26	
" fat,	2.17	43.40	39.49	91	
" protein (nitrogenous matter),	41.02	820.40	713.75	87	
Non-nitrogenous extract matter,	41.54	830.80	756.03	91	
	100.00	2,000.00	1,555.71	–	

Composition of Fodder Articles, etc. — Continued.

Hay (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.72	194.40	–	–	1 : 9.68
Dry matter, ...	90.28	1,805.60	-	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.43	128.60	–	–	
" cellulose, . . .	32.28	645 60	374.45	58	
" fat, ...	2.49	49.80	22 91	46	
" protein (nitrogenous matter), . .	9.54	190.80	108.76	57	
Non-nitrogenous extract matter, ...	49 26	985 20	620.68	63	
	100.00	2,000.00	1,126.80	–	

Rowen (Average).*

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.53	270.60	–	–	1 : 6.93
Dry matter, ...	86.47	1,729.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6 81	136.20	–	–	
" cellulose, . . .	·28.31	566.20	328.40	58	
" fat, ...	3.81	76.20	35.05	46	
" protein (nitrogenous matter), . .	12.94	258.80	147.52	57	
Non-nitrogenous extract matter), ...	48.13	962.60	606.44	63	
	100.00	2,000.00	1,117.41	-	

* Dried second cut of meadow growth.

Composition of Fodder Articles, etc. — Continued.

Corn Ensilage (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	72.95	1,459.00	–	–	1 : 11.67
Dry matter,	27 05	541.00	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6 48	129.60	–	–	
" cellulose,	26.33	526.60	379 15	72	
" fat,	5 17	103.40	77.55	75	
" protein (nitrogenous matter),	7.64	152.80	111.54	73	
Non-nitrogenous extract matter,	54.38	1,087.60	728.69	67	
	100 00	2,000.00	1,296.93	–	

Fodder Corn.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	20.42	408 40	–	--	1 : 9 80
Dry matter,	79.58	1,591.60	–	--	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	20 11	402.20	289.58	72	
" fat,	1.65	33.00	24.75	75	
" protein (nitrogenous matter),	8.31	166.20	121.33	73	
Non-nitrogenous extract matter,	62.53	1,250.60	837.90	67	
	100 00	2,000.00	1,273.56	–	

Composition of Fodder Articles, etc. — Continued.

Corn Stover.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	22 50	450.00	–	–	1 : 8.62
Dry matter,	77.50	1,550.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.97	79.40	–	–	
" cellulose,	34.96	699.20	503.42	72	
" fat,	1.54	30 80	23.10	75	
" protein (nitrogenous matter),	9.76	195.20	142.50	73	
Non-nitrogenous extract matter,	49.77	995.40	666.92	67	
	100.00	2,000.00	1,335.94	–	

Carrots.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.47	1,809.40	–	–	1 : 9.25
Dry matter,	9.53	190.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8 67	173.40	–	–	
" cellulose,	8.16	163.20	163.20	100	
" fat,	1.86	37.20	37.20	100	
" protein (nitrogenous matter),	9.18	183.60	183.60	100	
Non-nitrogenous extract matter,	72.13	1,442.60	1,442.60	100	
	100.00	2,000.00	1,826.60	–	

Composition of Fodder Articles, etc. — Concluded.

Sugar Beets.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90 02	1,800.40	–	–	
Dry matter,	9.98	199.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	11.84	236.80	–	–	
" cellulose,	8.20	164 00	164.00	100	1 : 6.74
" fat,	.71	14.20	14.20	100	
" protein (nitrogenous matter),	11.53	230 60	230.60	100	
Non-nitrogenous extract matter,	67.72	1,354.40	1,354.40	100	
	100.00	2,000.00	1,763.20	–	

3. *Summer Feeding Experiments with Milch Cows. July 12 to Sept. 30, 1890.*

Green Crops *vs.* English Hay, first and second cut.

Green feed: vetch and oats, soja beans.

Grain feed: corn meal, wheat bran, new-process linseed meal.

A series of feeding experiments with milch cows have been carried on at the station, since 1887, for the purpose of ascertaining the feeding value of several reputed fodder crops new to our section of the country. The new fodder crops were fed in their green state, and their nutritive value, as well as their general economical merits, compared with those of a good average English hay, first and second cut (rowen). The cutting of the new fodder crops for fodder commenced at the beginning of their blooming, and continued until their maturing. Most of them had at that time some of their seeds matured, yet their stems were still succulent.

The results obtained in this connection in previous years have already been published in our previous annual reports, five, six and seven; they were considered on the whole in a sufficient degree encouraging to advise a continuation of our investigations in that direction. For details regarding the merits of Southern cow-pea, serradella, vetch, vetch and oats and vetch and barley, as substitutes in part or in the whole of an average English hay and rowen, as coarse fodder ingredients of the daily diet in case of the same kinds and the same quantities of grain feed, I have to refer to some of our previous annual reports.

1890. — During our late experiments, July 12 to September 30, we used the following fodder articles in the compounding of the daily diet: a mixed crop of green vetch and oats, or green soja beans, with first and second cut of dried upland meadow growth, English hay and rowen, furnished the coarse feed, while corn meal, wheat bran and new-process linseed meal (Cleveland) served as fine or grain feed. The kind and the quantity of the daily grain feed remained the same during the entire experiment, *i.e.*, corn meal, wheat bran and new-process linseed meal, each three and one-quarter pounds daily per head of cows; five pounds of hay, with all the green crop the cows would consume, finished the daily diet. The green crops were cut into pieces from six to eight inches long before being fed. One-half of the daily ration of grain feed and of green fodder was fed during milking in the morning, and the other half at milking in the evening; the hay was fed between both meals. The daily quantities of grain and of hay remained the same, both being entirely consumed. The daily consumption of the green feed, however, was decided by the appetite of the different cows; vetch and oats varied from fifty to sixty pounds, and soja beans from forty to sixty pounds. The quantity consumed per day decreased in all cases toward the maturing of the crop, on account of the gradual increase of solid matter in the crop. The following statement contains the average daily fodder rations per head; they succeeded each other in the order in which they are reported: —

Daily Fodder Rations used.

I.

Corn meal,	3.25	lbs.
Wheat bran,	3.25	"
New-process linseed meal,	3.25	"
Hay,	5.00	"
Vetch and oats,	54.00	"
Total cost,	22.64	cts.
Net cost,	12.22	"
Manurial value obtainable,	10.42	"
Nutritive ratio,	1:5.97	

II.

Corn meal,	3.25	lbs.
Wheat bran,	3.25	"
New-process linseed meal,	3.25	"
Hay,	5.00	"
Soja bean,	55.00	"
Total cost,	27.31	cts.
Net cost,	15.02	"
Manurial value obtainable,	12.29	"
Nutritive ratio,	1:4.69	

III.

Corn meal,	3.25	lbs.
Wheat bran,	3.25	"
New-process linseed meal,	3.25	"
Rowen,	20.00	"
Total cost,	26.46	cts.
Net cost,	14.28	"
Manurial value obtainable,	12.18	"
Nutritive ratio,	1:4.92	

Price per Ton of the Fodder Articles used in our Valuations.

Corn meal,	$24 00
Wheat bran,	20 00
New-process linseed meal,	26 50
Hay,	15 00
Vetch and oats (green),	2 75
Soja bean (green),	4 40
Rowen (dry second cut of grass),	15 00

The valuation of green vetch and oats and of green soja beans is based on the value adopted for English hay, allowing two tons of English hay or six tons of green grass as the average produce per year for an acre of a good meadow, The remaining fodder articles were sold at the stated price per ton in our local market of feed stuffs. Some information regarding the raising of vetch and oats and of soja beans will be found farther on in the description of our field experiments.

Valuation of Essential Fertilizing Constituents contained in the Various Fodder Articles used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Corn Meal.	Wheat Bran.	New-process Linseed Meal	Hay.	Vetch and Oats.	Soja Beans.	Rowen.
Moisture at 100° C.,	12.39	11.52	10.06	9.72	76.21	72.95	13.53
Nitrogen, . .	1.466	2.600	5.392	1.379	0.293	0.590	1.790
Phosphoric acid, .	0.707	2.870	1.800	0.352	0.159	0.193	0.464
Potassium oxide, .	0.435	1.620	1.570	1.511	0.566	0.311	1.966
Valuation per 2,000 pounds, . .	$6 22	$13 74	$21 90	$6 50	$1 70	$2 52	$8 42

Six cows, grades, from five to six years old, and in different stages of their milking period, were selected for the experiment. They had been fed, previous to the observation, on a daily ration of corn meal, wheat bran and new-process linseed meal, each $3\frac{1}{4}$ pounds, with all the rowen called for, — from 20 to 22 pounds per head. Their average daily milk record at that time was as follows: —

1. Jessie, ... from 7.5 to 8 quarts.
2. Roxy, ... from 10 to 11 quarts.
3. Pink, ... from 11 to 12 quarts.
4. Nancy, ... from 11 to 12 quarts.
5. Juno, ... from 9 to 10 quarts.
6. Pearl, ... from 13 to 14 quarts.

The time of observation was subdivided into three periods, which were characterized by the change from vetch and oats to soja beans, and terminating with rowen, as the sole article of coarse food constituents. The grain feed remained the same during the three different feeding periods.

The results of the last experiment lead to similar conclusions as our preceding experiments in 1887, 1888 and 1889, with green vetch, green Southern cow-pea, green serradella and mixed green crops of vetch and oats and vetch and barley. (See Report seven, page 50.)

Conclusions of 1890.

1. The amount of dry matter in the feed consumed during different feeding periods for the production of one quart of milk obtained, varied from 3.32 to 3.55 pounds in case of a daily milk production of from 7 to 8 quarts (Jessie); it varied from 2.62 to 2.99 pounds (Pink), when from 9 to 10 quarts was the daily production of milk; and it was from 1.69 to 1.75 pounds per quart of milk produced when the yield rose to from 13 to 14 quarts (Pearl). The variations in the numerical relation of the amount of dry matter of the feed consumed for the production of one quart of milk, in case of the same animal and the same kind of feed, are materially due to a more or less advanced stage of the milking period of the animal on trial; yet they rarely correspond in different animals. Constitutional differences quite frequently modify the results under otherwise corresponding conditions.

2. The total cost of the feed consumed in connection with the production of one quart of milk differed during the same feeding period, in case of different animals, from 1.69 cents to 3.43 cents; 1.69 cents in case of Pearl and 3.43 cents in case of Jessie, second feeding period, — soja beans. This difference is mainly due to the rate of the daily yield of milk; yet constitutional peculiarities sometimes affect materially the final results.

3. The net cost of the feed consumed for the production of one quart of milk varied in case of different cows from 0.93 cents to 1.88 cents; Pearl 0.93 cents and Jessie 1.88 cents, second period, — soja-bean ration.

4. The market value of the obtainable manurial refuse amounts per quart of milk produced on an average to more than three-sevenths part of the entire cost of the daily fodder ration. Net cost of feed represents the money value of the feed after 80 per cent. of the manurial value of the

phosphoric acid, potassium oxide and nitrogen it contains has been deducted.

5. The soja bean exceeds in our case in five out of six cases the vetch and oats in feeding effect. Vetch and oats compare well with a good rowen. The latter leads the English hay thus far in all our observations with milk production.

6. Judging from our own experience, we can only recommend very highly the practice of raising any of the stated new fodder crops, after due consideration of local circumstances, either alone or as mixed crops, for the purpose of increasing the fodder resources of the farm during summer and autumn. They may serve as green fodder as well as hay; most of them have a higher nutritive ratio than either English hay, corn fodder or corn stover: they tend to improve the soil chemically and physically; they yield liberal returns, and are, as a rule, highly relished by cattle.

FEEDING RECORD.

JESSIE: *Age, six years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	New-process Linseed Meal.	Hay.	Vetch and Oats.	Soja Bean.	Rowen.					
1890.												
July 12 to Aug. 1,	3.25	3.25	3.25	4.38	50.10	–	–	24.52	7.23	3.39	1:5.82	901
Aug. 12 to Sept. 1,	3.25	3.25	3.25	5.00	–	57.67	–	28.76	8.11	3.55	1:4.70	908
Sept. 10 to Sept. 30,	3.25	3.25	3.25	–	–	–	19.24	25.29	7.60	3.33	1:4.89	924

ROXY: *Age, seven years; grade, Ayrshire; last calf, Feb. 5, 1890.*

July 12 to Aug. 1,	3.25	3.25	3.25	5.00	59.14	–	–	27.23	10.13	2.69	1:6.10	950
Aug. 12 to Sept. 1,	3.25	3.25	3.25	5.00	–	60.29	–	29.47	9.97	2.96	1:4.72	954
Sept. 10 to Sept. 30,	3.25	3.25	3.25	–	–	–	20.95	26.77	8.03	3.33	1:4.96	1,000

PINK: *Age, six years; native; last calf, Jan. 23, 1890.*

July 12 to Aug. 1,	3.25	3.25	3.25	5.00	55.67	–	–	26.40	10.06	2.62	1:6.01	851
Aug. 12 to Sept. 1,	3.25	3.25	3.25	5.00	–	61.19	–	29.71	10.96	2.71	1:4.73	876
Sept. 10 to Sept. 30,	3.25	3.25	3.25	–	–	–	20.00	25.94	8.68	2.99	1:4.92	873

FEEDING RECORD — *Concluded.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	New-process Linseed Meal.	Hay.	Vetch and Oats.	Soja Bean.	Rowen.					
NANCY: *Age, seven years; native; last calf, March 16, 1890.*												
1890.												
July 12 to Aug. 1,	3.25	3.25	3.25	4 81	52.48	–	–	25 47	11.23	2.27	1 : 5.92	877
Aug. 12 to Sept. 1,	3.25	3.25	3.25	5 00	–	54 33	–	27.86	11.42	2 44	1 : 4.69	868
Sept. 10 to Sept. 30,	3.25	3.25	3.25	–	–	–	19.57	25.57	10.61	2.41	1 : 4.90	893
JUNO: *Age, seven years; grade, Ayrshire; last calf, June 22, 1889.*												
July 12 to Aug. 1,	3.25	3 25	3.25	4.71	51.33	–	–	25.11	9.09	2.76	1 : 5.88	1,097
Aug. 12 to Sept. 1,	3 25	3.25	3 25	5.00	–	55.19	–	28.09	8.67	3.24	1 : 4.69	1,104
Sept. 10 to Sept. 30,	3.25	3.25	3.25	–	–	–	20.90	26.72	8.16	3.27	1 : 4.96	1,139
PEARL: *Age, five years; native; last calf, Aug. 8, 1890.*												
Aug. 19 to Sept. 4,	3.25	3 25	3.25	5.00	–	40.88	–	24.22	14.32	1.69	1 : 4.60	777
Sept. 10 to Sept. 30,	3.25	3 25	3 25	–	–	–	18.52	24.66	13.30	1.85	1 : 4.85	796

Total Cost of Feed per Quart of Milk.

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds.)	Total Amount of Hay consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Bean consumed (Pounds).	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Jessie.											
1890.											
July 12 to Aug. 1,	151.86	7.23	68.25	68.25	68.25	92.00	1,052.00	–	–	$4 54	2.99
Aug. 12 to Sept. 1,	170.35	8.11	68.25	68.25	68.25	105.00	–	1,211,00	–	5 85	3.43
Sept. 10 to Sept. 30,	159.65	7.60	68.25	68.25	68.25	–	–	–	404.00	5 43	3.40
Roxy.											
July 12 to Aug. 1,	212.79	10.13	68.25	68.25	68.25	105.00	1,242.00	–	–	$4 90	2.30
Aug. 12 to Sept. 1,	209.42	9.97	68.25	68.25	68.25	105.00	–	1,266.00	–	5 98	2.86
Sept. 10 to Sept. 30,	168.72	8.03	68.25	68.25	68.25	–	–	–	440.00	5 70	3.38
Pink.											
July 12 to Aug. 1,	211.28	10.06	68.25	68.25	68.25	105.00	1,169.00	–	–	$4 80	2.27
Aug. 12 to Sept. 1,	230.12	10.96	68.25	68.25	68.25	105.00	–	1,285.00	–	6 02	2.62
Sept. 10 to Sept. 30,	182.33	8.68	68.25	68.25	68.25	–	–	–	420.00	5 55	3.04

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of New-process Linseed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Bean consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
					Nancy.						
1890.											
July 12 to Aug. 1	235.93	11 23	68.25	68.25	68.25	101.00	1,102.00	–	–	$4 68	1.98
Aug. 12 to Sept. 1,	239.77	11.42	68 25	68.25	68.25	105.00	–	1,141.00	–	5 70	2.38
Sept. 10 to Sept. 30,	222.79	10.61	68.25	68.25	68.25	–	–	–	411.00	5 48	2.46
					Juno.						
July 12 to Aug. 1,	190.96	9.09	68.25	68.25	68.25	99.00	1,078.00	–	–	$4 63	2.42
Aug. 12 to Sept. 1,	182.09	8 67	68.25	68.25	68.25	105.00	–	1,159.00	–	5 74	3.15
Sept. 10 to Sept. 30,	171.40	8.16	68.25	68.25	68.25	–	–	–	439.00	5 69	3.32
					Pearl.						
Aug. 19 to Sept. 4,	243.37	14.32	55 25	55.25	55.25	85.00	–	695.00	–	$4 11	1 69
Sept. 10 to Sept. 30,	279.30	13.30	68.25	68.25	68.25	–	–	–	389.00	5 32	1 90

NET COST OF MILK AND MANURIAL VALUE OF FEED.

Jessie.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890.					Cents.	Pounds.
July 12 to Aug. 1, .	$4 54	$2 62	$2 10	$2 44	1.61	900
Aug. 12 to Sept. 1, .	5 85	3 30	2 64	3 21	1.88	900
Sept. 10 to Sept. 30, .	5 43	3 13	3 50	2 93	1.84	940
Total, . .	$15 82	$9 05	$7 24	$8 58	–	–

Roxy.

July 12 to Aug. 1, .	$4 90	$2 83	$2 26	$2 64	1.24	960
Aug. 12 to Sept. 1, .	5 98	3 37	2 70	3 28	1 57	945
Sept. 10 to Sept. 30, .	5 70	3 28	2 62	3 08	1 83	1,013
Total, . .	$16 58	$9 48	$7 58	$9 00	–	–

Pink.

July 12 to Aug. 1, .	$4 80	$2 76	$2 21	$2 59	1.23	865
Aug. 12 to Sept. 1, .	6 02	3 39	2 71	3 31	1.44	880
Sept. 10 to Sept. 30, .	5 55	3 20	2 56	2 99	1 64	874
Total, . .	$16 37	$9 35	$7 48	$8 89	–	–

Nancy.

July 12 to Aug. 1, .	$4 68	$2 70	$2 16	$2 52	1.07	880
Aug 12 to Sept. 1, .	5 70	3 21	2 57	3 13	1.31	870
Sept. 10 to Sept. 30, .	5 48	3 16	2 53	2 95	1.32	905
Total, . .	$15 86	$9 07	$7 26	$8 60	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Juno.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890.					Cents.	Pounds.
July 12 to Aug. 1, .	$4 63	$2 67	$2 14	$2 49	1.30	1,105
Aug. 12 to Sept. 1, .	5 74	3 23	2 58	3 16	1.74	1,105
Sept. 10 to Sept. 30, .	5 69	3 28	2 62	3 07	1.79	1,160
Total, . .	$16 06	$9 18	$7 34	$8 72	–	–

Pearl.

Aug. 19 to Sept. 4, .	$4 11	$2 31	$1 85	$2 26	0 93	772
Sept. 10 to Sept. 30, .	5 32	3 07	2 45	2 87	1.03	810
Total, . .	$9 43	$5 38	$4 30	$5 13	–	–

ANALYSES OF MILK.

Jessie.

	July 15.	July 22.	July 29.	Aug. 19.	Aug. 26.	Sept. 16.	Sept. 23.	Sept. 30.
Solids, . .	16.23	15.57	15.31	16.36	14.92	14.18	14.51	14.20
Fat, . . .	6.87	6.09	6.07	6.18	5.87	5.38	5.35	5.33
Solids not fat, .	9.36	9.48	9.24	10 18	9.05	8.80	9.16	8.87

Roxy.

Solids, . .	13.45	13.37	13 00	14.72	14.00	12.43	13.82	14.18
Fat, . . .	4.17	4.03	2.63	4.87	4.29	3 32	4.52	4.71
Solids not fat, .	9.28	9.34	10 37	9.85	9 71	9.11	9 30	9.47

ANALYSES OF MILK — *Concluded.*

Pink.

	July 15.	July 22.	July 29.	Aug. 19.	Aug. 26.	Sept. 16.	Sept. 23.	Sept. 30.
Solids, . .	15.15	15.26	14.57	15 03	15.57	14 59	15 22	14.82
Fat, . . .	5.19	5.60	5.12	5.17	5.68	5.37	5 89	5.28
Solids not fat, .	9 96	9.66	9.45	9.86	9.89	9.22	9.33	9.54

Nancy.

Solids, . .	13.21	13.29	13.31	13.92	14.18	12 54	13.85	12.61
Fat, . . .	4.22	4 02	4.18	4.56	4.48	4.02	5.14	4.03
Solids not fat, .	8.99	9 27	9.13	9.36	9.70	8.52	8.71	8.58

Juno.

Solids, . .	13.84	13.56	13 94	14 48	14 58	13 39	13 71	13.62
Fat, . . .	4.70	4.13	4.51	4 63	4.73	4.66	4.81	4.53
Solids not fat, .	9.14	9.43	9.43	9.85	9 85	8 73	8.90	9.09

Pearl.

Solids, . .	–	–	–	14 22	13 78	11 36	11.99	11.52
Fat, . . .	–	–	–	4 48	4 45	2 98	3 62	3.23
Solids not fat, .	–	–	–	9.74	9.33	8.38	8 37	8 29

COMPOSITION OF FODDER ARTICLES FED DURING THE PREVIOUSLY DESCRIBED EXPERIMENT.

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.39	247.80	–	–	1 : 9.70
Dry matter,	87.61	1,752.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.80	36.00	–	–	
" cellulose,	1.80	36.00	12.24	34	
" fat,	5.01	100.20	76.15	76	
" protein (nitrogenous matter),	10.46	209.20	177.82	85	
Non-nitrogenous extract matter,	80.93	1,618.60	1,521.48	94	
	100.00	2,000.00	1,787.69	–	

New-process Linseed Meal.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.06	201.20	–	–	1 : 1.54
Dry matter,	89.94	1,798.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.17	123.40	–	–	
" cellulose,	9.22	184.40	47.94	26	
" fat,	3.61	72.20	65.70	91	
" protein (nitrogenous matter),	37.47	749.40	651.98	87	
Non-nitrogenous extract matter,	43.53	870.60	792.25	91	
	100.00	2,000.00	1,557.87	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Wheat Bran.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.52	230.40	–	–	1 : 3.71
Dry matter,	88.48	1,769.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.13	142.60	–	–	
" cellulose,	10.63	212.60	42.52	20	
" fat,	5.62	112.40	89.92	80	
" protein (nitrogenous matter),	18.36	367.20	323.14	88	
Non-nitrogenous extract matter,	58.26	1,165.20	932.16	80	
	100.00	2,000 00	1,387.74	–	

Vetch and Oats.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	76.21	1,524.20	–	–	1 : 11.72
Dry matter,	23.79	475.80	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.25	145.00	–	–	
" cellulose,	31.73	634.60	–	–	
" fat,	3.37	67.40	33.70	50	
" protein (nitrogenous matter),	7.70	154.00	92.40	60	
Non-nitrogenous extract matter,	49.95	999.00	999.00	100	
	100.00	2,000.00	1,125.10	–	

Composition of Fodder Articles, etc. — *Concluded.*

Soja Beans.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	72.95	1,459.00	–	–	1 : 5.43
Dry matter,	27.05	541.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	11.05	221.00	–	–	
" cellulose,	24.73	494.60	355.12	71.8	
" fat,	7.22	144.40	26.28	18.2	
" protein (nitrogenous matter),	13.64	272.80	174.59	64	
Non-nitrogenous extract matter,	43.36	867.20	527.26	60.8	
	100.00	2,000 00	1,083.25	–	

For analysis of English hay, see preceding feeding records for 1889–90.

4. Creamery Record of the Station for the Years 1889 and 1890.

The cost of feed consumed is based on the market price of the various ingredients, as is stated in the subsequent table.

The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are also based on those given in the following table: —

Local Market Value per Ton of the Various Articles of Fodder used.

Corn meal,	$23 00
Corn and cob meal,	20 70
Wheat bran,	21 50
Rye middlings,	21 50
Gluten meal,	23 00
New-process linseed meal,	26 00
Old-process linseed meal,	27 00

Local Market Value per Ton, etc. — Concluded.

Hay,	$15 00	Soja bean (green),	$4 40
Rowen,	15 00	Vetch and oats (green),	2 75
Corn fodder,	5 00	Vetch (green),	3 50
Corn stover,	5 00	Serradella (green),	3 16
Corn ensilage,	2 25	Cow-pea (green),	3 14
Millet (dry),	12 00	Barley and horse bean (green),	3 00
Lucerne and vetch (dry),	12 00	Potatoes,	6 67
Lucerne and clover (dry),	12 00	Carrots,	7 00
Oats (dry),	12 00	Sugar beets,	5 00
Oats (green),	3 60		

Valuation of the Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

[Per cent.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Corn and cob meal,	1.46	0.603	0.441	5 91
Wheat bran,	2.82	3.05	1.49	14 24
Rye middlings,	1.84	1.26	0.81	8 27
Gluten meal,	5 22	0.40	0.05	17 75
New-process linseed meal,	6 25	1.42	1.16	23 32
Old-process linseed meal,	5.33	1.64	1.16	20 54
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Millet (dry),	1.106	0.38	2.49	6 23
Lucerne and vetch (dry),	2.02	0.70	2.273	9 44
Lucerne and clover (dry),	2.06	0.623	1 805	9 08
Oats (dry),	1.47	0.51	2.41	7 51
Oats (green),	0.33	0.155	0.68	1 85

Valuation of Essential Fertilizing Constituents, etc. — Concluded.

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Soja bean (green), . . .	0.590	0.193	0.311	$2 44
Vetch and oats (green), . .	0.23	0.09	0.79	1 54
Vetch (green), ...	0.49	0.20	0.66	2 42
Serradella (green), . . .	0.411	0.14	0.423	1 89
Cow-pea (green), ...	0.561	0.098	0.306	2 23
Barley and beans (green), . .	0 50	0.20	0.40	2 23
Potatoes, ...	0.476	0.18	0.56	2 18
Carrots, ...	0.14	0.10	0.54	1 04
Sugar beets, ...	0.29	0.03	0.18	1 15

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved; for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock, and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream, and modes of analysis of milk, cream and butter.

1. *Statement of Articles of Fodder used during 1889 (in Pounds).*

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Carrots.	Sugar Beets.
January, . .	608.75	604.75	584.75	–	1,772.00	–	–	–	1,475.00	–	–	–	4,868.00	–
February, . .	552.50	552.50	552.50	–	1,268.50	–	–	–	5,069.50	–	–	–	–	–
March, . .	591.50	591.50	591.50	–	2,396.00	–	–	–	–	–	–	–	–	4,084.00
April, . . .	572.00	562.25	563.88	–	2,395.50	838.00	–	–	–	–	–	–	–	1,125.00
May, . . .	604.50	583.38	604.50	–	900.50	2,713.50	–	–	–	–	–	–	–	–
June, . . .	585.00	585.00	585.00	–	1,858.50	1,295.50	–	–	–	582.75	–	–	–	–
July, . . .	604.50	604.50	604.50	–	434.00	1,871.00	–	–	–	4,308.75	–	–	–	–
August, . .	402.00	402.00	402.00	–	180.00	3,755.25	–	–	–	–	–	1,512.00	–	–
September, . .	585.00	585.00	585.00	–	1,002.00	–	–	–	–	–	8,182.50	4,983.00	–	–
October, . .	604.50	604.50	604.50	–	3,574.50	–	–	–	–	–	–	–	–	–
November, . .	585.00	585.00	585.00	–	3,491.50	–	–	–	–	–	–	–	–	–
December, . .	604.50	604.50	88.00	516.50	3,451.00	–	–	–	–	–	–	–	–	–

1. *Statement of Articles of Fodder used during 1890 (in Pounds).*

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Beans.	Carrots.	Sugar Beets.
January, .	604.50	604.50	-	604.50	-	-	1,016.00	-	-	-	7,737.50	-	-	-	-
February, .	370.50	546.00	-	529.75	-	-	514.00	-	850.50	-	4,687.50	-	-	1,080.00	-
March, .	-	604.50	-	604.50	-	-	-	-	1,132.00	1,665.00	-	-	-	3,680.00	-
April, . .	184.50	577.50	-	106.50	444.00	-	977.00	-	1,201.50	472.50	-	-	-	2,520.00	1,080.00
May, . .	604.50	604.50	-	340.50	262.50	-	2,656.50	360.00	-	-	-	-	-	-	3,240.00
June, . .	585.00	585.00	-	379 50	204.00	-	-	3,723.50	-	-	-	-	-	-	-
July, . .	604.50	604.50	-	-	604.50	-	725.50	613.00	-	-	-	7,463.00	-	-	-
August, .	604.50	604.50	-	-	604.50	-	920.00	-	-	-	-	910 50	8,882.50	-	-
September, .	585.00	585.00	-	-	585.00	-	120.00	2,935.00	-	-	-	-	1,767.00	-	-
October, .	571.50	571.50	-	-	223.50	348.00	-	3,221.50	-	-	-	-	-	-	-

2. *Record of Average Quality of Milk and of Fodder Rations (1889).*

1889.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds).												
					Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Ensilage.	Carrots.	Sugar Beets.	Vetch and Oats.	Serradella.	Cow-pea.
January, . .	14.49	3.90	1.76	1 : 6.21	3.25	3.25	3.25	-	10.00	-	-	-	39.57	-	-	-	-
February, .	13.93	4.29	1.74	1 : 6.57	3.25	3.25	3.25	-	5.00	-	-	36.51	-	-	-	-	-
March, . .	14.12	4.36	1.65	{ 1 : 5 99	3.25	3.25	3.25	-	16.40	-	-	-	-	-	-	-	-
				{ 1 : 6.14	3.25	3.25	3.25	-	10.00	-	-	-	-	45.60	-	-	-
April, . .	14.14	4 56	1.62	1 : 6.12	3.25	3.25	3.25	-	18.38	-	-	-	-	-	-	-	-
May, . .	14.03	4.34	1.60	1 : 5.21	3.25	3.25	3.25	-	-	19 53	-	-	-	-	-	-	-
June, . .	14.42	4.58	1.62	{ 1 : 5.30	3.25	3.25	3.25	-	-	20.60	-	-	-	-	-	-	-
				{ 1 : 6.18	3.25	3.25	3.25	-	18.00	-	-	-	-	-	-	-	-
July, . .	13.92	4.30	1.72	{ 1 : 6.38	3.25	3.25	3.25	-	5.00	-	-	-	-	-	46.50	-	-
				{ 1 : 5.30	3.25	3.25	3.25	-	-	20.60	-	-	-	-	-	-	-
August, . .	13.85	4.21	1.70	1 : 5.62	3.25	3.25	3.25	-	-	24.10	-	-	-	-	-	-	76.23
September, .	13.82	4.48	1.65	{ 1 : 6.05	3.25	3.25	3.25	-	5.00	-	-	-	-	-	-	78.23	-
				{ 1 : 4.70	3.25	3.25	3.25	-	5.00	-	-	-	-	-	-	-	-
October, . .	14.34	4.72	1.53	1 : 6.26	3.25	3.25	3.25	-	19.30	-	-	-	-	-	-	-	-
November, .	-	-	1.53	1 : 6.26	3.25	3.25	3.25	-	19.40	-	-	-	-	-	-	-	-
December, .	14.33	4.64	1.44	1 : 5.72	3.25	3.25	-	3.25	18.44	-	-	-	-	-	-	-	-
Averages, .	14.12	4.39	1.63	1 : 5.88													

2. *Record of Average Quality of Milk and of Fodder Rations (1890).*

1890.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make one Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds). Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Bean.	Carrots.	Sugar Beets.
January, .	14.18	4.72	1.45	1 : 6.25	3.25	3.25	-	3.25	-	-	5.00	-	-	-	44.74	-	-	-	-
February, .	14.02	4.64	1.51	1 : 6.25	3.25	3.25	-	3.25	-	-	5.00	-	-	-	44.74	-	-	-	-
				1 : 5.14	-	3.25	-	3.25	-	-	-	-	13.74	-	-	-	-	20.00	-
March, .	14.21	4.99	1.57	1 : 5.14	-	3.25	-	3.25	-	-	-	-	13.74	-	-	-	-	20.00	-
				1 : 5.14	-	3.25	-	3.25	-	-	-	-	-	16.00	-	-	-	20.00	-
April, .	13.37	4.42	1.66	1 : 4.95	-	3.25	-	-	3.25	-	-	-	16.13	-	-	-	-	20.00	-
				1 : 5.22	3.25	3.25	-	-	3.25	-	15.90	-	-	-	-	-	-	-	20.00
May, . .	13.73	4.38	1.75	1 : 5.22	3.25	3.25	-	-	3.25	-	15.90	-	-	-	-	-	-	-	20.00
				1 : 5.60	3.25	3.25	-	3.25	-	-	15.67	-	-	-	-	-	-	-	20.00
June, . .	13.42	4.39	1.76	1 : 5.04	3.25	3.25	-	3.25	-	-	-	20.60	-	-	-	-	-	-	-
				1 : 4.73	3.25	3.25	-	-	3.25	-	-	20.75	-	-	-	-	-	-	-
July, . .	13.91	4.45	1.67	1 : 5.96	3.25	3 25	-	-	3.25	-	5.00	-	-	-	-	53.75	-	-	-
August, .	14.65	4.95	1.61	1 : 4.69	3.25	3.25	-	-	3.25	-	5.00	-	-	-	-	-	55.00	-	-
September,	13.47	4.57	1.59	1 : 4.91	3.25	3.25	-	-	3.25	-	-	19.86	-	-	-	-	-	-	-
October, .	13.84	4.82	1.56	1 : 4.91	3.25	3.25	-	-	3.25	-	-	19.86	-	-	-	-	-	-	-
				1 : 4.84	3.00	3.00	-	-	-	3.00	-	19.25	-	-	-	-	-	-	-
Averages,	13.88	4.63	1.61	1 : 5.25															

3. Value of Cream produced at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1889.					
January,	$52 21	$21 23	$0 63	$31 64	$40 60
February,	33 86	19 15	0 63	15 34	36 19
March,	48 14	21 77	0 75	27 11	42 48
April,	46 17	23 40	0 78	23 55	42 84
May,	47 28	27 23	0 83	20 88	39 28
June,	44 21	23 98	0 72	20 95	33 06
July,	43 63	25 28	0 76	19 11	34 92
August,	45 44	27 54	0 76	18 66	36 33
September,	48 01	28 08	0 73	20 66	38 25
October,	47 21	23 47	0 71	24 45	39 06
November,	45 93	22 82	0 66	23 77	36 11
December,	47 18	24 38	0 67	23 47	36 68
Averages,	$45 77	$24 03	$0 72	$22 46	$37 98
1890.					
January,	$37 78	$23 07	$0 64	$15 35	$33 99
February,	32 19	19 62	0 69	13 26	36 93
March,	34 38	19 75	0 66	15 29	37 52
April,	38 54	19 75	0 68	19 47	32 40
May,	52 09	25 32	0 73	27 50	33 45
June,	48 63	30 05	0 72	19 30	30 66
July,	41 65	23 90	0 68	18 43	29 04
August,	49 09	27 52	0 73	22 30	39 27
September,	47 43	28 68	0 72	19 47	42 05
October,	44 48	27 82	0 65	17 31	39 92
Averages,	$42 63	$24 55	$0 69	$18 77	$35 52

4. *Cost of Skim-milk at the Selling Price of Three Cents per Quart for Whole Milk.*

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1889.								Cents.	
January, .	1,791.1	1,015	298.5	1,492.6	4.00	2.27	$40 60	0.88	$13 13
February, .	1,680.0	965	283.8	1,396.2	3.75	2.15	36 19	1.02	14 21
March, . .	1,895.0	1,148	337.6	1,557.4	3.70	2.24	42 48	0.92	14 37
April, . .	1,931.6	1,190	350.0	1,581.6	3.60	2.22	42 84	0.96	15 11
May, . .	2,025.2	1,267	372.6	1,652.6	3.10	1.94	39 28	1.30	21 48
June, . .	1,785.6	1,102	324.1	1,461.5	3.00	1.85	33 06	1.40	20 51
July, . .	2,001.2	1,164	342.4	1,658.8	3.00	1.74	34 92	1.51	25 12
August, . .	1,991.9	1,172	344.7	1,647.2	3.10	1.82	36 33	1.42	23 43
September, .	1,856.0	1,125	330.9	1,525.1	3.40	2.06	38 25	1.14	17 43
October, .	1,665.0	1,085	319.1	1,345.9	3.60	2.35	39 06	0.81	10 89
November, .	1,538.1	1,003	295.0	1,243.1	3.60	2.35	36 11	0.81	10 03
December, .	1,463.8	1,019	299.7	1,164.1	3.60	2.51	36 68	0.62	7 23
Averages, .	1,802.0	1,105	324.9	1,477.2	3.45	2.13	$37 98	1.07	$16 08
1890.									
January, .	1,404.1	971	285.6	1,118.5	3.50	2.42	$33 99	0.73	$8 13
February, .	1,596.2	1,055	310.3	1,285.9	3.50	2.31	36 93	0.85	10 96
March, . .	1,594.8	1,014	298.2	1,296.6	3.70	2.35	37 52	0.80	10 32
April, . .	1,720.8	1,035	304.4	1,416.4	3.13	1.88	32 40	1.36	19 22
May, . .	1,946.7	1,115	327.9	1,618 8	3.00	1.72	33 45	1.54	24 95
June, . .	1,922.4	1,095	322.1	1,600.3	2.80	1.59	30 66	1.69	27 01
July, . .	1,727.0	1,037	305.0	1,422.0	2.80	1.68	29 04	1.60	22 77
August, . .	1,809.5	1,122	330.0	1,479.5	3.50	2.17	39 27	1.02	15 02
September, .	1,747.4	1,098	322.9	1,424.5	3.83	2.41	42 05	0.73	10 37
October, .	1,556.9	998	293.5	1,263.4	4.00	2.56	39 92	0.54	6 79
Averages, .	1,702.6	1,054	310.0	1,392.6	3.38	2.11	$35 52	1.09	$15 55

5. *Fertilizing Constituents of Cream.*

[Average analysis.]

	Per Cent.
Moisture at 100° C., ...	75.22
Nitrogen (16½ cents per pound), ...	.54
Potassium oxide (4¼ cents per pound), ...	.123
Phosphoric acid (6 cents per pound), ...	.168

6. Conclusions.

1. The nutritive ratio of the feed in 1889 varied from 1 : 4.70 to 1 : 6.57, with an average of 1 : 5.88 ; it varied in 1890 from 1 : 4 64 to 1 : 6.25, with an average of 1 : 5.25.

2. The amount of fat in the milk varied, during the year 1889, from 3.90 per cent. to 4.72 per cent., average 4.39 per cent. In 1890 it varied from 4 38 per cent. to 4.99 per cent , with an average of 4.63 per cent.

3. The total solids varied, in 1889, from 13.82 per cent. to 14.49 per cent., average 14.12 per cent. In 1890 it ran from 13.37 per cent. to 14.65 per cent., average 13.88 per cent.

4. Total cost of feed for one quart of cream amounts, in 1889, to 14.09 cents, and in 1890 to 13.75 cents.

5. Net cost of feed for one quart of cream amounts, in 1889, to 6.09 cents, and in 1890 to 6.05 cents.

6. The value received for one space of cream varied, in 1889, from 3 to 4 cents, with an average of 3.43 cents. In 1890 it varied from 2.80 to 4 cents, with an average of 3.38 cents, which amounts, per quart, in 1889 to 11.69 cents, and in 1890 to 11.46 cents.

7. The quantity of milk, in quarts, required to produce one space of cream, in 1889, amounted to 1.63, and 1.62 in 1890, or 5.54 quarts of whole milk to produce one quart of cream in 1889, and 5.49 quarts in 1890.

8. The net cost of feed per quart of cream averages, in 1889, 6.9 cents, and in 1890 6.05 cents. We received per quart of cream, in 1889, 11.69 cents, and in 1890 11.46 cents, thereby securing a profit of 4.79 cents in 1889, and 5.41 cents in 1890.

From these statements it appears, as has already been claimed in previous reports, that close fodder rations tend to improve the quality of the milk, as well as the condition of the animal.

For further details concerning results in preceding years, see pages 82 to 84, seventh annual report.

Our average statements for the current year apply in each case to only ten months, due to the fact that financial settlement with our local creamery is made two months after cream is furnished.

7. Creamery Record, 1890. — Analyses of Cream and Butter Fat.

Date of Sampling.	Analysis of Cream.			Date of Testing.	Analysis of Fat.		Average Daily Fodder Ration.
	Solids.	Fat.	Solids not Fat.		Volatile Acids.	Non-volatile Acids.	
1890.				1890.			
January 23,	27.62	18.65	8.97	January 23,	6.55	86.93	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 5 pounds hay, 50 pounds corn ensilage.
" 24,	27.85	17.80	10.05	" 24,	6.63	87.10	
" 27,	25.08	17.30	7.68	" 27,	6.29	87.99	
February 3,	27.52	19.20	8.32	February 3,	6.61	88.92	
" 5,	25.80	18.31	7.49	" 5,	6.53	88.18	
" 11,	27.70	18.43	9.27	" 11,	6.40	88.60	
February 24,	26.47	20.96	5.51	February 24,	6.12	89.20	3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds carrots, 18 pounds fodder corn.
" 26,	25.18	16.52	8.66	" 26,	6.37	89.02	
March 3,	25.10	16.62	8.48	March 3,	6.44	88.84	
" 6,	26.38	18.14	8.24	" 6,	6.38	88.92	
" 10,	25.40	17.82	7.58	" 10,	6.38	88.90	
" 11,	26.10	18.24	7.86	" 11,	6.32	88.94	
April 30,	23.30	14.51	8.79	April 30,	6.57	87.10	3¼ pounds wheat bran, 3¼ pounds corn meal, 3¼ pounds new-process linseed meal, 20 pounds sugar beets, 15 pounds hay.
May 2,	24.67	16.37	8.36	May 2,	6.44	88.31	
" 5,	26.05	17.49	8.56	" 5,	6.35	87.58	
" 7,	23.93	15.00	8.93	" 7,	6.62	88.49	
" 9,	24.72	15.94	8.78	" 9,	6.45	87.39	
" 12,	24.88	14.96	9.92	" 12,	6.52	88.10	
May 20,	25.12	16.90	8.22	June 25,	6.54	88.02	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds sugar beets, 15 pounds hay.
" 21,	25.76	17.46	8.30	" 28,	6.48	87.90	
" 23,	26.69	19.18	7.51	July 20,	7.59	84.76	
" 26,	25.61	17.52	8.09	" 22,	7.96	82.04	
" 28,	24.42	16.35	8.07	" 24,	8.11	78.69	
June 6,	25.76	17.95	7.81	July 28,	7.44	83.56	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds rowen.
" 9,	27.70	19.86	7.84	August 1,	7.37	85.35	
" 12,	26.00	18.26	7.74	" 3,	8.06	82.99	
" 13,	26.26	18.38	7.88	September 16,	7.21	83.55	
June 17,	24.53	17.93	6.60	September 19,	6.75	86.59	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds rowen.
" 18,	25.54	17.67	7.87	" 23,	6.61	86.40	

7. *Creamery Record, 1890* — Concluded.

Date of Sampling.	Analysis of Cream. Solids.	Fat.	Solids not Fat.	Date of Testing.	Analysis of Fat. Volatile Acids.	Non-volatile Acids.	Average Daily Fodder Ration.
1890.				**1890.**			
June 27,	24.30	17.34	6.96	September 30,	6.99	86.23	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 20 pounds rowen.
" 29,	25.59	18.01	7.58	–	–	–	
July 2,	24.88	17.02	7.86	October 7,	6.74	86.68	
" 3,	22.94	15.97	6.97	" 9,	6.94	86.47	
July 29,	23.61	16.37	7.24	August 7,	6.78	86.61	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 5 pounds hay, 45 pounds vetch and oats.
August 1,	21.32	14.85	6.47	" 11,	6.78	87.14	
August 20,	26.14	18.84	7.30	August 20,	6.70	87.34	3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 5 pounds hay, 50 pounds soja bean.
" 27,	26.44	19.07	7.27	" 27,	6.35	87.92	
September 5,	26.72	19.37	7.35	September 5,	6.25	88.40	
September 17,	24.20	16.97	7.23	September 17,	6.39	87.49	3¼ pounds corn meal, 3¼ pounds wheat bran, 3½ pounds new-process linseed meal, 20 pounds rowen.
" 24,	22.07	14.87	7.20	" 24,	6.43	86.99	
November 7,	24.12	15.46	8.66	November 12,	7.36	86.35	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 20 pounds rowen.
" 12,	25.18	16.42	8.76	" 12,	6.94	87.04	
" 19,	25.15	15.96	9.19	" 19,	7.06	84.84	
December 2,	–	–	–	December 2,	6.10	84.35	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 18 pounds rowen.
" 9,	26.17	17.21	8.96	" 9,	6.48	86.45	
" 16,	21.30	13.63	7.67	" 16,	6.87	85.50	
December 24,	25.95	17.29	8.66	December 24,	6.71	85.40	3 pounds corn meal, 3 pounds wheat bran, 3 pounds old-process linseed meal, 17 pounds rowen.
" 30,	24.78	16.32	8.46	" 30,	6.61	85.28	

The analyses of samples taken prior to May 20 were made according to the method of R. W. Moore, as modified by Waller. Those analyzed subsequent to that date were made according to the method of L. F. Nilson, as described in this report, on page 68.

Method of Milk Analysis.

Total Solids. — Evaporate a known quantity of milk (approximately 5 grams) in a weighed porcelain dish, containing 15 to 20 grams of pure, dry sand, on the water bath until apparently dry, then transfer to the air bath and dry at 100° to 105° C. to a constant weight, weighing at intervals of about an hour. In case of cream, use 2.5 to 3 grams for evaporation.

Fat. — Pulverize the sand containing the solids without removing from the dish, subsequently transfer to a filter, and exhaust with anhydrous, alcohol-free ether. Dry the fat obtained on the evaporation of the ether in an air bath at 100° to 105° C. to a constant weight.

Ash. — A weighed quantity of milk is evaporated to dryness with a few drops of nitric acid, and burned in a muffle at a low red heat until free from carbon.

Methods of Butter Analysis.

(1) *Moisture.* — Two and five-tenths to 3 grams are dried at 100° C. in an air bath.

(2) *Salt.* — Six to 7 grams of the butter are washed into a separatory funnel with hot water, and are well shaken, and allowed to stand until the fat has collected on top; the water is then drawn off, and a fresh quantity added, and shaken up with the butter. This is continued until 200 to 300 cubic centimetres of water have passed through the funnel. The washings are mixed, and made up to 500 cubic centimetres, and the chlorine determined in an aliquot part by means of silver nitrate. From the chlorine the salt is readily calculated.

(3) *Fat.* — Two and five-tenths to 3 grams of the fat freed from salt by the above operation (2), and from water by drying in the air bath, are dissolved in ether, and filtered from the curd into a tared flask. The ether is driven off, and the residual fat dried and weighed. In calculating the per cent., allowance is made for salt and water removed.

(4) *Casein.* — The residue remaining on the filter in (3) is tested for nitrogen by the Kjeldahl method. The factor 6.33 is used in reducing the per cent. of nitrogen found to casein.

Method for determining Volatile and Non-volatile Fatty Acids (first).

Directly after receiving the sample of cream from the Cooley cream-setting apparatus, the solids and fat were determined as usual. The cream was churned by vigorous shaking in a bottle, and was washed several times with cold water. The butter was then dissolved in ether, filtered from the curd, and the ether evaporated. About 2.5 grams of fat were placed in a weighed Erlenmeyer flask, the exact weight taken, and the fat saponified by 1 gram of potassium hydrate dissolved in 50 cubic centimetres of 70 per cent. alcohol. Heat is necessary for complete saponification. The alcohol is next driven off by continued heating in a boiling-water bath. The resulting soap is dissolved in 50 cubic centimetres of water, and decomposed by means of 20 cubic centimetres of dilute sulphuric acid (1 part of strong acid to 10 of water) ; 50 cubic centimetres are then distilled off, using a condenser for that purpose, the distillate passing through a filter. The distillate is titrated with one-tenth-normal sodium hydrate solution (4 grams of pure sodium hydrate per litre of water), 50 cubic centimetres of water are added to the contents of the flask, and an equal quantity distilled off, which is titrated as before. This treatment is continued until .1 cubic centimetre or less of the soda solution is required for neutralization. Phenolphthalein is used as an indicator. The volatile fatty acids are calculated from the sum of the cubic centimetres of soda solution required to neutralize all the distillates, calculating the acid as butyric. After cooling, the liquid remaining in the flask is poured off from the solidified non-volatile fatty acids through the same filter used in filtering the distillates. The solid fatty acids are washed repeatedly with hot water, until all traces of sulphuric acid are removed. The condenser is then washed out with hot alcohol, and the filter exhausted with the same solvent, the washings being collected in the flask. The alcohol is then driven off, the flask and contents dried at 100° C., and weighed, and the per cent. of non-volatile fatty acids calculated. The above method is that of R. W. Moore, as modified by Waller, and described in the "Journal of the American Chemical Society," No. 9, 1889, by R. W. Moore.

Method for determining Volatile and Non-volatile Fatty Acids contained in Butter (second).

The sample is prepared by churning the cream in a suitable bottle, washing the butter well with cold water, melting at 50° C. and filtering from the curd through a hot-water funnel. The fat is then heated in the air bath until free from water.

The method pursued in the determination of the volatile and non-volatile fatty acids is essentially that described by L. F. Nilson, in "Zeit. f. Anal. Chemie," 28, 2, 176.

Two and eight-tenths cubic centimetres to 2.9 cubic centimetres (approximately 2.5 grams) are measured into a tared Erlenmeyer flask of 250 cubic centimetres capacity, and the exact weight determined. Saponification is accomplished by adding 1 gram of potassium hydrate dissolved in 2 cubic centimetres of water, and 5 cubic centimetres of strong (95 per cent.) alcohol. The flask is provided with a reflux condenser, and heated until saponification is complete. The alcohol is then driven off, the last traces being removed by means of the following device: the flask is provided with a double perforated rubber cork, one hole carrying a glass tube reaching nearly to the bottom of the flask and provided above with a short rubber tube carrying a pinch-cock, the other connected by means of a rubber tube with a suction pump. By alternately opening and closing the pinch-cock while the pump is working, the last traces of alcohol can be readily removed from the soap.

Dissolve the soap thus obtained in 30 cubic centimetres of warm water, decompose with 20 cubic centimetres of a 20 per cent. solution of orthophosphoric acid, distil off the volatile acids through a condenser, filtering the distillate, and titrate with decinormal sodium hydrate, using phenolphthalein as indicator. The volatile acids are expelled from the flask by a current of steam. When the distillate amounts to 500 cubic centimetres, the operation is considered to be complete. The volatile acids are calculated as butyric.

The condenser and connections are rinsed back into the flask with boiling water, and the non-volatile acids washed with hot water, and filtered when cool through the same filter that was used for the distillate. The washing is continued until no traces of phosphoric acid are left in the distillate. The filter is then exhausted with hot alcohol, allowing the solution to run into the flask. The alcohol is driven off on the water bath, and the non-volatile fatty acids dried at 100 ° C. in the air bath until they begin to gain weight.

Dairy Salt, 1890.

[Sent on from the Cummington Creamery.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	0.880	0.320	0.295
Sodium chloride,	97.877	98.009	98.513
Calcium chloride,	0.016	0.013	0.010
Calcium sulphate,	1.108	1.644	1.160
Magnesium chloride,	0.010	0.014	0.012
Magnesium oxide,	0.007	–	–
Insoluble matter,	0.102	0.020	0.010

Dairy Salt, 1890.

[I. and II. sent on from Amherst, Mass.; III. and IV. sent on from Northampton, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	0.235	0.200	0.855	0.565
Sodium chloride,	98.563	98.575	98.891	97.935
Calcium sulphate,	1.137	1.185	0.906	1.376
Calcium chloride,	0.045	0.029	0.293	0.097
Magnesium chloride,	0.020	0.007	0.055	0.027
Magnesium oxide,	–	0.004	–	–
Insoluble matter,	–	–	–	–

A good dairy salt ought to be of a uniform, fine granulation, of a white color, free from colored sp cks, free from any odor, of a pure saline test and of a neutral reaction. The chlorides of calcium and magnesia should not exceed one-tenth of one per cent.

II. — Feeding Experiments with Lambs, 1890.

The feeding experiments which are briefly described within a few subsequent pages are the first of a series devised for the purpose of ascertaining the cost of feed, when fattening lambs, by means of winter fodder rations, for the meat market.

The selection of animals, with reference to breeds best adapted for our purpose, was controlled by the temporary supply of our local market. Six lambs, three ewes and three wethers, bought of a farmer in our vicinity, Sept. 4, 1889, served for our observations. They were grades of a somewhat doubtful parentage; five showed some of the characteristics of Hampshire Downs, and one of Merinos. Each animal occupied, during the entire period of observation, a separate pen. They were shorn before being weighed, at the beginning of the experiment.

The daily diet of the entire lot consisted, during the first week, of rowen (dried second cut of grass lands). They were subsequently treated in two divisions, each comprising three animals. This division was made for the purpose of comparing the effect of two distinctly different daily fodder rations on the financial results of the operation. Division I. (Nos. 1–3) received a daily diet much richer in nitrogenous food constituents than the one adopted for Division II. (Nos. 4–6). This circumstance was brought about by feeding to the first division as grain feed a mixture of wheat bran and of gluten meal, and to the second division one consisting of a liberal proportion of corn meal, with some wheat bran and gluten meal. The coarse portion of the daily feed was in both cases essentially the same; namely, either rowen, or rowen and corn ensilage, or corn ensilage alone. It was cut before being mixed with the grain feed, when fed. The daily fodder ration was divided into two equal parts, and fed respectively in the morning and in the evening. The amount of feed left unconsumed, if any, was collected each morning and deducted from the daily ration offered the preceding day for consumption.

The observations in case of the first division of lambs (Nos. 1–3) were continued for 152 successive days (Sept.

5, 1889, to Feb. 4, 1890), while in case of the second division (Nos. 4–6) they were extended to March 18, 1890, and lasted thus for 194 consecutive days. Low rate of increase in live weight and local market condition advised the extension of the trial in the latter case.

The three lambs of the first division gained within 152 days, in live weight, in the aggregate 107½ pounds, or each individual on an average 35⅚ pounds; while those of the second division (Nos. 4–6) gained during 194 days, in the aggregate, only 86 pounds, or each individual on an average 28⅔ pounds.

Some of the essential points of interest in the experiment here under discussion are stated in some subsequent pages, under the following headings: —

1. Weight of lambs.
2. Cost of lambs.
3. Character and cost of feed consumed.
4. Gain in live weight during the observation.
5. Financial statement.
6. Conclusion.
7. Detailed statement of feeding record.

1. *Weight of Lambs.*

The aggregate live weight of six lambs when bought amounted to 450½ pounds.

The wool secured before the beginning of the feeding experiments amounted to 22¼ pounds.

	Live Weights when bought.	Wool removed.	Live Weights at the Beginning of Trial.
1, . .	82.50 pounds.	3.50 pounds.	79.00 pounds (wether).
2, . .	69.50 pounds.	3.50 pounds.	66.00 pounds (ewe).
3, . .	75.00 pounds.	4.25 pounds.	70.75 pounds (ewe).
4, . .	71.00 pounds.	3.50 pounds.	67.50 pounds (ewe).
5, . .	70.00 pounds.	3.75 pounds.	66.25 pounds (wether).
6, . .	82.50 pounds.	3.75 pounds.	78.75 pounds (wether).
	450.50 pounds.	22.25 pounds.	428.25 pounds.

Division I. consisted of lambs Nos. 1–3; its aggregate live weight was 215.75 pounds at the beginning of the experiment.

Division II. consisted of lambs Nos. 4–6; its aggregate live weight at the beginning of the experiment was 212.50 pounds.

2. *Cost of Lambs.*

The entire lot was bought at six cents per pound of live weight, and the sum paid for 450.5 pounds of the original weight amounted to $27.03.

The wool secured before the beginning of the feeding trial, which amounted to 22.25 pounds, was returned at 23 cents per pound. The sum realized by that transaction was $5.12. Allowing the deduction of $5.12 on the first cost of the lambs, which was $27.03, it will be found that their actual cost at the beginning of the experiment was but $21.91, or 5.12 cents per pound of live weight. The live weight without the removed wool was 428.25 pounds.

Division I.

1.	79.00 pounds of live weight, at 5.12 cents,	$4 05	$11 01
2.	66.00 pounds of live weight, at 5.12 cents,	3 38	
3.	70.00 pounds of live weight, at 5.12 cents,	3 58	

Division II.

4.	67 00 pounds of live weight, at 5 12 cents,	$3 43	$10 85
5.	66.25 pounds of live weight, at 5.12 cents,	3 39	
6.	78.75 pounds of live weight, at 5.12 cents,	4 03	

3. *Character and Cost of the Feed consumed.*

To secure a normal and uniform condition of the animals selected for a comparative test of different fodder rations, with reference to their influence on the financial results of the operation, nothing but rowen was fed to the entire lot for ten days preceding the experiment (September 4 to September 16). Subsequently a division of animals was made. Three lambs, 1–3, were fed with daily rations richer in digestible nitrogenous food constituents than those fed to the remaining number, 4–6.

The daily feed of the first division (1–3) contained on an average from 4.5 to 5.5 parts of digestible non-nitrogenous food constituents to one part of digestible nitrogenous food constituents, 1 : 4.5 to 1 : 5.5.

The daily diet of the second division (4–6) contained, during a corresponding period of the feeding experiment, one part of digestible nitrogenous food constituents to from 6.99 to 7.3 parts of digestible non-nitrogenous food constituents, 1 : 6.99 to 1 : 7.3. Subsequently a diet similar to that adopted for the first division was substituted.

Fodder Combinations used in Division I. (1–3).

The daily quantity of the subsequently stated fodder rations was regulated by the appetite of each animal.

a. September 16 to September 30 : —

Two pounds of rowen, 1 pound of a mixture consisting of wheat bran, 2 weight parts; gluten meal, 1 weight part.

Nutritive ratio, 1 : 4.75.

b. October 1 to December 31 : —

Two pounds of rowen, 1 pound of a mixture consisting of wheat bran and gluten meal, equal weights.

Nutritive ratio, 1 : 4.55.

c. January 2 to January 20 : —

One pound of rowen, 3½ pounds of corn ensilage, 1 pound of the same grain mixture as in ration *b*.

Nutritive ratio, 1 : 5.09.

d. January 21 to February 3 : —

Seven pounds of corn ensilage, 1 pound of grain mixture as in ration *b*.

Nutritive ratio, 1 : 5.5.

Cost of Above Fodder Rations for Weights stated.

	a.	*b.*	*c.*	*d.*
Total cost of feed consumed (cents),	2.45	2.51	2.24	1.97
Manurial value obtainable (cents),	1 13	1.15	1.10	1.04
Net cost of feed (cents),	1.32	1.36	1 14	0.93

Fodder Combinations used in Division II. (4–6).

a. September 16 to December 31 : —

Two pounds of rowen, ½ pound of a mixture consisting of corn meal, 10 weight parts; wheat bran, 2 weight parts; gluten meal, 1 weight part.

Nutritive ratio, 1 : 7.00.

b. January 2 to January 20 : —

One pound of rowen, 3½ pounds of corn ensilage, ½ pound of the same grain mixture as in preceding ration *a*.

Nutritive ratio, 1 : 7.3.

c. February 4 to February 15 : —

Six pounds of corn ensilage, 1 pound of a mixture consisting of wheat bran and gluten meal, equal weights.

Nutritive ratio, 1 : 5.7.

d. February 18 to March 17 : —

One and one-half pounds of corn fodder, 1 pound of a mixture the same as in ration c.

Nutritive ratio, 1 : 4.88.

Cost of Fodder Rations used in Division II.

	a.	*b*	*c.*	*d.*
Total cost of feed consumed (cents),	1.98	1 71	1.83	1.56
Manurial value obtainable (cents),	0.71	0.50	0.97	0.89
Net cost of feed (cents),	1.27	1.21	0.86	0.67

The customary deduction of twenty per cent. of the manurial value of the feed consumed is adopted in the above valuation. Net cost of feed represents its first cost, or local market value, less eighty per cent. of the market value of its manurial constituents.

Cost of Fodder Articles used in the Experiment.

Rowen, per ton,	$15 00
Corn ensilage, per ton,	2 75
Corn meal, per ton,	19 00
Wheat bran, per ton,	17 00
Gluten meal, per ton,	23 00

4. Gain in Live Weight during the Experiment.

Division I. (1–3). Time of Observation extended over 152 Days.

	Live Weight at the Beginning of the Experiment (Pounds).	Live Weight at the Time of Killing before shearing (Pounds).	Gain in Live Weight during the Experiment (Pounds).
One,	79.00	118 25	39.25
Two,	66.00	98.50	32.50
Three,	70 75	106.50	35.75
	215.75	323 25	107.50

Division II. (4–6). Time of Observation extended over 194 Days.

	Live Weight at the Beginning of the Experiment (Pounds).	Live Weight at the Time of Killing before shearing (Pounds).	Gain in Live Weight during the Experiment (Pounds).
Four, ...	67.50	102.50	35.00
Five, ...	66.25	86 50	20.50
Six, ...	78 75	109.50	30.75
	212.50	298.50	86.25

Division I., entire lot gained in live weight on an average per day, 0.706 pounds.

Division II., entire lot gained in live weight on an average per day, 0.445 pounds.

The Amount of Raw Wool secured after the Close of the Experiments. Division I. (1–3).

	Live Weight, with Wool.	Live Weight after shearing.	Amount of Wool obtained.	
	Pounds.	Pounds.	Pounds.	Ounces.
One, ...	118.25	114.38	3	14
Two, ...	98.50	94.60	3	15
Three, ...	106.50	102.00	4	8
	323.25	310.98	12	5

Division II. (4–6).

	Live Weight, with Wool.	Live Weight after shearing.	Amount of Wool obtained.	
	Pounds.	Pounds.	Pounds.	Ounces.
Four, ...	102.50	99.25	3	4
Five, ...	86.50	82.00	4	8
Six, ...	109.50	105.00	4	8
	298.50	286.25	12	4

Division I. yielded 12 pounds, 5 ounces of wool.

Division II. yielded 12 pounds, 4 ounces of wool.

The former is the result of 152 days of growth, and the latter that of 194 days. Lamb No. 5 is a Merino grade; the remainder are Hampshire Down grades.

5. *Financial Statement.*

The wool was sold at 23 cents per pound, the pelts brought 12½ cents each.

Division I. (1–3).

The difference between the live weights of the animals at the close of the experiment, after shearing, and the dressed lambs, when sold, amounted on an average to 44.3 per cent.

Yield Dressed Weights.

1.	66 pounds, at 11 cents per pound,	$7 26
2.	54 pounds, at 11 cents per pound,	5 94
3.	60 pounds, at 11 cents per pound,	6 60
	180 pounds,	$19 80

Division II. (4–6).

The difference between the live weights of the animals at the close of the experiment, after shearing, and the dressed lambs, when sold, amounted on an average to 46.3 per cent.

Yield Dressed Weights.

4.	54 pounds, at 11 cents per pound,	$5 94
5.	46 pounds, at 11 cents per pound,	5 06
6.	60.50 pounds, at 11 cents per pound,	6 65
	160.50 pounds,	$17 65

Division I.

	1.	2.	3.	
Cost of lamb,	$4 05	$3 38	$3 58	$22 78
Cost of feed consumed,	4 58	3 11	4 08	
	$8 63	$6 49	$7 66	
Value received for meat,	$7 26	$5 94	$6 60	$28 70
Value received for wool and pelt,	1 02	1 04	1 17	
Value of obtainable manure,	2 19	1 52	1 96	
	$10 47	$8 50	$9 73	

Difference in favor, $5.92.

Division II.

	4.	5.	6.	
Cost of lamb,	$3 43	$3 39	$4 03	$22 34
Cost of feed consumed,	4 64	3 03	3 82	
	$8 07	$6 42	$7 85	
Value received for meat,	$5 94	$5 06	$6 65	$25 37
Value received for wool and pelt,	0 89	1 17	1 17	
Value of obtainable manure,	1 71	1 23	1 55	
	$8 54	$7 46	$9 37	

Difference in favor, $3.03.

6. Conclusions.

1. The well-established superior feeding effect of a daily diet rich in digestible nitrogenous food constituents, when raising lambs for the meat market, is shown in a marked degree in Division I., as compared with those in Division II.

2. The good services of the particular fodder rations used in case of the first division of lambs is shown by a fair rate of increase in live weight.

3. Corn ensilage as a substitute in part for rowen has given very satisfactory results.

4. The profit obtained with reference to both divisions of lambs is due to the commercial value of the fertilizing constituents contained in the obtainable manure. This value amounts in the case of the first division of lambs to $5.67. To appreciate this value properly, it needs to be considered that, in determining the financial results of the experiment, all home-raised fodder articles are counted on the basis of their retail selling price in our vicinity. Sheep are known to produce one of the best home-made manures.

The decidedly beneficial influence of a rational and liberal system of stock-feeding on the financial results of a mixed farm management cannot find *its full expression* in the mere presentation of the results of a feeding experiment, however carefully the matter may be arranged.

7. *Detailed Statement of Feeding Record.*

Sheep No. 1.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.				Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.					
1889-1890.									
Sept. 17 to Sept. 30, .	0.74	0.37	1.93	–	2.67	0.32	8.34	1 : 4.74	86.00
Oct. 1 to Dec. 3, .	0.69	0.69	2.52	–	3.43	0.26	13.19	1 : 4.55	96.75
Dec. 17 to Dec 31, .	0.75	0.75	2.87	–	3.84	0 30	12.80	1 : 4.59	111.00
Jan. 2 to Jan. 20, .	0.77	0.77	1.54	4.05	3.82	0.26	14.69	1 : 5.09	114.50
Jan. 21 to Feb. 3, .	0.63	0.63	–	6.29	2.84	0.02	142.00	1 : 5.52	117.50

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
104.57 pounds wheat bran, ...	94.88	$0 89	$0 71
97.07 pounds gluten meal, ...	87.56	1 12	0 79
310.00 pounds rowen, ...	268.05	2 33	1 07
178.50 pounds corn ensilage, . . .	48.42	0 24	0 15
	498.91	$4 58	$2 72

* Includes the feed during the 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, . . .	79.00
Live weight at time of killing, ...	118.25
Live weight gained during experiment, ...	39.25
Average gain in weight per day, ...	0.25
Dressed weight of animal, ...	66.00
Loss in weight by dressing, . . . 52.25 pounds, or 44.19 per cent.	
Pounds of dry matter fed to produce 1 pound of live weight,	12.71
Cost of feed per pound of live weight gained, ...	11.67 cents
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	6.11 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 1.

FEEDING PERIODS.	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 17 to Sept. 30, .	10.33	5.17	27.00	-	1 : 4.74	84 00	88.50	0.32
Oct. 1 to Dec. 3, .	44.31	44.31	161.00	-	1 : 4.55	88.50	105.00	0.26
Dec. 17 to Dec. 31, .	11.25	11.25	43.00	-	1 : 4.59	108.00	112.50	0.30
Jan. 2 to Jan. 20, .	14.63	14.63	29.25	77.00	1 : 5.09	113.00	118.00	0.26
Jan. 21 to Feb. 3, .	8.88	8.88	-	88.00	1 : 5.52	118.00	118.25	0.02

Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.

	Pounds.
99.90 pounds wheat bran, equal to dry matter, ...	90.64
94.74 pounds gluten meal, equal to dry matter, . . .	85.46
281.00 pounds rowen, equal to dry matter, ...	242.98
178.50 pounds corn ensilage, equal to dry matter, . . .	48.42
Total amount of dry matter, ...	467.50

	Pounds.
Live weight of animal at beginning of experiment, . .	84.00
Live weight of animal at time of killing, ...	118.25
Live weight gained during experiment, ...	34.25
Dressed weight at time of killing, ...	66.00

Loss in weight by dressing, . . 52.25 pounds or 44.19 per cent.

Cost of Feed consumed during Experiment.

99.90 pounds wheat bran, at $17.00 per ton, ...	$0 85
94.74 pounds gluten meal, at $23.00 per ton, ...	1 09
281.00 pounds rowen, at $15.00 per ton, ...	2 11
178.50 pounds corn ensilage, at $2.75 per ton, ...	0 24
	$4 29

13.65 pounds of dry matter yielded 1 pound of live weight.

Cost of feed for production of 1 pound of live weight, 12.52 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 2.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.				Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced one Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.					
1889-1890.									
Sept. 17 to Sept. 30, .	0.61	0.31	1.43	–	2.07	0.50	4.14	1:4.64	70.00
Oct. 1 to Dec. 3, .	0.51	0.51	1.66	–	2.36	0.22	10.73	1:4.45	82.75
Dec. 17 to Dec. 31, .	0.51	0.51	1.23	–	1.98	0.12	16.50	1:4.20	90.25
Jan. 2 to Jan. 20, .	0.50	0.50	0.58	2.92	2.19	0.29	7.55	1:5.01	95.00
Jan. 21 to Feb. 3, .	0.58	0.58	–	4.79	2.35	0.11	21.36	1:5.24	98.00

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
79.61 pounds wheat bran, ...	72.23	$0 68	$0 54
72.99 pounds gluten meal, ...	65.84	0 84	0 59
188.00 pounds rowen, ...	162.56	1 41	0 65
130.75 pounds corn fodder, ...	35.36	0 18	0 11
	335.99	$3 11	$1 89

* Includes the feed during the 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, ...	66.00
Live weight at time of killing, ...	98.50
Live weight gained during experiment, ...	32.50
Average gain in weight per day, ...	0.21
Dressed weight of animal, ...	54.00
Loss in weight by dressing, . . . 44.50 pounds, or	45.18 per cent.
Pounds of dry matter fed to produce 1 pound of live weight, .	10.34
Cost of feed per pound of live weight gained, ...	9.57 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	4.92 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 2.

FEEDING PERIODS.	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 17 to Sept. 30, .	8 56	4.28	20.00	–	1.4.64	67.50	74.50	0.50
Oct. 1 to Dec. 3, .	32.63	32.63	106.00	–	1:4.45	74.50	88.50	0.22
Dec. 17 to Dec. 31, .	7.63	7.63	18.50	–	1:4.20	88.50	90.50	0.12
Jan. 2 to Jan. 20, .	9.50	9.50	11.00	55.50	1:5.01	91.50	97.00	0.29
Jan. 21 to Feb. 3, .	8.12	8.12	–	67.00	1:5.24	97.00	98.50	0.11

Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.

	Pounds.
74.94 pounds wheat bran, equal to dry matter, ...	67.99
70.66 pounds gluten meal, equal to dry matter, ...	63.74
168.00 pounds rowen, equal to dry matter, ...	145.27
126.50 pounds corn ensilage, equal to dry matter, ...	35.36
Total amount of dry matter, ...	312.36

	Pounds
Live weight of animal at beginning of experiment, ...	67.50
Live weight at time of killing, ...	98.50
Live weight gained during experiment, ...	31.00
Dressed weight at time of killing, ...	54.00

Loss in weight by dressing, . . 44.50 pounds, or 45.18 per cent.

Cost of Feed consumed during Experiment.

74.94 pounds wheat bran, at $17.00 per ton, ...	$0 64
70.66 pounds gluten meal, at $23 00 per ton, ...	0 81
168.00 pounds rowen, at $15.00 per ton, ...	1 26
130.75 pounds corn ensilage, at $2.75 per ton, ...	0 18
	$2 89

10.08 pounds of dry matter yielded 1 pound of live weight.
Cost of feed for the production of 1 pound of live weight, 9.32 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.				Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.					
1889-1890.									
Sept. 17 to Sept. 30, .	0.71	0.35	1.96	–	2.65	0.30	8.83	1 : 4.78	79.25
Oct. 1 to Dec. 3, .	0.64	0.64	2.37	–	3.21	0.17	18.88	1 : 4.67	88.75
Dec. 17 to Dec. 31, .	0.63	0.63	2.00	–	2.87	0.30	9.57	1 : 4.42	97.25
Jan. 2 to Jan. 20, .	0.62	0.62	1.08	3.07	2.88	0.26	11.08	1 : 4.97	100.75
Jan. 21 to Feb. 3, .	0.58	0.58	–	5.02	2.41	0.18	13.39	1 : 5.29	105.00

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
95.79 pounds wheat bran, ...	86.91	$0 81	$0 65
88.49 pounds gluten meal, ...	79.82	1 02	0 72
274.25 pounds rowen, ...	237.14	2 06	0 95
149.00 pounds corn ensilage, ...	40.23	0 19	0 12
	444.10	$4 08	$2 44

* Includes the feed during 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, ...	71.00
Live weight at time of killing, ...	106.50
Live weight gained during experiment, ...	35.50
Average gain in weight per day, ...	0.23
Dressed weight of animal, ...	60.00
Loss in weight by dressing, . . 46.50 pounds, or 43.66 per cent.	
Pounds of dry matter fed to produce 1 pound of live weight, .	12.51
Cost of feed per pound of live weight gained, . . .	11.49 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	6.00 cents.

7. Detailed Statement of Feeding Record — Continued.

Sheep No. 3.

FEEDING PERIODS.	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 17 to Sept. 30, .	9.92	4.96	27.50	–	1 : 4.78	78.25	82.50	0.30
Oct. 1 to Dec. 3, .	41.06	41.06	151.50	–	1 : 4.67	82.50	93.50	0.17
Dec. 17 to Dec. 31, .	9.50	9.50	30.00	–	1 : 4.42	95.00	99.50	0.30
Jan. 2 to Jan. 20, .	11.87	11.87	29.50	58.25	1 : 4.97	99.00	104.00	0.26
Jan. 21 to Feb. 3, .	8.12	8.12	–	70.25	1 : 5.29	104.00	106.50	0.18

Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.

	Pounds.
91.12 pounds wheat bran, equal to dry matter, ...	82.67
86.16 pounds gluten meal, equal to dry matter, ...	77.72
252.25 pounds rowen, equal to dry matter, ...	218.12
149.00 pounds corn ensilage, equal to dry matter, ...	40.23
Total amount of dry matter, ...	418.74

	Pounds.
Live weight of animal at beginning of experiment, ...	78.25
Live weight at time of killing, ...	106.50
Live weight gained during experiment, ...	28.25
Dressed weight at time of killing, ...	60.00

Loss in weight by dressing, . . . 46.50 pounds, or 43.66 per cent.

Cost of Feed consumed during Experiment.

91.12 pounds wheat bran, at $17.00 per ton, ...	$0 77
86.16 pounds gluten meal, at $23.00 per ton, ...	0 99
252.25 pounds rowen, at $15.00 per ton, ...	1 89
149.00 pounds corn ensilage, at $2.75 per ton, ...	0 20
	$3 85

14.82 pounds of dry matter yielded 1 pound of live weight.
Cost of feed for the production of 1 pound of live weight, 13.59 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 4.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds)
	Corn Meal.	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.	Corn Fodder.					
1889-1890.											
Sept. 17 to Dec. 3,	0.54	0.11	0.05	2.56	–	–	2.84	0.13	21.85	1 6.99	82.00
Dec. 17 to Dec. 31,	0.58	0.12	0.06	1.97	–	–	2.37	0.02	118.50	1 7 01	89.75
Jan. 2 to Jan. 20,	0.58	0.12	0.06	1.16	2.05	–	2.22	0.14	15.86	1 7.30	91.50
Feb. 4 to Feb. 15,	–	0.50	0.50	–	5.67	–	2.43	0.33	7.36	1:5.76	98.50
Feb. 18 to Mar. 17,	–	0.55	0.55	–	–	1.59	2.27	0.03	75.67	1:4.88	101.50

*Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
78.21 pounds corn meal, ...	69.09	$0 75	$0 25
41.99 pounds wheat bran, . . .	38.10	0 36	0 28
32.25 pounds gluten meal, . . .	29.09	0 37	0 26
305.50 pounds rowen, ...	264.16	2 70	1 06
185.75 pounds corn ensilage, . . .	50.25	0 26	0 14
54.00 pounds corn fodder, . . .	42 23	0 20	0 14
	492.92	$4 64	$2 13

* Includes the feed during 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, . . .	67 50
Live weight at time of killing, ...	102.25
Live weight gained during experiment, ...	34.75
Average gain in weight per day, ...	0.18
Dressed weight of animal, ...	54.00
Loss in weight by dressing, . . 48.25 pounds, or 47.19 per cent.	
Pounds of dry matter fed to produce 1 pound of live weight, .	14.19
Cost of feed per pound of live weight gained, ...	13 35 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	8.46 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 4.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.										
Sept. 17 to Dec. 3,	41.88	4.19	8.38	–	–	200.00	1:6.99	74.50	85.00	0.13
Dec. 17 to Dec. 31,	8.65	0.87	1.73	–	–	29 50	1:7.01	90.00	90.25	0.02
Jan. 2 to Jan. 20,	10.96	1.10	2.19	39.00	–	22.00	1:7.30	90.00	92.75	0 14
Feb. 4 to Feb. 15,	–	6.00	6.00	68.00	–	–	1:5.76	96.50	100.50	0.33
Feb. 18 to Mar. 17,	–	15.50	15.50	–	44.50	–	1:4.88	101.50	102.25	0.03

Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.

	Pounds.
75.52 pounds corn meal, equal to dry matter,	66.71
31.98 pounds gluten meal, equal to dry matter,	28.85
41.45 pounds wheat bran, equal to dry matter,	37.61
283 50 pounds rowen, equal to dry matter,	245.14
185.75 pounds corn ensilage, equal to dry matter,	50.25
54.00 pounds corn fodder, equal to dry matter,	42.23
Total amount of dry matter,	470.79

	Pounds.
Live weight of animal at beginning of experiment,	74.50
Live weight at time of killing,	102.25
Live weight gained during experiment,	27.75
Dressed weight at time of killing,	54.00

Loss in weight by dressing, . . . 48 25 pounds, or 47.19 per cent.

Cost of Feed consumed during Experiment.

75.52 pounds corn meal, at $19 00 per ton,	$0 72
31.98 pounds gluten meal, at $23.00 per ton,	0 37
41 45 pounds wheat bran, at $17.00 per ton,	0 35
283 50 pounds rowen, at $15.00 per ton,	2 13
185.75 pounds corn ensilage, at $2.75 per ton,	0 26
54.00 pounds corn fodder, at $7.50 per ton,	0 20
	$4 03

16.97 pounds of dry matter fed yielded 1 pound of live weight.

Cost of feed for the production of 1 pound of live weight, 14 50 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 5.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.	Corn Fodder.					
1889-1890.											
Sept. 17 to Dec. 3,	0.40	0.08	0.04	1.80	–	–	2.02	0.12	16.83	1 : 6.99	72.75
Dec. 17 to Dec. 31,	0.39	0.08	0.04	1.47	–	–	1.72	-0.23	–	1 : 7.00	75.75
Jan. 2 to Jan. 20,	0.41	0.08	0.04	0.53	2.84	–	1.70	0.36	4.72	1 : 8.58	79.00
Feb. 4 to Feb. 15,	–	0.39	0.39	–	3.50	–	1.65	0.25	6.60	1 : 5.37	84.25
Feb. 18 to Mar. 17,	–	0.43	0.43	–	–	0.93	1.52	-0.02	–	1 : 4.53	86.75

*Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
59.85 pounds corn meal, ...	52.87	$0 57	$0 19
33.32 pounds wheat bran, . . .	30.23	0 29	0 22
25.42 pounds gluten meal, . . .	22.93	0 29	0 20
203.50 pounds rowen, ...	175.97	1 53	0 70
166.00 pounds corn ensilage, . . .	44.90	0 23	0 13
31.50 pounds corn fodder, . . .	24.74	0 12	0 08
	351.64	$3 03	$1 52

* Includes the feed during 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, . . .	66.25
Live weight at time of killing, ...	86.50
Live weight gained during experiment, ...	20.25
Average gain in weight per day, ...	0.10
Dressed weight of animal, ...	46.00
Loss in weight by dressing, . . .	40.50 pounds, or 46.82 per cent.
Pounds of dry matter fed to produce 1 pound of live weight, .	17.36
Cost of feed per pound of live weight gained, ...	14.96 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	8.94 cents.

7. *Detailed Statement of Feeding Record* — Continued.

Sheep No. 5.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.										
Sept. 17 to Dec. 3,	31.00	3.10	6.20	-	-	140 50	1 : 6.99	66.25	75.50	0.12
Dec. 17 to Dec. 31,	5.87	0.59	1.17	-	-	22 00	1 : 7.00	77.50	74.00	-0.23
Jan. 2 to Jan. 20,	7.70	0.77	1.54	54.00	-	10.00	1 : 8.58	75.00	81.75	0.36
Feb. 4 to Feb. 15,	-	4.63	4.63	42.00	-	-	1 : 5.37	83.00	86.00	0.25
Feb. 18 to Mar. 17,	-	12.13	12.13	-	26.00	-	1 : 4.53	87.00	86.50	-0.02

Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.

	Pounds.
57.16 pounds corn meal, equal to dry matter,	50.49
25.15 pounds gluten meal, equal to dry matter,	22.69
32.78 pounds wheat bran, equal to dry matter,	29.74
182.50 pounds rowen, equal to dry matter,	157.81
166.00 pounds corn ensilage, equal to dry matter,	40.90
31.50 pounds corn fodder, equal to dry matter,	24.74
Total amount of dry matter,	330.37

	Pounds.
Live weight of animal at beginning of experiment,	66.25
Live weight at time of killing,	86.50
Live weight gained during experiment,	20.25
Dressed weight at time of killing,	46.00

Loss in weight by dressing, . . 40.50 pounds, or 46.82 per cent.

Cost of Feed consumed during Experiment.

57.16 pounds corn meal, at $19.00 per ton,	$0 54
25.15 pounds gluten meal, at $23.00 per ton,	0 29
32.78 pounds wheat bran, at $17.00 per ton,	0 28
182.50 pounds rowen, at $15.00 per ton,	1 37
166.00 pounds corn ensilage, at $2.75 per ton,	0 23
31.50 pounds corn fodder, at $7.50 per ton,	0 12
	$2 83

16.31 pounds of dry matter fed yielded 1 pound of live weight.

Cost of feed for the production of 1 pound of live weight, 13.98 cents.

7. *Detailed Statement of Feeding Record*—Continued.

Sheep No. 6.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.	Corn Fodder.					
1889-1890.											
Sept. 17 to Dec. 3,	0.48	0.10	0.05	2.21	–	–	2.47	0.17	14.53	1 : 6 99	91.25
Dec. 17 to Dec. 31,	0.56	0.11	0 06	2.20	–	–	2.54	0.23	11.05	1 : 7.00	99.50
Jan. 2 to Jan. 20,	0.48	0.10	0.05	0.97	1.89	–	1.91	0.16	11.94	1 : 7.90	102.00
Feb. 4 to Feb. 15,	–	0.50	0.50	–	5.42	–	2.37	0.21	11.29	1 : 5.68	107.50
Feb. 18 to Mar. 17,	–	0.55	0.55	–	–	1.38	2.10	–	–	1 : 4.70	108.00

*Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

	Dry Matter (Pounds).	Cost.	Fertilizer Value.
71.31 pounds corn meal, ...	62.99	$0 68	$0 23
40.61 pounds wheat bran, . . .	36.85	0 35	0 27
31.55 pounds gluten meal, . . .	28.45	0 36	0 25
264.50 pounds rowen, ...	228.71	1 98	0 92
193.50 pounds corn ensilage, . . .	52.34	0 27	0 15
43.50 pounds corn fodder, . . .	34.40	0 17	0 11
	443.74	$3 81	$1 93

* Includes the feed during 12 days preceding the experiment proper.

	Pounds.
Live weight of animal at beginning of experiment, . . .	79.00
Live weight at time of killing, ...	109.50
Live weight gained during experiment, ...	30.50
Average gain in weight per day, ...	0.16
Dressed weight of animal, ...	60.50
Loss in weight by dressing, . . . 49 pounds, or 44.75 per cent.	
Pounds of dry matter fed to produce 1 pound of live weight, .	14.55
Cost of feed per pound of live weight gained, ...	12.49 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, ...	7.44 cents.

7. *Detailed Statement of Feeding Record* — Concluded.

Sheep No. 6.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Corn Ensilage consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Nutritive Ratio of Feed.	Live Weight of Animal at Beginning of Period (Pounds).	Live Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.										
Sept. 17 to Dec. 3,	37.10	3.71	7.42	–	–	172.00	1 : 6.99	83.25	96.75	0.17
Dec. 17 to Dec. 31,	8.46	0.85	1.69	–	–	33.00	1 : 7.00	98.00	101.50	0.23
Jan. 2 to Jan. 20,	9.13	0.91	1.83	36.00	–	18.50	1 : 7.90	100.50	103.50	0.16
Feb. 4 to Feb. 15,	–	6.00	6.00	65.00	–	–	1 : 5.68	105.50	108.00	0.21
Feb. 18 to Mar. 17,	–	15.50	15.50	–	38.50	–	1 : 4.70	109.50	109.50	–

Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.

	Pounds.
68.62 pounds corn meal, equal to dry matter,	60.61
31.28 pounds gluten meal, equal to dry matter,	28.21
40.07 pounds wheat bran, equal to dry matter,	36.36
242.50 pounds rowen, equal to dry matter,	209.69
193.50 pounds corn ensilage, equal to dry matter,	52.34
43.50 pounds corn fodder, equal to dry matter,	34.40
Total amount of dry matter,	421.61

	Pounds.
Live weight of animal at beginning of experiment,	83.25
Live weight at time of killing,	109.50
Live weight gained during experiment,	26.25
Dressed weight at time of killing,	60.50

Loss in weight by dressing, . . . 49 pounds, or 44.75 per cent.

Cost of Feed consumed during Experiment.

68.62 pounds corn meal, at $19.00 per ton,	$0 65
31.28 pounds gluten meal, at $23.00 per ton,	0 36
40.07 pounds wheat bran, at $17.00 per ton,	0 34
242.50 pounds rowen, at $15.00 per ton,	1 82
193.50 pounds corn ensilage, at $2.75 per ton,	0 27
43.50 pounds corn fodder, at $7.50 per ton,	0 17
	$3 61

16.06 pounds of dry matter fed yielded 1 pound of live weight.

Cost of feed for the production of 1 pound of live weight, 13.75 cents.

The composition of the fodder articles used during the experiment is the same as of those in preceding feeding records used during the corresponding months of the year.

Essential Fertilizing Constituents.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Wheat Bran.	Gluten Meal.	Rowen.	Corn Ensilage.	Corn Meal.	Corn Fodder.
Moisture at 100° C., .	9.27	9.80	13.53	72.95	88.33	20.42
Nitrogen, . . .	2.545	4.510	1.790	0.33	1.479	1.058
Phosphoric acid, . .	2.900	0.392	0.351	0.138	0.713	0.510
Potassium oxide, . .	1.637	0.049	0.462	0.301	0.430	0.760
Valuation per ton, .	$13 60	$16 18	$6 92	$1 56	$6 27	$4 89

III. Feeding Experiments with Young Pigs.

1. General remarks on feeding experiments with young pigs, reported in the preceding report, 1889.
2. Feeding experiments with pigs, 1890. Medium Yorkshire.
3. Feeding experiments with pigs, 1890. Medium Yorkshire and grade Chester White.

1. *Some General Remarks on raising Young Pigs for the Meat Market.*

In planning our experiments for raising young pigs for the meat market, it was proposed at the outset (1884) to confine our inquiry, for the present, in particular to the following question: —

How can we most profitably dispose of two by-products of the dairy, — skim-milk and creamery buttermilk, — as a constituent of the daily diet of young pigs raised for the meat market?

From our preceding reports in this connection, it will be seen that we consider *two conditions* on farms, namely, a *large supply* of either home-made skim-milk or of creamery buttermilk, or a *limited one*, when making up the fodder combination for the daily diet of the animals on trial.

As the first requirement of an *economical* diet for any kind of farm live stock consists in a desirable nutritive character of the feed, suitable to the kind, the condition and the purpose of the animal on trial, it became our first aim to obtain, in all cases, as far as practicable, a corresponding nutritive character of the different fodder combinations to be used.

This circumstance was secured in the following way: whenever a liberal supply of either kind of waste milk was on hand, the subsequently first stated course of compounding the daily diet of the pigs was adopted; while, in case of a limited supply of either kind of milk, the second mode has been practiced, to provide for the increasing call for a suitable feed. In case of the use of grain feed, water has taken the place of milk for diffusing the latter when fed.

I.

Live Weight of Animal.	Corn Meal, Skim-milk.
20 to 70 pounds, . .	2 ounces for every quart of milk consumed.
70 to 130 pounds, . .	4 ounces for every quart of milk consumed.
130 to 200 pounds, . .	6 ounces for every quart of milk consumed.

II.

Live Weight of Animal.	Grain Mixture to Supplement Skim-milk and Corn Meal.		
	Gluten Meal. (Weight Parts.)	Wheat Bran. (Weight Parts.)	Corn Meal. (Weight Parts.)
20 to 70 pounds, . . .	2	1	–
70 to 130 pounds, . . .	1	1	1
130 to 200 pounds, . . .	1	1	2

Live Weight of Animal.	Nutritive Character of the Feed in Both Instances.
20 to 70 pounds,	1 digestible nitrogenous organic constituent. 2.8–3 non-nitrogenous organic constituents.
70 to 130 pounds,	1 digestible nitrogenous organic constituent. 3.6–4 non-nitrogenous organic constituents.
130 to 200 pounds,	1 digestible nitrogenous organie constituent. 4.5–5 non-nitrogenous organic constituents.

Our observations in this connection with the management of twelve feeding experiments, lead to the following suggestions regarding a proper course of raising pigs for the meat market : —

1. Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from eighteen to twenty pounds in live weight ; in the colder seasons, when they weigh from twenty-five to thirty pounds.

2. The feed for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk,

with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

3. Change the character of the diet, at certain stages of growth, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed. Begin, for instance, with two ounces of corn meal to one quart of skim-milk; when the animal has reached from sixty to seventy pounds, use four ounces per quart; and feed six ounces of meal per quart after its live weight amounts to from one hundred and twenty to one hundred and thirty pounds. The superior feeding effect, noticed in case of one and the same diet during the earlier stages of growth, will not infrequently be found to decrease seriously during later stages.

4. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from one hundred and seventy-five to one hundred and eighty pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food, and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

5. It pays well, as far as the cost of feed is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

Our experiments previous to 1890 have been carried on with mixed breeds of a more or less doubtful parentage. Within the past year we began to compare thoroughbreds of distinct breeds with each other or with grades of known origin. The subsequent pages contain a description of two experiments, — one with medium Yorkshires, the other with medium Yorkshires and grade Chester Whites.

Another experiment with throughbreds — Berkshire, Tamworth, small Yorkshire and Poland China — is finished; the results will be published in connection with a second one of the same character as soon as the latter is closed.

Summary of Experiments I. to XII.

[Based on the same cost of feed and value of manurial refuse.]

EXPERIMENT.		Number of Pigs.	Average Weight of Pigs at Beginning of Experiment (Pounds).	Average Weight of Pigs at Close of Experiment (Pounds).	Articles of Fodder used.	Nutritive Ratio of Feed.	Pounds of Dry Matter consumed for the Production of One Pound of Dressed Pork.	Total Cost of Feed per Pound of Dressed Pork (Cents).	Manurial Value of Feed per Pound of Dressed Pork, after deducting Thirty Per Cent. taken by Pig (Cents).	Net Cost of Feed per Pound of Dressed Pork (Cents).
I. May 21 to Sept. 22, 1884,	*a*,	3	48.8	239.0	Skim-milk, corn meal,	1 : 2.50 to 1 : 2.97	2.50 to 3.11; average 2.90	5.15	1.70	3.45
	b,	3	47.6	253.9	Buttermilk, corn meal,	1 : 2.84 to 1 : 3.38	2.23 to 2.57; " 2.40	4.30	1.38	2.92
II. Nov. 5, 1884, to Mar. 21, 1885,	*a*,	6	30.1	209.7	Buttermilk, corn meal,	1 : 3.50 to 1 : 4.80	3.34 to 4.17; " 3.67	5.91	1.80	4.11
	b,	6	28.7	227.0	Skim-milk, corn meal,	1 : 2.70 to 1 : 5.00	2.97 to 3.48; " 3.31	5.51	1.69	3.82
III. April 1 to Sept. 16, 1885,		2	49.8	276.3	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 3.04 to 1 : 3.76	4.01 to 4.18; " 4.10	6.41	2.01	4.40
IV. Dec. 8, 1885, to May 31, 1886,		2	32.9	152.4	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.64 to 1 : 4.48	3.77 to 4.08; " 3.93	6.33	2.13	4.20
V. Sept. 15, 1886, to Jan. 19, 1887,		4	32.6	175.0	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.75 to 1 : 3.57	3.56 to 4.31; " 3.92	5.40	2.02	3.38
VI. Feb. 17 to May 2, 1887,		5	54.4	152.8	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.99 to 1 : 3.23	2.70 to 4.20; " 3.68	5.69	1.95	3.74
VII. June 28 to Oct. 26, 1887,		7	24.5	193.3	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.85 to 1 : 4.30	2.83 to 3.24; " 3.07	5.15	1.76	3.39
VIII. Nov. 8, 1887, to March 12, 1888,		6	25.2	186.4	Skim-milk, corn meal, Wheat bran, gluten meal, Corn and cob meal,	1 : 2.30 to 1 : 4.17	3.02 to 3.46; " 3.27	5.32	1.74	3.58
IX. April 12 to Aug. 8, 1888,		6	19.6	194.7	Skim-milk, corn meal, Wheat bran, gluten meal, Corn and cob meal,	1 : 2.53 to 1 : 4.35	2.81 to 3.17; " 3.00	4.89	1.62	3.27
X. April 26 to Aug. 28, 1889,		7	20.3	189.9	Skim milk, barley meal, Wheat bran, gluten meal,	1 : 2.90 to 1 : 4.65	3.40 to 3.81; " 3.60	6.07	1.75	4.32
XI. Sept. 10, 1889, to March 3, 1890,		5	20.8	189.5	Skim-milk, corn meal, Wheat bran, gluten meal,	1 : 2.99 to 1 : 4.36	3.80 to 3.99; " 3.89	6.11	1.98	4.13
XII. April 22 to Sept. 1, 1890,		4*	33.4	182.8	Skim-milk, Corn and cob meal, Wheat bran, gluten meal,	1 : 2.80 to 1 : 4.25	" 4.07	5.90	1.99	3.91
		4†	30.5	190.2		1 : 2.80 to 1 : 4.26	" 3.98	5.72	1.96	3.76

* Medium Yorkshires. † Grade Chester Whites.

The calculations included in the above summary were based upon the following valuations per ton: —

	Cost.	Manurial Value.
Corn meal, ...	$24 00	$7 97
Barley meal, ...	30 00	6 21
Skim-milk (10 per cent. solids), . .	1.8 cts. gal.	2 25
Buttermilk (7 to 8 per cent. solids), . .	1 37 " "	1 74
Corn and cob meal, ...	$20 70	6 06
Wheat bran, ...	22 50	13 51
Gluten meal, ...	22 50	17 49

2. *Eleventh Feeding Experiment with Pigs.*

Breed, medium Yorkshire; feed, skim-milk, corn meal, wheat bran and gluten meal; time, Sept. 10, 1889, to March 3, 1890.

Five pigs, sows, weighing at the beginning of the experiment from 18.5 to 21 pounds each, served for our observation. The systematic feeding began Sept. 10, 1889, and closed March 3, 1890, lasting thus 175 days. The live weight gained during that time varied in case of different animals from 160.75 to 178 pounds, with a daily average gain of .97 pound.

The daily consumption of skim-milk during the entire experiment was limited to 5 quarts per head, with the exception of the first ten days, when but 4 quarts were called for. Two ounces of corn meal were added to every quart of skim-milk consumed, to complete the daily diet for that period. The additional supply of food needed in consequence of the growth of the animal was composed of a mixture of, —

I. { Wheat bran, one weight part.
Gluten meal, two weight parts.

beginning with a daily ration of the mixture of 6 ounces per head, and increasing the quantity gradually until it reached to from 30 to 36 ounces. This point was obtained at the close of the second month of the observation, November 11. The live weights of the different animals varied at that time from 85 to 95 pounds. The nutritive ratio, *i. e.*, the relative proportion of the digestible nitrogen-containing organic constituents and non-nitrogen-containing organic constituents, calling the former one, in the daily fodder ration, remained practically the same during the first two months (1 : 3).

The composition of the grain feed was changed at the stated advance in the growth of the animal, while the daily quantity of skim-milk per head remained the same as before, — 5 quarts. The above specified grain mixture (I.) was simply replaced by the following, —

II. { Corn meal, four weight parts.
Wheat bran, one weight part.
Gluten meal, one weight part.

beginning with a daily average ration of 32 to 36 ounces per head, and closing with one of 42 to 45 ounces, December 30, when their respective live weights varied from 125 to 130 pounds.

The subsequent change in the composition of the daily diet consisted in an increase of the proportion of the corn meal in the daily grain feed. The daily quantity of skim-milk, 5 quarts, remained the same to the end of the experiment. An amount of water was added sufficient to satisfy the thirst of the animal. The new grain mixture (III.) consisted of, —

III. { Corn meal, six weight parts.
Wheat bran, one weight part.
Gluten meal, one weight part.

The amount consumed per day rose to 48 ounces per head in some instances, toward the close of the experiment.

The entire management of the feeding was divided, as will be noticed, into three periods, as far as the nutritive character of the daily diet was concerned: —

Periods.	Live Weight.	Nutritive Ratio.
I., . .	20 to 90 pounds, .	1 digestible nitrogenous organic constituent. 3 non-nitrogenous organic constituents.
II., .	90 to 130 pounds, .	1 digestible nitrogenous organic constituent. 3.8 non-nitrogenous organic constituents.
III., .	130 to 200 pounds,	1 digestible nitrogenous organic constituent 4.25 non-nitrogenous organic constituents.

Conclusions deducted from the Results obtained.

1. The amount of dry organic matter contained in the feed consumed per pound of dressed pork secured varies in case of different animals from 3.80 to 3.99 pounds, the mean being 3.87 pounds.

2. The total cost of the feed consumed for the production of one pound of dressed pork secured varies in case of different animals from 5.43 to 5.72 cents, with a mean of 5.55 cents.

3. The total cost of the entire feed consumed during our late experiment XI. amounts to $39. The total market value of the entire amount of the essential fertilizing constituents contained in the feed consumed amounts at current market prices to $19.92. In making the customary liberal allowance of 30 per cent. for the loss sustained in nitrogen, phosphoric acid and potassium oxide, in consequence of the formation of flesh and bone in the growing animals, it will be noticed that the obtainable manurial value of the feed consumed amounts still to $13.94, which sum is fairly equal to one-third of the original cost of the entire feed used, or 1.98 cents per pound of dressed pork produced (702.75 pounds).

4. As the first cost of the feed consumed for the production of one pound of dressed pork amounted on an

average to 5.55 cents, and as the available manurial value of the feed for the same weight of dressed pork produced is equal to 1.98 cents, it will be seen that the average net cost of the feed consumed amounted to 3.57 cents per pound of dressed pork produced.

5. Comparing the financial results of the experiment here under discussion with those of an earlier experiment of ours (IV.), adopting for that purpose in both the same market price for the fodder articles consumed, and allowing at the same time a corresponding selling price for the dressed pork produced, no material difference can be pointed out. During our earlier experiment corn meal sold at $24 and wheat bran $22.50; during our previously described experiment corn meal sold at $19 and wheat bran at $16.50 per ton; skim-milk and gluten meal were charged alike in both experiments. In the earlier experiment the *net cost of the feed consumed* for the production of one pound of dressed pork was 4.20 cents, and in our recent experiment, as above stated, 3.57 cents. The difference of .63 cent in favor of the recent trial is essentially due to contemporary lower market prices of corn meal and wheat bran.

For further details, see statements upon a few subsequent pages.

Feeding Record of Pigs.

(1)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 10 to Sept. 30, . .	11.63	93.00	–	–	1:3.05	20.75	38.00	0.82
Oct. 1 to Nov. 11, . .	26.25	210.00	20.71	41.42	1:2.99	38.00	90.50	1.25
Nov. 12 to Dec. 30, . .	73.52	245.00	18.38	18.38	1:3.81	90.50	133.50	0.88
Dec. 31 to Mar. 3, . .	120.12	334.00	20.02	20.02	1:4.06	133.50	187.75	0.86

Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.

	Pounds.
231.52 pounds corn meal, equal to dry matter,	204.50
882.00 quarts skim-milk, equal to dry matter,	195.60
59 11 pounds wheat bran, equal to dry matter,	53.63
79.82 pounds gluten meal, equal to dry matter,	72.00
Total amount of dry matter,	525.73

	Pounds.
Live weight of animal at beginning of experiment,	20.75
Live weight at time of killing,	187.75
Live weight gained during experiment,	167.00
Dressed weight at time of killing,	155.50
Loss in weight by dressing,	32.25 pounds, or 17.18 per cent.
Dressed weight gained during experiment,	138.50

Cost of Feed consumed during Experiment.

231.52 pounds corn meal, at $19.00 per ton,	$2 20
220.50 gallons skim-milk, at 1.8 cents per gallon,	3 97
59 11 pounds wheat bran, at $16.50 per ton,	0 49
79.82 pounds gluten meal, at $23.00 per ton,	0 92
	$7 58

3.15 pounds of dry matter fed yielded 1 pound of live weight, and 3.80 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.47 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.49 cents.

(2)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 10 to Sept. 30,	11.63	93.00	–	–	1:3.05	19.00	37.00	0.86
Oct. 1 to Nov. 11,	26.25	210.00	22.46	44.92	1:2.99	37.00	93.75	1.35
Nov. 12 to Dec. 30,	68.48	245.00	17.12	17.12	1:3.74	93.75	127.00	0.68
Dec. 31 to Mar. 3,	156.36	334.00	26.06	26.06	1:4.36	127.00	197.25	1.12

Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.

	Pounds.
262.72 pounds corn meal, equal to dry matter,	232.06
882.00 quarts skim-milk, equal to dry matter,	195.60
65 64 pounds wheat bran, equal to dry matter,	59.56
88.10 pounds gluten meal, equal to dry matter,	79.47
Total amount of dry matter,	566.69

	Pounds.
Live weight of animal at beginning of experiment,	19.00
Live weight at time of killing,	197.25
Live weight gained during experiment,	178.25
Dressed weight at time of killing,	163.50
Loss in weight by dressing, . 33.75 pounds, or 17.11 per cent.	
Dressed weight gained during experiment,	147.75

Cost of Feed consumed during Experiment.

262.72 pounds corn meal, at $19.00 per ton,	$2 50
220.50 gallons skim-milk, at 1.8 cents per gallon,	3 97
65.64 pounds wheat bran, at $16.50 per ton,	0 54
88.10 pounds gluten meal, at $23.00 per ton,	1 01
	$8 02

3.18 pounds of dry matter fed yielded 1 pound of live weight, and 3.84 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.43 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.45 cents.

(3)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-Milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 10 to Sept. 30,	11.63	93.00	–	–	1:3.05	24.25	41.75	0.83
Oct. 1 to Nov. 11,	26.25	210.00	22.08	44.16	1:2.99	41.75	92.75	1.21
Nov. 12 to Dec. 23,	83.48	210.00	20.87	20.87	1:4.08	92.75	136.50	1.04
Dec. 24 to Mar. 3,	153.30	369.00	25.55	25.55	1 4.23	136.50	199.00	0.89

Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.

	Pounds.
274.66 pounds corn meal, equal to dry matter,	242.61
882.00 quarts skim-milk, equal to dry matter,	195.60
68.50 pounds wheat bran, equal to dry matter,	62.15
90.58 pounds gluten meal, equal to dry matter,	81.70
Total amount of dry matter,	582.06

	Pounds.
Live weight of animal at beginning of experiment,	24.25
Live weight at time of killing,	199.00
Live weight gained during experiment,	174.75
Dressed weight at time of killing,	167.00
Loss in weight by dressing, . . . 32.00 pounds, or 16.08 per cent.	
Dressed weight gained during experiment,	146.75

Cost of Feed consumed during Experiment.

274.66 pounds corn meal, at $19.00 per ton,	$2 61
220.50 gallons skim-milk, at 1.8 cents per gallon,	3 67
68.50 pounds wheat bran, at $16.50 per ton,	0 57
90.58 pounds gluten meal, at $23.00 per ton,	1 04
	$8 19

3.33 pounds of dry matter fed yielded 1 pound of live weight, and 3.97 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.58 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.60 cents.

(4)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 10 to Sept. 30,	11.63	93.00	–	–	1 : 3.05	21.25	38.00	0.80
Oct. 1 to Nov. 11,	26.25	210.00	22.46	44.92	1 : 2.99	38.00	90.25	1.24
Nov. 12 to Dec. 23,	79.12	210.00	19.78	19.78	1 : 4.03	90.25	132.00	0.99
Dec. 24 to Mar. 3,	118.68	369.00	19.78	19.78	1 : 3.94	132.00	184.00	0.74

Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.

	Pounds.
235.68 pounds corn meal, equal to dry matter,	208.18
882.00 quarts skim-milk, equal to dry matter,	195.60
62.02 pounds wheat bran, equal to dry matter,	56.09
84.48 pounds gluten meal, equal to dry matter,	76.20
Total amount of dry matter,	536.07

	Pounds.
Live weight of animal at beginning of experiment,	21.25
Live weight at time of killing,	184.00
Live weight gained during experiment,	162.75
Dressed weight at time of killing,	152.00
Loss in weight by dressing, . 32.00 pounds, or 17.39 per cent.	
Dressed weight gained during experiment,	134.50

Cost of Feed consumed during Experiment.

235.68 pounds corn meal, at $19.00 per ton,	$2 24
220.50 gallons skim-milk, at 1.8 cents per gallon,	3 97
62.02 pounds wheat bran, at $16.50 per ton,	0 51
84.48 pounds gluten meal, at $23.00 per ton,	0 97
	$7 69

3.29 pounds of dry matter fed yielded 1 pound of live weight, and 3.99 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.72 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.74 cents.

(5)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1889-1890.								
Sept. 10 to Sept. 30,	11.63	93.00	–	–	1:3.05	18.75	35.75	0.81
Oct. 1 to Nov. 11,	26.25	210.00	20.08	40.16	1:2.98	35.75	83.50	1.14
Nov. 12 to Jan. 6,	68.25	280.00	17.06	17.06	1:3.61	83.50	128.00	0.80
Jan. 7 to Mar. 3,	124.14	299.00	20.69	20.69	1:4.23	128 00	179.50	0.92

Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.

	Pounds.
230.27 pounds corn meal, equal to dry matter,	203.40
882.00 quarts skim-milk, equal to dry matter,	195.60
57.83 pounds wheat bran, equal to dry matter,	52.47
77.91 pounds gluten meal, equal to dry matter,	70.27
Total amount of dry matter,	521.74

	Pounds.
Live weight of animal at beginning of experiment,	18.75
Live weight at time of killing,	179.50
Live weight gained during experiment,	160.75
Dressed weight at time of killing,	151.00
Loss in weight by dressing,	28.50 pounds, or 15.87 per cent.
Dressed weight gained during experiment,	135.25

Cost of Feed consumed during Experiment.

230.27 pounds corn meal, at $19.00 per ton,	$2 19
220.50 gallons skim-milk, at 1.8 cents per gallon,	3 97
57.83 pounds wheat bran, at $16.50 per ton,	0 48
77.91 pounds gluten meal, at $23.00 per ton,	0 90
	$7 54

3.25 pounds of dry matter fed yielded 1 pound of live weight, and 3.86 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.57 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.59 cents.

Summary of Experiment XI.

	Corn Meal (Pounds).	Skim-milk (Gallons).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment (Pounds).	Dressed Weight gained during Experiment (Pounds).	Cost per Pound of Dressed Pork (Cents).
Pig No. 1,	231.52	220.5	59.11	79.82	167.00	138.50	5.47
Pig No. 2,	262.72	220.5	65.64	88 10	178.25	147.75	5.43
Pig No. 3,	274.66	220 5	68 50	90.58	174.75	146.75	5.58
Pig No. 4,	235.68	220.5	62.02	84.48	162.75	134.50	5.72
Pig No. 5,	230.27	220.5	57 83	77.91	160.75	1[illegible]5.25	5.57
Total,	1,234.85	1,102.5	313 10	420.89	843.50	702.75	–

Total Cost of Feed consumed during Experiment.

1,102.50 gallons skim-milk, at 1.8 cents per gallon, ...	$19 85
1,234.85 pounds corn meal, at $19.00 per ton, ...	11 73
313.10 pounds wheat bran, at $16.50 per ton, ...	2 58
420.89 pounds gluten meal, at $23.00 per ton, ...	4 84
	$39 00

Average cost of feed for production of 1 pound of dressed pork, 5.55 cents.

Average net cost of feed for production of 1 pound of dressed pork, after deducting the manurial value less 30 per cent., 3.57 cents.

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Corn Meal.	Skim-milk	Wheat Bran.	Gluten Meal.
Moisture at 100° C., . . .	11.67	89.78	9.27	9.80
Nitrogen, ...	1.479	0.52	2.545	4.510
Phosphoric acid, . . .	0.713	0.19	2.900	0.392
Potassium oxide, . . .	0.430	0.20	1.637	0.049
Valuation per 2,000 pounds, .	$6 27	$2 18	$14 59	$15 85

Manurial Value of Feed consumed during Experiment.

Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$3 87	$10 43	$2 28	$3 34	$19 92

The manurial value of feed for the production of 1 pound of dressed pork is 2.83 cents; after the deduction of 30 per cent., 1.98 cents.

Composition of Fodder Articles fed during the Previously Described Experiment

Skim-milk (Average).

[One quart = 2.17 pounds.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	89.78	1,795.60	–	–	1:2.13
Dry matter,	10.22	204.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.85	137.00	–	–	
" cellulose,	–	–	–	–	
" fat,	3.82	76.40	76.40	100	
" protein (nitrogenous matter),	31.60	632.00	632.00	100	
Non-nitrogenous extract matter,	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	–	

Gluten Meal.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.80	196.00	–	–	1:2.60
Dry matter,	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.25	25.00	–	–	
" cellulose,	1.75	35.00	11.90	34	
" fat,	7.00	140.00	106.40	76	
" protein (nitrogenous matter),	31.25	625.00	531.25	85	
Non-nitrogenous extract matter,	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,754.05	–	

For analyses of corn meal and wheat bran used in this experiment, see winter cow feeding experiment.

3. *Twelfth Feeding Experiment with Pigs.*

Breed, medium Yorkshire, grade Chester White; feed, skim-milk, corn and cob meal, wheat bran, gluten meal; time, April 22 to Sept. 1, 1890.

Eight pigs, four medium Yorkshires and four grade Chester Whites, were secured for the trial. Each lot consisted of two sows and two barrows. The individual live weight of the medium Yorkshires varied from 30 to 37 pounds, and that of the grade Chester Whites from 28.75 to 33 pounds, at the beginning of the observation. The feeding began April 22 and closed September 1, thus covering a period of 133 days.

The general course pursued in the management of the experiment is materially the same as adopted in the preceding VII., VIII., IX., X., XI. The main alteration consists in the substitution of corn and cob meal in place of the corn meal. The amount of skim-milk consumed daily per head remained practically the same, after the first week, — four quarts. To every quart of milk required were added two ounces of corn and cob meal. The additional feed subsequently needed consisted of a mixture of two weight parts of gluten meal and one of wheat bran. At the close of the second month of our trial, when the live weights of the various animals amounted to from 120 to 130 pounds each, the diet was changed; a mixture of four weight parts of corn and cob meal and one weight part each of gluten meal and wheat bran was fed with the original quantity of skim-milk, — four quarts daily per head. The subsequent tabular statement shows the changes in the nutritive character of the feed at different stages of growth. The entire experiment might be divided practically into three feeding periods: —

	Live Weight.	Nutritive Ratio.
Period I.,	20 to 90 pounds.	1 : 2.83
Period II.,	90 to 130 pounds.	1 : 3.60
Period III.,	130 to 200 pounds.	1 : 4.25

The live weight gained during the experiment amounted in the case of the four medium Yorkshires to 596 pounds, and in the case of the four grade Chester Whites to 640 pounds, showing an increase of 44 pounds in favor of the latter.

Medium Yorkshires.

	Pounds.		Pounds.
1. Sow, live weight at beginning, .	37.00	Live weight at close,	174.5
2. Barrow, live weight at beginning,	32.25	Live weight at close,	197.0
3. Sow, live weight at beginning, .	30.00	Live weight at close,	163.0
4. Barrow, live weight at beginning,	34.25	Live weight at close,	195.0
	133.50		729.5

Grade Chester Whites.

	Pounds.		Pounds.
1. Sow, live weight at beginning, .	31.25	Live weight at close,	207.0
2. Sow, live weight at beginning, .	33.00	Live weight at close,	177.5
3. Barrow, live weight at beginning,	29.00	Live weight at close,	199.0
4. Barrow, live weight at beginning,	28.75	Live weight at close,	178.5
	122.00		762.0

The live weight gained during the experiment varied, as will be noticed from the preceding detailed record in case of different animals of medium Yorkshires from 133 to 164.75 pounds, and in case of grade Chester Whites from 144.5 to 175.75 pounds. Considering in both cases the entire lot, the average gain in live weight per head is 149 pounds in case of the medium Yorkshires, and 160 pounds in that of grade Chester Whites. This difference in the live weights of both lots disappears in the weights of the dressed pork.

Medium Yorkshires.

	Pounds.
1. Dressed weight, ...	134
2. Dressed weight, ...	158
3. Dressed weight, ...	130
4. Dressed weight, ...	157
Total, ...	579

Grade Chester Whites.

	Pounds.
1. Dressed weight, ...	160
2. Dressed weight, ...	128
3. Dressed weight, ...	151
4. Dressed weight, ...	138
Total, ...	577

The shrinkage of the medium Yorkshires was equal to 21 per cent., and that of the grade Chester Whites 24 per cent., of their live weights. The large percentage of shrinkage is mainly due to the fact that by some oversight the animals had been fed once on the day of killing. The medium Yorkshires lead the grade Chester Whites by two pounds in dressed weight, making the result an exceptionally close one.

Four and seven-hundredths pounds of dry matter in the feed produced one pound of dressed pork in the case of the medium Yorkshires, while 3.98 pounds of dry matter in the feed produced one pound of dressed pork in case of grade Chester Whites.

The market cost of feed consumed for the production of one pound of dressed pork was 5.60 cents in the case of medium Yorkshires, and 5.45 cents in that of the grade Chester Whites. The market cost of the feed consumed is $26.51 in the case of the medium Yorkshires, and in that of the grade Chester Whites it is $26.41.

The manurial value of the nitrogen, phosphoric acid and potassium oxide contained in the feed consumed is in the first-named instance equal to $13.46, and in the latter $13.59. Allowing 30 per cent. of the stated essential fertilizing constituents as retained in the organization of the growing animal and thus lost, there remain 70 per cent. of them obtainable in the manure. The obtainable portion of the manurial constituents of the feed is worth $9.42 in the case of the medium Yorkshires, and $9.51 in that of the grade Chester Whites, making the net cost of feed in the first-named lot $17.09, and in the second lot $16.90.

The net cost of the feed consumed for the production of one pound of dressed pork is 3.61 cents in the case of the medium Yorkshires, and 3.49 cents in that of the grade Chester Whites, — a difference of .12 cent per pound in favor of the latter.

Medium Yorkshires (Four Pigs).

FEEDING PERIODS.	Total Amount of Corn and Cob Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period (Pounds).
1890.								
April 22 to June 2, .	88.69	713.50	35.94	71.88	1 : 2.83	133.50	286.00	3.54
June 3 to July 21, .	351.56	882.00	131.06	131.06	1 : 3.68	286.00	515.75	4.69
July 22 to Sept. 8, .	532.51	876.00	114.40	114.40	1 : 4.25	515.75	729.50	4.36

Total Amount of Feed consumed from April 22 to Sept. 8, 1890.

	Pounds.
972.76 pounds corn and cob meal, equal to dry matter, . .	836.28
2,471.50 quarts skim-milk, equal to dry matter, . . .	548.11
281.40 pounds wheat bran, equal to dry matter, . . .	248.98
317.34 pounds gluten meal, equal to dry matter, . . .	290.43
Total amount of dry matter, ...	1,923.80

	Pounds.
Aggregate live weight of animals at beginning of experiment,	133.50
Aggregate live weight at time of killing, ...	729.50
Live weight gained during experiment, ...	596.00
Dressed weight at time of killing, ...	579.00
Loss in weight by dressing, . . . 20.63 per cent., or	150.50
Dressed weight gained during experiment, ...	473.04

Cost of Feed consumed during Experiment.

972.76 pounds corn and cob meal, at $18.00 per ton, . .	$8 75
617.88 gallons skim-milk, at 1.8 cents per gallon, . . .	11 12
281.40 pounds wheat bran, at $19.00 per ton, ...	2 67
317.34 pounds gluten meal, at $25.00 per ton, ...	3 97
	$26 51

3.23 pounds of dry matter fed yielded 1 pound of live weight, and 4.07 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for the production of 1 pound of dressed pork at stated market prices, 5.60 cents.

Net cost per pound of dressed pork produced, 3.61 cents.

Grade Chester Whites (Four Pigs).

FEEDING PERIODS.	Total Amount of Corn and Cob Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period (Pounds).
1890.								
April 22 to June 2, .	90.25	728.00	46.21	92.42	1:2.81	122.00	312.00	4.52
June 3 to July 21, .	353.94	882.00	133.44	133.44	1:3.68	312.00	541.00	4.67
July 22 to Sept. 1, .	504.47	750.00	123.99	123.99	1:4.26	541.00	762.00	5.26

Total Amount of Feed consumed from April 22 to Sept. 1, 1890.

	Pounds.
948.66 pounds corn and cob meal, equal to dry matter, . .	815.56
2,360.00 quarts skim-milk, equal to dry matter, . . .	523.39
303.63 pounds wheat bran, equal to dry matter, . . .	268.65
349.85 pounds gluten meal, equal to dry matter, . . .	320.18
Total amount of dry matter, ...	1,927.78

	Pounds.
Aggregate live weight of animals at beginning of experiment,	122.00
Aggregate live weight at time of killing, ...	762.00
Live weight gained during experiment, ...	640.00
Dressed weight at time of killing, ...	577.00
Loss in weight by dressing, ... 24.28 per cent, or	185.00
Dressed weight gained during experiment, ...	484.62

Cost of Feed consumed during Experiment.

948.66 pounds corn and cob meal, at $18.00 per ton, . . .	$8 54
590.00 gallons skim-milk, at 1.8 cents per gallon, . .	10 62
303.63 pounds wheat bran, at $19.00 per ton, ...	2 88
349.85 pounds gluten meal, at $25.00 per ton, ...	4 37
	$26 41

3.01 pounds of dry matter fed yielded 1 pound of live weight, and 3.98 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for the production of 1 pound of dressed pork at stated market prices, 5.45 cents.

Net cost per pound of dressed pork produced, 3.49 cents.

Valuation of Essential Fertilizing Constituents in the Various Fodder Articles used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Corn and Cob Meal.	Skim-milk	Wheat Bran.	Gluten Meal.
Moisture at 100° C.,	14.03	89.78	11.52	8.48
Nitrogen,	1.279	0.520	2.600	5.358
Phosphoric acid,	0.576	0.190	2.870	0.425
Potassium oxide,	0.440	0.200	1.620	0.045
Valuation per 2,000 pounds,	$5 43	$2 18	$13 74	$19 13

Manurial Value of the Feed.

	Grade Chester Whites.	Medium Yorkshires.
Corn and cob meal,	$2 58	$2 65
Skim-milk,	5 58	5 85
Wheat bran,	2 09	1 93
Gluten meal,	3 34	3 03
	$13 59	$13 46

Composition of Fodder Articles fed during the Previously Described Experiment.

Corn and Cob Meal.

	Per Cent.
Moisture at 100° C.,	14.03
Dry matter,	85.97
	100.00

Analysis of Dry Matter.

Crude ash,	1.74
" cellulose,	3.96
" fat,	3.59
" protein (nitrogenous matter),	9.30
Non-nitrogenous extract matter,	81.41
	100.00

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.39	247.80	–	–	1 : 9.70
Dry matter, . . .	87.61	1,752.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.80	36.00	–	–	
" cellulose, . . .	1.80	36.00	12.24	34	
" fat, ...	5.01	100.20	76.15	76	
" protein (nitrogenous matter), . .	10.46	209.20	177.82	85	
Non-nitrogenous extract matter, ...	80.93	1,618.60	1,521.48	94	
	100.00	2,000.00	1,787.69	–	

Skim-milk, same as in pig feeding experiment XI.

Wheat bran, same as in summer cow feeding experiment.

IV. Fodder Analyses. (1890.)

The majority of the analyses stated under the above heading are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

In presenting these analyses, it seems but proper to call the attention of farmers once more forcibly to a careful consideration of the following facts.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

The higher or lower commercial value of the manurial refuse left behind after the feed has accomplished its purpose in a satisfactory degree, decides its actual or net cost in farm industry. A disregard of this circumstance renders, in many instances, a remunerative dairying not less doubtful than a profitable feeding of live stock for the meat market.

Corn Meal.

[Amherst Mill.]

84.98 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13 00	260.00	–	–	1 : 9.94
Dry matter,	87.00	1,740.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1 10	22.00	–	–	
" cellulose,	2.09	41 80	14.21	34	
" fat,	4.95	99.00	75.24	76	
" protein (nitrogenous matter),	10.27	205 40	174.59	85	
Non-nitrogenous extract matter,	81.59	1,631.80	1,533 89	94	
	100 00	2,000.00	1,797.93	–	

Corn and Cob Meal.

[Amherst Mill.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.10	14.03
Dry matter,	91.90	85.97
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.47	1.74
" cellulose,	5.63	3.96
" fat,	3.73	3.59
" protein (nitrogenous matter),	9.79	9.30
Non-nitrogenous extract matter,	79.38	81.41
	100.00	100.00
Passed screen 144 meshes to square inch,	76.34	72.48

Corn Meal.

[Amherst Mill]

87.90 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13 64	272.80	–	–	1 : 9.95
Dry matter, ...	86 36	1,727.20	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	2.52	50.40	–	–	
" cellulose, . . .	1.78	35.60	12 10	34	
" fat, ...	4.83	96.60	73.42	76	
" protein (nitrogenous matter), . .	10.13	202.60	172.21	85	
Non-nitrogenous extract matter, ...	80.74	1,614.80	1,517.91	94	
	100.00	2,000.00	1,775.64	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.39	247.80	–	–	1 : 9 30
Dry matter, ...	87.61	1,752 20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.80	36.00	–	–	
" cellulose, . . .	1 80	36.00	12.24	34	
" fat, . . .	5.01	100.20	76.15	76	
" protein (nitrogenous matter), . .	10.46	209.20	177.82	85	
Non-nitrogenous extract matter, ...	80.93	1,618.60	1,521.48	94	
	100.00	2,000.00	1,787.69	–	

Corn Meal.

[Sent on from Bolton, Mass]

	Per Cent.		
	Cob Meal.	Corn Meal.	Corn Meal.
Moisture at 100° C.,	16.09	16.00	16.13
Dry matter,	83.91	84.00	83.87
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	2.50	1.82	1.99
" cellulose,	5.71	1.24	1.55
" fat,	4.48	4.21	5.00
" protein (nitrogenous matter),	9.69	11.01	10.43
Non-nitrogenous extract matter,	77.62	81.72	81.03
	100.00	100.00	100.00
Passed screen 144 meshes to square inch,	60.50	89.91	82.64

Corn Meal.

[Two samples, sent on by Geo. C. Fitch, East Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	13.92	14.53
Dry matter,	86.08	85.47
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.59	1.66
" cellulose,	1.93	1.44
" fat,	4.95	4.84
" protein (nitrogenous matter),	9.73	10 16
Non-nitrogenous extract matter,	81.80	81.90
	100.00	100.00
Passed screen 144 meshes to square inch,	90.48	73.50

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.69	193.80	–	–	1 : 3.68
Dry matter,	90.31	1,806.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	9.86	197.20	39.44	20	
" fat,	5.81	116.20	92.96	80	
" protein (nitrogenous matter),	18.60	372.00	327.36	88	
Non-nitrogenous extract matter,	58.33	1,166.60	933.28	80	
	100.00	2,000.00	1,393.04	–	

Wheat Bran.

[Amherst Mill.]

47.64 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.14	202.80	–	–	1 : 3.73
Dry matter,	89.86	1,797.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.11	142.20	–	–	
" cellulose,	10.57	211.40	42.28	20	
" fat,	5.38	107.60	86.08	80	
" protein (nitrogenous matter),	18.23	364.60	320.85	88	
Non-nitrogenous extract matter,	58.71	1,174.20	939.36	80	
	100.00	2,000.00	1,388.57	–	

Wheat Bran.

[Amherst Mill.]

48.85 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11 52	230.40	–	–	1 : 3.70
Dry matter, ...	88.48	1,769.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.13	142 60	–	–	
" cellulose, . . .	10.63	212 60	42.52	20	
" fat, ...	5.62	112.40	89.92	80	
" protein (nitrogenous matter), . .	18.36	367.20	323.14	88	
Non-nitrogenous extract matter, ...	58.26	1,165 20	932 16	80	
	100.00	2,000.00	1,387.74	–	

Wheat Bran.

[Amherst Mill.]

20.04 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.69	253.80	–	–	1 : 3.38
Dry matter, ...	87.31	1,746.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7 06	141.20	–	–	
" cellulose, . . .	14.01	280.20	56.04	20	
" fat, ...	5.47	109.40	87.52	80	
" protein (nitrogenous matter), . .	19.19	383.80	337.74	88	
Non-nitrogenous extract matter, ...	54.27	1,085.40	868.32	80	
	100.00	2,000.00	1,349.62	–	

Wheat Shorts.

[Two samples, sent on by C. A. Newhall, Lynn, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.87	10.33
Dry matter,	91.13	89.67
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.14	7.96
" cellulose,	8.58	11.21
" fat.	5.86	5.52
" protein (nitrogenous matter),	16.71	17.28
Non-nitrogenous extract matter,	61.71	58.03
	100.00	100.00
Passed screen 144 meshes to square inch,	52.60	55.00

Wheat Shorts.

[Sent on by W. F. Williams, South Amherst, Mass.]

	Per Cent	
	Winter Bran.	Summer Bran.
Moisture at 100° C.,	7.42	7.87
Dry matter,	92.58	92.13
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.19	6.82
" cellulose,	8.01	9.87
" fat,	5.75	5.86
" protein (nitrogenous matter),	18.09	17.77
Non-nitrogenous extract matter,	60.96	59.68
	100.00	100.00
Passed screen 144 meshes to square inch,	60.40	61.20

Old-process Linseed Meal.

76.40 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.72	174.40	–	–	
Dry matter,	91.28	1,825.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.96	119.20	–	–	
" cellulose,	8.23	164.60	42.79	26	1 : 1.93
" fat,	9.87	197.40	179.63	91	
" protein (nitrogenous matter),	36.19	723.80	629.70	87	
Non-nitrogenous extract matter,	39.75	795.00	723.45	91	
	100.00	2,000.00	1,575.57	–	

Fertilizing Constituents of Old-process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	8.72
Ash,	5.44
Calcium oxide,	0.68
Magnesium oxide,	0.69
Sodium oxide,	0.86
Ferric oxide,	0.05
Potassium oxide (4¼ cents per pound),	1.37
Phosphoric acid (6 cents per pound),	2.17
Nitrogen (17 cents per pound),	5.29
Insoluble matter,	0.31
Valuation per ton,	$21 75

Old-process Linseed Meal.

87.40 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.30	186.00	–	–	1 : 1.78
Dry matter,	90.70	1,814.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.70	154.00	–	–	
" cellulose,	8.96	179.20	46.59	26	
" fat,	6.50	130.00	118.30	91	
" protein (nitrogenous matter),	35.27	705.40	613.09	87	
Non-nitrogenous extract matter,	41.57	831.40	756.57	91	
	100.00	2,000.00	1,534.55	–	

Old-process Linseed Meal.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.50	230.00	–	–	1 : 1.50
Dry matter,	88.50	1,770.00	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.08	121.60	–	–	
" cellulose,	8.64	172.80	44.93	26	
" fat,	6.43	128.60	117.03	91	
" protein (nitrogenous matter),	39.97	799.40	695.48	87	
Non-nitrogenous extract matter,	38.88	777.60	707.62	91	
	100.00	2,000.00	1,565.06	–	

New-process Linseed Meal.

58.84 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.06	101.20	-	-	1 : 1.26
Dry matter,	94.94	1,898.80	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	6.34	126.80	-	-	
" cellulose,	8.93	178.60	46.43	26	
" fat,	2.17	43.40	39.49	91	
" protein (nitrogenous matter),	41.02	820.40	713.74	87	
Non-nitrogenous extract matter,	41.54	830.80	756.02	91	
	100.00	2,000.00	1,555.68	-	

New-process Linseed Meal.

47.35 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.83	236.60	-	-	1 : 1.376
Dry matter,	88.17	1,763.40	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	6.43	128.60	-	-	
" cellulose,	9.01	180.20	48.65	26	
" fat,	3.15	63.00	57.33	91	
" protein (nitrogenous matter),	39.91	798.20	694.43	87	
Non-nitrogenous extract matter,	41.50	830.00	755.30	91	
	100.00	2,000.00	1,555.71	-	

New-process Linseed Meal.

55.60 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.29	165.80	–	–	1 : 1.74
Dry matter,	91.71	1,834.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.91	118.20	–	–	
" cellulose,	9.43	188.60	49.04	26	
" fat,	4.08	81.60	74.26	91	
" protein (nitrogenous matter),	35.03	700.60	609.51	87	
Non-nitrogenous extract matter,	45.55	911.00	829.01	91	
	100.00	2,000.00	1,561.82	–	

Fertilizing Constituents of New-process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	8.29
Ash,	5.42
Calcium oxide,	0.96
Magnesium oxide,	0.63
Ferric oxide,	0.06
Potassium oxide (4¼ cents per pound),	1.57
Phosphoric acid (6 cents per pound),	1.80
Nitrogen (17 cents per pound),	5.14
Insoluble matter,	0.17
Valuation per ton,	$20 97

Cotton-seed Meal.

[Sent on by E. H. McIntosh, Needham, Mass.]

	Per Cent.
Moisture at 100° C.,	10.50
Dry matter,	89.50
	100.00
Analysis of Dry Matter.	
Crude ash,	8.47
" cellulose,	10.40
" fat,	9.57
" protein (nitrogenous matter),	46.92
Non-nitrogenous extract matter,	24.64
	100.00
Passed screen 144 meshes to square inch,	66.24

Fertilizing Constituents of Cotton-seed Meal.

	Per Cent.
Moisture at 100° C.,	10.500
Calcium oxide,	0.295
Magnesium oxide,	0.721
Sodium oxide,	0.249
Potassium oxide,	1.830
Nitrogen,	6.720
Phosphoric acid,	2.350
Insoluble matter,	0.390

Sea Island Cotton-seed Meal (Ground with Hulls on).

[Sent on by Butler, Breed & Co., Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	11.62
Dry matter,	88.38
	100.00

Analysis of Dry Matter.

Crude ash,	12.07
" cellulose,	20.04
" fat,	8.90
" protein (nitrogenous matter),	26.07
Non-nitrogenous extract matter,	32.92
	100.00
Passed screen 144 meshes to square inch,	52.72

Fertilizing Constituents of the Above.

	Per Cent.
Moisture at 100° C.,	11.62
Calcium oxide,	0.57
Magnesium oxide,	0.60
Potassium oxide (4½ cents per pound),	1.31
Phosphoric acid (6 cents per pound),	2.09
Nitrogen (15 cents per pound).	3.59
Insoluble matter,	0.57
Valuation per ton,	$14 46

Gluten Meal (Chicago).

[Springfield, Mass.]

56.40 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.45	209.00	–	–	1 : 2.11
Dry matter,	89.55	1,791.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	0.85	17.00	–	–	
" cellulose,	0.67	13.40	5.55	34	
" fat,	12.05	241.00	183.16	76	
" protein (nitrogenous matter),	38.17	763.40	648.89	85	
Non-nitrogenous extract matter,	48.26	965.20	907.29	94	
	100.00	2,000.00	1,744.89	–	

Gluten Meal.

[Springfield, Mass.]

54.10 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.50	130.00	–	–	1 : 2.37
Dry matter,	93.50	1,870.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	0.68	13.60	–	–	
" cellulose,	0.68	13.60	4.62	34	
" fat,	10.03	204.60	155.49	76	
" protein (nitrogenous matter),	35.02	700.40	588.34	85	
Non-nitrogenous extract matter,	53.39	1,067.80	1,003.73	94	
	100.00	2,000.00	1,752.18	–	

Gluten Meal.

[I., sent on by S. N. Fletcher, South Acton, Mass.; II., sent on by J. L. Smith, Barre, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.30	10.70
Dry matter,	92.70	89.30
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.32	2.79
" cellulose,	1.14	6.40
" fat,	17.60	11.87
" protein (nitrogenous matter),	39.77	26.95
Non-nitrogenous extract matter,	40.17	51.99
	100.00	100.00
Passed screen 144 meshes to square inch,	84.80	65.64

Fertilizing Constituents of Gluten Meal.

	Per Cent.	
	I	II.
Moisture at 100° C.,	7.300	10.70
Calcium oxide,	0.051	0.083
Magnesium oxide,	0.035	0.253
Ferric oxide,	0.070	–
Sodium oxide,	0.018	0.165
Potassium oxide (4¼ cents per pound),	0.045	0.099
Phosphoric acid (6 cents per pound),	0.429	0.718
Nitrogen (17 cents per pound),	5.900	3.850
Valuation per ton,	$20 61	$14 04

Buckwheat Middlings.

[Sent on by J. A. Cunningham, Bolton, Mass.]

	Per Cent.
Moisture at 100° C.,	11.51
Dry matter,	88.49
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	5.44
" cellulose,	5.18
" fat,	7.53
" protein (nitrogenous matter),	25.49
Non-nitrogenous extract matter,	56.36
	100.00

71.40 per cent. passed screen 144 meshes to square inch.

Wheat Middlings.

[Sent on by F. H. Williams, Sunderland, Mass.]

	Per Cent.
Moisture at 100° C.,	12.43
Dry matter,	87.57
	100.00

Analysis of Dry Matter.

Crude ash,	4.21
" cellulose,	5.78
" fat,	3.38
" protein (nitrogenous matter),	15.13
Non-nitrogenous extract matter.	71.50
	100.00

94.16 per cent. passed screen 144 meshes to square inch.

Corn Fodder (Pride of the North).

[East Fields, collected Sept. 4, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.68	1,593.60	–	–	1 : 9.24
Dry matter,	25.32	506.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	20.11	402.20	289.58	72	
" fat,	1.65	33.00	24.75	75	
" protein (nitrogenous matter),	8.31	166.20	128.62	73	
Non-nitrogenous extract matter,	62.53	1,250.60	837.90	67	
	100.00	2,000.00	1,280.85	–	

Fertilizing Constituents of Corn Fodder.

	Per Cent.
Moisture at 100° C.,	74.680
Calcium oxide,	0.528
Magnesium oxide,	0.256
Ferric oxide,	0.078
Sodium oxide,	0.179
Potassium oxide,	0.921
Phosphoric acid,	0.495
Nitrogen,	0.337
Insoluble matter,	1.102
Valuation per ton,	$2 52

Corn Stover (Clark Corn).

[Station, Field A, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.77	115.40	–	–	1 : 13.92
Dry matter,	94.23	1,884.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.64	152.80	–	–	
" cellulose,	33.70	674.00	485.28	72	
" fat,	1.77	35.40	26.55	75	
" protein (nitrogenous matter),	6.04	120.80	88.18	73	
Non-nitrogenous extract matter,	50.85	1,017.00	681.39	67	
	100.00	2.000.00	1,281.40	–	

Corn Stover (Pride of the North).

[Experiment Station, 1890.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	21.76	435.20	-	-	1 : 8.61
Dry matter,	78.24	1,564.80	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	3.97	79.40	-	-	
" cellulose,	34.96	699.20	503.42	72	
" fat,	1.54	30.80	23.10	75	
" protein (nitrogenous matter),	9.76	195.20	142.50	73	
Non-nitrogenous extract matter,	49.77	995.40	666.92	67	
	100.00	2,000.00	1,335.94	-	

Ensilage Corn (Pride of the North).

[Sept. 8, 1890.]

	Per Cent.
Moisture at 100° C.,	9.42
Dry matter,	90.58
	100.00

Analysis of Dry Matter.

Crude ash,	6.01
" cellulose,	23.03
" fat,	2.76
" protein (nitrogenous matter),	9.31
Non-nitrogenous extract matter,	58.89
	100.00

Ensilage of Soja Bean and Cow-pea.

[Station, 1889.]

	Per Cent.
Moisture at 100° C.,	69.78
Dry matter,	30.22
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	14.96
" cellulose,	31.53
" fat,	4.44
" protein (nitrogenous matter),	12.47
Non-nitrogenous extract matter,	36.60
	100.00

Fertilizing Constituents of Soja Bean and Cow-pea Ensilage.

	Per Cent.
Moisture at 100° C ,	9.780
Calcium oxide,	0.263
Magnesium oxide,	0.786
Ferric oxide,	0.369
Sodium oxide,	1.213
Potassium oxide (4½ cents per pound),	1.378
Phosphoric acid (6 cents per pound),	0.812
Nitrogen (17 cents per pound),	1.800
Insoluble matter,	4.777
Valuation per ton,	$8 46

Ensilage of Red-cob Corn.

[Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.48	1,489.60	–	–	1 : 13.68
Dry matter,	25.52	510.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.55	131.00	–	–	
" cellulose,	28.48	569.60	410.11	72	
" fat,	4.81	96.20	72.15	75	
" protein (nitrogenous matter),	6.55	131.00	95.63	73	
Non-nitrogenous extract matter,	53.61	1,072.20	718.37	67	
	100.00	2,000.00	1,296.26	–	

Ensilage of Pride of North Corn.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.41	1,428.20	–	–	1 : 10.17.
Dry matter,	28.59	571.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.41	128.20	–	–	
" cellulose,	24.19	483.80	348.34	72	
" fat,	5.53	110.60	82.95	75	
" protein (nitrogenous matter),	8.72	174.40	127.31	73	
Non-nitrogenous extract matter,	55.15	1,103.00	739.01	67	
	100.00	2,000.00	1,297.61	–	

Imported Seed of Scotch Tares.

	Per Cent.
Moisture at 100° C.,	14.26
Dry matter,	85.74
	100.00

Analysis of Dry Matter.

Crude ash,	4.15
" cellulose,	3.87
" fat,	7.38
" protein (nitrogenous matter),	32.08
Non-nitrogenous extract matter,	52.52
	100.00

Fertilizing Constituents of the Above.

Moisture at 100° C,	14.26
Calcium oxide,	0.20
Magnesium oxide,	0.14
Ferric oxide,	0.02
Sodium oxide,	0.40
Potassium oxide,	1.29
Phosphoric acid,	1.02
Nitrogen,	4.24
Insoluble matter,	0.04
Valuation per ton,	$16 74

Vetch and Oats.

[Station, collected July 23, 1890.]

	Per Cent.
Moisture at 100° C.,	79.26
Dry matter,	20.74
	100.00

Analysis of Dry Matter.

Crude ash,	7.25
" cellulose,	31.73
" fat,	3.37
" protein (nitrogenous matter),	7.70
Non-nitrogenous extract matter,	49.95
	100.00

Fertilizing Constituents of Vetch and Oats.

Moisture at 100° C.,	5.78
Calcium oxide,	0.91
Magnesium oxide,	0.29
Ferric oxide,	0.02
Sodium oxide,	0.64
Potassium oxide,	2.24
Phosphoric acid,	0.63
Nitrogen,	1.16
Insoluble matter,	0.83
Valuation per ton,	$6 72

Royal English Horse and Cattle Condiment.

[I., from S. N. Thompson, Southborough, Mass.; II., from C. H. Heywood, Holyoke, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.30	10.82
Dry matter,	89.70	89.18
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.53	8.57
" cellulose,	3.59	4.52
" fat,	6.23	5.43
" protein (nitrogenous matter),	14.21	13.73
Non-nitrogenous extract matter,	69.44	67.75
	100.00	100.00

Harvey's Universal Vegetable Food.

[Sent on by E. F. Richardson, Millis, Mass.]

	Per Cent.
Moisture at 100° C.,	11.18
Dry matter,	88.82
	100.00

Analysis of Dry Matter.

Crude ash,	4.59
" cellulose,	7.06
" fat,	3.03
" protein (nitrogenous matter),	15.34
Non-nitrogenous extract matter,	69.98
	100.00
Passed screen 144 meshes to square inch,	72.98

Methods of Analysis of Cattle Foods.

1. Moisture. — Dry 2 grams in an air-bath at 100–110° C. to a constant weight.

2. Ash. — Char 2 to 5 grams in a muffle furnace at a low red heat, cool and weigh. Digest for a short time with dilute hydrochloric acid; collect the residue insoluble in acid in a Gooch crucible, wash, dry and weigh. Substract this from the total weight for pure ash.

3. Ether Extract. — Dry 2 grams at 100° C. for two hours. Exhaust with anhydrous, alcohol-free ether, until the extraction is complete. Dry the extract in the air-bath at 100° C. to a constant weight.

4. Crude Protein. — Determine nitrogen by the Kjeldahl or soda-lime method, and multiply the result by 6.25 for crude protein.

5. Albuminoid Nitrogen. — Determine by Stutzer's method, as given in the "Proceedings of the Association of Official Agricultural Chemists," 1889 (pages 226 and 227), except that the protein-copper is dried before being introduced into the flask.

6. Crude Fibre, or Cellulose. — The Weende method, as described in the "Proceedings of the Association of Official Agricultural Chemists," 1888 (page 70). In this method 2 grams of the material, having been nearly or completely freed from fat, are boiled for thirty minutes with 200 cubic centimetres of $1\frac{1}{4}$ per cent. sulphuric acid, brought upon a linen filter and thoroughly washed with boiling water. It is then washed into the boiling-flask with a $1\frac{1}{4}$ per cent. solution of sodium hydrate, brought quickly to 100° C., and boiled for thirty minutes, when it is filtered through a Gooch crucible, or balanced filter-papers, washed with boiling water, alcohol and ether, dried at 100° C. for an hour, and weighed. The organic matter is then burned off, and the weight of the ash deducted for crude cellulose.

ON FIELD EXPERIMENTS.

V. Some suggestions regarding the question, How can we improve in an economical way the productiveness of our farm lands?

VI. Experiments to ascertain the effect of different combinations of nitrogen, nitrate of soda, sulphate of ammonia and organic-nitrogen-containing materials, blood, as well as the absence of nitrogen-containing manurial matter, under otherwise corresponding circumstances, on oats. (Field A.)

VII. Field experiments with prominent grasses and leguminous plants, to study their composition and general economical value in our section of the country. (Field B.)

VIII. Field experiments with reputed field and garden crops, to ascertain their adaptation to our soil and climate. (Fields C and D.)

IX. Field experiments to study the economy of using different commercial sources of phosphoric acid for manurial purposes in farm practice. (Potatoes. Field F.)

X. Experiments with grass land. (East Field Meadow.)

XI. Report on general farm work.

XII. Professor Humphrey's report. (On diseases of farm plants.)

V. Some Suggestions regarding the Question, How can we improve in an Economical Way the Productiveness of our Farm Lands?

An insufficient supply of suitable manurial matter, required for the successful and liberal production of the crops to be raised, is at present universally recognized as being the most fatal circumstance in any system of farming for profit. Adopting this conclusion as the correct verdict of past and present experience in agricultural industries, it becomes most desirable, in the interest of satisfactory pecuniary returns, that every available manurial resource of the farm should be turned to account to its full extent. To secure this end we are advised to begin the work with a timely, thorough, mechanical preparation of the soil under cultivation; to select the crops to be raised, as far as practicable, with reference to their tendency of economizing existing natural resources of plant-food; to increase the latter to the full extent of suitable home-made manure on hand, and to supplement the latter liberally by buying commercial concentrated fodder articles and commercial fertilizer, as far as circumstances advise. To discuss briefly some of the means of developing and economizing manurial sources of the farm, is one of the objects of this communication. On the present occasion only two of those means will be discussed, which, although more or less at the disposition of every farmer engaged in mixed farm management, quite frequently do not receive that degree of consideration which they deserve, namely: —

1. A judicious selection and a liberal production of fodder crops.
2. An economical system of feeding farm live stock.

1. *Production and Selection of Fodder Crops.*

A careful inquiry into the history of agriculture, down to the middle of the present century, has shown that the original productiveness of farm lands in all civilized countries, even in the most favored localities, has suffered in the course of time a gradual decline. This general decline in the fertility of the soil under cultivation has been ascribed, with much propriety in the majority of instances, mainly to two causes: namely, a gradual but serious reduction in the area occupied by forage crops, natural pastures and meadows; and a marked decline in the annual yield of fodder upon large tracts of land but ill suited for a permanent cultivation of grasses, — the main reliance of fodder production at the time. A serious falling off in the annual yield of pastures and meadows was followed usually by a reduction in farm live stock, which, in turn, caused a falling off in the principal home resource of manurial matter. This chapter in the history of farm management has repeated itself in most countries. The unsatisfactory results of that system of farming finds still an abundant illustration in the present exhausted condition of a comparatively large area of farm lands in New England.

Scientific investigations, carried on during the past fifty years for the particular benefit of agriculture, have not only been instrumental in recognizing the principal causes of an almost universal periodical decline of the original fertility of farm lands, but have also materially assisted, by field experiments and otherwise, in introducing efficient remedies to arrest the noted decline in the annual yield of our most prominent farm crops. As a scanty supply of manurial matter, due to a serious falling off of one of the principal fodder crops, was found to be one of the chief causes of less remunerative crops, and thus indirectly has proved to be the main cause of an increase in the cost of the products of the animal industry of the farm, — milk and meat, — it is but natural that the remedies devised should include, as one of the foremost recommendations, a more liberal production of nutritious fodder crops. The soundness of this advice is to-day fully demonstrated in the most successful agricultural regions of the world. An intensive system of cultivation has replaced in those localities the extensive one of preceding periods; although the area under cultivation for the production of general farm crops has been reduced, the total value of products of the farm have increased materially, in consequence of a more liberal cultivation of reputed fodder crops. The change has been gradual, and the results are highly satisfactory.

Viewing our own present condition, we notice that well-paying grass land, good natural meadow, with rich and extensive pastures, are rather an exception than the rule. The benefits derived from indifferently yielding natural pastures are more apparent than real; the low cost of the production of the fodder is frequently, in a large degree, set off by a mere chance distribution of the manure produced. A continued cultivation of one and the same crop upon the same land, without a liberal, rational system of manuring, has caused in many instances a one-sided exhaustion of the land under cultivation. This circumstance has frequently been brought about, in a marked degree, by a close rotation of mixed grasses (meadow growth) and of our next main reliance for fodder, — the corn (maize). Both crops require potash and phosphoric acid, in similar proportion (4, potassium oxide, to 1, phosphoric acid), and both require an exceptional amount of the former. There is good reason to assume that the low state of productiveness of many of our farms, so often complained of, is largely due to the fact that crops have been raised in succession for years, which, like those mentioned, have consumed one or the other essential article of plant food in an exceptionally large proportion, and thereby have gradually unfitted the soil for their remunerative production; while a liberal supply of other important articles of plant food is left inactive behind. As the amount of available plant food contained in the soil represents largely the working capital of the farmer, it cannot be otherwise but that the practice of allowing a part of it to lie idle must reduce the interest on the investment.

Our personal observation upon the lands assigned for the use of the station has furnished abundant illustration of the above-described condition of farm lands. In one instance it was noticed that a piece of old, worn-out grass land, after being turned under and properly prepared, as far as the mechanical condition of the soil was concerned, produced, without any previous application of manure, an exceptionally large crop of horse-beans and lupine, — two reputed fodder crops. A similar observation was made during the past season, when lands, which for years had been used for the production of English hay and corn, were used for the cultivation of southern cow-pea, serradella, and a mixed crop of oats and vetch, to serve as green fodder for milch cows. The field engaged for the production of these crops was not manured, because it was to be prepared for a special field experiment during the present season. An area of this land, which, under favorable circumstances, would not produce more than six tons of green grass at the time of blooming, yielded nine to ten tons of green vetch and oats, ten tons of green southern cow-pea, and from twelve to thirteen tons of green serradella. The exceptional exhaustion of our lands in potash has been shown by detailed description of experiments with fodder corn in previous annual reports.

The results obtained during past years tend to confirm the opinion held by successful agriculturists, that dry grass lands which are in an exceptional degree inclined to a spontaneous overgrowing by an inferior class of fodder plants and weeds, if at all fit for a more thorough system of cultivation, ought to be turned by the plough and subsequently planted with some hoed crop, to kill off the foul growth and to improve the physical and chemical condition of the soil. These lands prove, in many instances, ultimately a far better investment when used for the raising of other farm crops than grasses. The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhausted soil, and the sooner, as a rule, will be noticed a decrease in the annual yield. The introduction of a greater variety of fodder plants enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc , is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotation, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

The subsequent tabular statement contains a list of fodder crops raised on the lands of the station. Those marked with * have been tried successfully on a large scale for fodder; the remainder seem to be well adapted to our climate. All are reported in their *dry* state, to compare their relative nutritive character, as well as the value of their fertilizing constituents. For further details, see seventh annual report, for 1889.

Composition of Fodder Crops raised upon the Station Grounds.

NAME OF CROP. (SUITABLE FOR FEEDING.)	Nutritive Ratio.	Fodder Constituents (in Pounds) in 1,000 Pounds of Dry Matter.					Fertilizing Constituents (in Pounds) in 1,000 Pounds of Dry Matter.			Manurial Value per Ton of Dry Matter.
		Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	
Medium clover (*Trifolium pratense*),	1 : 2.5 to 1 : 5.5	89.0	299.7	26.2	146.3	438.8	23.40	4.88	24.65	$10 64
Alsike clover (*Trifolium hybridum*),		116.7	261.8	26.6	162.2	432.7	25.88	7.81	24.72	11 86
*Cow-pea (*Dolichos*),		69.2	235.9	24.8	145.9	524.2	23.40	5.79	14.44	9 86
*Serradella (*Ornithopus sativus*),		116.9	321.9	23.7	149.6	384.9	23.94	8.04	24.12	11 15
*Vetch (*Vicia sativa*),		82.4	303.7	25.0	150.9	438.0	24.14	5.47	12.75	9 95
*Soja bean (*Soja hispida*),		75.1	212.6	59.9	154.0	497.5	24.78	4.66	16.53	10 39
Lucerne (*Medicago sativa*),		81.1	297.2	16.5	142.2	463.0	22.75	5.61	15.59	9 73
*Herds grass (*Phleum pratense*),	1 : 5.5 to 1 : 9.5	53.3	328.7	20.1	85.2	512.7	13.95	4.97	16.54	6 75
*Corn stover,		50.3	320.2	16.5	79.2	533.8	12.67	4.22	18.39	6 38
*Fodder corn,		48.8	314.0	15.3	72.1	549.8	11.54	7.38	10.99	5 75
*Oats (entire plant),		60.8	343.2	26.9	108.9	460.2	17.42	7.81	22.90	8 81
Barley (entire plant),		49.5	291.2	27.6	102.6	529.1	16.42	6.44	19.53	8 02
Millet,		54.9	335.4	17.4	75.9	516.4	12.14	5.03	10.89	5 66
Hungarian grass (*Setaria italica*),		71.5	246.6	10.1	93.8	578.0	15.01	6.21	13.50	7 00
Japanese buckwheat,		123.6	360.2	22.2	108.0	386.0	17.28	9.04	35.21	9 95
*Sugar beets,	1 : 9.5 to 1 : 13.	46.4	60.0	6.5	108.4	778.7	17.34	5.41	18.57	8 12
*Ruta-bagas,		97.5	118.3	15.3	110.1	658.8	17.62	10.76	41.05	10 77
*Mangel-wurzels,		90.6	79.4	8.8	103.7	717.5	16.59	7.32	30.13	9 08
*Carrots,		81.4	95.3	25.0	88.4	709.9	14.14	10.02	54.11	10 61

2. *Economical Feeding of Farm Live Stock.*

The adoption of an economical system of feeding farm live stock in the case of a mixed farm management is only second in importance, as far as financial success is concerned, to the remunerative production of the leading farm crops. The benefits derived from a successful management of the latter are not unfrequently largely offset by a mismanagement of the former. Comparatively recent investigations, regarding the principles which control success in feeding farm live stock for various purposes, have greatly improved our chances for profit. Although much needs still to be learned in regard to many details, it is quite generally conceded that some important facts, bearing on the economical side of the question, have been fairly established.

The introduction of the chemical analysis of fodder articles has made us more familiar with their general character. The influences which affect their composition are also better known. A fair knowledge in both directions is to-day considered indispensable for a due appreciation of the results obtained in feeding experiments. The latter, carried on under better-defined circumstances, have demonstrated the important fact that three distinctly different groups of substances are required for the support of the life of animals. These groups are: nitrogen-containing organic substances, commonly called nitrogenous organic matter; non-nitrogenous organic matter, like sugar, starch, fat, etc.; and certain saline or mineral substances. Neither one nor two of these groups by themselves can for any length of time sustain animal life; nor can any excess of one or the other, contained in the diet used, benefit the animal. The excess, as a rule, is ejected, and can only, if at all, benefit the manure. We know, also, that all our farm plants contain more or less of each of the three essential groups of food constituents. As no single plant or part of plant has proved to any extent to furnish the most nutritious and at the same time the most economical diet for any particular class of animals, it becomes advisable to supplement them with other suitable articles, to secure their full benefit. An economical system of stock feeding has, therefore, to strive to select among the suitable fodder articles those which furnish the required quantity and proportion of the three essential food constituents in digestible form at the lowest cost. For more details regarding this point, I have to refer to previous annual reports.

Assuming a similar degree of adaptation of the various fodder articles offered for our choice, the question of cost deserves a serious consideration, when feeding for profit. The actual cost of a fodder article does not depend merely upon its market price, but is materially affected by the value of the manurial refuse it leaves behind, when it has served its purpose as food. The higher the percentage of nitrogen, phosphoric acid and potash a diet contains, the more valuable is the manure it furnishes, under otherwise corresponding circumstances. An excess, therefore, of any one or of all three in one diet, as compared with that of another, counts in favor of that particular diet, as far as the net cost of feed is concerned; for it is admissible, for mere practical economical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, or feeding them for the same purpose, a corresponding amount of nitrogen, phosphoric acid, potassium oxide, etc., will be retained, and, according to circumstances, either stored up in the growing animal, or pass into the milk, etc. The commercial value of the three above-mentioned essential articles of plant food, contained in the manure secured in connection with our feeding experiments with milch cows, has differed in case of different diets from less than one-third to more than one-half of the market cost of feed consumed. A few tabular statements may not be without interest on this occasion; for further illustration, I refer to our seventh annual report, — 1889.

1. Table showing the relative manurial value of stated fodder. Net cost signifies market cost, less manurial value.

2. Tables designed to show the approximate relative cost per pound of digestible nitrogenous matter of some prominent fodder articles. The calculation assumes in every case a value of nine-tenths cents per pound of digestible non-nitrogenous extract matter, and four and one-third cents for digestible crude fat. The difference between

the sum of the money values of fat and non-nitrogenous extract matter and cellulose present, and the market price of the particular fodder articles, is charged to the digestible nitrogenous matter. The corn meal has been adopted as the basis for the comparison, as far as value of non-nitrogenous matter is concerned. In presenting this table, it is by no means assumed that the nitrogenous matter, as stated below, is pound for pound of equal nutritive value; it merely aims to show what class of articles suggest themselves for trials, when an increase of nitrogenous matter is the main object for consideration in making up a class suitable for the occasion.

1. *Valuation of Fodder Articles (per Ton).*

	Market Cost.	Manurial Value.	Net Cost.
Corn meal, ...	$20 00	$7 50	$12 50
Wheat bran, ...	17 00	14 50	2 50
Wheat middlings, ...	20 00	10 75	9 25
Gluten meal, ...	24 00	17 00	7 00
Cotton-seed meal, ...	26 00	19 75	6 25
Linseed meal (old-process), . .	27 00	21 75	5 25
Linseed meal (new-process), . .	25 00	24 00	1 00
English hay (mixed), . . .	12 00	5 50	6 50
Corn fodder, ...	5 00	4 32	0 68
Corn stover, ...	5 00	4 80	0 20
Sugar beets, ...	5 00	1 15	3 85
Mangel-wurzels, ...	3 00	1 10	1 90
Skim-milk, ...	4 10	2 25	1 85

2. *Cost of Digestible Nitrogenous Matter of Fodder Articles (per Pound).*

[The constituents are given in pounds per 1,000 pounds of the substance which contains them.]

	Market Cost per Ton.	Moisture at 100° C.	Dry Matter.	Total Nitrogenous Matter.	Rate of Digestibility.	Digestible Nitrogenous Matter (Pounds).	Indigestible Nitrogenous Matter (Pounds).	Cost of Digestible Nitrogenous Matter per Pound, allowing for Digestible Fat Four and One-third Cents, for Cellulose and Non-nitrogenous Extract Matter Nine-tenths Cents, per Pound.	Total Nitrogen in Article.	Digestible Nitrogen.	Indigestible Nitrogen.
								Cents.			
Corn meal,	$20 00	128.6	871.4	98.47	85	83.70	14.77	3.30	15.66	13.31	2.35
Wheat bran,	17 00	109.7	890.3	158.36	83	139.36	19.00	2.21	25.33	22.29	3.04
Wheat middlings,	20 00	95.5	904.5	164.71	88	144.94	19.77	3.08	26.35	23.19	3.16
Gluten meal,	24 00	96.1	903.9	289.88	85	246.40	43.48	2.20	46.38	39.42	6.96
Cotton-seed meal,	26 00	80.8	919.2	388.09	74	287.20	100.89	2.41	62.09	45.95	16.14
Linseed meal (old-process),	27 00	74.8	925.2	343.70	87	299.02	44.68	2.50	54.99	47.84	7.15
Linseed meal (new-process),	25 00	60.1	939.9	383.08	87	333.28	49.80	2.40	61.29	53.32	7.97
Timothy hay,	12 00	85.7	914.3	75.97	57	43.30	32.67	3.10	12.15	6.93	5.22
English hay (mixed),	12 00	97.2	902.8	86.13	57	49.09	37.04	3.09	13.78	7.85	5.93
Corn fodder,	5 00	200.0	800.0	57.68	73	42.10	15.58	–*	9.23	6.74	2.49
Corn stover,	5 00	162.7	837.3	68.74	73	50.18	18.56	–*	11.00	8.03	2.97
Sugar beets,	5 00	835.2	164.8	19.17	100	19.17	0.00	6.47	3.07	3.07	0.00
Mangel-wurzels,	3 00	877.5	122.5	12.70	100	12.70	0.00	4.52	2.03	2.03	0.00
Skim-milk,	4 10	904.2	95.8	33.27	100	33.27	0.00	4.39	5.32	5.32	0.00

Rate of Digestibility: Approximate values.

* The digestible fat, cellulose and non-nitrogenous extract matter at stated prices more than cover the market cost.

Corn Ensilage (Six Samples).

[Sent on by J. H. Esterbrook for the Dudley Grange.]

Statements of Parties.

a. Variety of corn: —

1. Cross between Stowell's evergreen and eight-rowed variety.
2. Common field.
3. Eureka ensilage.
4. Southern white.
5. Stowell's evergreen.
6. Southern white.

b. Fertilization per acre: —

1. Three cords stable manure broadcast, with five hundred pounds ground bone in hill.
2. About thirty loads or ten cords stable manure broadcast, and two hundred pounds phosphate in hill.
3. Forty loads stable manure broadcast.
4. After a crop of rye for fodder, with five cords stable manure, four hundred pounds E. F. Coe's phosphate in drill.
5. Six cords horse manure, with three hundred pounds Bradley's fish in hill.
6. Two and one-half cords stable manure broadcast, on grass sod in the fall, and ploughed in with four hundred pounds of phosphate in drill when planting.

c. Mode of planting: —

1. Rows three feet apart; hills twenty-six inches apart; four kernels to hill.
2. Rows three and a half feet apart; hills twenty inches apart.
3. Rows three feet apart; hills twelve inches apart.
4. Rows three feet apart; kernels about three inches apart in drills.
5. Rows thirty-two inches apart; kernels about six inches apart in drills.
6. Rows three feet apart; kernels about one foot apart in drills.

d. Period of harvesting: —

1. Somewhat past the milk.
2. Over ripe; rather dry (September 23).
3. In the milk.
4. Ears commencing to form in the more exposed parts of the field.
5. Ears ripe enough for seed.
6. Past the milk (September 25).

e. Yield per acre (approximately): —

1. Eighteen to twenty tons.

2. About eight tons of ensilage and eighty bushels of ears. Estimated, thirty-five to forty tons; ten to fifteen feet high.
4. Twelve tons.
5. Twenty to twenty-two tons.
6. Twelve tons.

f. Mode of ensilaging: —

1. Cut in short pieces; silo filled in two days.
2. Cut in pieces one inch long.
3. Cut in short pieces by a Bailey cutter.
4. Cut in pieces one inch long by a Bailey cutter; covered with twelve inches of old hay or straw; then with inch boards and ten inches thickness of stones.
5. Cut in pieces three to four inches long by a Bailey cutter; silo filled in two days, covered and weighted.
6. Same as 4.

g. Fodder analysis: —

Sample.	Acidity calculated to Acetic Acid.	Moisture at 100° C.	Dry Matter.	Analysis of Dry Matter, 100 Parts.				
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.
	Per Cent.	Per Cent.	Per Cent.					
No. 1, .	3.68	76.38	23.62	6.18	20.05	5.57	8.49	59.71
No. 2, .	2.12	70.01	29.99	6.74	34.97	2.74	5.98	49.57
No. 3, .	1.98	82.87	17.13	7.22	38.92	1.82	6.04	46.00
No. 4, .	2.69	75.36	24.64	6.25	30.26	2.57	6.52	54.40
No. 5, .	1.27	78.84	21.16	6.94	24.40	3.78	7.53	57.35
No. 6, .	1.13	71.65	28.35	4.37	24.64	2.68	6.82	61.49

Observations made at the Laboratory.

No. 1. Best-looking sample, bright and fresh. Good per cent. of ears. Agreeable acid odor.

No. 2. Odor and appearance not as good as No. 1. Smaller per cent. of ears.

No. 3. Small per cent. of ears. Bright looking. Odor slightly sour.

No. 4. Fair per cent. of ears. Odor agreeable, but slightly sour. Not so bright looking as No. 1.

No. 5. Larger per cent. of ears. Odor agreeable. Color, fair. Small weeds and grass mixed in.

No. 6. Fair per cent. of ears. Color not as bright as No. 1. Smell, fair.

VI. Field Experiments to ascertain the Effect of Different Combinations of Nitrogen, Nitrate of Soda, Sulphate of Ammonia and Organic-nitrogen-containing Compounds, Blood, under Otherwise Corresponding Circumstances, on Oats. 1890. (Field A.)

The area occupied by this experiment is the same which has served during four preceding years in succession — 1884 to 1888 — for the purpose of ascertaining the extent of the inherent natural resources of potash. The results obtained in that connection, which are described in our third, fourth, fifth and sixth annual reports, left no doubt about the fact that our farm land had been in an exceptional degree impoverished in potash, in consequence of a too close rotation of grass and corn.

The field record of each of the ten plats, one-tenth of an acre in size, extended over a period of more than six years, as far as modes of cultivation and of manuring are concerned. Some plats had received during that period a supply of nitrogen for manurial purposes in but one and the same specified form, while others had received none in any form. This condition of the various plats was turned to proper account in our new plans.

1889 — Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes, were retained in that state to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received, without an exception, a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid, and from 40 to 50 pounds of available nitrogen, were supplied per acre.

One plat, marked 0, received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate, and 18 pounds of dissolved bone-black.

Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 1 and 2 received nitrogen in form of sodium nitrate; plats 5, 6 and 8 received nitrogen in form of ammonium sulphate; plats 3 and 10 received nitrogen in form of dried blood; plat 0 received nitrogen in form of barn-yard manure.

The entire field, eleven plats, was ploughed April 9. The fertilizer was applied broadcast to each plat, and subsequently slightly harrowed under, April 27. The final preparation of the soil for seeding, by ploughing and harrowing, took place May 9. The same variety of corn (Clark), a flint corn, was planted in drills in a similar manner as during preceding years, May 10. The crop on all plats was kept clean by means of the cultivator and hoe; it was cut September 3, when the kernels were fairly glazed over.

Yield of Corn Stover and Ears on Plats (1889), at Forty-eight Per Cent. Moisture.

	Weight of Whole Crop.	Weight of Stover.	Weight of Ears.	Form of Nitrogen applied.
	Pounds.	Pounds.	Pounds.	
Plat 0, . .	500.62	342.35	158.27	Barn-yard manure.
Plat 1, . .	648.48	475.95	172 53	Nitrate of soda.
Plat 2, . .	576 91	375.75	201.16	Nitrate of soda.
Plat 3, . .	618.31	425 85	192.46	Blood.
Plat 4, . .	381.18	283.90	97.28	No nitrogen.
Plat 5, . .	488.01	359 05	128.96	Ammonium sulphate.
Plat 6, . .	541.95	367.05	174.90	Ammonium sulphate.
Plat 7, . .	525.82	484 30	41.52	No nitrogen.
Plat 8, . .	359.12	237.98	121.14	Ammonium sulphate.
Plat 9, . .	475.63	417.50	58.13	No nitrogen.
Plat 10, . .	639 55	467.60	171.95	Dried blood.

Percentage of Well-developed and Undeveloped Ears on Plats (1889).

	Well-developed Ears.	Undeveloped Ears.
	Per Cent.	Per Cent.
Plat 0, ...	60 3	39.7
Plat 1, ...	48.5	51.5
Plat 2, ...	46 7	53.3
Plat 3, ...	28.3	71.7
Plat 4, ...	14 7	85.3
Plat 5, ...	18.7	81.3
Plat 6, ...	29 0	71.0
Plat 7, ...	41 6	58.4
Plat 8, ...	21.3	78.7
Plat 9, ...	24.4	75.6
Plat 10, ...	50 2	49.8

The following tabular statement shows the general condition of the soil and its crop-producing quality during the years 1888 and 1889 : —

Field A.

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.	
	1888.	1889.	1888.	1889.
Plat 1,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	617	648
Plat 2,	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	303	577
Plat 3,	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	150	618
Plat 4,	Nothing,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	114	381
Plat 5,	97 lbs. magnesium sulphate,	22 5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48 5 lbs potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	564	488
Plat 6,	Nothing,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen). 25 lbs. muriate of potash (= 12 to 13 lbs potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	193	542
Plat 7,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	676	526
Plat 8,	50 lbs. ammonium sulphate (= 10 lbs. nitrogen),	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	146	359
Plat 9,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	553	476
Plat 10,	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	737	640

The results of our first season of observation, 1889, regarding the influence of nitrogen-containing manurial substances on the character and on the quantity of the fodder corn raised under otherwise corresponding circumstances, although not without some interest, were not decisive enough to advise a detailed explanation of causes. The larger part of the summer season of 1889 with us was cold and wet, and for this reason of an exceptionally unfavorable character for the raising of fodder corn. How much this circumstance has affected our first results, is difficult to decide. Not less difficult is it to decide, at this stage of observation, how much the special conditions of various plats may yet control the results. The comparatively low yield of ears and the large percentage of undeveloped ears, on plats 4, 7, 9, which received no nitrogen-containing manurial matter, was, however, very marked.

1890. — During the past season, oats was chosen as the crop for our trial. The field was prepared by ploughing in the fall and in the spring, previous to the manuring. The same kind and the same quantity of manurial substances were applied broadcast to the different plats as in the preceding year shortly before seeding.

NUMBER OF PLAT.	
Plat 0, .	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid.)
Plat 2, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 3, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 5, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 8, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

The above weights of the different manurial substances were taken for the purpose of securing to each plat, as far as practicable, potash, phosphoric acid and nitrogen in corresponding proportions.

The manurial substances were slightly harrowed under before seeding. The oats were seeded April 29 and 30, in rows, two feet apart, to allow a one-horse cultivator to pass between the rows. Each plat had sixteen rows, and thirty-nine pounds of oats, Pringle's Progress, were in equal weights divided between eleven plats. A brush seed drill with no plate under the brush was used for that purpose.

The young plants appeared above ground on May 5. The plants on plats 6 and 8 appeared sickly, having a yellowish tint, May 23. The entire field became subsequently somewhat infested with plant lice, plats 6 and 8 suffering most, May 26. Cultivator and hoe were used at this stage, to renovate the ground, June 2 and 3. The entire crop, with the exception of that upon Plat 8, soon improved and recovered entirely. Plat 8 suffered for some days longer than the rest from the infection; it showed later on a lower and somewhat uneven stand of its oats.

The shade of the green of the growth upon different plats showed during the progress of the season in many instances a quite marked difference. Upon plats which had received their nitrogen in the form of sulphate of ammonia, as well as upon those which had received no nitrogen-containing manurial matter, a light-green tint of the foliage was noticed alike in the earlier stages of the growth of the oats. In the latter case this light-green color of the crop remained until the maturing began; in the former case, *i. e.*, where sulphate of ammonia had furnished the nitrogen supply, the color became deeper green as the season progressed.

The progress of growth varied at times in a marked degree, yet no exceptional differences in height were noticeable at the maturing of the crop..

The following tabular statement contains the measurements of the height of the plants at stated dates: —

	June 20 (Inches).	June 27 (Inches).	July 4 (Inches).	July 11 (Inches).	July 18 (Inches)	July 25 (Inches).
Plat 0, . .	15	20	25	31	36	33
Plat 1, . .	16	19	25	31	36	36
Plat 2, . .	15	20	28	33	40	40
Plat 3, . .	14	17	21	30	34	36
Plat 4, . .	13	16	22	27	30	33
Plat 5, . .	15	19	28	34	38	40
Plat 6, . .	12	15	22	30	37	40
Plat 7, . .	12	15	20	28	35	36
Plat 8, . .	7	11	16	23	32	36
Plat 9, . .	12	13	21	27	31	35
Plat 10, . .	14½	19	24	32	40	40

The entire crop was cut August 11; it was removed to the barn August 13. To secure as far as practicable a uniform state of dryness, the final weighing of the yield of each plat was deferred to August 21, when the following results were obtained: —

	Grain and Straw (Pounds).	Grain (Pounds).	Straw and Chaff (Pounds).
Plat 0, ...	315	120	195
Plat 1, ...	362	128	234
Plat 2, ...	365	129	236
Plat 3, ...	345	116	229
Plat 4, ...	260	90	170
Plat 5, ...	360	141	219
Plat 6, ...	385	124	261
Plat 7, ...	320	110	210
Plat 8, ...	220	59	161
Plat 9, ...	290	101	189
Plat 10, ...	395	140	255
	3,617	1,258	2,359

Considering Plat 8 a failure for known cause, the low yield of kernels on plats 4, 7 and 9, which received no nitrogen application, is, to say the least, very significant.

Comparative Weights and Moisture Tests of the Above-recorded Grains.

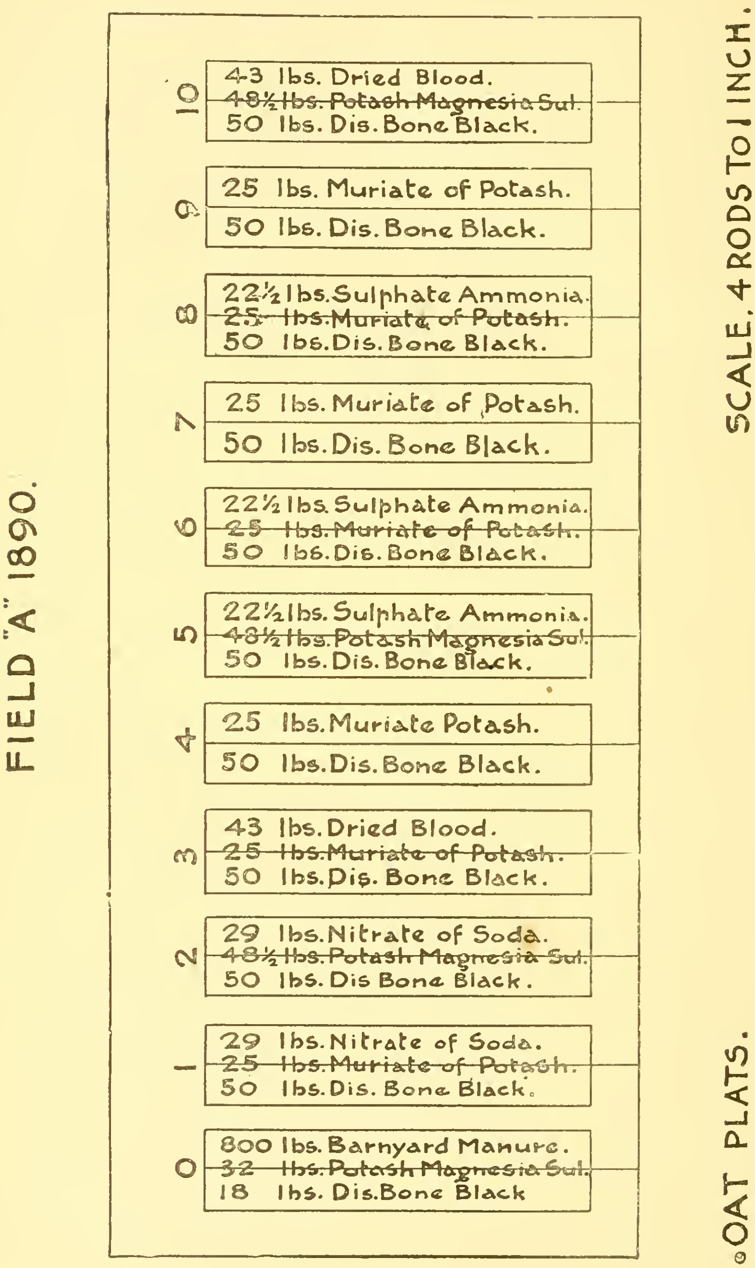
One hundred average kernels of each plat were taken for the test; three independent tests were made; the weights below recorded are the mean of the three tests made. The oats were kept in glass-stoppered bottles during the examination.

PLATS.	Average Weight of 100 Kernels (Grams).	Average Per Cent. of Water.	Percentage of Dry Matter.
0, ...	3.2151	16.96	83.04
1, ...	3.3577	17.58	82.42
2, ...	3.1236	17.43	82.57
3, ...	3.3260	20.88	79.12
4, ...	3.2991	20.99	79.01
5, ...	3.2015	18.79	81.21
6, ...	3.1201	22.60	77.40
7, ...	3.3956	22.22	77.78
8, ...	3.0727	17.74	82.26
9, ...	3.3408	23.94	76.06
10, ...	3.0740	18.34	81.66

The difference in moisture points evidently towards some varying degree in maturity. In the majority of cases where muriate of potash has furnished the potassa, the maturing of the crop was somewhat later than where sulphate of potassa was used.

PLAT.	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Dry Matter in Grain (Pounds).	Relative Percentage of Dry Matter in Grain.	Analysis of Dry Matter.		
						Potassium Oxide.	Phosphoric Acid.	Nitrogen.
						Per Cent.	Per Cent.	Per Cent.
0, .	315	38.10	61.90	99.66	86.97	0.82	1.13	2.62
1, .	362	35.36	64.64	105.50	92.13	0.76	1.21	2.75
2, .	365	35.34	64.66	106.52	93.02	0.75	1.02	2.72
3, .	345	33.62	66.38	91.78	80.15	0.84	1.21	2.49
4, .	260	34.61	63.39	71.11	62.09	0.79	1.08	2.53
5, .	360	39.20	60.80	114.51	100.00	0.85	0.96	2.68
6, .	385	32.21	67.79	95.98	83.82	0.90	1.15	2.64
7, .	320	34.40	65.60	85.56	74.72	0.80	1.06	2.36
8, .	220	26.82	73.18	48.53	42,30	0.84	1.09	2.64
9, .	290	34.83	65.17	76.82	67.08	0.80	0.97	2.59
10, .	395	35.44	64.56	114.33	99.84	0.84	1.18	2.59
Average,	329	34.54	65.46					

The absence of nitrogen in the manurial matter applied to plats 4, 7, 9, is accompanied by the lowest yield in dry matter in the grain; the yield of dried grain in case of plats 4, 7, 9, averages 67.9 per cent., and in case of the remaining plats, excluding Plat 8 for stated reasons, it averages 90.8 per cent. The plats containing potash-magnesia sulphate as the potash source, namely, plats 2, 5, 10, have yielded the largest amount of grain; each of these plats received its nitrogen supply in a different form, — ammonium sulphate, blood, and nitrate of soda. The field (A) has been seeded with winter rye during the late autumn, to continue the investigation in the same direction.


FIELD "A" 1890.
SCALE, 4 RODS TO 1 INCH.
OAT PLATS.
10
43 lbs. Dried Blood.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis. Bone Black.
9
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
8
22½ lbs. Sulphate Ammonia.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
7
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
6
22½ lbs. Sulphate Ammonia.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
5
22½ lbs. Sulphate Ammonia.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis. Bone Black.
4
25 lbs. Muriate Potash.
50 lbs. Dis. Bone Black.
3
43 lbs. Dried Blood.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
2
29 lbs. Nitrate of Soda.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis Bone Black.
1
29 lbs. Nitrate of Soda.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
0
800 lbs. Barnyard Manure.
~~32 lbs. Potash Magnesia Sul.~~
18 lbs. Dis. Bone Black

VII. Field Experiments with Prominent Fodder Crops, to study Their Composition and Their General Economical Value in our Section of the Country. — Grasses and Leguminous Plants (Field B).

The field here under discussion is located west of Field A, described within some preceding pages. It occupies an area of one and seven-tenths acres. The land is nearly level, and the soil consists of a sandy loam several feet deep.

In 1884 the entire field was subdivided into eleven plats of equal size, thirty-three by one hundred and seventy-five feet, with five feet of space between them. Every alternate plat has received from that date annually the same kind and the same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. Since 1885 all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and, in the case of grasses, two feet. The space between the different plats has received, thus far, no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 were fertilized annually; plats 12, 14, 16, 18 and 20 have received no fertilizer until the season of 1889.

The details of the work carried on upon Field B are from year to year recorded in the annual report of the station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins, and the reports of the succeeding year.

The subsequent tabular statement of crops raised upon the different plats of Field B since 1886 may assist in a desirable understanding of its late history, and its condition at the beginning of the season of 1890.

PLATS.	1887.	1888.	1889.	1890.
Plat 11 (fertilized), .	Corn, ...	Kentucky blue-grass (*Poa pratensis*), . . .	Kentucky blue-grass, ...	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12 (unfertilized), .	Corn, ...	Kentucky blue-grass, .	Kentucky blue-grass, . . .	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 13 (fertilized), .	Italian rye-grass (*Lolium Italicum*), English rye-grass (*Lolium perenne*),	Italian rye-grass, . . English rye-grass, . .	Red-cob ensilage corn, . . .	Red top, sown Sept. 24, 1889.
Plat 14 (unfertilized), .	Italian rye-grass, ... English rye-grass, ...	Italian rye-grass, . . English rye-grass, . .	Red-cob ensilage corn, . . .	Red top, sown Sept. 24, 1889.
Plat 15 (fertilized) .	Five varieties Southern cow-pea, .	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*), . Sainfoin (*Onobrychis sativa*), .	Bokhara clover, sown May 8, 1889. Sainfoin, sown May 8, 1889.
Plat 16 (unfertilized), .	Five varieties Southern cow-pea, .	Soja bean, . . .	Bokhara clover, ... Sainfoin, ...	Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889.
Plat 17 (fertilized), .	Meadow fescue (*Festuca pratensis*),	Meadow fescue, . .	Meadow fescue, ...	Meadow fescue, sown September, 1887.
Plat 18 (unfertilized), .	Alsike clover (*Trifolium hybridum*), Medium red clover (*Trifolium pratense*), ...	Alsike clover, ... Medium red clover, .	Red-cob ensilage corn, . . .	Meadow fescue, sown September, 1889.
Plat 19 (fertilized), .	Alsike clover, ... Medium red clover, ...	Alsike clover, . . . Medium red clover, . .	Alsike clover, ... Medium red clover, ...	Herds grass, sown September, 1889.
Plat 20 (unfertilized), .	Mammoth red clover (*Trifolium medium*), ... Alfalfa or lucerne (*Medicago sativa*),	Mammoth red clover, . Alfalfa, ...	Red-cob ensilage corn, . . .	Red top and herds grass, mixed, sown September, 1889.
Plat 21 (fertilized), .	Mammoth red clover, . . Alfalfa, ...	Mammoth red clover, . Alfalfa, ...	Corn (variety, Clark), . . .	Meadow fescue and herds grass, mixed, sown September, 1889.

The fertilizer annually applied since 1889 to all the plats alike consisted in each case of eighty pounds of steamed ground bones and of twenty-seven pounds of muriate of potash, or six hundred pounds of bones and two hundred pounds of muriate of potash per acre.

1890. — A grass mixture was sown broadcast on plats 20 and 21. The remaining plats were sown in drills two feet apart, sixteen rows in each plat. The crops seeded in rows were cultivated two or three times, and cleaned with the hoe during the growing season to remove the weeds and to clear the crops from admixtures.

The majority of the plats appeared well at the beginning of the season. The seeds proved, however, subsequently, in several instances, a bad investment for our purposes, where distinct varieties and not mixtures of grass seeds were needed.

Plats 11, 12, Kentucky blue-grass, sown Sept. 24, 1889. The growth looked well at the opening of spring, 1890. The cultivator and hoe were applied in the beginning of the season, and again in June, to remove the weeds. The crop was cut for the first time September 19 ; it did not head out during the season. The hay weighed two hundred pounds on Plat 11, and two hundred and sixty pounds on Plat 12.

Plats 13, 14, red top (*Agrostis vulgaris*), sown Sept. 24, 1889. The seed proved not well adapted to our purpose. It contained a considerable amount of seeds of herds grass. The crop was cut on both plats July 10, and yielded seven hundred and ten pounds of hay in all. The sod was subsequently ploughed under, and cut up by means of a wheel harrow. The soil prepared later on was reseeded Sept. 24, 1890.

Plat 15, Bokhara clover (*Melilotus alba*) and esparsette or sainfoin (*Onobrychis sativa*). Both were sown May 8, 1889. The Bokhara clover yielded, September 9, two hundred and three pounds of hay ; the sainfoin did not head out in the first year, — it reached about five inches in height. Both crops looked fairly well in the spring of 1890, yet showed here and there the effects of winter-killing. They were cut for hay ; Bokhara clover yielded two cuts, sainfoin but one. Bokhara clover was cut June 24, yielding two hundred and five pounds of hay, and again September 22, yielding seventy-five pounds. Sainfoin was cut June 24, and yielded one hundred and twenty-five pounds of hay; the aftergrowth would have furnished a rich pasture for cows.

Plat 16, Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889. The growth looked promising at the opening of the season, yet turned out later on to contain a considerable admixture of herds grass. The crop was cut July 9, and it yielded three hundred and twenty pounds of hay. The sod was turned under July 15, and cut up with a wheel harrow. The plat, after thorough preparation, was reseeded in September, 1890.

Plat 17, meadow fescue (*Festuca pratensis*), sown September, 1887. Started out vigorously with an unbroken sod; began blooming during the first week of June, and was nearly through blooming June 20. It was cut June 24, and measured from three to three and a half feet in height. Two crops were secured, June 24 and September 22. The first cut yielded seven hundred and thirty pounds of hay, and the second cut two hundred and fifty-five pounds.

Plat 18, meadow fescue, sown Sept. 22, 1889. The seed proved, to a serious degree, to be a mixture of grass seeds. The crop was cut July 9, and yielded three hundred and ninety pounds of hay. The sod was ploughed under July 15, cut up with a wheel harrow, and subsequently, after due preparation, reseeded Sept. 24, 1890.

Plat 19, herds grass (*Phleum pratense*), sown Sept. 25, 1889. Looked well in the spring; began to blossom June 30; was cut July 9. It yielded five hundred and fifty pounds of hay. The second crop was cut September 22, and yielded two hundred and five pounds of hay.

Plat 20, a mixture of herds grass, two and one-half pounds (= 2 quarts), and red top, two and one-half pounds (= 6 quarts), which were sown Sept. 24, 1889. The crop looked fair in the spring; was cut July 9; it yielded four hundred and thirty pounds of hay, first cut. The grass suffered somewhat from a brown fungus. The sod was for this reason ploughed under, and the soil prepared, in the same manner as previously described in case of other plats, for a reseeding during the succeeding September.

Plat 21, a mixture of meadow fescue, two and one-half pounds (= 4 quarts), and herds grass, two and one-half pounds (= 2 quarts), was sown Sept. 25, 1889. The plat looked well in the spring; it proved in part a failure, on account of the mixed character of the seeds, and of the appearance of a brown fungus upon the plants. The first cut yielded three hundred and ninety pounds of hay. The sod was ploughed under soon after harvesting the hay, and the land reseeded after a careful preparation of the soil, Sept. 25, 1890.

All plats reseeded during the late autumn have been fertilized in a like manner, with the same mixture which has been used for several years upon Field B; namely, six hundred pounds of ground steamed bones and two hundred pounds of muriate of potash per acre. Extra precaution has been taken to secure seeds fit for our purpose, which in this connection consists in comparing single varieties of grasses and other reputed fodder crops, regarding their nutritive character and their comparative economical value, when raised under otherwise corresponding circumstances upon farms in Massachusetts.

Some of the results of the analyses of crops raised upon Field B, during 1889 and 1890, as far as they are not yet published, will be found upon a few subsequent pages.

Meadow Fescue.

[In full bloom, June 14, 1889. (Field B.)]

	Per Cent.
Moisture at 100° C.,	5.30
Dry matter,	94.70
	100.00

Analysis of Dry Matter.

Crude ash,	8.50
" cellulose,	39.65
" fat,	1.97
" protein (nitrogenous matter),	7.85
Non-nitrogenous extract matter,	42.03
	100.00

Fertilizing Constituents of Meadow Fescue.

	Per Cent.
Moisture at 100° C.,	5.300
Calcium oxide,	0.616
Magnesium oxide,	0.269
Ferric oxide,	0.019
Sodium oxide,	0.603
Potassium oxide,	2.461
Phosphoric acid,	0.625
Nitrogen,	1.190
Insoluble matter,	0.151
Ash,	8.500
Valuation per ton,	$6 89

Kentucky Blue-grass.

[Collected June 14, 1889; just past blooming. (Field B.)]

	Per Cent.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	6.78	3.90
Dry matter,	93.22	96.10
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	8.24	7.45
" cellulose,	36.84	32.21
" fat,	2.03	2.08
" protein (nitrogenous matter),	8.78	8.65
Non-nitrogenous extract matter,	44.11	49.61
	100.00	100.00

Fertilizing Constituents of Kentucky Blue-grass.

	Per Cent.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	6.780	3.900
Calcium oxide,	0.366	0.429
Ferric oxide,	0.031	0.057
Sodium oxide,	0.067	0.181
Potassium oxide,	2.110	1.277
Phosphoric acid,	0.414	0.447
Nitrogen,	1.310	1.330
Insoluble matter,	3.203	2.522
Valuation per ton,	$6 74	$5 66

Alsike Clover.

[Collected June 14, 1889; in full bloom. (Field B.)]

	Per Cent.
Moisture at 100° C.,	9.96
Dry matter,	90.04
	100.00

Analysis of Dry Matter.

Crude ash,	13.06
" cellulose,	26.11
" fat,	2.19
" protein (nitrogenous matter),	16.65
Non-nitrogenous extract matter,	41.99
	100.00

Fertilizing Constituents of Alsike Clover.

	Per Cent.
Moisture at 100° C.,	9.960
Calcium oxide,	1.870
Ferric oxide,	0.104
Sodium oxide,	0.266
Potassium oxide,	3.320
Phosphoric acid,	0.495
Nitrogen,	2.399
Insoluble matter,	1.928
Valuation per ton,	$11 57

Medium Clover.

[Collected July 12, 1889; in full bloom. (Field B.)]

	Per Cent.
Moisture at 100° C.,	5.10
Dry matter,	94.90
	100.00

Analysis of Dry Matter.

Crude ash,	9.06
" cellulose,	30.76
" fat,	2.36
" protein (nitrogenous matter),	15.01
Non-nitrogenous extract matter,	42.81
	100.00

Fertilizing Constituents of Medium Clover.

	Per Cent.
Moisture at 100° C.,	5.100
Calcium oxide,	1.539
Ferric oxide,	0.137
Sodium oxide,	0.227
Potassium oxide,	2.370
Phosphoric acid,	0.457
Nitrogen,	2.279
Insoluble matter,	1.583
Valuation per ton,	$10 35

Sweet Clover (Melilotus alba).

[Collected Oct. 3, 1889. (Field C.)]

	Per Cent.
Moisture at 100° C.,	6.36
Dry matter,	93.64
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	28.08
" fat,	1.85
" protein (nitrogenous matter),	11.81
Non-nitrogenous extract matter,	51.36
	100.00

Fertilizing Constituents of Sweet Clover.

	Per Cent.
Moisture at 100° C.,	6.360
Calcium oxide,	1.938
Magnesium oxide,	0.373
Ferric oxide,	0.025
Sodium oxide,	0.077
Potassium oxide,	1.673
Phosphoric acid,	0.436
Nitrogen,	1.770
Insoluble matter,	0.013
Valuation per ton,	$7 96

Sainfoin (Onobrychis sativa).

[Past blooming; collected June 20, 1890.]

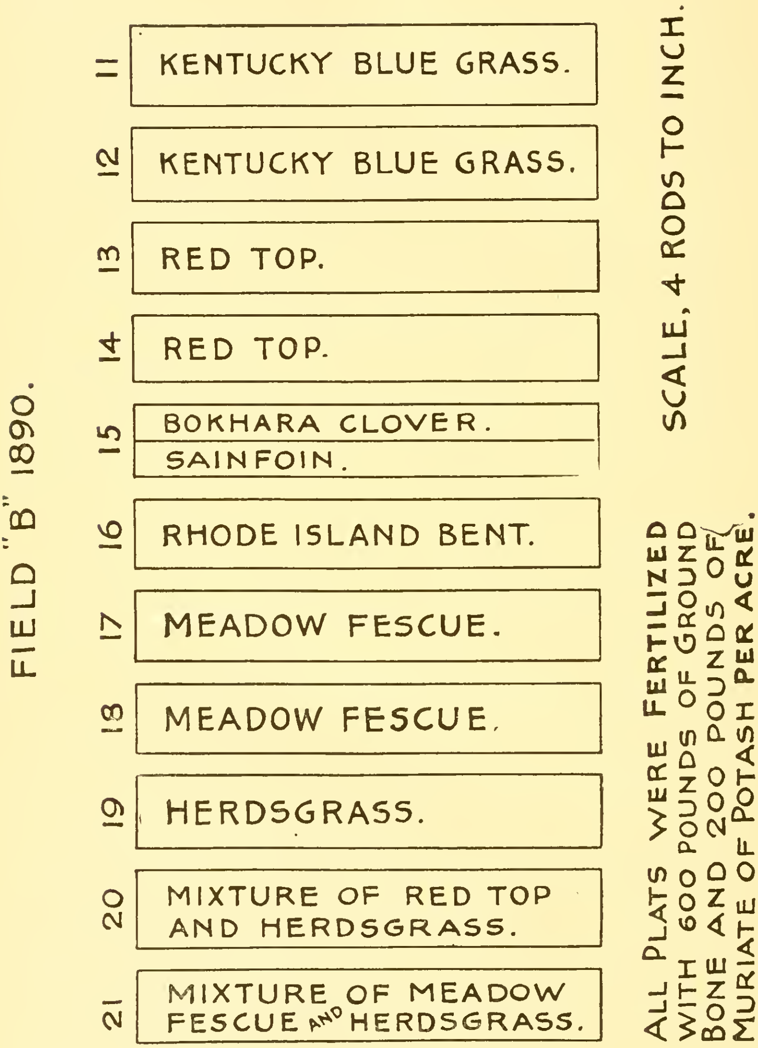
	Per Cent.
Moisture at 100° C.,	12.17
Dry matter,	87.83
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	8.54
" cellulose,	26.95
" fat,	4.49
" protein (nitrogenous matter),	17.70
Non-nitrogenous extract matter,	42.27
	100.00

Fertilizing Constituents of Sainfoin.

	Per Cent.
Moisture at 100° C.,	12.17
Calcium oxide,	1.16
Magnesium oxide,	0.43
Ferric oxide,	0.04
Sodium oxide,	0.54
Potassium oxide,	2.02
Phosphoric acid,	0.76
Nitrogen,	2.63
Insoluble matter,	0.47
Valuation per ton,	$11 57


FIELD "B" 1890.
11 KENTUCKY BLUE GRASS.
12 KENTUCKY BLUE GRASS.
13 RED TOP.
14 RED TOP.
15 BOKHARA CLOVER.
SAINFOIN.
16 RHODE ISLAND BENT.
17 MEADOW FESCUE.
18 MEADOW FESCUE.
19 HERDSGRASS.
20 MIXTURE OF RED TOP AND HERDSGRASS.
21 MIXTURE OF MEADOW FESCUE AND HERDSGRASS.
SCALE, 4 RODS TO INCH.
ALL PLATS WERE FERTILIZED WITH 600 POUNDS OF GROUND BONE AND 200 POUNDS OF MURIATE OF POTASH PER ACRE.

VIII. Experiments with Field and Garden Crops. (Fields C and D.)

Field C.

This field comprises an area 328 feet long and 183 feet wide; it is subdivided into two parts, running from east to west; they are separated by a passage-way three feet wide.

The system of manuring and of cultivating is the same on both divisions. They are annually manured with a mixture consisting of fine-ground steamed bone, six hundred pounds, and muriate of potash, two hundred pounds, per acre. The field is usually ploughed in the fall and early in spring, with the exception of small areas occupied by perennial plants. The fertilizer is applied broadcast early in spring, and subsequently slightly harrowed in.

The crops are in the majority of cases planted in drills, to secure chances for clean cultivation. The land has served, for several years past, for the same purposes; namely, to ascertain the particular degree of adaptation of reputed farm crops to our climate and our soil. In some instances sufficient quantities of one or the other were raised to furnish fodder for summer and winter feeding experiments. In the majority of cases, however, the main object of the planting was to secure suitable material for analysis, to determine their relative economical value either for general farm purposes or for special industrial purposes. The variety of crops already tested in this connection is quite numerous; for details regarding previous years, we have to refer to our preceding annual reports. Some analyses of crops raised on fields C and D during the year 1889 are published, for the first time, within a few subsequent pages.

Lotus villosus.
Sulla (*Hedysarum coronaria*).
Teosinte.
Japanese buckwheat.
Small pea (*Lathyrus sativus*).
Carrot (*Daucus carota*).

1890. — The entire field, both divisions, was ploughed during the autumn of 1889, and again May 1, 1890. The fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash, per acre, was sown soon after the ploughing, slightly harrowed under, and the various seeds subsequently planted as stated below.

The entire south side of Field C was planted with barley, in rows two feet apart. The north side was occupied by a series of crops in the following order, beginning at the east end of the field: —

5 rows English rye grass, rows two feet apart.
3 rows early Southern white corn, rows three feet three inches apart.
2 rows early Southern cow-pea, rows three feet three inches apart.
4 rows horse bean, rows three feet three inches apart.
4 rows white soja bean, rows three feet three inches apart.
4 rows black soja bean, rows three feet three inches apart.
2 rows bush peas, rows three feet three inches apart.
4 rows Scotch tares, rows three feet three inches apart.
4 rows common vetch, rows three feet three inches apart.
4 rows white lupine, rows three feet three inches apart.
4 rows serradella, rows three feet three inches apart.
4 rows Bokhara clover, rows three feet three inches apart.
4 rows sainfoin, rows three feet three inches apart.
4 rows English rye grass, rows two feet apart.
1 row sulla.
1 row festuca No. 1 (Connecticut).
2 rows pyrethrum, rows two feet apart.
3 rows lotus villosus, rows three feet three inches apart.
15 rows Florimond Desprez's richest sugar beet, rows two feet apart.
15 rows Bulteau Desprez's richest sugar beet, rows two feet apart.
15 rows Dippe's Kleinwanzleben sugar beet, rows two feet apart.
15 rows Dippe's Vilmorin sugar beet, rows two feet apart.
16 rows Simon Le Grand's white improved sugar beet, rows two feet apart.

The entire field was kept clean from weeds by a timely use of a one-horse cultivator and the hoe.

Barley. — The area occupied by barley was 30,504 square feet. It required thirty-four pounds of seed, or forty-eight to fifty pounds per acre. The seed was planted with a brush seeding machine, without plate, May 3. The young plants began to come up May 6. They were cultivated June 3, and headed out June 25. The heads remained free from smut, but the leaves showed many brown spots, due to fungous growth.

The crop reached a height of twenty-five inches, and turned yellow July 25. It was cut July 31, and put in the barn August 3. When threshed, September 15, it yielded 430 pounds of grain and 1,795 pounds of straw and chaff, which is equal to 610 pounds of grain and 2,531 pounds of straw and chaff, per acre.

The ground which was used for the production of the barley was ploughed August 2. After being fertilized with 225 pounds of fine-ground steamed bone (one-half of our customary annual dressing of bone), it was planted with turnips and ruta-bagas, in rows two feet apart. The crop was thinned out in the rows and twice cleaned with the cultivator. It was harvested November 5. The turnips came to a good average size, and the ruta-bagas only to a small medium size. Both were of excellent quality for family use, selling in our local market at fifty cents per bushel. The entire crop amounted to 7,715 pounds.

English Rye Grass (Lolium perenne). — This was sown May 30. The young plants appeared above ground June 5. They made a good growth, yet did not head out during the season. The grass was cut at the customary time for second cut of upland meadow grasses, and the sod left over winter, to notice the effect of that season on the crop. In one of our preceding experiments the plants were winter-killed. The main object of this trial was to secure additional facts regarding that point.

Early Southern White Corn. — The corn was planted May 23. The young plants were noticed above ground June 2. It made a very heavy rank growth, yet proved much too late for maturing in our locality.

Horse Bean (Vicia faba). — This was planted May 23, appeared above ground June 2; reached a height of twenty-five inches before it began to bloom, July 9. It suffered temporarily somewhat from drought; recovered, however, subsequently. The roots of the plants, when thirty-one inches high, July 18, showed a remarkably large number of tubercles. The plant keeps on blooming until a killing frost destroys it. This plant has served us well on former occasions for green manuring.

Soja Bean (Soja hispida). — Two varieties, white and black, were planted May 23; they came above ground June 2. The white variety began to bloom August 9, and the black variety but one day later. The foliage of the white variety was darker green than that of the black, throughout the season. Both stood the drought well. The roots had apparently no tubercles. The white variety matured sooner than the black one. The soja bean promises to be a valuable addition to the leguminous fodder crops in New England. Two acres have been planted with soja beans during the past season, on the grounds of the station. The growth of one acre has served, in its semi-matured state, as green fodder during the autumn (see summer feeding experiment on previous pages of this report) for milch cows; and that of the other has been put in a silo as an admixture to corn ensilage (see statements on silos).

Scotch Tares (a coarse variety of vetch). — The seed was kindly furnished by Mr. James Cheesman of Southborough, Mass., who had imported some for his own experiments. It was planted May 23, was above ground June 3; had reached a height of twelve inches, July 18, before it began to spread. The plants began blooming July 23. The crop was cut for hay August 2. One acre has been planted on another part of our farm during the past season, to serve as winter fodder for cattle.

Common Vetch (*Vicia sativa*). — The seed was planted May 23; the young plants were above ground June 1. They began to bloom July 12, when twelve inches high. The plants formed subsequently a rank, thick growth. This variety of vetch has been raised for several years very successfully on our farm, either by itself or as an admixture of oats and barley, for green fodder, toward the close of July, when they begin to bloom. It is one of the earliest annual leguminous fodder crops at our disposal, and has rendered us for several years past excellent services as green fodder for milch cows. It can be used green or in its dried state, as circumstances advise. An admixture of oats and barley renders the crop very acceptable to dairy stock.

White Lupine (*Lupinus alba*). — This was planted May 23; appeared above ground June 1; began to blossom July 7, and reached a height of twenty-five inches. The crop became infested with insects, and proved no success during the past season. The best services we have thus far received from the various varieties of lupines, white, yellow and blue, consists in their fitness for green manuring. The plant grows rapidly, is succulent, and comparatively rich in nitrogenous matter. The crop can be ploughed under with profit in the beginning of August. The disintegration of the plant has usually sufficiently advanced at the beginning of September to render the soil fit for thorough mechanical preparation, preparatory to the seeding down of grasses or of winter crops.

Serradella (*Ornithopus sativus*). — The successful cultivation of this valuable fodder crop depends, in our part of the country, apparently in exceptional degrees, on the character of the soil and the season. A deep, sandy loam, and a fair average temperature of the summer season, tend to secure success. Under favorable circumstances we have obtained from ten to twelve tons of green fodder, with an average percentage of dry matter of from nineteen to twenty per cent. Fed green from the beginning to the end of September, 1887 and 1889, at the rate of seventy to eighty pounds per day, with one-quarter of the ordinary English hay ration (five pounds), the result has been in an exceptional degree satisfactory. Serradella has surpassed in our case the effect of Southern cow-pea and vetch and oats, as a green fodder for dairy cows. It competes fairly with soja bean in that connection. Cold and wet summer seasons, and cold, springy lands, each in their own way interfere seriously with a timely vigorous growth, and thus with the production of a remunerative crop. Our trial with this crop during the late season has been a failure, on account of the springy character of the land selected for its cultivation.

Bokhara Clover (*Melilotus alba*) and *Sainfoin* (*Onobrychis sativa,* — *Esparsette*) are already described in previous pages (Field B). The bulky, heavy growth of the Bokhara clover, and its pleasant odor, resembling somewhat that of the sweet vernal grass (*Anthoxanthum odoratum*), render it desirable to institute experiments for the purpose of ascertaining its fitness for ensilage. Its stems are succulent at the time when the plant has reached its full height (four to four and one-half feet). Our locality is evidently too cold to render the cultivation of sainfoin advisable.

Sulla (*Hedysarum coronaria*) and *Lotus villosus* have for several years shown a healthy and vigorous growth on our grounds; they stand our average winter very well. Both deserve a serious trial for stocking pastures with a nutritious growth. They shade the ground more efficiently in such localities than any of our coarser clover varieties. Some subsequent statements of their composition illustrate their high feeding value.

Sugar Beets. — The seeds were sent on by the United States Department of Agriculture, for trial, accompanied by the directions to return in due time average specimens of roots of the five varieties for examination at the laboratory of the department in Washington.

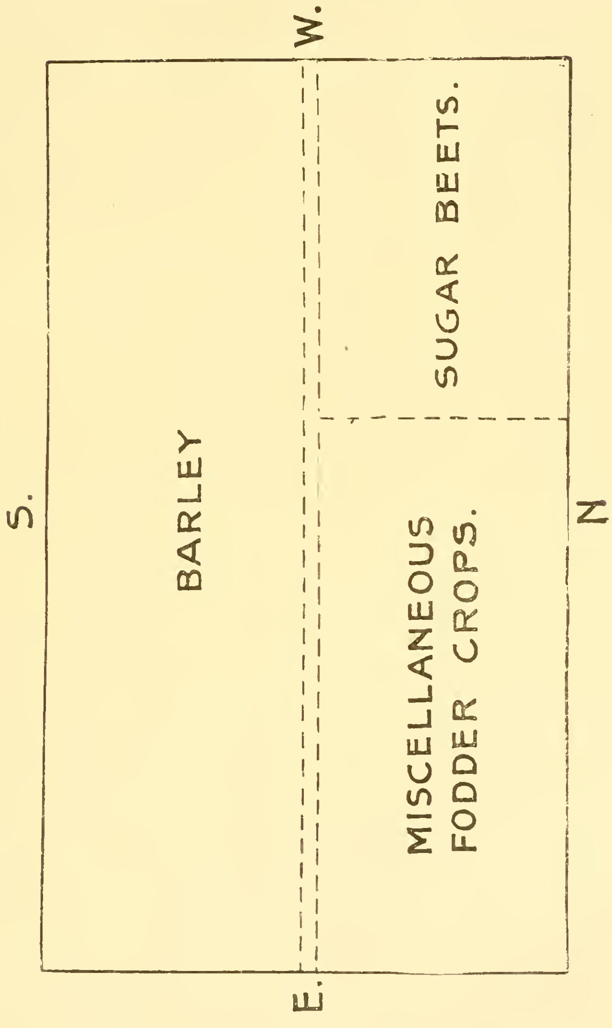
They were planted in rows two feet apart, in a well-prepared soil, May 5, each variety properly marked. The young plants came up May 17; they suffered subsequently somewhat from leaf-miners, but soon recovered without any apparent serious consequences. The crop was cleaned twice with the cultivator, and the plants thinned out to six inches apart July 8. They suffered during the latter part of the summer here and there from brown spots on the leaves. The pulling of the roots began October 2, with the following.

		Pounds.
I.	Florimond Desprez's richest,	760
II.	Bulteau Desprez's richest,	760
III.	Dippe's Kleinwanzleben,	705
IV.	Dippe's Vilmorin,	680
V.	Simon Le Grand's white improved,	865
	Total,	3,770


1
2

3
4
5

FIELD "C" 1890.



SCALE, 4 RODS TO INCH.

The majority of the roots were of a smaller size than usual. The quality of some varieties proved to be fair; others have but little value for the production of sugar, as will be seen from the analyses farther on.

The importance of a reliable seed, a good preparation of a deep soil, a proper system of fertilization, a close planting, and a subsequent careful mode of cultivation for the successful production of sugar beet roots fit for an economical manufacture of sugar, has been abundantly illustrated by the writer, by a series of field experiments upon the college farm, as far back as 1873–1876. (See Massachusetts Agricultural College reports for those years.)

Field D.

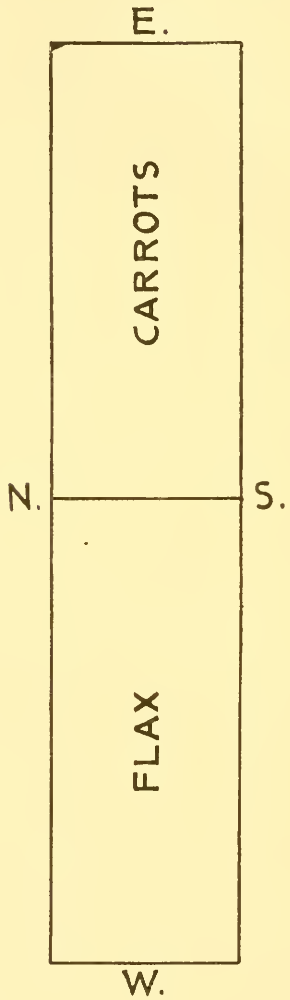
It comprises an area 328 feet long and 70 feet wide, equal to 22,960 square feet, running from east to west, parallel with Field C, with a grass road twelve feet in width between them. Mode of manuring and preparation of the soil previous to seeding corresponds with that described in connection with Field C. The eastern half of the land was planted with carrots, the western with flax.

Flax (*Linum usitatissimum*). — About one-fourth of an acre was sown with flax-seed May 23. Forty-four pounds of seed were used for that purpose. The seed was applied broadcast in two directions, to secure a close stand of the crop. The young plants showed themselves above ground May 29. The crop was weeded by hand June 30. It began to bloom July 2, and reached a height of two feet August 1. As soon as the color of the plants changed decidedly into a greenish-yellow tint, they were pulled, to secure a valuable straw. The seeds were but partly matured. The entire crop when harvested weighed 1,510 pounds. The seed heads were taken off by means of an iron comb, and the straw set up out of doors to dry. The dried straw weighed 670 pounds, August 22. This weight corresponds to 2,570 pounds per acre.

The entire crop was sent to a New York company, according to a previous arrangement, to be converted, by a new process of bleaching, etc., into linen goods, to test its quality for that purpose.

Carrots (*Daucus carota*), *Danvers Yellow.* — The seed was planted by means of a brush-seeding apparatus, using the plate third in size from the smallest, in rows two feet apart, to allow the use of a one-horse cultivator for cleaning, etc., May 9. The crop was subsequently thinned out July 16, and weeded twice by hand. The roots were pulled October 15. They were left for several days in the field in piles, covered with the tops of the roots, before hauling them in. The yield amounted to somewhat over four tons, equal to from sixteen to seventeen tons of carrots per acre.

FIELD "D" 1890.



SCALE, 4 RODS To 1 INCH.

Sugar Beets.

[From station grounds.]

1. Florimond Desprez's richest sugar beet.
2. Bulteau Desprez's richest sugar beet.
3. Dippe's Kleinwanzleben.
4. Dippe's Vilmorin.
5. Simon Le Grand's white improved.

	Date of Test.	Sugar by Polariscope.	Sugar by Fehling's Test.	Degrees Brix.	Specific Gravity of Juice.	Moisture at 100°C.
		Per Cent.	Per Cent.			
1, Sugar beet,	October 29,	11.92	11.95	–	–	82.13
2, Sugar beet,	October 30,	11.66	11.55	–	–	83.19
3, Sugar beet,	October 29,	12.25	12.09	–	–	81.63
4, Sugar beet,	October 30,	11.76	11.69	–	–	83.15
5, Sugar beet,	October 31,	9.74	9.52	–	–	85.04
		Sugar in Juice.	Sugar in Beets.			
		Per Cent.	Per Cent.	Juice.	Juice.	
1, Sugar beet,	November 10,	13.08	–	16.50	1.06783	–
2, Sugar beet,	November 11,	13.16	12.42	17.04	1.07002	–
3, Sugar beet,	November 10,	14.30	13.10	17.30	1.07133	–
4, Sugar beet,	November 10,	12.75	12.26	15.70	1.06436	–
5, Sugar beet,	November 11,	13.42	12.67	16.60	1.06827	–

Lotus Villosus.

[Collected June 21, 1889; in full bloom. (Field D.)]

	Per Cent.
Moisture at 100° C.,	10.68
Dry matter,	89.32
	100.00

Analysis of Dry Matter.

Crude ash,	8.23
" cellulose,	24.48
" fat,	3.00
" protein (nitrogenous matter),	13.49
Non-nitrogenous extract matter,	50.80
	100.00

Fertilizing Constituents of Lotus Villosus.

	Per Cent.
Moisture at 100° C.,	10.680
Calcium oxide,	1.579
Magnesium oxide,	0.336
Ferric oxide,	0.076

Fertilizing Constituents of Lotus Villosus — Concluded.

	Per Cent.
Sodium oxide,	0.365
Potassium oxide,	2.064
Phosphoric acid,	0.688
Nitrogen,	1.930
Insoluble matter,	0.888
Valuation per ton,	$9 13

Sulla (Hedysarum coronaria).

[Collected June 11, 1889; in full bloom. (Field D.)]

	Per Cent.
Moisture at 100° C.,	8.32
Dry matter,	91.68
	100.00

Analysis of Dry Matter.

Crude ash,	9.87
" cellulose,	28.95
" fat,	2.39
" protein (nitrogenous matter),	16.90
Non-nitrogenous extract matter,	41.89
	100.00

Fertilizing Constituents of Sulla.

	Per Cent.
Moisture at 100° C.,	8.320
Calcium oxide,	2.203
Magnesium oxide,	0.321
Ferric oxide,	0.081
Sodium oxide,	0.083
Potassium oxide,	2.314
Phosphoric acid,	0.482
Nitrogen,	2.479
Insoluble matter,	0.240
Valuation per ton,	$10 98

Teosinte.

[Station, 1889. (Field D.)]

	Per Cent.
Moisture at 100° C.,	6.06
Dry matter,	93.94
	100.00

Analysis of Dry Matter.

Crude ash,	6.95
" cellulose,	28.88
" fat,	1.28
" protein (nitrogenous matter),	9.71
Non-nitrogenous extract matter,	53.18
	100.00

Fertilizing Constituents of Teosinte.

	Per Cent.
Moisture at 100° C.,	6.060
Calcium oxide,	1.597
Magnesium oxide,	0.458
Ferric oxide,	0.021
Sodium oxide,	0.109
Potassium oxide,	3.696
Phosphoric acid,	0.546
Nitrogen,	1.460
Insoluble matter,	0.315
Valuation per ton,	$8 76

Japanese Buckwheat.

[Collected June 28, 1889; little past blooming. (Field D.)]

	Per Cent.
Moisture at 100° C.,	5.72
Dry matter,	94.28
	100.00

Analysis of Dry Matter.

Crude ash,	12.36
" cellulose,	36.02
" fat,	2.22
" protein (nitrogenous matter),	10.80
Non-nitrogenous extract matter,	38.60
	100.00

Fertilizing Constituents of Japanese Buckwheat.

	Per Cent.
Moisture at 100° C.,	5.720
Calcium oxide,	3.418
Magnesium oxide,	0.421
Ferric oxide,	0.148
Sodium oxide,	0.349
Potassium oxide,	3.320
Phosphoric acid,	0.850
Nitrogen,	1.629
Insoluble matter,	0.378
Valuation per ton,	$9 38

Small Pea (Lathyrus sativus).

[Collected Sept. 3, 1889. (Field D.)]

	Per Cent.
Moisture at 100° C.,	5.80
Dry matter,	94.20
	100.00

Analysis of Dry Matter

	Per Cent.
Crude ash,	6.30
" cellulose,	32.88
" fat,	1.49
" protein (nitrogenous matter),	16.57
Non-nitrogenous extract matter,	42.76
	100.00

Fertilizing Constituents of Small Pea.

	Per Cent.
Moisture at 100° C.,	5.800
Calcium oxide,	1.373
Magnesium oxide,	0.276
Ferric oxide,	0.138
Sodium oxide,	0.469
Potassium oxide,	1.990
Phosphoric acid,	0.592
Nitrogen,	2.497
Insoluble matter,	1.081
Valuation per ton,	$10.89

Scotch Tares.

[Whole plant, at end of blooming; station, 1890. (Field C.)]

	Per Cent.
Moisture at 100° C.,	15.80
Dry matter,	84.20
	100.00

Analysis of Dry Matter.

Crude ash,	13.76
" cellulose,	30.89
" fat,	1.89
" protein (nitrogenous matter),	22.00
Non-nitrogenous extract matter,	31.46
	100.00

Fertilizing Constituents of Scotch Tares.

	Per Cent.
Moisture at 100° C.,	15.800
Calcium oxide,	1.698
Magnesium oxide,	0.354
Ferric oxide,	0.460
Sodium oxide,	0.238
Potassium oxide,	3.004
Phosphoric acid,	0.815
Nitrogen,	2.964
Insoluble matter,	4.062
Valuation per ton,	$13.61

Carrots.

[Station, 1889.]

	Per Cent.
Moisture at 100° C.,	89.57
Dry matter,	10.43
	100.00

Analysis of Dry Matter.

Crude ash,	8.76
" cellulose,	8.16
" fat,	1.86
" protein (nitrogenous matter),	9.18
Non-nitrogenous extract matter,	72.13
	100.00

Fertilizing Constituents of Carrots.

	Per Cent.
Moisture at 100° C.,	89.570
Calcium oxide,	0.064
Magnesium oxide,	0.025
Ferric oxide,	0.007
Sodium oxide,	0.013
Potassium oxide,	0.472
Phosphoric acid,	0.086
Nitrogen,	0.153
Insoluble matter,	0.027
Valuation per ton,	$1 02

Carrot Tops (1889).

	Per Cent.
Moisture at 100° C.,	9.760
Calcium oxide,	2.089
Magnesium oxide,	0.667
Ferric oxide,	0.118
Sodium oxide,	4.028
Potassium oxide,	4.883
Phosphoric acid,	0.612
Nitrogen,	3.130
Insoluble matter,	0.098
Valuation per ton,	$15 52

Parsnips.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	80.34
Dry matter,	19.66
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	7.43
" cellulose,	7.67
" fat,	3.37
" protein (nitrogenous matter),	6.88
Non-nitrogenous extract matter,	74.65
	100.00

Fertilizing Constituents of Parsnips.

	Per Cent.
Moisture at 100° C.,	80.340
Calcium oxide,	0.088
Magnesium oxide,	0.045
Ferric oxide,	0.005
Sodium oxide,	0.006
Potassium oxide,	0.617
Phosphoric acid,	0.187
Nitrogen,	0.217
Insoluble matter,	0.019
Valuation per ton,	$1 50

Barley Straw.

[Station, 1890. (Field C.)]

	Per Cent.
Moisture at 100° C.,	11.44
Dry matter,	88.56
	100.00

Analysis of Dry Matter.

Crude ash,	5.30
" cellulose,	33.85
" fat,	3.38
" protein (nitrogenous matter),	9.24
Non-nitrogenous extract matter,	48.23
	100.00

Fertilizing Constituents of Barley Straw.

	Per Cent.
Moisture at 100° C.,	11.44
Calcium oxide,	0.57
Magnesium oxide,	0.18
Sodium oxide,	0.18
Potassium oxide,	2.09
Phosphoric acid,	0.30
Nitrogen,	1.31
Insoluble matter,	0.24
Valuation per ton,	$6 59

Bokhara Clover.

[Collected June 26, 1890. (Field D.)]

	Per Cent.
Moisture at 100° C.,	8.50
Dry matter,	91.50
	100.00

Analysis of Dry Matter.

Crude ash,	8.41
" cellulose,	33.05
" fat,	4.79
" protein (nitrogenous matter),	14.92
Non-nitrogenous extract matter,	38.82
	100.00

Fertilizing Constituents of Bokhara Clover.

	Per Cent.
Moisture at 100° C.,	8.50
Calcium oxide,	1.63
Magnesium oxide,	0.32
Ferric oxide,	0.02
Sodium oxide,	0.15
Potassium oxide,	1.99
Phosphoric acid,	0.68
Nitrogen,	2.18
Insoluble matter,	0.10
Valuation per ton,	$9 92

Soja Bean.

[Collected Aug. 27, 1890, station; blooming. (Field D.)]

	Per Cent.
Moisture at 100° C.,	74.17
Dry matter,	25.83
	100.00

Analysis of Dry Matter.

Crude ash,	11.05
" cellulose,	24.73
" fat,	7.22
" protein (nitrogenous matter),	13.64
Non-nitrogenous extract matter,	43.36
	100.00

Turnips.

[Experiment Station, 1890.]

	Per Cent.
Moisture at 100° C.,	91.78
Dry matter,	8.22
	100.00

Analysis of Dry Matter.

	Per Cent
Crude ash,	9.54
" cellulose,	12.61
" fat,	2.05
" protein (nitrogenous matter),	9.89
Non-nitrogenous extract matter,	65.91
	100.00
Albuminoid nitrogen (in dry matter),	1.09
Total nitrogen,	1.58

Fertilizing Constituents of Turnips.

	Per Cent.
Moisture at 100° C.,	91.780
Calcium oxide,	0.061
Magnesium oxide,	0.020
Sodium oxide,	0.022
Potassium oxide.	0.358
Phosphoric acid,	0.092
Nitrogen,	0.134
Insoluble matter,	0.038
Valuation per ton.	$0 87

IX. Experiments to study the Economy of using Different Commercial Sources of Phosphoric Acid for Manurial Purposes in Farm Practice. (Field F.)

The field selected for this purpose was 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under, and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella), followed each other in the order stated.

1890. — The land had been ploughed during the preceding fall, and again April 19, 1890. The field was subdivided subsequently into five plats of definite size, each running from east to west. These plats were separated from each other by a space eight feet wide.

The plats and spaces between them were ploughed and harrowed alike. The plats were fertilized at stated times; the spaces which separated them received at no time any kind of manurial matter.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, apatite, South Carolina phosphate (floats), and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value, in its particular kind of phosphate.

	Cost per Ton.
Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Ground apatite (Canada),	6 25
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I. Phosphatic slag; II. Mona guano; III. Apatite; IV. South Carolina phosphate (floats); V. Dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	0.47	12.52	0.09	0.39	15.96
Ash,	–	75.99	–	–	61.46
Calcium oxide,	46.47	37.49	–	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	–	5.78	–
Total phosphoric acid,	19.04	21.88	36.08	27.57	15.82
Soluble phosphoric acid,	–	0.00	–	0.00	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	9.55	9.04	6.26

The following fertilizers were applied to the different plats April 17, 1890: —

Plat I. (south side), 6,494 square feet, . . .
- 127 pounds of ground phosphatic slag.
- 43 pounds of nitrate of soda.
- 58 pounds of potash-magnesia sulphate.

Plat II., 6,565 square feet, . .
- 128 pounds of ground Mona guano.
- 43½ pounds of nitrate of soda.
- 59 pounds of potash-magnesia sulphate.

Plat III., 6,636 square feet, .	304 pounds of ground apatite. 44 pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.
Plat IV., 6,707 square feet, .	131 pounds of South Carolina phosphate. 44½ pounds of nitrate of soda. 60 pounds of potash-magnesia sulphate.
Plat V., 6,778 square feet, .	78 pounds of dissolved bone-black. 45 pounds of nitrate of soda. 61 pounds of potash-magnesia sulphate.

The phosphatic slag, Mona guano and South Carolina floats were applied at the rate of 850 pounds per acre, apatite at the rate of 2,000 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. These figures represent approximately the equal local cash values of the different sources of phosphoric acid applied. Nitrate of soda corresponds in all cases to an application of 290 pounds per acre, and the potash-magnesia sulphate at the rate of 390 pounds per acre.

The field was planted with potatoes, Beauty of Hebron; the large-sized ones were cut in halves, and the small ones left whole, when planted, May 1, 1890. The rows were three feet three inches apart, and the hills in the rows eighteen inches. Each plat had sixteen rows. The young plants came up quite uniformly; they were cultivated and hoed June 2. Several applications of Paris green with plaster were made during the season, to prevent damage by potato bugs. The crop looked well until the middle of July, when the effects of a serious drought showed itself to such an extent that the maturing seemed to be hastened on by it.

The potatoes were harvested from all the plats August 12 to 14. They were assorted in the field into marketable ones and small ones. The former were sold at sixty cents per bushel; the latter were used for chicken feed, at twenty cents per bushel, — our local market prices.

No. of Plat.	Total Yield of Potatoes (Pounds).	Marketable Potatoes (Pounds)	Small Potatoes (Pounds)
I. (south end),	1,600	1,215	385
II.,	1,415	915	500
III.,	1,500	1,070	430
IV.,	1,830	1,380	450
V. (west end),	2,120	1,590	530

Yield per Acre.

I. Phosphatic slag,	10,671	8,087	2,584
II. Mona guano,	9,388	6,071	3,317
III. Ground apatite,	9,845	7,023	2,822
IV. South Carolina phosphate,	11,886	8,963	2,923
V. Dissolved bone-black,	13,626	10,218	3,408

Statement of Percentages.

Plats.	Marketable Potatoes (Per Cent).	Small Potatoes (Per Cent).
I.,	75.78	24.22
II.,	64.66	35.34
III.,	71.32	28.68
IV.,	75.40	24.60
V.,	74.91	25.09

Money Value of Crop.

[One bushel = 60 pounds.]

Plat.	Marketable Potatoes, at 60 Cents per Bushel.	Small Potatoes, at 20 Cents per Bushel.	Total Sum.
I.,	134.6 bushels = $80 76	43.0 bushels = $8 60	$89 36
II.,	101.2 bushels = 60 72	55.3 bushels = 11 06	71 78
III.,	117.1 bushels = 70 26	47.1 bushels = 9 42	79 68
IV.,	149.3 bushels = 89 58	48.7 bushels = 9 74	99 32
V.,	170.3 bushels = 102 18	56.8 bushels = 11 36	113 54

As a first year's results, the above statements are reported without any further comment, beyond the remark that the dryness of the season renders the advantages of a soluble form of phosphoric acid very striking. The experiment will be repeated during the coming season. Winter wheat has been sown, to continue the inquiry. One year's results cannot furnish a basis for a final decision. The varying accumulation of phosphoric acid in the soil is an important fact, which deserves a serious consideration as the investigation advances.

Plat I. received 24.18 pounds of phosphoric acid.
Plat II. received 28.01 pounds of phosphoric acid.
Plat III. received 109.68 pounds of phosphoric acid.
Plat IV. received 36.12 pounds of phosphoric acid.
Plat V. received 12.34 pounds of phosphoric acid.

The largest yield of potatoes has only removed 3.392 pounds of phosphoric acid from the soil.

Tabular Statement of the Approximate Amount of Nitrogen, Phosphoric Acid and Potash in the Crop raised.

PLATS.	Pounds of Potatoes per Plat.	Pounds of Nitrogen in Tubers.	Pounds of Phosphoric Acid in Tubers.	Pounds of Potassium Oxide in Tubers.
I., ...	1,600	5.440	2.560	9.280
II., ...	1,415	4.811	2.364	8.207
III., ...	1,500	5.100	2.400	8.700
IV., ...	1,830	6.222	2.928	10.614
V., ...	2,120	7.208	3.392	12.296

The calculation is based on E. Wolff's average analyses, 1,000 pounds of potatoes containing: nitrogen, 3.4 pounds; phosphoric acid, 1.6 pounds; and potassium oxide, 5.8 pounds.

X. Experiments with Grass Land, East Field Meadow.

The field assigned for a permanent production of grasses covers an area of from nine to ten acres. The main part of the land is nearly on a level, running from south to north, with a slight descent towards the north. The western side of the field is bordered by a public highway, the eastern by the new orchard of the station. Along the eastern side the grounds are gently sloping towards the centre of the field, and are here and there somewhat springy. The location of the level portion of the field renders it liable to a temporary overflow of water from the hillsides toward the south.

The soil consists largely of a sandy loam of from two to three feet in thickness, here and there resting upon either a layer of hard-pan or of a coarse, gravelly material.

The springy character of the eastern slope, as well as the periodical overflow of water from the hillsides toward the southern end of the field, without any adequate outlet to regulate the supply of water from both sources, had rendered the larger portion of the field an unsightly swamp meadow, covered with a comparatively worthless vegetation, previous to 1887.

The general character of the surface soil, as well as the apparent chances of regulating its state of moisture, promised to make the field, under proper management, in an exceptional degree fit for a permanent meadow.

The first attempt at improvement in that direction was made in August, 1886, soon after the first cut of its growth was harvested. The entire work required to secure satisfactory results was carried out during two succeeding summer seasons, on account of limited financial resources.

After securing the outlet necessary for the accumulating water, through the adjoining lands at the western termination of the field, it was decided to run, from ten to twelve feet apart, two parallel ditches from north to south, through the lowest part of the land. One was dug from three and one-half to four feet below the surface of the ground, to serve as a main ditch for laying drain tiles six inches in diameter, to prevent an accumulation and subsequent stagnation of water in the upper soil. The other was an open ditch, on an average of from one foot to eighteen inches deep, to assist in a speedy discharge of surface water, due to heavy rains or the melting of the snow and ice on adjoining hillsides in the spring. In both instances the necessary fall was secured to dispose of the surplus water in a desirable degree. One surface ditch sufficed for the whole area; while numerous branch ditches, starting out from the main tile ditch at varying distances from each other, were built at all places where local conditions indicated an exceptional state of moisture. The tiles in the branch drain ditches varied from two to four inches in diameter. The main tile drain at its southern starting point runs into a stone drain ten by twenty feet, which serves as a filter for the turbid water coming from the adjoining hillsides in case of heavy rains before entering the tile drain. The surface ditch runs up to the stone drain to prevent an accumulation of water, and thereby reduces the chances of untimely overflow of the meadow.

As soon as the drain tiles were covered and the ditches as far as practicable levelled, the entire area was ploughed, and the main depressions filled up with stones and earth, or earth, as circumstances advised, and left in that condition over winter.

The succeeding spring a wheel harrow was used to break up the rotten sod. The soil was subsequently repeatedly ploughed and harrowed, until it showed the desirable mechanical condition required for a successful cultivation of summer grain crops.

Barley and oats were chosen as the first crops in case of the meadow north of the new roadway. Both were seeded in drills, with rows two feet apart, to permit a thorough destruction of an objectionable foul growth, by a frequent use of the cultivator and hoe.

As soon as these crops were harvested, one ton of wood ashes per acre was ploughed in, to assist in the disintegration of the excess of organic peaty matter, and to serve as a general fertilizer. Ploughing once more and smoothing the surface by means of a brush harrow, the entire area was seeded down into grass to serve as meadow. The latter was subsequently cut into two, by a road built for communication to more remote fields. This arrangement caused a division into a northern and southern meadow.

In case of the land south of the roadway, leguminous plants, as soja bean, Southern cow-pea and serradella, served as first crop. The system of drainage and of seeding down remained the same as before. The meadow north of the road covers an area of somewhat more than six acres, and that south of the road is about three acres in size. The meadow north of the road was sown for the first time in the fall of 1887, with grass, and the one south of the roadway in the fall of 1888.

The more elevated portions of both were seeded down with the following mixture of grass seeds, at the rate of from two to two and one-half bushels per acre : —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

Early in the succeeding spring a mixture of equal weights of medium red clover and alsike clover was added broadcast, at the rate of from five to six pounds per acre.

The lower and still more wet portion of the meadow was seeded down with the following mixture of grass seeds : —

Twenty pounds of soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

From four to five pounds of alsike clover per acre were added by broadcast seeding early in the succeeding spring (1889).

The seed came up well, and suffered but here and there in wet spots during the first winter. Barren spots were reseeded.

Both meadows were cut but once during the first summer season, somewhat later than usual; the majority of grasses did not, as might be expected, head out.

As soon as the first crop of hay was secured, a system of manuring was planned, which would illustrate the comparative manurial effect of top-dressing, as follows: —

By barn-yard manure.
By ground bones and muriate of potash.
By unleached wood ashes.

The northern meadow, consisting of six and one-half acres, was subdivided into three plats, I., II., III., running from east to west, leaving a space of twenty feet in width between them without any manurial matter.

The southern meadow was divided into two plats, IV., V. (south end). Plats I., II., III. were sown down in grass during September, 1887, and plats IV. and V. during September, 1888. The subsequent stated system of manuring began in the autumn of 1888, on all plats at the same time.

Plat I. (north end of the field) is equal to 1.92 acres. It was top-dressed during the fall and early spring with barn-yard manure, at the rate of eighteen tons per acre (1888–89).

Plat II. covers a similar area as Plat I. (83,640 square feet). It received at the same time a top-dressing of barn-yard manure, at the rate of eight tons per acre (1888). The coarsest part of the barn-yard manure was subsequently removed from both plats before the growing grass interfered with its being raked off.

Plat III., about 2.41 acres, received, May 3, 1889, a top-dressing of six hundred pounds of fine-ground steamed bone and two hundred pounds of muriate of potash per acre.

Plat IV. (south of roadway), an area of 2.11 acres, received the same dressing, in the same proportion and at the same rate (six hundred pounds ground bone and two hundred pounds muriate of potash) per acre, as Plat III. (1889).

Plat V., equal to .91 acres, received as top-dressing, April 23, 1889, one ton of unleached Canada wood ashes, from our local market (1889).

Yield of Hay in Case of Plats I., II. and III. (Second Year after Seeding), and of Plats IV. and V. (First Year after Seeding).

Plat I.	First Cut.	Second Cut.
1.92 acres, . .	10,500 pounds, June 24.	4,370 pounds, August 26.

Total yield per acre, 7,745 pounds, or 3.87 tons.

Plat II.	First Cut.	Second Cut.
1.92 acres, . .	9,130 pounds, June 24.	4,650 pounds, August 26.

Total yield per acre, 7,177 pounds, or 3.59 tons.

Plat III.	First Cut.	Second Cut.
2.41 acres, . .	12,200 pounds, June 24.	4,950 pounds, August 26.

Total yield per acre, 7,116 pounds, or 3.56 tons.

Plat IV. (2.11 acres); Plat V. (.91 acres): The first year's hay consisted nearly entirely of herds grass, which was almost the only variety which had headed out in June. The yields of both plats were harvested together.

First Cut.	Second Cut.	Total Yield per Acre.
8,130 pounds, June 24.	3,105 pounds, August 31.	3,720 pounds, or 1.86 tons.

1890. — The different plats were prepared in a similar manner for the season of 1890 as they had been for the preceding season, 1889.

Plats I. and II. received a top-dressing of barn-yard manure during the months of October and November; the former at the rate of fourteen tons per acre, and the latter at the rate of eleven tons.

Plat III. was treated in April, 1890, as before, with a mixture of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash.

Plats IV. and V. were merged into one plat, and received a top-dressing of unleached wood ashes, at the rate of one ton per acre, April 19, 1890.

Barren spots in this plat, it being the second year after seeding down, were reseeded by the same seed mixture which had been used before.

The entire meadow received an addition of from two to three pounds of alsike clover seed, broadcast, per acre.

All plats were cut as far as practicable at the same time.

Yield of Hay in 1890.

PLAT I.	First Cut.	Second Cut.
1.92 acres, . .	14,625 pounds, July 1.	3,790 pounds, Sept. 1.

Total yield of hay, 18,415 pounds.
Yield per acre, 9,591 pounds, or 4.80 tons.

PLAT II.	First Cut.	Second Cut.
1.92 acres, . .	12,480 pounds, July 1.	3,105 pounds, Sept. 3.

Total yield of hay, 15,585 pounds.
Yield per acre, 8,117 pounds, or 4.06 tons

PLAT III.	First Cut.	Second Cut.
2.41 acres, . .	14,460 pounds, June 26.	3,535 pounds, September.

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

Yield of Hay in 1890 — Concluded.

PLAT IV. (IV. and V., 1889.)	First Cut.	Second Cut.
3 acres, . .	13,380 pounds, July 1.	4,080 pounds, Sept. 3.

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons

The total yield of hay on plats I., II. and III. averages 4.19 tons per acre. The total yield on Plat IV. averages 2.91 tons per acre.

The weight of the second cut of hay (rowen) averages about one-fourth of that of the first cut. The dryness of the season during the latter part of July affected seriously the yield of the second cut. The wet season of 1889, as compared with the dry season of 1890, as well as the difference in the age of the two meadows, renders further comparison not advisable at this early stage of our investigation.

XI. Report on General Farm Work.

Aside from the experimental work described within the preceding pages, much has been accomplished in other directions.

Some of this work is of a mere preparatory character, and will be reported in due time in connection with a detailed description of the experiment with which it is connected. The remainder concerns merely current farm work, as may be seen from a few subsequent statements.

The new orchard, covering an area of from six to seven acres, has been in part planted with apple, pear, peach and plum trees; other varieties, as well as small fruits, will be planted during the coming spring.

Several acres were sown with vetch and oats, soja bean and corn, to furnish green fodder for the dairy, and to serve as ensilaged crops for winter feed.

One silo is filled with fodder corn, and another with half soja bean and half fodder corn.

It has been the aim to improve the productiveness of the farm lands, wherever circumstances admitted a free choice of suitable means. To produce a variety of fodder crops has been the leading object of the general management.

The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the station, or engaged in a course of preparation for future experiments: —

Hay (first cut),	$46\frac{1}{2}$	tons.
Rowen (second cut),	$12\frac{1}{2}$	"
Fodder corn,	$5\frac{1}{2}$	"
Roots (carrots, $4\frac{1}{2}$ tons; sugar beets, 3 tons),	$7\frac{1}{2}$	"
Scotch tares (dry),	$1\frac{1}{3}$	"
Barley (grain, 430 pounds; straw, 1,200 pounds),	$\frac{4}{5}$	"
Oats (grain, 1,250 pounds; straw, 2,000 pounds),	$1\frac{3}{5}$	"
Vetch and oats (green),	4	"
Soja bean (green),	10	"
Corn for ensilage,	18	"
Potatoes,	190	bushels.
Flax,	670	pounds.
Miscellaneous fodder crops,	$1\frac{1}{2}$	tons.

XII. Department of Vegetable Physiology.

Report by Prof. James Ellis Humphrey.

The past year has seen the department finally settled in the new quarters provided for it, and fairly equipped for work. Owing to repeated delays, the new laboratory was not occupied until the middle of March, and the greenhouse was completed so late that it did not become practically available until fall. Therefore the present contains no reports of greenhouse work. What has been done the past fall consists of preparations for and the beginnings of experiments not yet completed, and is reserved until results can be reported.

The work of the past year here reported upon consists of laboratory and field studies of several diseases which cause very severe losses to farmers and fruit growers, or of the fungi which cause them, as follows : —

1. The black knot of the plum.
2. The mildew of cucumbers, etc.
3. The brown rot of stone fruits.
4. The potato scab.
5. Notes on various diseases.

Reference to the "General Account of the Fungi," in the last report of this station, will be found of assistance to a full comprehension of the following discussions.

The Black Knot of the Plum. — *Plowrightia morbosa* (Schw.) Sacc.

For a hundred years complaints have come from one or another part of the United States of the destruction of plum and cherry trees through the attacks of a conspicuous and fatal disease, which shows itself in the formation of dark, rough excrescences upon the limbs or even on the trunk of the tree.

These growths increase both in size and in number, spreading from branch to branch and from tree to tree, in a manner strongly suggesting their contagious nature; and their striking appearance has given to the disease the name by which it is too well known, "the black knot," or "plum wart."

The cause of this disease has been the subject of much discussion and of innumerable contributions to agricultural journals, from an early date. Some of the first remarks on the subject are to be found in an article by Prof. W. D. Peck of Cambridge.* The appearance of the knot is here attributed to the same insect which causes the falling of the fruit, now called the "curculio." This insect was believed to injure the branch in such a way that, as the writer says, the sap is diverted to the bark, which absorbs it and swells, forming the knots. The general theory here promulgated, that of an *insect* cause, was for over fifty years very tenaciously held and earnestly supported, and indeed is still held by many persons, although wholly discredited by scientific study. The fact that eggs or larvæ of the curculio are very commonly found in the tissue of the knot has been a strong argument with many in support of Peck's theory; but others, while holding to the general belief in an insect cause, have believed the knots to be due to some species of gall fly (*Cynips*), since none of the beetles, including the curculio, are known to be gall-producing insects. Thus argued the entomologist, B. D. Walsh, in an early paper.† But the difficulty here lies in the fact that no gall fly has been found in or raised from a knot.

Several writers have attributed the trouble to that conveniently indefinite cause, — a diseased condition of the sap; and Dr. Fitch, the former New York State Entomologist, held the disease to be of internal, "constitutional" origin. Quite early, Dr. Joel Burnett of Southborough discussed ‡ the question, showed that the curculio merely lays its eggs in the juicy mass of the knot, after it is formed, and attributed its formation to the attacks of a fungus. This is, perhaps, the earliest statement of this

* Mass. Agric. Repository, 1819, p. 307.

† Proceedings Entomol. Soc. Philadelphia, Vol. III, p. 613 (1864).

‡ Hovey's Mag. of Hortic., Vol. IX, p. 281; and N. E. Farmer, 16 Aug., 1843, p. 49.

view in a popular form, although the knots and the accompanying fungus had already been described by the pioneer student of American fungi, de Schweinitz, who appears to have regarded the knots as the combined result of the attacks of a gall fly and the fungus, to which he gave the name *Sphæria morbosa*.* In 1831 he described, in his "*Synopsis Fungorum in America Boreali media digentium*," the destruction of both wild and cultivated varieties by the disease. The distinguished entomologist, Dr. T. W. Harris, in his earlier writings advocated the view that the knot is caused by insects; but later † he mentions the fungus, which, he says, is sure to appear on the knots, and never elsewhere, though he does not commit himself fully to the theory that the disease is of fungous origin. In 1862 the editor of the "Gardener's Monthly," Mr. Thos. Meehan, took strong ground in favor of the fungous origin of the disease, and for several years following a spirited discussion of the subject was carried on by various correspondents in the columns of his journal. At about the same time it was logically argued, in the "Country Gentleman," that, even though insects were found in ninety-nine knots, the finding of the hundredth one free from them would be sufficient to show that they could not be the *cause* of the disease.

Mr. C. F. Austin gave ‡ what appear to have been the first account and illustrations of the microscopic structure of the knot fungus. Entomological writers now began rapidly to accept the fungus theory of the origin of the knots, as is shown by papers from Glover,§ Walsh‖ and Riley.¶ Walsh gives at considerable length an account of the supposed structure and life history of the knot fungus, so wholly unlike what we now know of it that it is impossible to conjecture what he could have seen. Up to 1872 knowledge of the fungus was very meagre, and confined to the winter spores to be described later. In that year Prof.

* Synopsis Fungorum Carolinæ superioris, no. 134 (1821).
† Insects Injurious to Vegetation, 2d ed., p. 69 (1852).
‡ Amer. Agriculturist, 1863, p. 113.
§ U. S. Agric. Report, 1863, p. 572.
‖ Practical Entomologist, Vol. I, p. 48, and Vol. II, p. 63 (1866-67).
¶ Gardener's Monthly, November, 1866, p. 331.

C. H. Peck, New York State Botanist, gave the first correct account * of some details of the structure of *Sphæria morbosa*, then first describing the summer spores and the time of maturity of the winter spores. In 1875 Dr. Thos. Taylor gave † an illustrated account of the fungus, which was incomplete and incorrect in several particulars, and added nothing to previous knowledge.

Now followed the fullest and best account we have of the structure and life history of this fungus, which was held to be the sole cause of black knot. It was by Dr. W. G. Farlow ‡ of Harvard University, and remains the authoritative account of the disease and its cause, to-day. The author described the summer and winter spores, and, as will be noticed later, other secondary forms, and figured the various organs. This paper has served as the basis of the present, as it must of all work on the black knot; but its comparative inaccessibility renders the repetition of certain descriptions and illustrations not superfluous in connection with the new facts to be presented here. Since its publication, the authority of this paper as to the cause of the disease has remained unquestioned, and all conflicting theories have fallen into discredit among scientific students and observers.

The black knot is known to attack nearly all our wild or cultivated species of plums and cherries; but, so far as the cultivated fruits are concerned, the plums are by far the greater sufferers. It has been thought there must be two or more species of fungi which produce the knots on different host-species. Walsh, for instance, considered that there are two fungi, one attacking the plum and the other the cherry; and a reviewer of his paper suggested a third on a species of wild plum. Others have based arguments for this opinion chiefly on the fact that certain hosts sometimes suffer from epidemics of the black knot, while others, equally liable to its attacks, remain free.§ De Schweinitz

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* A Paper on Botany, read as a Report before Albany Inst., Feb. 6, 1872.

† Monthly Micros. Journal, Vol. XIII, p. 118, with two plates; London, March, 1875.

‡ Bulletin Bussey Institution, Part V, p. 440, with three plates (1876).

§ See Gardener's Monthly, November, 1866, p. 335.

has mentioned * an instance of the sort as having occurred at Bethlehem, Penn. Soon after 1790, the very abundant trees of what he calls "Amarellæ," probably morello cherries, were nearly all destroyed by the knot; while a second visitation, about 1830, swept off most of the plum trees. Many farmers and fruit growers will recall similar cases in their own experience. In spite of these facts, however, there is no evidence that there is more than a single species of knot fungus, which attacks both plums and cherries; and we must probably seek other causes for its occasional selection of particular hosts, to the exclusion of others equally susceptible.

As has been the case with many cultivated plants, certain varieties of plums have been claimed by originators or dealers to be disease-proof. As early as 1843, Messrs. W. R. Prince and Co., nurserymen of Flushing, N. Y., published in the "New England Farmer" a list of varieties claimed by them to be not subject to the black knot, with the remark that they were all varieties of American origin. A few months later, a brief editorial note in the same paper stated, on the authority of prominent growers, that the list was of no value for the vicinity of Boston. And similar claims have usually met a similar fate.

This fungus is strictly American in origin, and has not yet, so far as has been reported, been introduced with its host plants into Europe, as have so many other American fungi. But in the United States it is very widely distributed, ranging from Maine to California, and from Wisconsin to Texas, where it is said to be rare. In most parts of the country it is abundant and destructive.

As above stated, the fungus was first described and named as *Sphæria morbosa* Schw. Various writers have proposed various other generic names as better indicating its relationships, but none of these was generally adopted until Saccardo, regarding it as a member of the family *Dothideaceæ* of the "Black Fungi" (*Pyrenomycetes*), called it *Plowrightia morbosa* (Schw.) Sacc., by which name it is now commonly known.

* Synopsis Fungorum Amer. Bor. Proc. Amer. Phil. Soc., Vol. III, p. 269.

The knot may first be observed in the fall as a slight swelling of the branch, arising near an old knot, or independently. If near a knot, it is probably caused by the extension of vegetative threads from the latter; but, if on a branch not before attacked, it is probably due to infection by spores from an earlier knot. A section across such a young knot shows that the swelling has taken place wholly in the bark and largely in the inner bark (Phloëm), in which may be seen radially placed bundles of the fine, intertwined threads of the fungus. The swelling continues in the spring, and the epidermis ruptures, allowing the protrusion of the dark, greenish-brown mass of tissue, presumably due to abnormal growth induced by the irritation caused by the presence of the fungus. This mass is firm and succulent, and its surface is usually irregularly cracked and granular. In May there are developed over this surface numerous short, erect threads, standing rather closely together, like the threads in the "pile" of velvet, and giving to the surface a dark-brown, velvety appearance. On these threads are borne, at and near their tips, the summer spores of the fungus, obovate bodies of a brownish tint. (Fig. 6.)

Toward midsummer these threads and spores disappear, and, in consequence, the knot loses its velvety appearance and brownish shade, and becomes dead black in color. It also becomes hard and dry, and the larvæ of insects whose eggs were laid in it when it was young and juicy have already begun to destroy its interior, so that very often only the outer crust finally remains. In this fact is to be found the basis of the stoutly defended theories of the insect origin of the knot already alluded to. The surface of the knot may now be seen to be checkered off into little rounded areas, each of which has a slight depression at the centre. In some cases, these black areas do not completely cover the surface, but leave intervening brown spaces. If a section be made across the knot in the fall, a year after its first appearance, under each of the black areas described may be seen with the unaided eye a white spot, which marks the position of a cavity in the dense, black fungus-tissue. This is filled with slender, colorless threads, as the microscope shows. Later, there appear in these cavities, among the slender threads, club-shaped structures, in each of which are gradually developed eight colorless winter spores, which become ripe and capable of germination by the middle of January. Crozier gives * a considerably later date for the maturity of the spores in Michigan; but the above, given by Dr. Farlow for eastern Massachusetts, has been found by the writer to be also correct for Amherst. These spores may continue in the cavity for some time, but eventually escape, probably by a pore formed at the central depression before mentioned. A fully developed knot ordinarily shows no spores remaining by late spring or summer.

Fig. 1 shows a magnified section through three of the spore cavities or *perithecia* of the fungus, containing the club-shaped spore-sacs or *asci*. In Fig. 2 are represented two spore-sacs, with their contained spores, and two of the sterile threads or paraphyses among which they grow.

When obtaining the winter spores in quantity by scraping the freshly cut surface of a section across many perithecia, I have nearly always found mixed with them a small proportion of the globular or slightly elliptical brownish bodies shown at Fig. 4, *a*; but I have not yet met with them in spore cavities.

Studies of the development of the three above-described spore forms have been carried on in the laboratory with interesting results. The following account gives a general outline of the progress and present status of the work. After its completion, a detailed account of the investigations, with their results, both theoretical and practical, will be published, with full illustrations, in a suitable form.

The winter spores, when sown in water and kept in a moist chamber, begin to germinate so promptly that they show germ tubes of some length at the end of one day (Fig. 3, *a*); while in two days as many as three threads, one of which has taken the lead, as a rule, and has become several times as long as the spore, may have developed (Fig. 3, *b*). The principal threads usually originate from

* Botanical Gazette, 1885, p. 368.

the larger of the two spore cells, though in exceptional cases one from the smaller cell may take the lead (Fig. 3, *b*). The threads may originate from any point on the surface of either cell.

The brown spores which occur with the winter spores germinate even more promptly than the latter, and may produce in two days threads whose length is ten or fifteen times the diameter of the spores (Fig. 4, *c*).

When sown on nutrient gelatine, prepared with an infusion of prunes, and kept in a moist chamber at the ordinary temperature of the laboratory, the winter spores produce abundant threads, which grow and branch rapidly, forming a close felt, which begins, in four or five days, to show a dark fuscous-brown tint. This color deepens and spreads, and there arise on the threads, in six or seven days, small black bodies, projecting somewhat above the surface of the gelatine. These present, when viewed under the microscope, from above, the appearance shown in Fig. 9, from which it will be seen that their exterior is composed of a close layer of angular cells, interrupted in the middle and highest part by an opening or mouth, which is fringed by a circle of radiating threads. It may be observed that spores escape from the interior of the body through this mouth in the form of a long, snake-like thread or *cirrhus*, consisting of innumerable spores, imbedded in a transparent, gelatinous substance. If a portion of this thread be placed in water, it becomes disintegrated by the rapid swelling and solution of its gelatinous basis, thus leaving the spores free. These bodies, which are evidently reproductive organs of the type known as *conidial fruits*, are of an approximately globular form, usually somewhat flattened, and with a slightly projecting mouth, as a vertical section (Fig. 10) shows. The wall is several cells thick, the membranes of the outer cells being rather thick and dark colored, while those of the inner cells are thin and delicate, with a tendency to become gelatinous. It is probable that the gelatinous substance of the spore cirrhus arises, in the present, as in other cases, by the breaking down of the innermost cells of the wall of the cavity. The spores are produced (Fig. 10) by budding from the interior cells of the wall, and, when fully developed, fall from their attachments and become free in the central cavity. These spores correspond in all respects with the brown spores before mentioned as found in small numbers with the winter spores. The latter are undoubtedly developed in special spore cavities, corresponding in structure to those developed on gelatine, which occur sparingly among those producing winter spores (*ascospores*). But I have not yet been able to recognize them in sections of the knot. From the fact stated it becomes probable that this hitherto undescribed fruit form is the *pycnidial* fructification of the black-knot fungus, and it may be seen that it corresponds in general with the known *pycnidia* of related fungi.

The spores, which we may designate *pycnospores*, taken from pycnidia developed on gelatine, germinate in water as promptly and in the same way as those from the knot (Figs. 4 and 5). When sown on fresh nutrient gelatine, their threads develop much more rapidly and branch more freely than in water, as may be seen by a comparison of Figs. 5, *c*, and 5, *d*. On gelatine the spots formed by the masses of dark threads become evident to the unaided eye in eight or nine days, and new pycnidia and pycnospores are produced in from nine to ten days, a slightly longer time than that required for their development from the winter spores. I have not yet succeeded in obtaining perithecia with winter spores from cultures.

Dr. Farlow describes, in his paper, quoted above, four kinds of spore-fruits, as follows: (1) those producing winter spores (*ascospores*) in sacs; (2) those producing bodies which he terms *stylospores*, which form has since been named, by Saccardo,* *Hendersonula morbosa;* (3) spore-fruits of the type usually known as *spermogonia;* (4) others which he calls *pycnidia*, which differ essentially, however, from the pycnidia above described. Of these forms the third has not been met with in course of my studies, but it is yet too early to say it is not likely to be found. I have seen, in a few sections, small spore-fruits among the perithecia, which may be identical with Dr.

* See Sylloge Fungorum, Vol. III, p. 445.

Farlow's *pycnidia*, above mentioned. They have oblong or triangular cavities, lined with layers of small cells, from which are produced large numbers of nearly colorless, oval spores, about half as long as the pycnospores developed on gelatine. I have not been able to see that they are developed on short threads, as is said by Dr. Farlow to be the case with the spores in his pycnidia. Should this form be proved to belong to the life cycle of the knot-fungus, it will constitute its second pycnidial stage.

The *Hendersonula* or stylosporic form described by Dr. Farlow, which would constitute a pycnidial form, according to present terminology, has also not been found even to the extent of a single spore, though very careful and thorough search has been made for it. It is also to be expected that, if it were a genuine pycnidial stage of the fungus, it might be produced on cultures, as the pycnidia above described have been. This total failure to find the form has led me to give it up as a feature in the developmental history of *Plowrightia morbosa*. On consultation with Dr. Farlow, he has kindly permitted me to say here that he does not think there is sufficient evidence that this form is really a stage of the knot-fungus, although it frequently occurs with it.

The summer spores, when sown on prune gelatine, swell to an elliptical form, resembling that of the pycnospores, and germinate by producing threads (Fig. 7). These also form close, felted patches, and assume, after a time, the characteristic dark color before mentioned; and send up, finally, erect threads, which bear conidial spores like those from which they have grown (Fig. 8). No other form was developed on these cultures, even after a long time.

While considerable work remains to be done in deciding the connection of doubtful spore forms, and in completing the structural history of this pleomorphic fungus, the most important work now remaining is the investigation of its relations to its host plants. How it attacks them, how the knots begin to develop, and the history of their development, are the subjects which most need investigation now. This Department has not heretofore been prepared for this study, but the necessary preparations have been made during the past season, and it is hoped that the work of the coming year may shed some light on these questions, which bear so directly and so practically on the treatment and prevention of the disease.

The Cucumber Mildew. — *Plasmopara Cubensis* (B. & C.).

In 1868, Berkeley and Curtis described * a fungus of the *Downy Mildew* group from specimens on a cucurbitaceous plant from Cuba, under the name *Peronospora Cubensis*. This fungus remained then comparatively unknown for twenty years; but meanwhile Spegazzini † had described a species on a cucurbitaceous host from the Argentine Republic, which he called *Peronospora australis*, and Trelease ‡ found the same species on the one-seeded star cucumber (*Sicyos angulatus*), in Wisconsin.

In 1889 Dr. W. G. Farlow § reported having received from Japan the previous year a fungus on cucumber leaves, and in 1889, from New Jersey, the same fungus on the leaves of hot-bed cucumbers. The same fungus appeared during 1889 on leaves of cucumbers and squashes in various parts of the country, and seemed likely to become a serious pest. The structure of the fungus is quite different from that of the only mildew heretofore known on *Cucurbitaceæ* in the United States, namely, *Peronospora australis* (compare Figs. 11 and 15); but a comparison with original specimens of the little-known *P. Cubensis* has shown it to be undoubtedly that species. Its almost simultaneous discovery in widely separated parts of the earth, where it had previously been wholly unknown, is a remarkable instance of the apparent vagaries of fungous epidemics, and shows how much we have yet to learn of the conditions which govern them.

This fungus attacked with fatal result a plot of cucumbers in Amherst the past season, and was received on

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* Journal Linnæan Society, Botany, Vol. X, p. 363.

† Annales Sociedad Cientif. Argentina, 1881, XII, p. 81.

‡ Botanical Gazette, 1883, p. 331; see also Paras. Fungi Wisconsin, p. 6.

§ Botanical Gazette, 1889, p. 187.

squashes from Mr. S. F. Libby of Milford, Mass., who reported it as killing the leaves completely, and thus stopping the growth of the plant and its fruit. It is unquestionable that farmers and gardeners have here a new and serious hindrance to the successful cultivation of squashes and cucumbers; and there is no reason why it should not extend to melons also. The fungus has never been figured, so far as I am aware, and some facts in regard to its structure are yet lacking. It is, therefore, thought worth while to supply some of these deficiencies here, with figures, for comparison, of the mildew of the wild star cucumber, which may also, very possibly, be found on cultivated *Cucurbitaceæ* in the future.

The vegetative threads of *P. Cubensis* and of *P. australis* do not differ essentially from those of other downy mildews, and ramify among the cells of the host plant, sending into these cells at intervals absorbing organs or *haustoria*, by means of which they abstract nourishment from them, and weaken or ultimately kill them. Among the downy mildews we meet two types of these haustoria. In the grape-vine mildew and others, they are small, knob-like outgrowths from the fungus threads, merely large enough to reach the interiors of the cells of the host: while in others, like the mildews of the turnip and of spinach, mentioned later, they are large and branching, and often nearly fill the cells within which they are developed. In both of the species under discussion the haustoria are of the first type, as shown in Figs. 14 and 16. The haustoria of *P. australis* have been said to grow often large, sometimes filling the cell, but I have observed none such. From the vegetative threads grow out through the pores in the epidermis of the leaf, chiefly on its under surface, the threads which bear the summer spores or *conidia*. Those of *P. Cubensis* are quite scattered over the yellow and dead-looking spots caused by the development of the fungus in the leaf, and do not form a close felt visible to the naked eye, as do so many mildews, because it is rare that more than two of the conidial threads issue from a given leaf pore (Fig. 12). *P. australis*, on the contrary, forms dense white tufts of small extent on the leaves of the star cucumber, because its conidial threads are developed in large numbers from each of a number of closely situated leaf pores. The structure of the spore-bearing threads in the two species is strikingly different, and furnishes the essential means of distinguishing between them. The details of this structure and the chief differences may best be understood from Figs. 11 and 15. Correlated with the development of small haustoria is frequently found, as in the grape-vine mildew and in *P. australis* (Fig. 15), a pinnate branching of the conidial threads, and conidia with an apical papilla, which germinate by producing *zoöspores* instead of a tube. In *P. Cubensis* we have the anomaly of conidial threads which follow the type of branching usually seen in the species with branched haustoria, and conidia of a violet tint, such as are almost unknown except among the latter group; while the haustoria are small, and the conidia have the apical papilla, and produce zoöspores on germination. This species goes far to break down the distinctions held by some writers to exist between the two groups which constitute the genera *Plasmopara* and *Peronospora* of recent writers, though all formerly included in *Peronospora*. If the distinction is to be maintained on the basis of the germination of the conidia, we must then call these two fungi *Plasmopara australis* (Speg.) and *Plasmopara Cubensis* (B. & C.). The formation of resting spores has not been observed in either species, yet it is evident that they have some means of surviving the winter. This is equally true of a considerable number of mildews; and the problem of what substitutes for resting spores certain species possess is one of the most interesting and important ones connected with these fungi.

This Department wishes to investigate all diseases affecting cucumbers, squashes and melons, cultivated either in the open air or under glass, and to this end urgently requests all persons who suffer from any disease of these crops to send specimens, with details as full as possible, to the writer, as soon as it appears.

The Brown Rot of Stone Fruits. — *Monilia fructigena* Pers.

The fact that great and sometimes almost total losses of the crop occur among the stone fruits, the peach, plum and cherry, through the attack of this disease, has been for some time recognized, more generally, perhaps, in this country than in Europe. Its effects have been described at some length by some European writers on plant diseases, while by others it is barely mentioned. So far as its general characters and cause are concerned, it has been pretty fully described by Peck,* Arthur,† Galloway‡ and Smith,§ and a brief summary will suffice here.

The disease is at first characterized by the browning of the fruit, whose flesh then becomes shrunken and shrivelled to a thin, tough pellicle over the stone, and remains in this condition and resists decay for an indefinite period. The term "mummied" aptly describes fruits which have been thus affected. Soon after it first turns brown, there may be seen thickly scattered over the surface of the fruit the ashy spore tufts of the fungus which has been shown to be the cause of the disease, and is known as *Monilia fructigena* Pers. The vegetative threads of this fungus ramify through the tissues of the fruit and break through the surface, where they produce spores in chains at their ends. When cultivated in the laboratory, these chains often reach a very great length, and branch more freely than is the case out of doors (Figs. 17–19). It may be easily observed on such specimens that the spores are formed by a sort of budding, the terminal one being the newest; and that where branching occurs it originates in a terminal cell, which assumes a somewhat triangular form, and buds from its two outer angles, as shown in Fig. 18. The spores, when fully formed, fall from the chains, and are capable of immediate germination. Under suitable conditions their germ threads can penetrate the uninjured skin of fruits, or

* Thirty-fourth Report N. Y. State Museum, p. 35 (1881).
† Fourth Report N. Y. Agric. Exp. Station, p. 254 (1885).
‡ Report U. S. Dep't. Agr., 1888, p. 349, and Plates V and VI.
§ Journal of Mycology. Vol. V, p. 123 (1889).

the tissues of flowers or even of leaves and young twigs, killing and browning all the tissues which they penetrate, and rapidly spreading. Finally, these threads come to the surface, and produce a new crop of spores.

Besides the stone fruits, this fungus is known to attack the apple, pear and others; but its destructive effects seem to be chiefly confined to the first named. My attention was called, in July, 1890, to a loss of early peaches, amounting to a very large percentage of the whole crop, in a small orchard of the Massachusetts Agricultural College, just following several days of warm and moist weather. The wholesale rotting then in progress was sufficient proof that the germ threads of the fungus can penetrate the uninjured skin of the peach, a power which has been doubted by some writers, though lately proved in laboratory cultures by Smith; for it is not to be supposed that most of the fruits on a tree were sufficiently injured to admit the entrance of germ threads otherwise unable to penetrate them. The mummied fruits usually remain hanging upon the branches, or lie, without decaying, on the ground beneath, until the following spring, when, as Smith has shown, the fungus threads, which have lain dormant through the winter, begin, under the influence of warmth and moisture, to grow again, and soon the apparently dead and harmless remains are covered with the ashy spore tufts, which will infect the new season's crop.

That the fungus does winter over in the dried flesh of its victims was further shown last April, by placing mummied plums, picked from the branches where they had hung all winter, before the weather was sufficiently warm to have caused any development, in a moist chamber in the laboratory. In two days the plums were thickly covered by the spore tufts of the fungus. A microscopic examination of the dried flesh from such plums just removed from the tree showed the presence of numerous threads, composed of large, thin-walled cells (Fig. 20, *a*), and of single thick-walled cells of somewhat varying form, which are probably to be regarded as the resting vegetative cells, known as *Chlamydospores* or *Gemmæ* (Fig. 20, *b*). It is probably these cells especially which are able to withstand the unfavorable conditions of winter, and germinate again when circumstances favor once more. They have been shown to be able to retain their vitality for a long time, under certain circumstances, but it would seem that the dry air of a room is fatal in a comparatively short time; for plums of the previous season, picked April 1, and kept till November 1 in a dry pasteboard box, in a closet, failed entirely to produce the fungus in a moist chamber, though given abundant opportunity to do so. Galloway states that spores of the fungus collected in July, 1886, germinated in May, 1888, but does not state how they were kept meanwhile.

It has often been supposed that *Monilia* represents simply the summer spore form of some fungus whose other stages may be found on other substances. With a view to getting some light on this question, several cultures of the *Monilia* spores have been made on nutrient gelatine, prepared with an infusion of prunes; and one was continued for four and a half months, without, however, producing any other than *Monilia* spores, which appeared in three days after the beginning of the culture. These facts, and the abundant demonstration of the ability of its vegetative threads to survive the winter, apparently through the formation of resting cells or *Gemmæ*, point to the probability that, whatever its origin, any other forms once connected with it have been lost, and it is therefore fairly safe to regard it as an autonomous fungus. Other points of theoretical interest came up during the progress of the cultures, which will be discussed in a technical journal.

Assuming that the *Monilia*, which is classed among the imperfect fungi, is an independent form, and that the simple course of development sketched above constitutes the whole of its life cycle, the problem of avoiding to a large degree the losses now annually caused by it becomes a comparatively simple one. While something can probably be done by judicious spraying with fungicides, the question is largely one of orchard hygiene. If fruit growers could be made to realize the power for harm which lies in a few mummied fruits, they would readily understand that the prompt removal of every one which shows a trace of this disease is the first necessity, and that the expense involved in a frequent inspection of the orchard during the fruiting season, and the thorough removal of all diseased twigs and fruits at the close of the season, would be manyfold repaid in the increased returns. The caution cannot be too often repeated, that all plants or parts of plants attacked by fungi should be burned at once, in order to completely destroy all spores contained in or upon them, and so prevent their becoming a source of infection. Of course, where several orchards lie in the same neighborhood, the owners of all must co-operate, to secure the best results; but if this were done, and all orchards put into a thoroughly healthy condition every fall, the losses from this and some other diseases would hardly be worthy of mention. The pathologist can do no more; and, if the cultivator will persist in the old uncleanly and wasteful way, let him take the consequences, and blame no one else.

Potato Scab.

Field experiments in continuation of those of 1889, and on lines suggested by the experience of that year, were carried out during the past season under fairly favorable conditions; and the results, though almost wholly negative, are not without practical value.

After the harvesting of the crop in 1889, the plot devoted to potato experiments was ploughed, and its southern half, including sections 1 to 14, was sown with winter rye, in order that it might have, as far as possible, the character of sod land when ploughed in the spring. The rye came up and made good growth before the close of the season. In the spring it was in vigorous growth, and eight inches high when the plot was again ploughed, May 7. The whole plot was dressed with bone and potash, in the same amounts as in the previous years, and this dressing and the green rye were harrowed in.

Seven varieties of potatoes had been obtained in quantity from Mr. G. D. Howe of North Hadley, together with small sample lots of six other varieties. The chief varieties were the Monroe County Prize, Quinnipiac, Triumph, White Seedling, Houlton Rose, Hampden Beauty, and Rural New Yorker, No. 2; while those of which small samples were received were Howe's Premium, Rough Diamond, Northern Spy, Early Market, Golden Flesh and Dakota Red. Retaining the same division into sections as was used last year, each of the principal varieties was planted in drills on four sections, except the Monroe County Prize, which was planted on only three sections, thus leaving one section, No. 14, for the samples, of each of which half a row was planted. The chief varieties were so arranged that two sections of each were on that half of the plot which had been sown to rye, and two on the other half; and so that one row of each was planted somewhat deeper and one considerably deeper than the usual depth of planting. All the varieties grew well and received the proper cultivation. In spite of the considerable interval between the maturity of the Triumph, the earliest, and that of the Rural New Yorker, the latest, all were allowed to remain in the ground until the last was matured, and were dug on the 16th and 17th of September. The crop was much better than that of 1889, and markedly less scabby. The results need not be given in full detail, since this would involve unnecessary repetition. It is sufficient to say that they fully warrant, so far as they go, the following statement, which must, however, be given no more weight than that due to a single experiment.

1. The only variety which showed no scab was the Rough Diamond, which, however, has few other features to recommend it, and seems interesting chiefly as a curiosity.

2. The best varieties, both in the general character of the crop and in their comparative freedom from scab, were the Rural New Yorker and White Seedling.

3. The ploughing-in of winter rye produced no perceptible effect on the scabbiness of potatoes raised on that half of the plot, as compared with the other half.

4. The comparison of results from deep and shallow drills does not bear out the opinion, doubtfully expressed last year, that deep planting diminishes scab. Neither for any single variety nor for the plot as a whole was any

distinct advantage in this respect noticeable for either method of planting.

5. The free use of coal ashes in the drill, which was tried by request, had no observable influence on the development of scab in the present case, although it has been thought by some to favor its development, and others have regarded it as a preventive.

6. The thicker-skinned and red-skinned varieties show no greater resistance to scab than others; our best results this season were from light-skinned and rather delicate, fine-grained sorts. These results conflict with some rather general beliefs, but they are the outcome of experiments carefully planned and carried out, and involve no inherent improbabilities.

The results of extended studies as to the *cause* of potato scab have lately been published by Mr. H. L. Bolley.* He believes it to be due to the action of a *Bacterium* which lives in the soil, and can live parasitically on the potato tuber, causing an irritation which results in the formation of the scab. Mr. Bolley's experiments were well planned and apparently carefully conducted, and his results are of much value. The scab produced by him was apparently the form first called by the writer in the last report of this station the "surface" form. In Bulletin No. 105 of the Connecticut Agricultural Experiment Station, Dr. Roland Thaxter has announced the results of some investigations, in which he had obtained, from potatoes affected by the "deep" form of scab, a vegetable organism of doubtful relationships, which, when sown on growing potatoes, reproduced the same form of the disease in a striking manner.

In our own microscopic study of scabbed potatoes, bacteria were, of course, constantly met with, and fungus threads occasionally, but never under such circumstances as to raise any serious suspicion of their causal relation to the trouble. Had such a suspicion been raised, however, it would have been impossible to have demonstrated the correctness or falsity of the view, since the Department had then

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* Agric. Science, September and October, 1890.

neither the necessary accommodations nor equipment for such investigations. At present other equally important studies are in progress, and it does not seem advisable for us to take up the subject, especially since the bacteriological investigations are of a very special nature, and are best conducted by persons who devote their entire attention to that field. It is to be hoped, however, that some European bacteriologist will take up the subject, and repeat the investigations already made in this country; since, as was shown in our last report, the same disease prevails there, at least in its "surface" form, as well as here.

From what has been already said, it is evident that the term "scab," as commonly used, is a general and not a specific one. The rough crusts which give rise to the name are cork formations produced by the growing tuber, in response to, and as an attempted protection against, external irritating influences. That this irritation is sometimes due to parasitic or semi-parasitic organisms seems probable, in the light of the investigations mentioned above; but that it is always so produced is by no means proved, since, in practice, badly diseased tubers have too often given a practically smooth crop. One who insists on the presence of some specific organism as a necessary preliminary to the development of scab must admit a very strong dependence on peculiar conditions on the part of such organism.

It is difficult to believe that the "deep" form of the scab is entirely distinct from the "surface" form, as Dr. Thaxter's results would indicate, although he has found potatoes attacked only by the former near New Haven, Conn., the past season; for both forms have occurred abundantly on potatoes from the same hill on our experimental plots, and not uncommonly both on the same tuber. And the "deep" form has shown, in our experience, such differences in depth as almost to furnish a series running up to the "surface" form; yet it is true that a certain darker and more decayed appearance almost always distinguishes it from the latter.

With regard to the prevention of these troubles, whatever their cause, our recommendation of last year can be repeated with much stronger emphasis. The best land for potatoes, so far as freedom from scab is concerned, is a light, porous, sandy soil. On such land there may often be raised, year after year, perfectly smooth crops; while on damp, heavy soil, as bad a crop may result the first year as after years of continuous potato culture. At present, then, we can only say that what is termed potato-scab is due to the reaction of one or more of several possible external irritants upon the tubers while they are growing, and that the conditions which least favor its appearance are those afforded by a *light, open, thoroughly drained soil.*

Notes.

Damping off. — During the past fall, a few cucumber seedlings in the Station greenhouse were killed by the affection known as "damping off," so common and destructive to seedlings in the forcing bench and the hot-bed. The disease, which manifests itself in the decay and consequent falling over of the seedling stem near the level of the surface of the soil, is familiar to most persons who raise plants under glass.

So far as I am aware, the cause of this trouble has not been precisely investigated in this country, though it has been assumed to be caused by the fungus which is known to produce the same effect in Europe, *Pythium de Baryanum* Hesse. The case mentioned afforded an opportunity to ascertain the correctness of this assumption. Examination of the stem of a fallen seedling at the point of attack showed the presence of abundant fungus threads in its disorganized tissues. A piece was placed in a drop of water in a moist chamber, and the threads rapidly extended themselves over the glass slip which held the whole, and in two days had developed the reproductive organs figured in Figs. 21 to 23. These structures agree with those of *P. de Baryanum*, as figured by Hesse, and the fungus is probably the same as that which produces the same results in Europe.

This fungus is closely related to the downy mildews, and reproduces itself by means of zoöspores and by resting spores. Fig. 21 shows two zoösporangia, and in Fig. 23 are seen some stages in the production of resting spores. Other resting bodies (*gemmæ*) may be formed from the threads in a purely vegetative way (Fig. 22).

The very general distribution of this fungus is indicated by the fact that the soil in which the affected seedlings grew in the present case was, as nearly as possible, virgin soil, having just been brought from a natural woodland, where it had probably been undisturbed for a very long period, into a new greenhouse then first used.

Assuming that "damping off" is always caused by the same fungus, certain directions for its treatment may be given. Plants affected should be at once removed, with the soil immediately surrounding them, and burned. If this is done *as soon as* the seedling falls, the trouble can be held in check, since the fungus will be destroyed before its reproductive organs have developed. When a hot-bed or propagating bench has become so badly infested by the fungus that a large part of the seedlings or cuttings "damp off," the soil should be entirely removed to a distance, and the containing walls thoroughly cleaned and washed with strong whitewash, and refilled with fresh earth. After this treatment, the prompt removal of diseased plants should be sufficient to limit the trouble to an occasional case.

THE MILDEW OF SPINACH (*Peronospora effusa* (Grev.) Rabh.) caused serious damage to that crop on the grounds of the Massachusetts Agricultural College. This fungus is one of the downy mildews, and makes its presence known by the appearance of discolored blotches on the upper surface of the leaf, and corresponding patches of its closely matted spore-bearing threads on the lower surface. Since this crop is cultivated for the leaves, the disease should be controlled by picking and destroying the leaves as fast as they become attacked, and by thorough cleaning of the field as soon as the crop is removed.

Spinach belongs to the same family of plants with some of our common weeds, which are also attacked by this mildew. One of these which appears in almost every field is the so-called pigweed or lamb's quarters (*Chenopodium album*). This plant is equally subject to the attack of the same fungus; and this fact makes it obvious that spinach fields should be kept scrupulously free from pigweed, which, if allowed to grow, may afford a favorable breeding place for the mildew.

THE GRAPE-VINE MILDEW (*Plasmopara viticola* (B. & C.) Berl. & de T.) might be expected to attack also our native species of *Ampelopsis*, the Virginia Creeper, and the species from Japan, now commonly planted under the name of Japanese or Boston ivy, since the species of *Ampelopsis* are so nearly related to the grapes that they are placed by some writers as a subdivision of the genus *Vitis*, which includes the true grapes. Its occurrence on the Virginia Creeper has been reported from various localities; but, so far as I know, the Japanese ivy (*A. Veitchii*) has been only once reported as its host.* It is therefore worth while to note the occurrence of the mildew on the latter plant, in October last, in Amherst. The fungus was well developed, almost as luxuriant as on the grape, and its summer spores, always varying considerably in size, showed an unusually wide range of dimension. The leaves attacked were large and strong, and the fungus threads penetrated their tissues very thoroughly, though a careful examination failed to discover the resting spores. The damage to the vines, which were well established and vigorous, was not important, and the chief interest of the facts noted lies in the possible danger to grape vines in the proximity of wild or cultivated *Ampelopsis* plants, which may serve as an important source of infection, if their presence is overlooked. The simplest precaution is, naturally, that of rigorously excluding the species named from the neighborhood of grape vines.

Two closely related fungi appeared to a considerable extent on a plot of purple-topped white turnips on the Station grounds in September last. They were the DOWNY MILDEW (*Peronospora parasitica* (P.) Tul.) and the WHITE RUST (*Cystopus candidus* (Pers.) Lev.) of *cruciferous* plants. They often appear together, and sometimes do considerable damage. Any field on which they

* Journal of Mycology, 1889, p. 202.

have appeared, and on which it is intended to plant turnips, cabbages, radishes, or any cruciferous crop, the next year, should be carefully cleaned of all refuse, leaves, etc., as soon as the crop is harvested; since these fungi winter over by means of resting spores developed in the leaves and stems, and set free by their decay.

Late potatoes have been an almost total loss throughout the State, on account of the attacks of the Potato-rot fungus (*Phytophthora infestans* (Mont.) de By.). As the weather early in the season was not especially favorable to the development of the fungus, early potatoes were, as a rule, harvested in excellent condition; but a period of warm, moist weather in September was fatal to the late crop. A few complaints of rotting were received early in the season, but whenever specimens were sent they showed no fungus, but merely a browning and shrivelling, due probably to the rather severe drought prevailing at the time. In accordance with a request, the following brief account of the characteristic appearance of leaves attacked by the rot fungus is here given. The spots, at first yellow, soon become of a dark-brown or blackish, muddy color, quite different from the clearer and lighter brown of merely dried leaves. Another peculiarity of these spots is their soft, rotten condition, very different from that produced by drying up, or by most other fungi. Around the edges of the dark spots may usually be observed, on close examination, especially with a hand magnifier, and chiefly on the lower side of the leaf, a delicate white "fuzz," composed of the spore-bearing threads of the fungus. The disease usually appears first at some part of a field, and thence spreads, frequently in a definite direction, with the prevailing wind.

Only the promptest action can save a field where the fungus has begun to spread; but it has been repeatedly shown that the sufficiently prompt and frequent application to the plants of the Bordeaux mixture, the materials for which must be kept on hand, will avert a very large part of the threatened loss.

The Elder Rust (*Æcidium Sambuci* Schw.) has been very abundant during the past season on our common elder

(*Sambucus Canadensis*), and its cultivated variety *aurea*, and was sent from Brookline by W. H. Manning, Esq., who reported it as greatly disfiguring the ornamental cut-leaved black elder (*S. nigra*, var. *laciniata*). It occurs on the leaf blades and stalks, where it causes the normal tissue to become greatly overdeveloped, producing large, fleshy masses, which distort the leaf and bear the spore cups on their surfaces.

The fungus is one which is difficult to deal with, as so little is known of its life history. It is the *cluster-cup* stage of one of the rust fungi, and none of the other stages has been found on the elder. It is probable that these occur on some other host plant; but, until the connection is established, little can be done to prevent its attacks, except to remove the affected foliage and burn it. The fact of the prevalence of the fungus in one season, however, does not prevent its being very rare in the next; and the controlling conditions are, as yet, very little understood.

THE RUST OF BLACKBERRIES AND RASPBERRIES (*Cæoma nitens* Schw.) is one of the commonest and most striking of our fungi. It produces at first a stunted and yellowish appearance of the shoots attacked, which is soon followed by the development of the spores in brilliant orange patches, almost or quite covering the lower surfaces of the leaves.

Experiments point to the probability that its spread by means of its spores can be checked by spraying with the Bordeaux mixture; but when a plant is once attacked there is no alternative but to dig it up and burn it, since the vegetative threads of the fungus live through the winter in the stalks, and thence penetrate the new shoots and leaves in the spring, developing the spores on the leaves. The spores are summer spores and have not yet been proved to be connected with any resting-spore form, but it is not improbable that such a connection may yet be traced; though its ability to hibernate in the host plant makes it possible that we have to deal with an independent form.

THE HOLLYHOCK RUST (*Puccinia Malvaccarum* Mont.) has become, within a few years, an important disease in Massachusetts. It is a native of Chili, whence it was introduced into Europe some years ago. In 1885 it was brought to this country with some imported *Malope* planted at Beverly Farms, Mass., and spread to the hollyhocks there in 1886. From this point, or possibly from other points as well, it extended, appearing in Boston, Cambridge, Nahant and elsewhere, and has been recently observed in central New York. It was forwarded this year to the station by G. L. Lovett, Esq., of West Newton.

The spores have the structure of the resting spores of the rusts, but are not resting spores, since they germinate at once, and infect new plants. Perhaps the last spores of the season are resting spores, by which the fungus survives the winter, as has been shown to be the case with some similar species. Affected plants should be promptly removed and destroyed, if it is desired to protect those still unharmed.

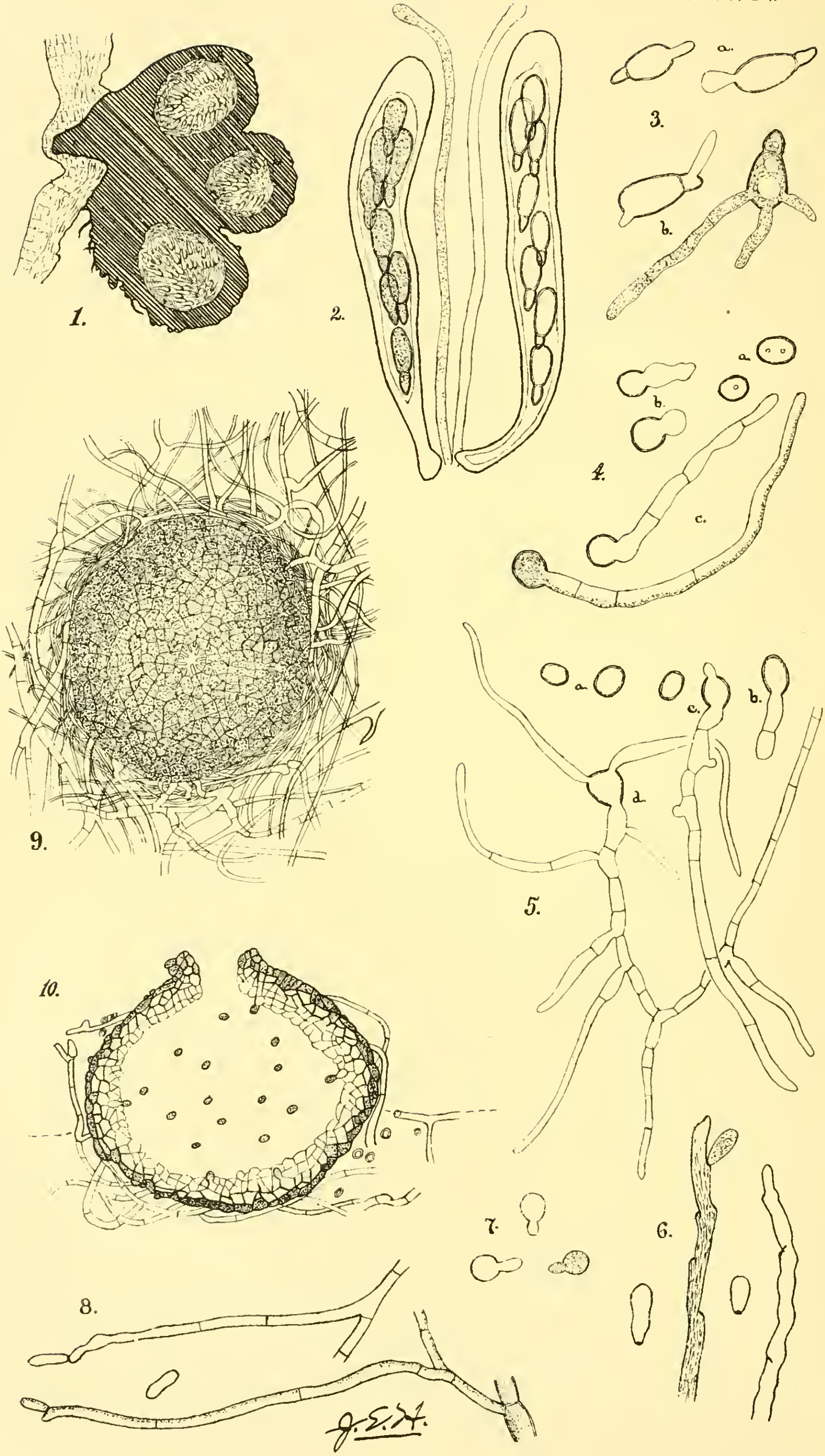
Disease of Oats. — The Massachusetts Crop Report for June, 1890, contained numerous complaints, especially from the western counties, of the failure of oats from "rusting;" and the October Report mentions oats among the crops which generally failed throughout the State. Letters to the Crop Report correspondents in Barre, Deerfield and Ludlow brought replies and specimens of the affected oats, for which the gentlemen named have the thanks of this Department. In every case the plants had a general brown or "rusty" color, but their appearance was quite different from that of plants attacked by the grain-rust fungi (*Puccinia graminis* Pers., *P. coronata* Cda., etc.). No fungus or animal could be detected in any part of the plant, but Bacteria were always present. Other work prevented any detailed study of the trouble; but there is no reason to doubt that it is the same which was very generally reported from the Eastern and Central States, and which materially reduced the oat crops of those sections. This disease has been investigated by the Division of Vegetable Pathology of the United States Department of Agriculture, and is regarded as caused by a specific Bacterium.* Until our knowledge of it is much more com-

* Journal of Mycology, 1890. p. 72.

plete, no recommendations concerning treatment can be made; and, indeed, it is by no means improbable that it may prove to be so dependent upon meteorological and other conditions as not to occur again for a long period, as has been suggested.

Note on Fungicides.

Formulæ for some of the most useful fungicides were given in our last report, at page 212. The materials for the preparation of these and others, together with an effective spraying pump, were purchased by the station last spring, in the expectation that we should be able to test them on crops on the station plots during the season. No fungous disease appeared on any crop, however, to such a degree as to render any test of fungicides possible, and the outfit and materials remain in our hands for use next season, should circumstances favor. Full directions for preparing and applying such fungicides as the latest experience has shown to be most valuable will be given in a bulletin of this station early next spring.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J. E. H.

EXPLANATION OF PLATE I.

The Fungus of Black Knot. (*Plowrightia Morbosa* (Sz.) Sacc.)

Fig. 1. Diagrammatic representation of a section through three perithecia containing spore sacs (*asci*). x 72.*

Fig. 2. Two sacs containing ripe spores, and two sterile threads (*paraphyses*). x 940.

Fig. 3. Four winter spores (*ascospores*), germinating in water; *a*, after one day; *b*, after two days. x 940.

Fig. 4. Six *pycnospores* from a knot; *a*, just placed in water; *b*, after one day; *c*, after two days in water. x 940.

Fig. 5. Six *pycnospores* from a *pycnidium* developed on gelatine from winter spores; *a*, three fresh spores; *b*, a spore after one day in water; *c*, a spore after two days in water; *d*, a spore after two days on nutrient gelatine. *d* x 540; others x 940.

Fig. 6. Three summer spores (*conidia*), with two of the threads on which they are borne. x 940.

Fig. 7. Three summer spores beginning to germinate after one day on nutrient gelatine. x 940.

Fig. 8. Threads bearing new crop of summer spores produced on gelatine culture of summer spores from young knot, shown in Figs. 6 and 7. x 540.

Fig. 9. Surface view, from above, of a *pycnidium* developed on gelatine from winter spores. x 350.

Fig. 10. Vertical section through such a *pycnidium*, showing origin of spores. x 350.

Drawn chiefly from a single section, but completed in some details from others. The threads about the mouth are not shown in the section.

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* The number given after each figure represents the degree of magnification of the original drawing, which has been reduced about one-third in this plate. The magnification of the figures, as here given, is therefore about two-thirds of that indicated by the printed numbers.

EXPLANATION OF PLATE II.

The Cucumber Mildew. (*Plasmopara Cubensis*) (B. & C.)

Fig. 11. A conidial thread arising from a vegetative thread; *sp.*, two summer spores (*conidia*). x 540.*

Fig. 12. A portion of a vegetative thread giving rise to two conidial threads through the same leaf-pore. x 540.

Fig. 13. A young conidial thread with the spores not yet fully developed and still in place. x 540.

Fig. 14. A portion of a vegetative thread among the cells of a leaf, four of which are shown, and penetrating them by its *haustoria*, *h.* x 540.

The Mildew of the Star Cucumber. (*Plasmopara australis* Spag.)

Fig. 15. A conidial thread and spores; *a* x 350 ; *sp.* spores x 540.

Fig. 16. A portion of a vegetative thread, with *haustoria*, *h.* x 540.

The Brown Rot of Stone Fruits. (*Monilia fructigena* Pers.)

Fig. 17. Spore chains. x 540.

Fig. 18. End of a growing chain, showing beginnings of new spores and origin of branching. x 540.

Fig. 19. Threads terminating in spore chains, developed in five days from spores sown on nutrient gelatine. x 200.

Fig. 20. Threads, *a*, and resting cells (*Gemmæ*), *b*, from the flesh of "mummied" plums, in winter. x 540.

The "Damping-off" Fungus. (*Pythium de Baryanum* Hesse.)

Fig. 21. Two *zoösporangia*, showing beginnings in formation of *zoöspores.* x 540.

Fig. 22. A resting cell (*Gemma*). x 540.

Fig. 23. Sexual organs; *a*, female cell (*oögonium*), with a single male (*antheridium*) ; *b*, with two males ; *c*, resting spore (*oöspore*), formed and fertilized as shown by emptying of male cell. x 540.

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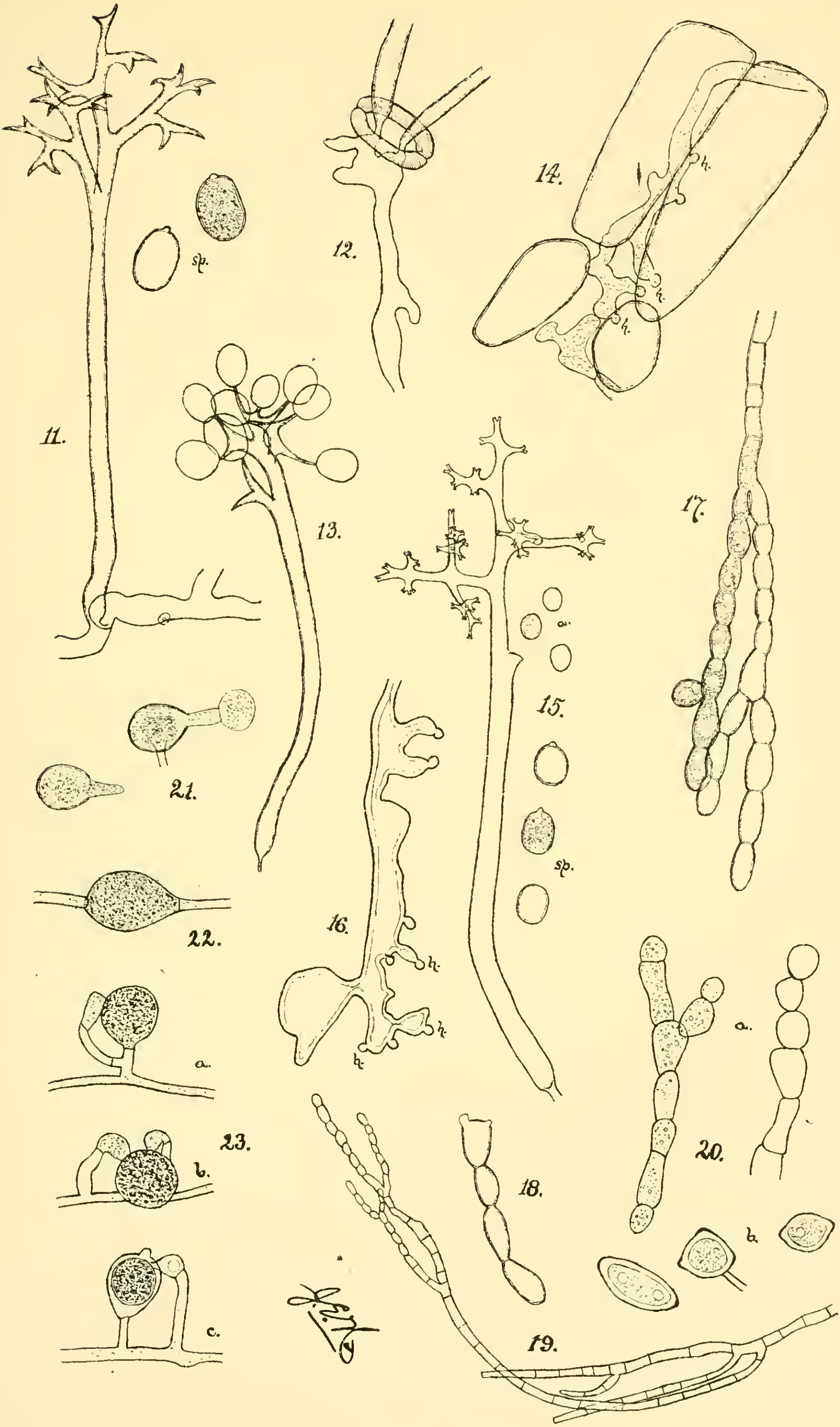
* See note to Plate I.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SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers : —
  1. General introduction.
  2. Laws for the regulation of the trade in commercial fertilizers.
  3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
  4. Analyses of licensed fertilizers.
  5. Analyses of commercial fertilizers and manurial substances sent on for examination.
  6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

I. Communication on Commercial Fertilizers.

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1. *General Introduction.*

The trade in commercial fertilizers has been quite active in our State during the past year. Fifty-one manufacturers and dealers in manurial substances have applied for and received certificates for their compliance with our State laws for the regulation of the trade in commercial fertilizers; twenty-nine of these are residing in the State, while twenty-two are residents of other States.

One hundred and fifty-eight samples of licensed articles of various description have been collected in all parts of the State by a duly authorized agent of the station. They were analyzed at the chemical laboratory of the latter, with the following results: fifty-four samples contained one single essential constituent below the lowest guaranty; ten samples contained two essential constituents below the lowest guaranty; three samples contained all three essential constituents below the lowest guaranty; fifty-six samples contained one essential constituent above the highest guaranty; thirteen samples contained two essential constituents above the highest guaranty; four samples contained all three essential constituents above the highest guaranty. The deficiency in regard to one or two essential constituents was in the majority of cases commercially compensated by the excess of another one.

The fluctuation in the market price of most standard articles used in the manufacture of compound fertilizers has been within the usual limits during the past season. Tankage, nitrate of soda, blood, azotin and sulphate of potash declined during the middle of May. Bones, refuse bone-black and crude phosphate rock have remained unchanged in price since January 1. Muriate of potash and kainite held their own, while sulphate of ammonia advanced somewhat. Judging from present indications, some changes regarding the cost of commercial fertilizers may be expected for the coming season.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to discriminate, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition, and to such additional information as relates to the latter. The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage, — a circumstance not unfrequently overlooked.

The approximate market value of the different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance. To select judiciously, from among the various brands of fertilizers offered for patronage, requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food — *i.e.*, phosphoric acid, nitrogen and potash — which they contain. To ascertain, by this mode of valuation, the approximate market value of a fertilizer (*i.e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payments at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1890. Cents per Pound.
Nitrogen in ammoniates,	17
Nitrogen in nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	17
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals — Concluded.

	1890. Cents per Pound.
Organic nitrogen in coarser bone and tankage, ...	8½
Organic nitrogen in hair, horn-shavings and coarse fish scraps,	8
Phosphoric acid soluble in water, ...	8
Phosphoric acid soluble in ammonium citrate, ...	7½
Phosphoric acid in dry ground fish, fine bone and tankage, .	7
Phosphoric acid in fine medium bone and tankage, . .	6
Phosphoric acid in medium bone and tankage, . . .	5
Phosphoric acid in coarse bone and tankage, ...	4
Phosphoric acid in fine-ground rock phosphate, . . .	2
Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc..	6
Potash as kainite, ...	4½
Potash as muriate, ...	4½

The organic nitrogen in superphosphates, special manures and mixed fertilizers of a high grade, is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, seventeen cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. For similar reason, the insoluble phosphoric acid is valued in this connection at three cents, it being assumed, unless found otherwise, that it is from bone or similar sources, and not from rock phosphate. In this latter form the phosphoric acid is worth but two cents per pound.

The above trade values are figures at which, in the six months preceding March, 1890, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends upon the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect, at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. A mistake or misunderstanding may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding, in its composition, with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale on our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. *Laws for the Regulation of the Trade in Commercial Fertilizers.*

[Chap. 296.]

An Act to regulate the sale of commercial fertilizers

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing inredients: namely, nitrogen, phosphorus, and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relate only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

Sect. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

Sect. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions issued, at the Beginning of the Season, to Dealers in Commercial Fertilizers.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers, but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the 1st of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions, until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

3. List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year, and the Brands licensed by Each.

E. Frank Coe, New York, N. Y.: —
High-grade Ammoniated Bone Superphosphate.
Fish and Potash.
Potato Fertilizer.
Gold Brand Excelsior Guano.

Standard Fertilizer Company, Boston, Mass.: —
Standard Fertilizer.
Standard Superphosphate.

H. S. Miller & Co., Newark, N. J.: —
Standard Superphosphate of Lime.
Ammoniated Dissolved Bone Phosphate.
Potato Fertilizer.
Ground Bone.

J. E. Soper & Co., Boston, Mass.: —
Cotton-seed Hull Ashes.

Leander Wilcox, Mystic Bridge, Conn.: —
Dry Ground Fish Guano.
Acidulated Fish Guano.

J. M. Butman, Lowell, Mass.: —
Lowell Bone Fertilizer.

J. S. Reese & Co. Baltimore, Md., licensees of Clark's Cove Guano Company, New Bedford, Mass.: —
Bay State Fertilizer.
Concentrated Manure for Corn and Potatoes.
King Philip Alkaline Guano.
Great Planet A. A. Manure.
Fish and Potash.
New England Favorite.
Pilgrim Fertilizer.

E. H. Smith, Northborough, Mass.: —
Steamed Bone.

Whittemore Bros., Wayland, Mass.: —
Whittemore's Complete Manure.

Ames Fertilizer Company, Peabody, Mass.: —
Ames' Bone Fertilizer.

G. E. Holmes, Worcester, Mass.: —
Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

J. C. Dow & Co., Boston, Mass. : —
- Nitrogenous Superphosphate.
- Ground Bone Fertilizer.
- Fine-ground Bone.

N. Ward Company, Boston, Mass. : —
- High-grade Animal Fertilizer.

Hargrave Manufacturing Company, Fall River, Mass. : —
- Steamed Bone.

Bradley Fertilizer Company, Boston, Mass. : —
- XL Phosphate.
- B. D. Sea-fowl Guano.
- Coe's Original Superphosphate of Lime.
- Fish and Potash.
- Pure Fine-ground Bone.
- Bradley's Complete Manures : —
  - For Potatoes and Vegetables.
  - For Corn and Grain.
  - For Top-dressing Grass and Grain.
- Bradley's Grass Manure for Top-dressing.
- Bradley's Potato Manure.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Muriate of Potash.
- Dissolved Bone-black.

A. Lee & Co., Boston, Mass. : —
- Lawrence Fertilizer.
- Ground Bone.

Lister's Agricultural Chemical Works, Newark, N. J. : —
- Standard Superphosphate of Lime.
- Ammoniated Dissolved Bone.

W. D. Stewart & Co., Boston, Mass. : —
- Soluble Pacific Guano.

Cleveland Dryer Company, Boston, Mass. : —
- Cleveland Potato Phosphate.
- Cleveland Superphosphate.

Cumberland Bone Company, Portland, Me. : —
- Cumberland Superphosphate.
- Seeding-down Fertilizer.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Read Fertilizer Company, Syracuse, N. Y.: —
Farmers' Friend.
Lion Brand.
High-grade Farmers' Friend Special.
Sampson Brand, or Lion Special.

W. J. Brightman & Co., Tiverton, R. I.: —
Fish and Potash.
Superphosphate.
Dry Ground Fish.

Adams & Thomas, Springfield, Mass.: —
Adams' Market Bone Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
Darling's Animal Fertilizer.
Extra Bone Phosphate.
Potato and Root-crop Manure.
Pure Bone.
Muriate of Potash.
Sulphate of Potash.

Joseph Church & Co., Tiverton, R. I.: —
Fish and Potash.
Church's Special.
Church's Standard.
Dried and Ground Fish.

F. C. Sturtevant, Hartford, Conn.: —
Tobacco and Sulphur Fertilizer.

Edmund Hersey, Hingham, Mass.: —
Steamed Bone.

Forest City Wood Ash Company, London, Ontario: —
Unleached Wood Ashes.

C. E. Mayo & Co., Boston, Mass.: —
Mayo's Superphosphate.

Great Eastern Fertilizer Company, Rutland, Vt.: —
Great Eastern General, for Grain and Grass.
Great Eastern Vegetable, Vine and Tobacco Fertilizers.
Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

Sandford Winter, Brockton, Mass.: —
Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Prentiss, Brooks & Co., Holyoke, Mass. : —
- Dry Fish.
- Dissolved Bone-black.
- Muriate of Potash.
- Nitrate of Soda.
- Sulphate of Potash.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
- The Mapes Bone Manures.
- Peruvian Guano.
- Mapes Superphosphate.
- Mapes Special Crop Manures.

Bowker Fertilizer Company, Boston, Mass. : —
- Stockbridge Manures.
- Hill and Drill Phosphate.
- Lawn and Garden Fertilizer.
- Ammoniated Bone Fertilizer.
- Fish and Potash.
- Dry Ground Fish.
- Gloucester Fish and Potash.
- Fine-ground Bone.
- Plain Superphosphate.
- Kainite.
- Nitrate of Soda.
- Dried Blood.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.

C. A. Bartlett, Worcester, Mass. : —
- Pure Ground Bone.
- Animal Fertilizer.

W. E. Fyfe & Co., Clinton, Mass. : —
- Unleached Wood Ashes.

Quinnipiac Fertilizer Company, New London, Conn. : —
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash.
- Muriate of Potash.
- Sulphate of Potash.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

John G. Jefferds, Worcester, Mass. : —
Jefferds' Animal Fertilizer.
Jefferds' Fine-ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.

James E. McGovern, Lawrence, Mass. : —
West Andover Market Bone Phosphate.
Fine-ground Bone.

American Manufacturing Company, Boston, Mass. : —
The Allen Fertilizer.

Thomas Hersom & Co., New Bedford, Mass. : —
Fine-ground Bone.
Meat and Bone.

H. J. Baker & Bro., New York, N. Y. : —
A. A. Ammoniated Superphosphate.
Pelican Bone Fertilizer.
Potato Manure.

Munroe, Judson and Stroup, Oswego, N. Y. : —
Unleached Wood Ashes.

The Geo. W. Miles Fertilizer and Oil Company, Milford, Conn. : —
IXL Ammoniated Bone Superphosphate.
Fish and Potash.

Joseph Breck & Son, Boston, Mass. : —
Breck's Lawn and Garden Dressing.

National Fertilizer Company, Bridgeport, Conn. : —
Chittenden's Complete Fertilizer.
Chittenden's Fish and Potash.
Chittenden's Universal Phosphate.
Ground Bone.

Stearns' Fertilizer Company, New York, N. Y. : —
Ammoniated Bone Superphosphate.
American Guano.

3. *List of Dealers who have secured Certificates, etc.* — Concluded.

Davidge Fertilizer Company, New York, N. Y. : —
- Potato Manure.
- Vegetator.
- Special Favorite.

The Le Page Company, Boston, Mass. : —
- Red Star Brand 203 Fertilizer.
- Red Star Brand Special Potato Fertilizer.

William Lavery, Amesbury, Mass. : —
- Lavery's Superphosphate.
- Steamed Bone.

4. *Analyses of Commercial Fertilizers collected during the Past Season in the General Markets by the Agent of the Massachusetts Agricultural Experiment Station.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
1	Tuttle's Fish,	Prentiss, Brooks & Co., Holyoke, Mass.,	Hatfield.
3	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Wayland.
4	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
8	Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Boston.
14	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	North Sudbury.
19	Fish and Potash,	Joseph Church & Co , Tiverton, R. I.,	Springfield.
25	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
37	Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Framingham.
39	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	North Framingham.
41	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Framingham.
44	Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Northborough.
51	Darling's Pure Dissolved Bone,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Lawrence.
67	Wilcox's Dry Ground Fish Guano,	Leander Wilcox, Mystic Bridge, Conn.,	Amherst.
77	Quinnipiac Dry Ground Fish,	The Quinnipiac Company, New London, Conn.,	Northampton.
	Bones.		
2	Steamed Bone,	E. H. Smith, Northborough, Mass.,	Northborough.
5	Bone Flour,	H. S. Miller & Co., Newark, N. J.,	Boston.
6	Ground Bone,	H. S. Miller & Co., Newark, N. J.,	Boston.
16	Steamed Bone,	J. G. Jefferds, Worcester, Mass.,	Worcester.
17	Steamed Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
18	Steamed Bone,	G. E. Holmes, Worcester, Mass.,	Worcester.
110	S. Winter's Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.		Mechanical Analyses.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Compound Fertilizers.																
1	Tuttle's Fish,	10.00	7 86	8.24—9.89	0.99	4.07	2.92	7.98	-	5.06	-	-	-				
3	Whittemore's Complete Manure,	15.11	2.68	2.47—3.3	7.68	6.52	2.02	16.22	12—14	14.20	8—12	3.71	3—4				
4	Lowell Bone Fertilizer,	11.46	2.22	2—2.5	5.19	8.57	2.23	15.99	11—16.5	13.76	9—13.5	2.23	2—3.5				
8	Potato Manure,	10.62	3.91	3.3	5.36	1.06	0.91	7.33	-	6.42	5.75	9.32	10				
14	Hill and Drill Phosphate,	11.15	2.68	2.5—3.25	6.01	1.84	6.09	13.94	12—14	7.85	8—10	2.15	2—3				
19	Fish and Potash,	21.74	3.16	3.3—4.12	1.16	2.52	1.57	5.25	5—6	3.68	-	4.03	3—4				
25	Adams' Market Bone Fertilizer,	12.77	2.52	2.5—3.5	0.32	3.84	6.42	10.58	8—10	4.16	6—8	5.12	3—5				
37	Vegetable, Vine and Tobacco Fertilizer,	15.69	2.06	2.06—2.88	7.16	0.36	2.23	9.75	9—13	7.52	8—11	5.42	6—8				
39	Potato and Root Crop Manure,	13.92	2.98	2.88—4.12	3.25	5.09	3.25	11.59	10—12	8.34	-	7.88	7—9				
41	Original Bay State Bone Superphosphate,	20.72	2.70	2.47—2.88	2.64	4.70	3.15	10.49	10—12	7.34	9—9.5	2.95	2—3				
44	Ammoniated Bone Superphosphate,	17.46	2.26	1.65—2.47	6.70	3.36	0.97	11.03	9—11	10.06	7—8	2 71	2—4				
54	Darling's Pure Dissolved Bone,	11.88	2.10	2.06—2.88	3.61	12.99	3.51	20.11	-	16.60	14—16	-	-				
67	Wilcox's Dry Ground Fish Guano,	8.22	7.86	8—11	0.62	3.91	3.02	7.55	-	4.53	4—6	-	-				
7	Quinnipiac Dry Ground Fish,	10.00	7.94	7.5—10	0.64	3.37	2.85	6.86	7—10	4.01	4—6	-	-				
	Bones.																
2	Steamed Bone,	6.13	3.76	3.5—4	0.43	7.41	14.42	22.26	21—23	7.84	-			37.34	28.74	29.78	4.14
5	Bone Flour,	3.45	2.88	2.88—3.30	0.20	11.21	21.11	32.52	20—25	11.41	-			89.63	10.37	-	-
6	Ground Bone,	8.23	2.76	2.7—2.9	0.26	4.65	19.78	24.69	12—14	4.91	-			55.56	21.02	14.52	8.90
16	Steamed Bone,	5.75	3.42	3.3—4.12	0.54	11.72	17.42	29.68	27—30	12.26	-			73.05	19.00	7.95	-
17	Steamed Bone,	7.19	2.41	2.3—2.5	0.43	10.50	15.17	26.10	26—28	10.93	8—10			58.00	21.30	20.70	-
18	Steamed Bone,	5.77	2.82	2.5—3.5	1.36	3.09	16.91	21.36	22—24	4.45	-			48.31	22.70	18.80	10.19
110	S. Winter's Pure Ground Bone,	8.62	3.16	2.5—3.5	0.43	10.35	12.32	23.60	22—24	10.78	-			62.91	22.66	10.38	4.05

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer	Sampled at—
	Compound Fertilizers.		
7	The Allen Fertilizer,	American Manufacturing Company, Boston, Mass.,	Boston.
24	Mapes' Potato Manure,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Springfield.
26	Sampson Brand, or Lion Special,	Read Fertilizer Company, New York, N. Y.,	Lee.
27	Farmer's Friend Special,	Read Fertilizer Company, New York, N. Y.,	Lee.
36	Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	North Adams.
46	Americus Ammoniated Bone Superphosphate,	Williams & Clark Co., New York, N. Y.,	Northborough.
93	Brightman's Dry Ground Fish,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
95	Bay State Fertilizer,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
96	Reese's Concentrated Manure for Corn and Potatoes,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
127	Fine-ground Dry Fish,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
	Chemicals.		
72	Sulphate of Ammonia,	The Quinnipiac Company, New London, Conn., Agents,	Northampton.
73	Sulphate of Potash,	The Quinnipiac Company, New London, Conn., Agents,	Northampton.
74	Muriate of Potash,	The Quinnipiac Company, New London, Conn., Agents,	Northampton.
86	Muriate of Potash,	Bradley Fertilizer Company, Boston, Mass., Agents,	Worcester.
124	Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass., Agents,	Northampton.
125	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass., Agents,	Northampton.
	Bones.		
31	Pure Raw Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
58	McGovern's Ground Bone,	James E. McGovern, West Andover, Mass.,	West Andover.
103	Pure Fine-ground Bone,	Thos. Hersom & Co , New Bedford, Mass.,	New Bedford.
104	Meat and Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.		Mechanical Analyses.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Compound Fertilizers.																
7	The Allen Fertilizer,	7.15	2.22	2.06—2.47	5.12	2.81	3.58	11.51	6—10	7.93	5—8	5.35	4—6				
24	Mapes' Potato Manure,	9.09	3.76	3.71—4.12	5.85	3.06	2.53	11.44	–	8.91	8	5.68	6—8				
26	Sampson Brand, or Lion Special,	10.12	2.80	2.47—3.30	6.06	2.66	2.60	11.32	10—12	8.72	8—10	4.18	–*				
27	Farmer's Friend Special,	13.70	4.30	3.3—4.12	3.40	1.90	2.56	7.86	6—7	5.30	5—6	10.02	10—12				
36	Potato Manure,	12.30	2.19	2.5—3.25	6.67	1.46	1.71	9.84	8—11	8.13	6—8	5.27	5—6				
46	Americus Ammoniated Bone Superphosphate,	15.70	1.94	2—3	8.96	1.27	1.80	12.03	11—16	10.23	9—11	2.36	2—3				
93	Brightman's Dry Ground Fish,	9.47	8.36	8.24—9.88	0.49	4.71	5.09	10.29	–	5.20	–	–	–				
95	Bay State Fertilizer,	9.86	2.38	2.4—3.3	6.52	6.94	3.48	16.94	–	13.46	9—12	1.93	2—3				
96	Reese's Concentrated Manure for Corn and Potatoes,	10.82	3.16	2.88—3.5	3.33	5.80	5.12	14.25	–	9.13	6—8	7.26	7.5—9.5				
127	Fine-ground Dry Fish,	9.50	8.20	8—10	0.59	4.56	2.17	7.32	7—8	5.15	–	–	–				
	Chemicals.																
72	Sulphate of Ammonia,	2.00	20.40	19.76—21.42	–	–	–	–	–	–	–	–					
73	Sulphate of Potash,	5.94	–	–	–	–	–	–	–	–	–	24.80	–*				
74	Muriate of Potash,	2.50	–	–	–	–	–	–	–	–	–	48.56	–†				
86	Muriate of Potash,	3.50	–	–	–	–	–	–	–	–	–	50.12	48—55				
124	Sulphate of Potash,	5.27	–	–	–	–	–	–	–	–	–	24.52	24—26*				
125	Nitrate of Soda,	1.74	15.10	14.82—15.64	–	–	–	–	–	–	–	–	–				
	Bones.																
31	Pure Raw Ground Bone,	7.69	3.66	2.88—3.3	0.18	7.40	16.96	24.54	25	7.58	–			34.05	27.55	22.00	16.40
58	McGovern's Ground Bone,	12.89	1.66	1.5—2.25	0.20	6.84	12.87	19.91	18—20	7.04	–			39.85	32.30	18.35	9.50
103	Pure Fine-ground Bone,	3.32	1.80	1.75—2.25	0.24	8.02	22.03	30.29	27—30	8.26	–			51.32	33.83	13.04	1.81
104	Meat and Bone,	4.45	4.76	4—5	0.28	0.76	11.37	18.41	18—20	7.04	–			–	–	–	–

* Sulphate of potash, the source of potash.

† Guaranteed 80—85 per cent. muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
21	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Springfield.
32	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
35	XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	North Adams.
40	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	North Framingham.
42	Ammoniated Wheat and Corn Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
47	The Ames Fertilizer,	Ames Fertilizer Company, Peabody, Mass.,	North Sudbury.
48	The N. Ward Company's High-grade Animal Fertilizer,	The N. Ward Company, Boston, Mass.,	Boston.
49	Red Star Brand 203 Fertilizer for General Crops,	Le Page Company, Boston, Mass.,	Woburn.
56	The Lawrence Fertilizer,	A. Lee & Co., Lawrence, Mass.,	Lawrence.
60	Lister's Success Fertilizer,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
83	Cumberland Seeding-down Fertilizer,	Cumberland Bone Company, Portland, Me.,	Jefferson's.
97	Clark's Cove King Philip Alkaline Guano,	John S. Reese & Co., Baltimore, Md., Licensees,	New Bedford.
98	Clark's Cove Great Planet A. A. Manure,	John S. Reese & Co., Baltimore, Md., Licensees,	New Bedford.
105	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Taunton.
106	Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Taunton.
115	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
128	Fish and Potash, Anchor Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
130	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
137	Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Cambridgeport.
146	Soluble Pacific Guano,	W. D. Stewart & Co., Boston, Mass.,	Berlin.
147	Special Favorite,	Davidge Fertilizer Company, New York City, N. Y.,	Barre Plains.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Tobacco and Sulphur Lawn Fertilizer,	22.06	1.96	2.38	-	-	-	0.71	0.75	-	-	7.80	7.66
32	Potato, Hop and Tobacco Phosphate,	14.23	2.08	2—3	7.65	1.74	1.78	11.17	11—15	9.39	10—13	4.24	3.5—4.5
35	XL Superphosphate of Lime,	13.87	2.66	2.5—3	7.14	2.46	1.79	11.39	11—14	9.60	9—11	1.91	2—3
40	Darling's Animal Fertilizer,	12.33	2.83	3.3—4.94	4.03	3.69	4.66	12.38	-	7.72	10—12	5.87	4—6
42	Ammoniated Wheat and Corn Manure,	15.61	2.02	2—3	8.47	2.23	0.64	11.31	11—15	10.70	10—13	1.80	1.75—2.93
47	The Ames Fertilizer,	21.22	3.12	2.47—3.3	5.05	4.53	0.42	10.00	8—12	9.58	7—10	1.04	0.75—2
48	N. Ward & Co.'s High-grade Animal Fertilizer,	18.25	3.29	2.88—3.7	5.40	5.64	1.14	12.18	-	11.04	12—14	4.76	4—5
49	Red Star Brand 203 Fertilizer for General Crops,	13.65	3.30	3—4	4.44	2.61	2.14	9.19	10—12	7.05	8—10	4.20	3—4
56	The Lawrence Fertilizer,	14.06	2.32	2.06—2.88	6.45	6.42	2.56	15.43	-	12.87	10—12	1.94	2—3
60	Lister's Success Fertilizer,	11.99	1.52	1.03—1.65	8.11	1.54	2.25	11.90	-	9.65	10.5—12	1.69	1.5—2
83	Cumberland Seeding-down Fertilizer,	13.89	1.62	1.65	2.35	6.20	6.59	18.14	18—20	8.55	5—9	1.05	1
97	Clark's Cove King Philip Alkaline Guano,	12.30	1.70	1.24—1.65	5.20	3.04	2.20	10.44	-	8.24	6.5—8	3.42	3—4
98	Clark's Cove Great Planet A. A. Manure,	10 21	3.22	2.88—3.71	4.89	2.24	2.67	9.80	-	7.13	6—8	7.85	7.5—9.5
105	Standard Fertilizer,	13.85	2.66	2—3	7.79	1.63	1.54	10.96	10—15	9.42	8—12	2.09	2—3
106	Potato Fertilizer,	12.35	2.16	2—2.5	6.75	2.89	1.46	11.10	-	9.64	8—11	6.89	6
115	Cumberland Superphosphate,	14.28	2.20	2—3	5.01	2.28	8.09	15 38	12—14	7.29	9—13	2.24	2—3
128	Fish and Potash, Anchor Brand,	18.74	3.72	3.25—4.25	4.22	1.44	1.43	7.09	-	5.66	3—5	4.30	3—5
130	Dry Fish Guano,	12.38	8.48	8.24—9.88	0.08	3.55	4.07	7.70	6—8	3.63	-	-	-
137	Nitrogenous Superphosphate,	15.84	2.48	2.06—2.88	5 32	4.41	2.17	11.90	-	9.73	8—10	3.17	3—4
146	Soluble Pacific Guano,	17.28	2.60	2.25—3	7.93	1.89	2.56	12.38	10.5—16	9.82	8.5—11	2.42	2—3
147	Special Favorite,	18.38	1.64	1.24—2.06	9.98	1.40	0.03	11.41	11—14	11.38	10—12	1.82	1.5—2.5

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number	Name of Brand.	Name of Manufacturer.	Sampled at —
29	Farmer's Friend Superphosphate,	Read Fertilizer Company, New York, N. Y.,	Lee.
30	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
45	Chittenden's Potato Manure,	National Fertilizer Company, Bridgeport, Conn.,	Northborough.
49	Red Star Brand 203 Fertilizer for General Crops,	Le Page Company, Boston, Mass.,	Woburn.
52	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, Ohio,	South Framingham.
64	Mapes' Complete Manure for General Use,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Lowell.
90	Quinnipiac Phosphate,	The Quinnipiac Company, New London, Conn.,	Fall River.
119	Fish and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
132	Tobacco Manure, Wrapper Brand,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
148	IXL Ammoniated Bone Superphosphate,	The Miles Fertilizer and Oil Company, Milford, Conn.,	Northampton.
151	Soluble Bone Phosphate,	Davidge Fertilizer Company, New York, N. Y.,	Williamsburg.
	Bones.		
20	Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
55	Royal Pure Ground Bone,	A. Lee & Co., Lawrence, Mass.,	Lawrence.
59	Chittenden's Ground Bone,	National Fertilizer Company, Bridgeport, Conn.,	Lawrence.
61	Lister's Celebrated Bone,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
71	Quinnipiac Pure Bone Meal,	The Quinnipiac Company, New London, Conn.,	Northampton.
78	Bowker's Fine-ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
89	Hargrave's Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
111	Ground Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
138	Fine-ground Bone,	J. C. Dow & Co., Boston, Mass.,	Cambridgeport.
141	Pure Ground Bone,	Wm. Lavery, Amesbury, Mass.,	Amesbury.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen in One Hundred Pounds. Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide in One Hundred Pounds. Guaranteed.
29	Farmer's Friend Superphosphate,	14.80	2.60	2.06—2.47	6.98	3.00	2.70	12.68	11—13	9.98	9—11	2.40	–*
30	Ammoniated Bone Superphosphate,	11.77	3.25	2.88—3.71	6.54	0.49	3.42	10.45	11—15	7.03	10—13	1.41	1—2
45	Chittenden's Potato Manure,	10.10	3.30	3.29—4.12	3.68	4.08	4.64	12.40	–	7.76	6—8	6.28	6—8
49	Red Star Brand 203 Fertilizer for General Crops,	13.65	3.30	3—4	4.44	2.61	2.14	9.19	10—12	7.05	8—10	4.20	3—4
52	Cleveland Potato Phosphate,	16.97	2.18	2.05—2.85	7.89	1.28	0.55	9.72	–	9.17	8—10	3.76	3.25—4.25
64	Mapes' Complete Manure for General Use,	15.47	3.44	3.29—4.12	3.79	4.85	3.33	11.97	10—12	8.64	8—10	3.96	4—5
90	Quinnipiac Phosphate,	21.76	2.80	2.5—3.5	2.71	7.14	0.77	10.62	10—16	9.85	9—13	2.42	2—3
119	Fish and Potash,	6.02	3.70	3.29—4.12	2.62	2.78	1.09	6.49	5—6	5.40	–	5.03	4—6
132	Tobacco Manure, Wrapper Brand,	1.49	5.98	6.18	0.92	3.50	2.56	6.98	4.5	4.42	–	11.05	10.50
148	IXL Ammoniated Bone Superphosphate,	15.14	2.96	2.06—3.30	8.64	0.81	0.19	9.64	9—14	9.45	8—12	2.27	1.5—3
151	Soluble Bone Phosphate,	11.60	–	–	8.30	2.48	0.22	11.00	11—14	10.78	10—12	1.90	1.5—2.5

Bones.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
20	Ground Bone,	11.07	4.22	3.85	0.08	6.14	14.43	20.65	23.75	6.22	–	52.65	41.90	5.45	–
55	Royal Pure Ground Bone,	9.76	3.80	4—5	0.16	11.14	13.50	24.80	25—27	11.30	–	39.10	25.50	18.30	17.10
59	Chittenden's Ground Bone,	6.00	3.04	2.88—3.71	0.15	5.10	19.34	24.59	20—24	5.25	–	18.64	31.78	38.09	11.49
61	Lister's Celebrated Bone,	6.16	2.50	2.47—2.88	0.43	7.63	6.73	14.79	12—18	8.06	–	31.96	28.82	19.01	20.21
71	Quinnipiac Pure Bone Meal,	19.23	2.76	2.47—4.12	0.20	11.43	12.22	23.85	22—25	11.63	–	32.74	33.18	18.69	15.39
78	Bowker's Fine-ground Bone,	5.81	3.20	2.47—3.30	0.33	8.23	13.19	21.75	18—22	8.56	–	57.32	23.19	13.89	5.60
89	Hargrave's Bone,	11.48	3.10	2.5—3.5	–	7.58	17.78	25.36	23—25	7.58	–	31.12	24.78	18.22	25.88
111	Ground Bone,	2.99	2.90	3—4	0.38	9.06	18.64	28.08	19—25	9.44	–	46.37	30.08	19.64	3.91
138	Fine-ground Bone,	2.67	2.08	1.65—2.47	0.61	6.74	19.52	26.87	24—26	7.35	–	70.13	28.70	1.17	–
114	Pure Ground Bone,	14.68	2.52	2—3	–	4.94	9.34	14.28	12—18	4.94	–	47.10	44.19	8.71	–

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
9	Lawn Dressing,	H. J. Baker & Bro., New York, N. Y.,	Boston.
10	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Boston.
11	Square Brand Bone and Potash,	Bowker Fertilizer Company, Boston, Mass.,	North Sudbury.
12	Ammoniated Bone Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	North Sudbury.
13	Stockbridge's Manure for Asparagus,	Bowker Fertilizer Company, Boston, Mass.,	North Sudbury.
15	Stockbridge's Manure for Vegetables and Potatoes,	Bowker Fertilizer Company, Boston, Mass.,	North Sudbury.
28	Lion Brand,	Read Fertilizer Company, New York, N. Y.,	Lee.
38	Grass and Grain Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Framingham.
50	Mayo's Superphosphate,	C. E. Mayo & Co., Boston, Mass.,	Woburn.
53	Breck's Lawn Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Boston.
63	Chittenden's Universal Phosphate,	National Fertilizer Company, Bridgeport, Conn.,	Lawrence.
66	Mapes' Grass and Grain Spring Top-dressing,	Mapes' Formula and Peruvian Guano Company, New York, N. Y.,	Lowell.
68	Wilcox Prepared Fertilizer,	Leander Wilcox, Mystic Bridge, Conn.,	Amherst.
69	Wilcox Fish and Potash,	Leander Wilcox, Mystic Bridge, Conn.,	Amherst.
75	Quinnipiac Fish and Potash, Cross Brand,	The Quinnipiac Company, New London, Conn.,	Northampton.
79	Bowker's Square Brand Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
84	Jefferd's Animal Fertilizer with Potash,	J. G. Jefferds, Worcester, Mass.,	Worcester.
85	Bartlett's Animal Fertilizer with Potash,	C. A. Bartlett, Worcester, Mass.,	Worcester.
99	Clark's Cove Fish and Potash,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
100	Clark's Cove New England Favorite,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
102	Red Star Brand Special for Potatoes,	Le Page Company, Boston, Mass.,	New Bedford.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
9	Lawn Dressing,	18.87	4.16	3.50	4.66	1.75	0.38	6.79	-	6.41	4.75	6.81	7.00
10	A. A. Ammoniated Superphosphate,	14.55	2.63	2.47—3.30	10.08	0.82	0.14	11.04	-	10.90	10—12	2.38	2—3
11	Square Brand Bone and Potash,	6 00	1.56	1.65—2.47	0.92	5.78	7.19	13.89	-	6.70	12—15	1.96	2—3
12	Ammoniated Bone Fertilizer,	12.85	2.21	2—3	2.72	3.95	5.73	12.40	10—12	6.67	8—10	2.43	2—3
13	Stockbridge's Manure for Asparagus,	11.94	3.54	3.25—4.25	2.93	2.48	4.73	10.14	8—10	5.41	7—8	5.06	5—6
15	Stockbridge's Manure for Vegetables and Potatoes,	10.97	4.12	3.25—4.25	2.87	4.72	4.58	12.17	8—10	7.59	7—8	5.23	5—6
28	Lion Brand,	14.16	1.12	0.82—1.65	5.86	3.33	1.91	11.10	10—12	9.19	8—10	4 22	—*
38	Grass and Grain Fertilizer,	13.61	3.19	2.88—3.71	6.42	1.67	2.12	10.21	9—15	8.09	8—12	1.73	2—4
50	Mayo's Superphosphate,	17.11	2.50	2.05—2.85	8.15	0.85	1.23	10.23	10—14	9.00	9—12	2.46	2.5—3.5
53	Breck's Lawn Dressing,	9.41	3.84	4.12—4.94	2.20	3.09	6.97	12.26	-	5.29	5—6	5.03	5—6
63	Chittenden's Universal Phosphate,	15.15	2.65	2.06—2.88	4.95	3.62	2.57	11.14	11—12	8.57	9—11	3.19	2—3
66	Mapes Grass and Grain Spring Top-dressing,	12.00	4.16	4.12—5.77	3.35	3.80	2.60	9.75	7—9	7.15	7	5.44	5—7
68	Wilcox Prepared Fertilizer,	24.76	3.51	3.30—4.12	3.38	2.07	1.51	6.96	-	5.45	5.5—7.5	3 65	-
69	Wilcox Fish and Potash,	21.40	3.86	3.5—4.5	2.82	2.46	1.25	6.53	5—7	5.28	-	4.02	4—6
75	Quinnipiac Fish and Potash, Cross Brand,	21.24	3.37	3.25—4.25	2.17	2.82	1.71	6.70	-	4.99	2—5	4.16	3—5
79	Bowker's Square Brand Fish and Potash,	14.50	2 64	2.25—3.25	3.74	2.75	2 87	9.36	8—10	6.49	-	4.01	4—6
84	Jefferd's Animal Fertilizer with Potash,	4.93	3 60	4.12—5.77	0.13	12.05	5.78	17.96	14—16	12.18	-	5.28	5—7
85	Bartlett's Animal Fertilizer with Potash,	4.34	4.46	3.30—4.12	0.15	5.83	7.00	12.98	16—18	5.98	-	5.84	7—8
99	Clark's Cove Fish and Potash,	13.26	3.28	2.47—4.12	2.57	3.85	2.71	9.13	-	6.42	6—8	4.90	3—5
100	Clark's Cove New England Favorite,	13.19	2.54	2.27—2.68	5.86	3.42	3.67	12.95	-	9.28	9—11	2.03	2—2.5
102	Red Star Brand Special for Potatoes,	15.87	2.69	3—4	2.33	3.56	3 15	9.04	8—10	5.89	6—8	4.70	5—6

* Sulphate of potash, the source of potash

4. Analyses of Commercial Fertilizers, etc. — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
107	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Taunton.
108	Standard Ground Bone and Potash,	B. Randall, 113 Central St., Boston, Mass.,	Boston.
112	Potato Fertilizer,	H. S. Miller & Co., Newark, N. J.,	Sunderland.
113	Standard Superphosphate,	H. S. Miller & Co., Newark, N. J.,	Sunderland.
116	Onion, Potato and Tobacco Manure,	The Quinnipiac Company, New London, Conn.,	South Deerfield.
117	Pequot Fish and Potash,	The Quinnipiac Company, New London, Conn.,	South Deerfield.
118	Potato Manure,	The Quinnipiac Company, New London, Conn.	South Deerfield.
120	Phelps' Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
121	Phelps' Complete Manure for Top-dressing,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
129	Complete Manure for Top-dressing Grass and Grain,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
131	Fish and Potash, "A" Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
133	Grass and Grain Spring Top-dressing,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
135	Fish and Potash, "D" Brand,	Joseph Church & Co , Tiverton, R. I.,	Stoughton.
136	Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Boston.
139	Ground Bone Fertilizer,	J. C. Dow & Co , Boston, Mass.,	Cambridgeport.
140	Standard Superphosphate,	Standard Fertilizer Company, Boston, Mass.,	Ipswich.
142	Lavery's Superphosphate,	Wm. Lavery, Amesbury, Mass.,	Amesbury.
143	Ammoniated Dissolved Bone Phosphate,	H. S. Miller & Co., Newark, N. J.,	Clinton.
144	Harvest Queen Phosphate,	H. S. Miller & Co., Newark, N. J.,	Clinton.
145	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Clinton.
149	Fish and Potash,	The Miles Fertilizer and Oil Company, Milford, Conn.,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
107	High-grade Ammoniated Bone Superphosphate,	13.46	2.24	2—2.5	7.92	2.29	2.11	12.32	11—15	10.21	9—12	1.78	2
108	Standard Ground Bone and Potash,	10.18	2.64	1.6—2.5	0.95	7.89	7.79	16.63	13—16	8.84	5—7	1.88	2
112	Potato Fertilizer,	9.77	4.86	3.71—4.12	3.66	2.89	0.91	7.45	-	6.55	8.5—10	7.66	7—8
113	Standard Superphosphate,	16.74	2.80	2.35—2.68	9.30	1.06	0.40	10.76	11.5—14.5	10.36	10—12	2.20	1.5—2
116	Onion, Potato and Tobacco Manure,	16.05	3.26	3.25—4.25	2.39	7.04	1.62	11.05	9—14	9.43	8—11	6.52	7—8
117	Pequot Fish and Potash,	9.50	2.86	2.5—3.25	0.20	4.28	3.67	8.15	-	4.48	3—5	5.15	4—6
118	Potato Manure,	14.04	3.57	2.5—3.25	1.71	4.97	3.11	9.79	6—11	6.68	5—9	5.81	5—6
120	Phelps' Phosphate,	15.51	2.78	2.47—3.30	10.26	0.69	0.33	11.28	10—12	10.95	-	3.02	3—4
121	Phelps' Complete Manure for Top-dressing,	9.83	5.63	4.12—4.94	5.23	2.46	0.32	8.01	7—8	7.69	4—5	8.27	8—10
129	Complete Manure for Top-dressing Grass and Grain,	10.29	4.94	4.94—5.77	3.53	3.02	0.26	6.81	-	6.55	5—7	3.13	2.5—3.5
131	Fish and Potash, "A" Brand,	23.34	2.86	2—3	3.94	2.60	0.96	7.50	-	6.54	4—6	3.94	4—6
133	Grass and Grain Spring Top dressing,	10.93	5.02	4.12—5.77	3.93	2.66	2.56	9.15	7—9	6.59	7	6.26	5—7
135	Fish and Potash, "D" Brand,	18.59	3.36	3.30—4.12	1.05	2.92	1.66	5.63	5—6	3.97	-	4.62	3—4
136	Imperial Bone Superphosphate,	18.48	2.50	2.06—2.47	0.86	5.60	3.89	10.35	9—10	6.46	8—9	2.45	2.5—3
139	Ground Bone Fertilizer,	5.65	1.73	1.65—2.47	0.43	5.62	16.11	22.16	18—22	6.05	-	2.86	3—4
140	Standard Superphosphate,	12.93	2.32	2.5—3.5	8.80	2.02	1.19	12.01	11—16	10.82	9—13	1.83	2—3
142	Lavery's Superphosphate,	11.86	2.04	1.97	2.28	4.39	5.71	12.38	10.17	6.67	7.08	2.60	2.36
143	Ammoniated Dissolved Bone Phosphate,	11.50	1.82	1.65—2.06	7.57	2.18	0.46	10.21	9.5—12.5	9.75	8—10	1.90	1.5—2
144	Harvest Queen Phosphate,	6.22	1.04	0.82—1.65	3.10	8.11	1.25	12.46	10—12	11.21	10—12	1.83	1.5—2
145	Vegetable Bone Superphosphate,	13.24	5.80	4.94—5.77	4.20	3.82	0.42	8.44	9—7	8.02	6—7	6.10	-*
149	Fish and Potash,	21.50	3.06	3.30—4.94	5.91	0.12	1.13	7.16	-	6.03	5—8	4.10	4—6

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
22	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
23	Stockbridge's Manure for Top-dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
34	Original Coe's Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Lee.
43	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham
62	Darling's Fertilizer for Lawn and Gardens,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Lowell.
65	Mapes' Fruit and Vine Manure,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Lowell.
70	Ammoniated Dissolved Bone,	Quinnipiac Company, New London, Conn.,	Northampton.
80	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
88	Potato Phosphate,	Williams & Clark Co., New York, N. Y.,	Worcester.
91	Quinnipiac Market Garden Manure,	The Quinnipiac Company, New London, Conn.,	Fall River.
92	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
94	Complete Grass Manure,	H. J Baker & Bro., New York, N. Y.,	Fall River.
101	Clark's Cove Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md., Licensees,	New Bedford.
109	Market Garden Fertilizer,	B. Randall, Boston, Mass.,	Boston.
114	Tobacco Fertilizer,	H. S. Miller & Co., Newark, N. J.,	South Deerfield.
122	Phelps' Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
123	Phelps' Complete Manure for Potatoes,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
150	Special Favorite,	Davidge Fertilizer Company, New York, N. Y.,	Williamsburg.

4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
22	Lawn and Garden Dressing,	10.35	4.29	4—5	3.44	2.70	3.98	10.12	-	6.14	5—6	4.46	5—6
23	Stockbridge's Manure for Top-dressing,	6.20	4.56	5—6	3.25	3.68	5.40	12.33	-	6.93	6—7	4.76	5—6
34	Original Coe's Superphosphate of Lime,	14.89	2.34	2.05—2.85	8.84	1.36	1.66	11.86	10—14	10.20	8—11	1.87	1—2
43	Special Potato Manure,	21.07	3.18	3.7—4.5	5.48	1.97	2.09	9.54	7—10	7.45	6—8	4.86	-*
62	Darling's Fertilizer for Lawn and Gardens,	16.40	4.22	4—6	3.24	6.82	1.94	12.00	10—12	10.06	-	5.99	5—6
65	Mapes' Fruit and Vine Manure,	14.10	2.30	1.65—2.47	7.11	0.36	0.51	7.98	7—9	7.47	-	12.22	11—12
70	Ammoniated Dissolved Bone,	14.69	1.94	1.65—2.47	3.52	6.24	1.70	11.46	11—14	9.76	9—12	2.54	4—6
80	Stockbridge's Manure for Onions,	18.87	3.05	3.25—4.25	5.83	3.05	1.15	10.03	8—10	8.88	7—8	4.58	5—6
88	Potato Phosphate,	11.28	2.52	2—3	5.89	2.64	1.88	10.41	-	8.53	6—8	6.12	6—8
91	Quinnipiac Market Garden Manure,	16.07	3.68	3.25—4.25	3.09	6.30	1.19	10.58	-	9.39	8—11	6.34	7—8
92	Brightman's Fish and Potash,	20.91	3.80	2.47—4.12	1.79	2.54	1.30	5.63	6—7	4.33	2—3	3.67	2—3
94	Complete Grass Manure,	18.70	3.20	3.71	4.82	1.60	0.28	6.70	-	6.42	5	8.35	7
101	Clark's Cove Pilgrim Fertilizer,	17.56	1.36	1.03—2.68	5.53	1.95	1.97	9.45	-	7.48	6.5—7.5	3.11	2.5—3.5
109	Market Garden Fertilizer,	17.89	3.76	1.65—2.47	4.41	5.52	0.29	10.22	10—16	9.93	8—10	2.97	2—4
114	Tobacco Fertilizer,	19.24	5.30	5.35	0.36	0.75	1.13	2.24	-	1.11	3—4	7.89	5.5
122	Phelps' Complete Manure for Corn,	13.59	4.36	4.12—4.94	7.41	3.90	0.56	11.87	8—10	11.31	6—7	8.31	6—7
123	Phelps' Complete Manure for Potatoes,	12.03	4.52	3.30—4.12	5.88	2.39	0.42	10.16	6—8	8.27	5—6	10.16	8—10
150	Special Favorite,	16.82	1.80	1.24—2.06	7.70	3.73	1.15	12.58	11—14	11.43	10—12	1.66	1.5—2.5

* Sulphate of potash, the source of potash.

Agricultural Chemicals.

Muriate of Potash.

[I. and II. sent on from Amherst, Mass.; III. sent on from Concord, Mass.; IV. and V. sent on from Eastham, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	0.43	1.90	0.64	2.97	2.10
Potassium oxide,	50.97	49.20	49.68	47.24	49.20
Chlorine,	48.64	53.00	50.00	38.83	44.85
Insoluble matter,	0.11	0.11	Trace.	0.54	0.42

[I. and II., sulphate of potash and magnesia, sent on from Amherst, Mass.; III., sulphate of potash, sent on from Eastham; IV., sulphate of potash, sent on from Feeding Hills.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	14.70	17.35	8.26	2.54
Magnesium oxide,	6.97	7.02	–	10.88
Potassium oxide,	16.96	29.48	26.60	24.90
Sulphuric acid,	32.97	40.68	41.96	48.32
Insoluble matter,	2.70	1.47	0.51	2.67

Nitrate of Soda.

[I. and II. sent on from Amherst; III. sent on from Eastham; IV. sent on from Concord.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	1.74	1.50	6.62	1.30
Sodium oxide,	38.14	33.63	44.96	–
Nitrogen,	14.44	15.46	14.92	15.48
Insoluble matter,	Trace.	0.10	None.	Trace.

Agricultural Chemicals — Concluded.

Sulphate of Ammonia.

[Two samples from Amherst.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.46	2.21
Nitrogen,	20.14	21.30
Sulphuric acid,	60.05	59.37
Insoluble matter,	0.06	Trace.

5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

Wood Ashes.

[I, II. and III. sent on by Geo. A. Tapley, Revere, Mass.; IV. sent on by Coolidge Bros., South Sudbury, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C,	18.74	12.25	4.08	2.92
Calcium oxide,	28.24	5.08	25.63	37.10
Magnesium oxide,	4.64	0.27	5.64	6.45
Ferric oxide,	1.10	12.36	1.18	1.77
Potassium oxide,	5.94	2.24	5.34	5.42
Phosphoric acid,	2.11	0.46	2.92	2.05
Insoluble matter (before calcination),	10.52	58.45	13.69	15.37
Insoluble matter (after calcination),	8.31	55.19	12.11	13.11

5. *Analyses, etc.* — Continued.

Wood Ashes (Four Samples).

[Sent on by Coolidge Bros., South Sudbury, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	1.59	1.88	1.66	1.98
Calcium oxide,	41.60	39.89	43.09	40.39
Magnesium oxide,	3.00	4.41	2.33	3.85
Ferric oxide,	0.84	1.07	0.69	0.97
Potassium oxide,	6.96	6.08	5.44	5.18
Phosphoric acid,	1.23	2.06	1.17	1.71
Insoluble matter (before calcination),	11.65	15.87	9.03	12.17
Insoluble matter (after calcination),	11.07	12.96	7.91	10.26

Wood Ashes.

[I. sent on by H. G. Herrick, Lawrence, Mass.; II. sent on by James Logan, Worcester, Mass.; III. sent on by Frank Wheeler, Concord, Mass.; IV. sent on by Anson Wheeler, Concord, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C,	9.12	0.18	15.60	18.51
Calcium oxide,	31.63	39.39	32.86	31.07
Magnesium oxide,	3.34	3.12	3.81	2.69
Ferric oxide,	1.07	–	–	–
Potassium oxide,	5.88	7.28	5.11	5.84
Phosphoric acid,	2.97	2.10	1.48	2.00
Insoluble matter (before calcination),	18.79	12.80	16.59	8.67
Insoluble matter (after calcination),	12.67	11.94	15.68	6.52

5. *Analyses, etc.* — Continued.

Wood Ashes

[I. from Experiment Station, Amherst, Mass.; II. sent on by C. L. Hartshorn, Worcester, Mass.; III. sent on by L. F. Priest, Rock Bottom, Mass.; IV. sent on by H. F. Cross, Hingham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	15.07	0.42	15.70	4.26
Calcium oxide,	31.09	28.34	34.07	20.05
Magnesium oxide,	3.34	2.99	3.57	6.36
Ferric oxide,	–	–	–	–
Potassium oxide,	5.29	8.72	4.64	4.68
Phosphoric acid,	1.37	0.71	1.36	2.88
Insoluble matter (before calcination),	13.20	52.73	12.56	42.30
Insoluble matter (after calcination),	10.22	27.73	11.10	39.98

Wood Ashes.

[I. and II. sent on by W. L. Hubbard, Sunderland, Mass.; III. sent on by W. L. Faxon, Quincy, Mass.; IV. sent on by F. H. Williams, Sunderland, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	22.29	20.91	4.73	16.54
Calcium oxide,	32.32	29.97	32.94	32.74
Magnesium oxide,	3.14	3.04	4.43	3.01
Ferric oxide,	1.05	1.24	1.24	0.37
Potassium oxide,	4.27	5.64	6.79	6.56
Phosphoric acid,	1.47	1.32	1.79	1.43
Insoluble matter (before calcination),	14.75	12.13	15.15	10.54
Insoluble matter (after calcination),	11.52	10.33	13.12	8.78

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by C. F. Clark, Granby, Mass.; III. sent on by L. B. Smith, Eastham, Mass.; IV. sent on by J. D. W. French, North Andover, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	15.37	13.17	14.08	14.52
Calcium oxide,	35.28	32.82	35.16	34.02
Magnesium oxide,	3.24	3.50	2.79	3.79
Ferric oxide,	1.62	2.80	0.93	0.94
Potassium oxide,	7.73	6.86	4.16	5.88
Phosphoric acid,	0.78	0.79	1.69	2.37
Insoluble matter (before calcination),	7.56	11.10	13.57	11.49
Insoluble matter (after calcination),	6.80	8.73	11.32	9.64

Wood Ashes.

[I. sent on by F. F. O'Neil, North Sudbury, Mass.; II. sent on by Jonathan Ames, South Lincoln, Mass.; III. sent on by F. C. Davis, East Longmeadow, Mass.; IV. sent on by B. W. Brown Concord, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.88	2.31	21.39	12.70
Calcium oxide,	35.41	32.82	28.01	32.67
Magnesium oxide,	2.75	5.34	2.86	2.64
Ferric oxide,	1.65	1.71	1.64	1.16
Potassium oxide,	6.17	6.53	4.60	5.22
Phosphoric acid,	1.83	2.29	2.21	1.40
Insoluble matter (before calcination),	12.69	20.46	13.66	24.81
Insoluble matter (after calcination),	11.60	16.20	12.37	17.41

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. sent on by Elijah Bradstreet, Danvers, Mass.; II. sent on by C. W. Copeland, Campello, Mass.; III. sent on by C. E. Adams, South Framingham, Mass.; IV. sent on by Thomas Roche, South Deerfield, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.33	10.24	11.01	23.36
Calcium oxide,	34.10	37.89	33.64	25.75
Magnesium oxide,	2.64	2.70	4.01	3.75
Ferric oxide,	0.98	0.85	1.30	–
Potassium oxide,	10.80	6.70	5.77	7.96
Phosphoric acid,	1.06	1.60	1.45	2.58
Insoluble matter (before calcination),	20.04	9.84	16.30	14.83
Insoluble matter (after calcination),	7.54	8.54	14.60	9.36

Cotton-hull Ashes.

[Sent on by W. L. Boutwell, Leverett, Mass.]

	Per Cent.
Moisture at 100° C.,	10.35
Calcium oxide,	19.35
Magnesium oxide,	10.99
Potassium oxide,	27.19
Phosphoric acid,	9.48
Insoluble matter (before calcination),	13.27
Insoluble matter (after calcination),	10.86

5. *Analyses, etc.* — Continued.

Saltpetre Waste.

[I. sent on from the American Powder Mills, Acton, Mass.; II. sent on by Coolidge Bros., South Sudbury, Mass.; III. sent on by L. B. Smith, Barre, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.19	0.38	4.82
Calcium oxide,	0.47	0.84	0.85
Magnesium oxide,	0.27	0.05	0.25
Sodium oxide,	36.82	49.37	50.07
Potassium oxide (4½ cents per pound),	15.04	2.55	1.55
Sulphuric acid,	1.02	0.81	1.30
Chlorine,	53.50	58.00	57.04
Nitrogen (17 cents per pound),	1.90	0.65	0.52
Insoluble matter,	Trace.	Trace.	0.09
Valuation per ton,	$20 00	$4 11	$3 17

Refuse from Glue Factory.

[Sent on by Chas. A. Newhall, Lynn, Mass.]

	Per Cent.
Moisture at 100° C.,	43.06
Organic and volatile matter,	71.02
Ash,	28.98
Phosphoric acid,	0.217
Nitrogen,	7.82
Insoluble matter,	18.65

5. *Analyses, etc.* — Continued.

Fish Chum.

[Two samples, sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	11.19	14.53
Organic and volatile matter,	84.94	44.35
Total phosphoric acid,	6.58	4.98
Soluble phosphoric acid,	0.44	0.57
Reverted phosphoric acid,	3.26	3.19
Insoluble phosphoric acid,	2.88	1.22
Nitrogen,	8.14	4.70
Insoluble matter,	1.23	29.37

Dry Ground Fish.

[I. sent on by S. S. Dwight, Hatfield, Mass.; II. sent on by S. G. Hubbard, Hatfield, Mass.; III. sent on by Thaddeus Graves, Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	9.65	6.30	8.86
Ash,	22.40	20.40	17.72
Total phosphoric acid,	6.88	7.25	6.97
Soluble phosphoric acid,	0.49	0.52	0.49
Reverted phosphoric acid,	3.06	3.89	2.04
Insoluble phosphoric acid,	3.33	2.84	4.44
Nitrogen,	9.50	6.73	7.56
Insoluble matter,	1.92	4.99	1.17

5. *Analyses, etc.* — Continued.

Blood, Meat and Bone.

[Sent on by Isaac Madill, Lexington, Mass.]

	Per Cent.
Moisture at 100° C.,	7.87
Ash,	20.63
Calcium oxide,	10.33
Phosphoric acid,	8.29
Nitrogen,	5.84
Insoluble matter,	0.48

Ground Bone.

[I. sent on by E. H. Smith, Northborough, Mass.; II. sent on by the Hargrave Manufacturing Company, Fall River, Mass.; III. sent on by Anson Wheeler, Concord, Mass.; IV. sent on by A. W. Green, Carlton, Mass ; V. sent on by L. B. Smith, Eastham, Mass.]

Mechanical Analyses.

	Per Cent.				
	I.	II.	III.	IV.	V.
Fine, smaller than $\frac{1}{50}$ inch,	36.83	46.87	–	42.43	6.14
Fine medium, smaller than $\frac{1}{25}$ inch,	36.86	37.23	–	28.43	25.39
Medium, smaller than $\frac{1}{12}$ inch,	24.58	11.80	–	21.12	28.17
Coarser than $\frac{1}{12}$ inch,	1.73	4.10	–	8.02	40.30
	100.00	100.00	–	100.00	100.00

Chemical Analyses.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	4.51	8.29	6.14	8.21	8.25
Ash,	56.83	67.21	50.71	62.02	57.53
Total phosphoric acid,	22.69	26.72	18.17	17.67	16.84
Soluble phosphoric acid,	0.14	0.34	4.14	0.56	0.14
Reverted phosphoric acid,	5.70	2.78	8.77	3.61	0.35
Insoluble phosphoric acid,	16.85	23.60	5.26	13.50	16.35
Nitrogen,	3.86	2.78	2.78	2.72	3.42
Insoluble matter,	1.48	0.65	1.02	0.36	1.29

5. *Analyses, etc.* — Continued.

Bones boiled in Potash.

[Sent on from South Framingham, Mass.]

	Per Cent.
Moisture at 100° C.,	10.96
Organic and volatile matter,	40.52
Total phosphoric acid,	20.85
Soluble phosphoric acid,	0.06
Reverted phosphoric acid,	11.25
Insoluble phosphoric acid,	9.54
Potassium oxide,	4.33
Nitrogen,	2.60
Insoluble matter,	0.12

Starch Waste.

[Sent on from Rubber Factory, Hudson, Mass.]

	Per Cent.
Moisture at 100° C.,	10.01
Ash,	0.23
Nitrogen,	0.026

"Sludge" from Worcester Sewage Precipitating Tanks.

[Sent on by J. G. Jefferds, Worcester, Mass.]

	Per Cent.	
	As Received.	Dried to 100° C.
Moisture at 100° C.,	88.49	–
Organic and volatile matter,	90.50	–
Calcium oxide,	1.58	16.69
Magnesium oxide,	0.39	4.13
Ferric and aluminic oxides,	6.22	65.36
Potassium oxide,	0.05	0.51
Phosphoric acid,	0.10	1.05
Nitrogen,	0.05	0.54
Insoluble,	0.93	9.76
Valuation per ton,	$0 35	$3 77

5. *Analyses, etc.* — Continued.

Tankage.

[Sent on by the Bowker Fertilizer Company, Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	2.17
Total phosphoric acid,	12.79
Available phosphoric acid,	6.01
Insoluble phosphoric acid,	6.78
Fat (ether extract),	19.19

Florida Phosphate Rock.

[I., II. and III. sent on from Boston, Mass.; IV., V. and VI. sent on by Geo. Frost, Mandarin, Fla.; VII. sent on by M. D. Brooks, Fort Meade, Fla.]

Number.	Moisture at 100° C.	Phosphoric Acid.	Calcium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter.
I.,	1.43	33.33	44.16	1.31	4.65
II.,	1.18	27.07	37.57	2.59	21.96
III.,	5.47	6.95	12.36	4.07	53.61
IV.,	1.23	18.40	17.14	6.17	54.74
V.,	1.06	27.42	28.08	7.43	34.00
VI.,	10.79	2.92	0.55	–	71.32
VII.,	13.62	22.42	28.06	9.46	23.30

Phosphatic Fertilizers.

[I., plain superphosphate, sent on by Anson Wheeler, Concord, Mass.; II., dissolved bone-black, sent on by Anson Wheeler, Concord, Mass.; III., dissolved bone-black, sent on from Amherst, Mass.; IV., acid phosphate, sent on by L. B. Smith, Eastham, Mass.; V., German phosphatic slag, sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.43	10.26	20.07	10.39	0.47
Total phosphoric acid,	16.55	16.77	17.35	13.45	19.04
Soluble phosphoric acid,	10.87	13.92	14.80	10.17	–
Reverted phosphoric acid,	1.92	1.29	2.28	2.26	–
Insoluble phosphoric acid,	3.76	1.56	0.27	1.02	–
Calcium oxide,	Not	determ	ined.	–	46.47
Insoluble matter,	7.42	4.28	2.13	10.39	4.39

5. *Analyses, etc.* — Continued.

Hen Manure.

[Sent on by A. F. Hunter, South Natick, Mass.]

	Per Cent.
Moisture at 100° C.,	58.98
Ash,	24.75
Calcium oxide,	1.21
Magnesium oxide,	0.89
Potassium oxide,	0.32
Sulphuric acid (SO_3),	1.24
Phosphoric acid,	1.00
Nitrogen,	1.20
Insoluble matter,	17.69

Jute Waste.

[Sent on by J. H. Easterbrook, Dudley, Mass.]

	Per Cent.
Moisture at 100° C.,	13.10
Potassium oxide (4¼ cents per pound),	0.08
Phosphoric acid (6 cents per pound),	0.72
Nitrogen (10 cents per pound),	1.50
Valuation per ton,	$3 93

Shelled Corn, damaged by Fire and Water.

[Sent on by Chas. I. Pierce, West Northfield, Mass.]

	Per Cent.
Moisture at 100° C.,	21.40
Dry matter,	78.60
	100.00

Analysis of Dry Matter.

Crude ash,	1.54
" cellulose,	2.78
" fat,	4.96
" protein (nitrogenous matter),	9.77
Non-nitrogenous extract matter,	80.95
	100.00

Fertilizing Constituents of the Above.

	Per Cent.
Moisture at 100° C.,	21.40
Ash,	1.21
Phosphoric acid,	0.48
Potassium oxide,	0.28
Nitrogen,	1.06
Insoluble matter,	0.10
Valuation per ton,	$4 52

5. *Analyses, etc.* — Continued.

Buckwheat Hulls.

[Sent on by E. L. Smith, South Schodack, N. Y.]

	Per Cent.
Moisture at 100° C.,	11.900
Calcium oxide,	0.247
Magnesium oxide,	0.236
Ferric oxide,	0.020
Potassium oxide,	0.521
Phosphoric acid,	0.073
Nitrogen,	0.490
Insoluble matter,	0.066

Sea Weed.

[Sent on by D. C. Potter, Fairhaven, Mass.]

	Per Cent.
Moisture at 100° C.,	16.260
Calcium oxide,	2.061
Magnesium oxide,	1.175
Sodium oxide,	3.529
Potassium oxide,	0.785
Phosphoric acid,	0.191
Nitrogen,	4.250
Insoluble matter,	5.525

Residuum from Soft Coal.

[Sent on by B. N. Farren, Montague City, Mass.]

	Per Cent.
Moisture at 100° C.,	2.63
Calcium oxide,	1.38
Magnesium oxide,	0.45
Ferric oxide,	6.02
Aluminic oxide,	2.71
Potassium oxide,	0.20
Phosphoric acid,	0.47
Insoluble matter (before calcination),	88.09
Insoluble matter (after calcination),	72.38

5. *Analyses, etc.* — Continued.

"*Vegetable Ivory.*"

[Sent on by Moses Field, Longmeadow, Mass.]

	Per Cent.
Moisture at 100° C.,	8.140
Organic and volatile matter,	93.580
Ash,	6.420
Calcium oxide,	4.842
Magnesium oxide,	0.430
Ferric oxide,	0.043
Sodium oxide,	0.125
Potassium oxide,	0.461
Phosphoric acid,	0.237
Nitrogen,	0.500
Silicic acid,	0.033
Insoluble matter,	0.196

Concentrated Flower Food.

[Sent on from Springfield, Mass.]

	Per Cent.
Moisture at 100° C.,	11.20
Ash,	42.89
Phosphoric acid,	5.30
Lime,	6.18
Sulphuric acid,	15.73
Potassium oxide,	4.72
Sodium oxide,	17.45
Nitrogen in organic matter,	2.31
Nitrogen in nitrates,	4.66
Insoluble matter,	0.25

"*Flora Vita.*"

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C,	85.30
Solids,	14.70
Ferric and aluminic oxides,	0.65
Calcium oxide,	0.72
Magnesium oxide,	0.17
Potassium oxide,	4.16
Sodium oxide,	2.48
Phosphoric acid,	2.80
Sulphuric acid,	0.84
Chlorine,	0.06
Nitrogen,	2.61

5. *Analyses, etc.* — Concluded.

Compound Fertilizers.

[I. sent on by C. A. Bartlett, Worcester, Mass ; II. sent on by Ebed L. Ripley, Hingham, Mass.; III. sent on by A. L. Ames, Peabody, Mass.; IV. and V. sent on by A. E. Belden, North Hadley, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	3.54	4.41	10.70	14.29	9.26
Ash,	37.69	34.28	–	56.28	50.07
Total phosphoric acid,	14.12	14.70	10.55	12.04	7.39
Soluble phosphoric acid,	1.41	0.58	5.69	7.27	5.27
Reverted phosphoric acid,	7.46	6.84	3.66	3.41	0.24
Insoluble phosphoric acid,	5.25	7.28	1.20	1.36	1.88
Potassium oxide,	0.07	0.46	0.96	4.39	7.30
Nitrogen,	4.84	6.18	3.77	4.58	5.10
Insoluble matter,	0.55	0.49	1.29	0.72	0.82

Compound Fertilizers.

[I. sent on by J. M. Butman, Lowell, Mass.; II. sent on by Joseph Breck & Sons, Boston, Mass.; III. sent on by A. F. Crocker, North Amherst, Mass.; IV. and V. sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.99	11.01	9.16	11.51	15.81
Ash,	51.46	71.33	61.27	84.53	72.59
Total phosphoric acid,	14.57	8.47	14.89	0.67	10.23
Soluble phosphoric acid,	6.54	2.64	5.38	–	4.54
Reverted phosphoric acid,	5.83	4.38	3.78	0.50	4.32
Insoluble phosphoric acid,	2.20	1.45	5.73	0.17	1.37
Potassium oxide,	2.26	3.81	3.24	9.67	3.71
Nitrogen,	3.07	3.88	2.30	4.30	1.84
Insoluble matter,	0.83	4.31	4.90	1.74	7.41

Methods of Fertilizer Analysis.

Preparation of Sample. — The entire available sample is spread upon a smooth, hard surface, and intimately mixed without grinding, all lumps being broken up with a spatula. Unnecessary loss or gain of moisture is to be avoided. *Moisture:* dry 2 grams in the air-bath at 100 to 110° C. to a constant weight.

1. Total Phosphoric Acid. — Weigh out 2 grams in a platinum crucible, and destroy the organic matter by carefully burning in a muffle. Weigh when cool, to determine the "organic and volatile matter." Digest the crucible and contents with dilute hydrochloric acid, until the solution of the latter is complete. Filter, and evaporate the filtrate to complete dryness. The "insoluble matter" on the filter is burned and weighed. The residue left from the evaporation is taken up with dilute nitric acid, if the molybdic method is to be followed, but with hydrochloric acid if method (2) is preferred. The solution after filtering is made up to a volume of 200 cubic centimetres with distilled water.

(1) The molybdic method: 25 cubic centimetres of the solution are digested in a water-bath at 65° C. from one to two hours, with an excess of molybdic solution. The precipitate is brought upon a filter, and washed with water containing a little molybdic solution. It is then dissolved in ammonia water, the solution nearly neutralized with hydrochloric acid, and magnesia mixture added slowly, with constant stirring. The precipitate is allowed to stand at least three hours, when it is filtered through a Gooch crucible, washed with dilute ammonia, ignited and weighed.

(2) The following method is occasionally employed when phosphates of iron and alumina are present in small quantities only: To 50 cubic centimetres of the hydrochloric acid solution add ammonia in slight excess. After standing a few minutes, acidify with acetic acid, and filter off the phosphates of iron and alumina, washing carefully with water. To the filtrate add sufficient oxalate of ammonia to precipitate all the lime; digest for several hours at a temperature below boiling, and filter through double filters which have

previously been washed with oxalate of ammonia, washing thoroughly with water. Dissolve the phosphates of iron and alumina on the filter with warm dilute hydrochloric acid, and wash into a beaker containing a small quantity of powdered tartaric acid. When the latter has gone into solution, mix with the filtrate from the oxalate of ammonia. The phosphoric acid is precipitated with magnesia mixture, and treated as in (1).

Soluble phosphoric acid: Weigh out 2 grams into a beaker, cover with 10 to 15 cubic centimetres of water, and allow it to stand for fifteen minutes, stirring three times at equal intervals. Decant the solution through a filter into a graduated cylinder. Add another like quantity of water, and let it stand fifteen minutes more, stirring as before. Filter the solution into the cylinder, and wash the residue on the filter until the filtrate amounts to 200 cubic centimetres. The phosphoric acid is determined in an aliquot part of the solution as under total phosphoric acid.

Insoluble phosphoric acid: Add 100 cubic centimetres of neutral ammonia citrate (sp. gr. 1.09) to the beaker in which the digestion with water has been made. Put in a water-bath and heat to 65° C. Drop in the filter containing the residue from the above operation, and digest for thirty minutes, stirring every five minutes. Filter and wash thoroughly, using the suction pump. Dry, and burn. The ash is then treated as under total phosphoric acid.

Reverted phosphoric acid: The sum of the soluble and insoluble subtracted from the total gives the reverted or citrate-soluble phosphoric acid.

Reagents: The reagents used in the estimation of phosphoric acid are prepared according to directions given in the "Proceedings of the Association of Official Agricultural Chemists," 1889, pages 225 and 226.

For ammonium citrate, 370 grams of citric acid are dissolved in 1,500 cubic centimetres of water, nearly neutralized with crushed carbonate of ammonia, heated to expel carbonic acid, exactly neutralized with ammonia, and brought to a specific gravity of 1.09.

The molybdic solution is prepared by dissolving 100 grams of molybdic acid in 417 cubic centimetres of ammonia of specific gravity .96. Pour this solution into 1,250 cubic centimetres of nitric acid of specific gravity 1.20, and set in a warm place for several days, or until a portion heated to 40° C. deposits no yellow precipitate.

The magnesia mixture is prepared by dissolving 110 grams of crystallized magnesium chloride and 280 grams of ammonium chloride in 700 cubic centimetres of ammonia of specific gravity .96, and bringing to a volume of two liters.

2. *Methods of Determining Nitrogen.* — The Kjeldahl and soda-lime methods recommended by the Association of Official Agricultural Chemists, in their "Proceedings," 1889, pages 218 to 221, are employed, with occasional control analyses by the absolute cupric oxide mode.

3. *Method for Determining Potash.* — Weigh out two grams of the material in a platinum crucible, and char thoroughly at a temperature just below red heat. Digest for several hours with very dilute hydrochloric acid, on the water-bath. Filter into a graduated cylinder, and make up to 200 cubic centimetres. Take 50 cubic centimetres for each test. Warm, and add, in small quantities at a time, an excess of barium hydrate. Digest for one or two hours at a temperature of 70 to 90° C., filter, washing carefully, and add to the filtrate a few drops of ammonium hydrate, and enough ammonium carbonate to precipitate the excess of barium hydrate. Filter, and bring the filtrate to dryness on the water-bath in a platinum dish. Heat carefully in the covered platinum dish at a temperature just below red heat, until compounds of ammonia cease to come off. Take up the residue in water, filtering if necessary, and add an excess of platinum tetrachloride. Evaporate to dryness on the water-bath, add a small quantity of 80 per cent. alcohol, and allow it to stand for a few hours. Filter through a Gooch crucible, washing with alcohol, dry, and weigh; or filter through paper, wash as before, dry, and brush the potassium platinic chloride upon a weighed watch glass, with a camel's-hair brush, and weigh. If very impure, the double salt is washed with the strong solution of ammonium chloride, saturated with potassium platinic chloride, as recommended in the "Proceedings of the Association of Official Agricultural Chemists," 1889, page 223.

6. *Miscellaneous Analyses.*
(*Insecticides*).

Paris Green.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	1.34	1.31
Copper oxide,	33.35	33.45
Arsenious oxide,	61.25	61.21
Insoluble matter,	0.13	0.09
Acetic acid,	3.93	3.94
	100.00	100.00

Sulphatine.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.40
Calcium oxide,	18.60
Copper oxide,	2.61
Sulphuric acid,	4.73
Sulphur,	48.28
Insoluble matter,	1.63

Death to Rose Bugs.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	2.95
Ash,	54.14
Calcium oxide,	17.76
Copper oxide,	1.05
Sulphuric acid,	4.35
Sulphur,	34.53
Insoluble matter,	0.49

6. *Miscellaneous Analyses* — Concluded.

Prof. De Graff's Bug Destroyer.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	95.811
Residue from evaporation,	4.189
Mercury,	0.782
Chlorine,	0.265
Sulphuric acid,	0.484
Aluminic oxide,	0.904
Potassium oxide,	0.267

Tobacco Liquor.

[I. sent on by Franklin Crocker, Hyannis, Mass.; II. made at station: 6 pounds of stems treated for two days with warm water gave 13.5 ounces liquor.]

	Per Cent.	
	I.	II.
Specific gravity,	1.3858	1.3777
Moisture at 100° C.,	37.710	40.890
Ash,	19.420	27.770
Nitrogen, total,	2.010	1.730
Nitrogen as nitrates,	0.170	–
Nicotine,	2.115	0.530
Ferric and aluminic oxides,	0.229	0.017
Calcium oxide,	3.069	1.466
Magnesium oxide,	2.303	1.121
Phosphoric acid,	0.404	0.057
Sodium oxide,	0.207	0.525
Potassium oxide,	6.550	16.340
Insoluble matter,	Trace.	–

II. Analyses of Water sent on for Examination.

[Parts per million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1,	.06	.120	3.00	32.00	24.00	1.95	-	Amherst.
2,	.02	.140	6.00	90.00	58.00	2.60	None.	Amherst.
3,	.02	.040	Trace.	44.00	20.00	.79	None.	Rutland.
4,	None.	.03	52.00	194.00	70.00	3.51	None.	North Hadley.
5,	.02	.03	14.00	170.00	90.00	8 14	None.	Southbridge.
6,	.016	.070	32.00	224.00	84.00	2.60	None.	Amherst.
7,	.60	.12	10.00	58.00	16.00	1.69	None.	Gilbertville.
8,	.02	.04	16.00	162.00	76.00	3.25	None.	Northborough.
9,	.02	.03	8.00	96.00	16.00	1.27	None.	Amherst.
10,	.20	.04	12.00	92.00	48.00	1.95	None.	Gilbertville.
11,	.18	.04	12.00	74.00	40.00	1.95	None.	Gilbertville.
12,	.08	.12	24.00	130.00	62.00	3.51	-	Foxborough.
13,	Trace.	.04	16.00	102.00	46.00	3.25	None.	Southbridge.
14,	.20	.18	32.00	378.00	150.00	-	-	Amherst.
15,	.01	.07	Trace.	82.00	14.00	.79	-	Westhampton.
16,	.03	.14	Trace.	60.00	8.00	.63	None.	West Farms.
17,	.16	.06	20.00	160.00	30.00	2.99	-	North Amherst.
18,	.16	.32	6.00	134.00	36.00	1.27	-	South Gardner.
19,	.25	.30	4.00	-	-	-	-	Amherst.
20,	.08	.06	10.00	320.00	210.00	11.35	-	Rome, N. Y.
21,	None.	.08	16.00	168.00	28.00	2.60	-	North Amherst.
22,	.04	.20	18.00	178.00	98.00	3.77	None.	Amherst.
23,	Trace.	.04	14.00	102 00	92.00	1.56	Present.	Amherst.
24,	.02	.48	6.00	110.00	10.00	2.99	-	Northborough.
25,	.06	.10	22.00	274 00	104.00	6.71	None.	South Deerfield.
26,	Trace.	.04	10.00	160.00	40.00	2.86	-	Amherst.
27,	.13	.12	8.00	144.00	44.00	1.43	None.	Ashby.
28,	.03	.04	8.00	124.00	24.00	4.16	None.	Sunderland.
29,	Trace.	.02	28.00	144.00	14.00	5.00	Present.	Amherst.

Analyses of Water — Continued.

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
30,	None.	.05	20.00	180.00	60.00	3.38	None.	Roxbury.
31,	Trace.	.24	10.00	210.00	60.00	4.71	–	Sunderland.
32,	.24	15.36	12.00	64.00	20.00	1.95	–	Sunderland.
33,	.04	.20	8.00	110.00	14.00	2.08	–	Amherst.
34,	None.	.04	12.00	170.00	70.00	3.77	None.	Amherst.
35,	.01	.05	6.00	152.00	30.00	8.14	None.	South Amherst.
36,	.72	.56	6.00	154.00	76.00	3.51	–	Littleton.
37,	None.	.036	6.00	62.00	40.00	2.08	Present.	Amherst.
38,	.01	.135	34.00	202.00	100.00	2.73	–	Eastham.
39,	.06	.628	10.00	124.00	98.00	3.25	–	Amherst.
40,	1.12	3.84	28.00	450.00	216.00	6.86	None.	Amherst.
41,	.04	.104	14.00	180.00	54.00	3.25	None.	Amherst.
42,	.072	.10	8.00	126.00	90.00	3.25	None.	Sunderland.
43,	.276	.172	4.00	60.00	38.00	2.60	–	North Amherst.
44,	.128	.196	16.00	150.00	74.00	1.69	None.	Westford.
45,	.104	.152	4.00	34.00	16.00	.32	Present.	Westford.
46,	.10	.112	68.00	392.00	122.00	5.71	None.	Westford.
47,	.084	.128	16.00	150.00	44.00	1.69	None.	Westford.
48,	.08	.196	70.00	420.00	164.00	6.00	None.	Acton.
49,	.068	.120	22.00	124.00	54.00	1.27	–	Gloucester.
50,	.37	.21	12.00	58.00	28.00	1.95	None.	Weston.
51,	.022	.068	20.00	204.00	120.00	3.90	None.	Amherst.
52,	1.55	.40	32.00	314.00	118.00	3.90	Present.	Amherst.
53,	.064	.176	60.00	352.00	158.00	3.51	Present.	Amherst.
54,	.140	.180	76.00	458.00	150.00	9.57	Present.	Acton.
55,	.088	.080	12.00	92.00	78.00	1.95	None.	Barre Plains.
56,	.060	.044	16.00	156.00	56.00	2.60	None.	Barre Plains.
57,	.084	.092	Trace.	62.00	44.00	.48	None.	Brookline.
58,	.076	.108	4.00	32.00	20.00	.32	None.	Brookline.
59,	.100	.248	36.00	110.00	10.00	1.95	None.	Brookline.

Analyses of Water — Concluded.

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
60,	.08	.226	14.00	106.00	40.00	2.47	None.	Leverett.
61,	Trace.	.016	Trace.	88.00	18.00	3.25	None.	Shutesbury.
62,	.052	.052	340.00	844.00	664.00	3.25	None.	Clifton.
63,	.188	.176	8.00	126.00	82.00	2.60	Present.	Bedford.
64,	.140	.180	32.00	560.00	460.00	6.71	None.	Bedford.
65,	.088	.116	24.00	320.00	220.00	3.64	None.	Bedford.

The analyses have been made according to Wanklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wanklyn and E. T. Chapman.)

Mr. Wanklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated results of analyses indicate that Nos. 7, 10, 11, 14, 17, 18, 19, 23, 27, 29, 32, 36, 37, 40, 43, 44, 45, 46, 50, 52, 54, 59, 63 and 64 ought to be condemned as unfit for family use, while Nos. 12, 20, 25, 33, 39, 42, 47, 48, 49, 53, 55, 56, 58, 60 and 65 must be considered suspicious. From this record it will be seen that over one-third of the entire number of well waters tried proved unfit for drinking. Heating well waters to the boiling point removes, not unfrequently, immediate danger. Eight samples gave unmistakable evidence of the presence of lead.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by W. H. Beal.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1891.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1890, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse Salts, Ashes, etc.																							
Muriate of potash,	54	2.00	-	-	-	-	58.98	45.94	**51.80**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.60	.75
Sulphate of potash,	19	2.50	-	-	-	-	51.28	21.36	**33.60**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	15	4.75	-	-	-	-	29.48	16.96	**23.50**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Kainite,	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.55	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.57	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (*Kieserite*),	9	22.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	19	1.40	-	16.01	14.44	**15.75**	-	-	-	-	-	-	-	-	-	35.25	-	-	-	-	-	.50	.50
Sulphate of ammonia,	24	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Saltpetre waste,	10	2.75	-	3.30	.52	**2.43**	30.94	1.55	**15.50**	-	-	-	-	-	-	34.25	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	156	12.00	-	-	-	-	10.80	2.93	**5.25**	4.61	.51	**1.75**	-	-	-	-	34.80	3.25	.88	-	-	-	12.50
Cotton-seed hull ashes,	21	7.33	-	-	-	-	42.12	17.34	**23.80**	13.67	2.89	**8.50**	-	-	-	-	9.50	11.25	1.60	-	-	-	11.79
Ashes of spent tan-bark,	3	3.61	-	-	-	-	2.87	1.14	**2.04**	2.77	.13	**1.61**	-	-	-	-	33.46	3.55	-	-	-	-	24.33

Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue works,	1	12.74	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	.86	3.16	.36	1.18	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	5	18.18	-	-	-	-	-	-	-	2.72	.06	1.05	-	-	-	-	40.07	.64	.69	-	28.51	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	.67	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (*Orchilla*),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.08	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45
South Carolina rock phosphate,	5	1.50	-	-	-	-	-	-	-	30.51	25.81	28.03	.27	.33	27.69	-	41.87	3.03	4.80	-	-	-	9.04
Florida rock phosphate,	14	2.12	-	-	-	-	-	-	-	37.27	6.95	22.19	-	-	-	-	23.31	-	6.03	-	-	-	34.14

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc. — Concluded.																							
Navassa phosphate, ...	2	7.60	–	–	–	–	–	–	–	34.45	34.09	**34.27**	–	–	–	–	37.45	–	10.27	–	–	–	2.70
Brockville phosphate, ...	1	2.50	–	–	–	–	–	–	–	–	–	**35.21**	–	–	–	–	–	–	–	–	–	–	6.46
Phosphatic slag, ...	4	1.45	–	–	–	–	–	–	–	30.51	18.91	**23.49**	–	3.06	21.65	–	48.66	3.42	10.12	–	–	–	9.40
Bone-black, ...	5	4.60	–	–	–	–	–	–	–	30.54	16.56	**28.28**	–	–	–	–	–	–	–	–	–	–	3.64
South American bone-ash, ...	1	7.00	–	–	–	–	–	–	–	–	–	**35.89**	–	–	–	–	44.89	–	–	–	–	–	4.50
III. Refuse Substances.																							
Dried blood, ...	14	12.50	6.37	13.55	8.10	**10.52**	–	–	–	6.23	1.53	**1.91**	–	–	–	–	–	–	–	–	–	–	–
Ammonite, ...	1	5.88	–	–	–	**11.33**	–	–	–	–	–	**3.43**	–	–	–	–	–	–	–	–	–	–	1.38
Oleomargarine refuse, ...	1	8.54	14.42	–	–	**12.12**	–	–	–	–	–	**.88**	–	–	–	–	–	–	–	–	–	–	.96
Felt refuse, ...	1	29.24	33.53	–	–	**5.26**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.44
Sponge refuse, ...	1	7.25	–	–	–	**2.43**	–	–	–	–	–	**3.19**	–	–	–	–	3.94	1.27	–	–	–	–	39.05
Horn and hoof waste, ...	3	10.17	7.63	15.49	11.84	**13.25**	–	–	–	2.30	1.36	**1.83**	–	–	–	–	–	–	–	–	–	–	.24
Raw wool, ...	1	6.95	7.54	–	–	**12.88**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.63
Wool waste, ...	5	9.27	–	10.20	1.18	**5.64**	3.08	.54	**1.30**	–	–	**.29**	–	–	–	–	.67	.07	–	–	–	–	4.60
Wool washings (water), ...	1	–	–	–	–	–	–	–	**3.92**	–	–	–	–	–	–	.49	.28	–	–	–	–	–	–

Wool washings (acid), ...	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-	-
Wool washings (alkaline), ...	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	-	.22
Meat mass, ...	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	-	.58
Bone soup, ...	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone, . . .	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	-	64
Dried soup from rendering cattle feet, .	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering, . .	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse, ...	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	-	1.29
Bones, ...	131	7.47	56.07	4.70	1.62	4.12	-	-	-	32.52	18.04	23.50	.43	7.85	15.22	-	-	-	-	-	-	-	-	1.25
Tankage, ...	13	13.20	28.75	8.07	4.60	6.82	-	-	-	16.94	8.76	11.25	.27	4.75	6.23	-	-	-	-	-	-	-	-	1.23
Fish with less than twenty per cent. water,	55	12.75	21.50	11.40	6.81	7.25	-	-	-	11.26	5.50	8.25	.55	2.50	5.10	-	-	-	-	-	-	-	-	2.20
Fish with between twenty and forty per cent. water, ...	9	29.34	19.14	7.41	4.22	5.81	-	-	-	8.32	4.68	7.25	.82	2.87	3.56	-	-	-	-	-	-	-	-	1.85
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	-	1.35
Whale meat, raw, ...	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells, ...	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	-	.27
Castor-bean pomace, ...	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	-	-	-	-	.87	.29	-	-	-	-	-	1.75
Cotton-seed meal, ...	10	7.75	5.77	7.26	4.02	6.66	2.09	.89	1.62	3.17	1.26	1.95	-	-	-	-	.39	.99	-	-	-	-	-	.60
Rotten brewer's grain, ...	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	-	.59
Tobacco stems, ...	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	-	.82
Cotton waste, wet, ...	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	-	41.33
Cotton waste, dry, ...	2	6.89	-	2.09	1.32	1.71	1.62	.89	1.26	.84	.83	.84	-	-	-	-	1.99	.77	-	-	-	-	-	34.89

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances — Concluded.																							
Cotton dust,	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Hop refuse,	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Sumac waste,	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Wet kelp,	1	88.04	2.26	-	-	.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blue-green alga (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	12	55.13	13.75	2.54	.26	1.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peat,	9	61.50	7.71	1.40	.41	.75	-	-	-	-	-	-	-	-	-	-	.50	-	-	-	-	-	.38

Turf,	1	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	1	5.54	77.10	-	-	-	-	-	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	35.34
IV. Animal Excrement, etc.																							
Barn-yard manure,	21	69.77	8.36	.67	.26	.41	.80	.13	.40	.75	.13	.28	-	-	-	-	.30	.19	-	-	-	-	6.92
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fresh,	1	45.73	-	-	-	.79	-	-	.18	-	-	.47	-	-	-	-	.97	-	-	-	-	-	39.32
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1891.

Prepared by W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen — Free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	23	30.53	10.33	**19.13**	17.19	8.04	**10.33**	6.10	1.42	**2.42**	63.13	42.02	**55.30**	31.53	19.26	**25.97**	5.98	1:7.99
Fodder corn (ensilaged),	26	28.59	13.12	**22.03**	12.58	5.98	**8.11**	6.49	1.82	**3.84**	65.69	42.99	**55.79**	38.92	17.67	**26.88**	5.38	1:10.80
Sorghum,	6	23.18	12.38	**17.41**	11.84	7.46	**8.74**	2.00	1.21	**1.55**	64.93	47.65	**56.15**	29.27	22.00	**26.73**	6.83	1:11.62
Common millet,	9	49.29	21.32	**35.42**	12.16	5.43	**7.50**	3.99	2.09	**2.74**	58.61	46.39	**53.89**	33.98	24.88	**30.99**	4.84	–
Japanese millet ("white head"),	3	26.24	20.95	**24.76**	10.98	7.26	**8.72**	2.64	1.94	**2.33**	50.87	46.71	**49.60**	38.90	30.12	**34.47**	4.88	–
Japanese millet ("red head"),	6	33.83	22.66	**27.33**	7.99	4.92	**6.90**	2.45	1.58	**2.01**	60.83	50.11	**52.91**	35.29	25.21	**32.10**	6.08	–
White kibi,	2	24.26	22.85	**23.56**	15.14	10.79	**12.97**	1.61	1.50	**1.56**	53.66	52.30	**52.91**	31.70	23.03	**27.37**	5.19	–
Mochi millet,	3	42.29	30.07	**37.42**	11.90	6.11	**9.94**	1.94	1.74	**1.81**	67.08	49.06	**55.69**	29.80	20.01	**25.56**	7.00	–
Mix,	3	31.36	18.17	**24.45**	16.70	9.81	**13.53**	2.48	1.35	**1.86**	52.30	47.75	**51.27**	27.44	26.82	**27.06**	6.28	–
Green oats,	5	28.82	15.51	**20.03**	20.47	7.05	**13.85**	3.32	2.02	**2.68**	50.69	40.81	**45.90**	33.12	25.20	**29.70**	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	**34.63**	8.83	8.20	**8.52**	2.07	1.95	**2.01**	51.33	51.23	**51.27**	33.23	32.50	**32.87**	5.33	1:10.96
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	**25.93**	–	–	**9.38**	–	–	**1.01**	–	–	**57.80**	–	–	**24.66**	7.15	1:6.86
Vetch and oats (1 part vetch and 9 parts oats),	2	24.04	13.89	**18.97**	10.76	10.59	**10.68**	2.74	2.29	**2.52**	43.75	40.10	**41.91**	35.81	34.20	**35.01**	9.88	1:6.85
Horse bean, whole plant (*Vicia faba* L.),	1	–	–	**15.17**	–	–	**16.68**	–	–	**2.31**	–	–	**47.09**	–	–	**28.17**	5.75	1:2.71
Soja bean, whole plant (*Soja hispida* Mönch.),	9	36.36	18.54	**23.12**	22.19	14.02	**16.76**	8.98	2.71	**4.99**	47.89	40.80	**44.44**	31.89	21.67	**25.92**	7.89	1:4.09
Cow-pea vines,	3	21.19	18.15	**19.63**	17.93	11.24	**14.59**	2.99	1.81	**2.48**	60.62	46.13	**52.42**	25.88	21.87	**23.59**	6.92	1:5.82

Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	17.41	17.75	12.17	14.96	2.65	2.09	2.37	41.54	35.45	38.49	38.76	26.21	32.49	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	–	–	14.65	–	–	18.71	–	–	2.41	–	–	42.67	–	–	31.18	5.03	–
Spanish moss (*Tillandsia usneoides* L.),	1	–	–	39.20	–	–	4.45	–	–	2.54	–	–	57.73	–	–	32.61	2.67	–
II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	6	91.94	86.96	89.73	11.93	8.75	9.94	2.77	2.09	2.54	54.43	47.11	49.12	35.55	29.21	31.96	6.44	1:11.33
Rowen of mixed hay,	4	91.16	80.29	86.10	14.70	11.63	13.45	5.03	2.60	3.91	53.52	41.92	45.48	31.50	25.11	28.88	8.28	1:6.36
Timothy hay,	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.73	36.59	29.21	32.90	4.85	1:11.44
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	94.66	8.78	8.65	8.72	2.08	2.03	2.06	49.61	44.11	46.29	36.84	32.21	34.58	8.35	1:10.38
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	91.09	7.85	5.89	6.76	2.17	1.65	1.87	49.18	42.03	46.31	39.90	34.61	36.93	8.13	1:13.69
Perennial rye grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1:7.40
Italian rye grass (*Lolium Italicum* A Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass,	1	–	–	92.55	–	–	9.45	–	–	2.22	–	–	50.64	–	–	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	93.35	–	–	15.27	–	–	1.95	–	–	30.24	–	–	33.72	10.02	1:2.94
Low meadow hay,	1	–	–	91.99	–	–	9.51	–	–	1.88	–	–	46.27	–	–	35.59	6.75	–
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.64	35.91	29.80	33.54	5.49	1:7.78
Oats in blossom,	1	–	–	93.57	–	–	6.58	–	–	2.92	–	–	50.03	–	–	34.06	6.41	1:14.23
Oats in milk,	1	–	–	90.45	–	–	10.89	–	–	2.69	–	–	46.02	–	–	34.32	6.08	1:7.90
Oats, ripe,	1	–	–	91.30	–	–	6.05	–	–	2.61	–	–	48.92	–	–	36.31	6.11	1:15.03
Winter rye in blossom,	1	–	–	91.45	–	–	10.66	–	–	2.57	–	–	47.40	–	–	32.97	6.40	1:8.28

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen — free extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Coarse Dry Fodders — Concluded.																		
Barley in milk,	1	–	–	89.75	–	–	10.26	–	–	2.76	–	–	52.91	–	–	29.12	4.95	1:9.59
Japanese buckwheat,	1	–	–	94.29	–	–	10.80	–	–	2.22	–	–	38.60	–	–	36.02	12.36	–
Dry fodder corn,	4	93.35	90.58	92.11	9.31	6.17	7.74	2.76	1.11	1.84	58.89	53.86	55.97	33.75	23.03	29.31	5.14	–
Corn stover,	25	94.44	75.00	88.50	12.15	5.46	7.35	2.63	1.08	1.33	63.05	44.65	50.83	38.83	20.93	34.85	5.64	1:11.49
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	–	–	93.94	–	–	9.71	–	–	1.28	–	–	53.18	–	–	28.88	6.95	–
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	94.44	15.01	14.63	14.82	2.62	2.36	2.49	43.88	42.81	43.34	30.76	29.97	30.37	8.98	1:5.52
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	90.07	17.55	14.77	16.63	3.26	1.88	2.58	46.64	38.03	42.72	32.34	21.44	26.17	11.90	1:3.25
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.20	34.39	25.42	29.72	8.11	1:4.09
Sand lucerne, in bloom (*Medicago media* Pers.),	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	2	93.64	91.50	92.57	14.93	11.81	13.37	4.79	1.85	3.32	51.36	38.83	45.08	33.05	28.08	30.57	7.66	–
Blue melilot (*Melilotus cærulea* Desr.),	1	–	–	91.78	–	–	13.81	–	–	1.67	–	–	43.22	–	–	27.17	14.87	–
Sainfoin (*Onobrychis sativa*),	1	–	–	87.83	–	–	17.70	–	–	4.49	–	–	42.27	–	–	26.95	8.54	–
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	90.61	17.03	16.90	16.97	3.16	2.39	2.78	58.66	41.89	50.26	28.95	12.38	20.67	9.32	–
Hairy lotus (*Lotus villosus* Thuill.),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.48	15.07	19.78	8.27	–
Soja bean,	3	93.88	79.91	89.10	19.06	15.10	16.68	8.33	5.62	6.77	51.28	41.09	46.96	25.84	20.76	22.79	6.90	1:4.23

Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.58	19.06	21.67	9.29	1:4.82
Small pea (*Lathyrus sativus*),	1	-	-	94.20	-	-	16.57	-	-	1.49	-	-	42.76	-	-	32.88	6.30	-
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.23	41.49	48.18	25.92	24.37	25.15	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	-	-	92.56	-	-	19.58	-	-	1.22	-	-	38.95	-	-	31.88	8.37	-
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.80	30.68	30.05	30.37	8.24	1:3.87
Scotch tares,	1	-	-	84.20	-	-	22.00	-	-	1.89	-	-	31.46	-	-	30.89	13.76	-
Vetch and oats,	2	94.22	87.47	90.85	7.72	7.70	7.71	3.37	2.53	2.95	49.95	49.00	49.47	36.22	31.73	33.98	5.89	1:11.49
Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55
Soja-bean straw,	1	-	-	87.00	-	-	5.39	-	-	1.80	-	-	43.72	-	-	43.85	5.24	-
White daisy (*Chrysanthemum Leucanthemum* L.),	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Dry carrot tops,	1	-	-	90.24	-	-	20.12	-	-	2.01	-	-	50.39	-	-	13.61	13.87	-
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
Barley straw,	1	-	-	88.56	-	-	9.24	-	-	3.38	-	-	48.23	-	-	33.85	5.30	-
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	1:8.24
Beets, sugar,	11	19.53	9.87	14.73	17.44	7.32	10.97	.83	.58	.66	81.50	61.93	75.93	9.69	4.82	6.49	5.95	1:11.80
Beets, yellow fodder,	1	-	-	9.40	-	-	12.78	-	-	1.80	-	-	67.50	-	-	7.83	10.09	1:8.33
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	1:9.94
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	3	12.80	8.22	9.79	10.81	9.67	10.12	2.05	1.42	1.74	70.62	65.91	68.44	12.61	10.12	11.23	8.47	1:13.26
Carrots,	4	12.52	9.95	10.72	9.63	7.98	8.93	3.94	1.67	2.34	73.96	67.24	71.27	10.76	7.55	9.19	8.27	1:9.67

A. *Analyses of Fodder Articles* — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen — free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc. — Concluded.																		
Parsnips,	1	–	–	19.66	–	–	6.88	–	–	3.37	–	–	74.65	–	–	7.67	7.43	–
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn kernels and cobs (corn and cob meal),	36	94.00	83.91	89.71	15.06	7.82	10.00	5.27	3.36	4.09	81.41	70.13	76.73	10.41	5.63	7.56	1.62	–
Wheat grain,	1	–	–	89.42	–	–	13.35	–	–	1.79	–	–	80.26	–	–	2.42	2.18	1:6.42
Broom-corn seed,	1	–	–	85.90	–	–	11.21	–	–	4.05	–	–	74.05	–	–	8.34	2.35	–
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans,	1	–	–	89.72	–	–	30.03	–	–	1.11	–	–	56.48	–	–	8.11	4.27	1:2.24
V. Flour and Meal.																		
Corn meal,	25	89.95	82.96	86.03	16.08	9.73	10.87	5.08	3.10	4.48	83.24	73.20	80.80	3.60	1.20	2.18	1.67	1:9.75
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	9.33	78.07	68.00	72.55	4.78	3.69	4.08	2.43	1:8.82
Ground barley,	2	87.81	86.39	87.10	11.17	10.42	10.80	2.19	1.69	1.94	78.25	77.45	77.79	7.37	6.85	7.11	2.36	1:9.72

Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
VI. By-products and Refuse.																		
Linseed cake, old process,	7	92.52	88.50	90.54	39.97	30.98	36.64	9.87	6.24	7.16	44.72	37.76	40.61	9.69	8.04	8.68	6.91	1:1.66
Linseed cake, new process,	5	94.94	88.17	92.05	41.02	35.03	39.18	4.08	2.17	3.12	46.49	40.83	41.87	10.31	8.93	9.38	6.45	1:1.32
Cotton-seed meal,	9	93.16	88.81	91.31	47.04	36.54	43.12	14.72	9.57	12.89	33.87	24.61	27.50	10.83	6.28	8.29	8.20	1:1 39
Wheat bran,	27	92.58	86.30	89.43	20.54	15.67	17.85	6.08	2.80	5.03	62.18	54.27	59.48	14.26	7.49	10.70	6.94	1:4.12
Wheat middlings,	6	90.75	87.57	89.93	19.21	15.13	16.72	6.46	3.19	5.31	74.30	58.03	61.77	11.21	1.40	9.21	6.99	1:4.21
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Buckwheat middlings,	1	-	-	88.49	-	-	25.49	-	-	7.53	-	-	66.36	-	-	5.18	5.44	-
Gluten meal,	19	93.50	68.32	90.48	39.28	28.24	32.17	12.05	3.92	7.08	66.26	48.26	59.07	4.74	.41	1.07	.61	1:2.57
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewer's grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	1:3.06
Cocoa dust, from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.10	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46	-
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
I. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$2 84
Fodder corn ensilage,	1	71.60	.360	–	.330	.050	.100	.090	.020	.140	.040	1 68
Sorghum,	7	82.19	.233	–	.229	.025	.076	.075	.012	.088	.136	1 09
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	2 09
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 65
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 38
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	2 14
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 58
Horse bean,	1	74.71	.675	1.45	1.370	.090	1.370	.620	.200	.330	2.040	3 87
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 51
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 92
White lupine,	1	85.35	.440	.74	1.730	.680	3.070	.730	.170	.350	.900	3 39
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 20
II. Hay and Dry Coarse Fodders.												
English hay,	4	11.45	1.440	6.34	1.575	.160	.399	.240	.043	.391	.997	6 71
Rowen,	2	12.48	1.746	9.57	1.966	.168	.814	.250	.064	.464	1.920	8 16

Timothy hay,	2	7.52	1.260	4.93	1.530	.220	.710	.100	–	.460	1.170	6 14
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	5 20
Kentucky blue-grass,	2	5.34	1.320	–	1.694	.129	.398	–	.044	.431	2.863	6 45
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 55
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	5 63
Perennial rye grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	6 16
Italian rye grass,	4	8.71	1.189	–	1.273	.451	.857	.321	.071	.556	2.598	5 79
Salt hay,	1	5.36	1.180	–	.718	.017	.371	.335	.028	.248	–	4 92
Japanese millet ("white head"),	1	12.07	1.365	–	.788	–	.323	.328	.013	.418	1.228	5 81
Japanese buckwheat,	1	5.72	1.629	–	3.320	.349	3.418	.421	.148	.852	.378	9 38
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	7 40
Corn stover,	16	9.12	1.043	3.74	1.400	.112	.622	.384	.068	.293	1.885	5 28
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 72
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	9 38
Medium red clover,	2	7.91	2.184	8.36	2.286	.210	1.689	.402	.099	.447	.919	9 91
Alsike clover,	6	9.94	2.342	11.11	2.227	.309	2.153	.537	.197	.668	1.776	10 65
Lucerne (alfalfa),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 92
Bokhara clover,	2	7.43	1.975	7.70	1.832	.114	1.784	.347	.023	.558	.057	8 95
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	9 55
Sainfoin,	1	12.17	2.630	7.55	2.020	.540	1.160	.430	.040	.760	.470	11 57
Sulla,	2	9.39	2.460	–	2.093	.223	2.497	.350	.114	.453	.614	10 68
Lotus villosus,	2	11.52	2.095	8.23	1.807	.499	2.220	.476	.112	.594	.976	9 37

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	$9 54
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.683	.046	.527	.832	6 96
Small pea,	1	5.80	2.497	–	1.990	.469	1.373	.276	.138	.592	1.081	10 89
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	10 64
Scotch tares,	1	15.80	2.964	–	3.004	.238	1.698	.354	.460	.815	4.062	13 61
Vetch and oats,	3	9.91	1.299	9.58	1.349	.420	.663	.265	.098	.560	.521	6 24
Soja bean straw,	1	13.00	.750	–	1.322	–	.436	.469	.035	.397	.218	4 15
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	2 54
Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	15 52
Barley straw,	1	11.44	1.310	5.30	2.086	.183	.572	.180	–	.303	2.380	6 58
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	1 31
Beets, sugar,	4	86.95	.223	1.04	.477	.081	.057	.040	.013	.101	.048	1 28
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 14
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 06

Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 21
Turnips,	2	89.49	.178	1.01	.385	.078	.089	.027	.009	.104	.055	1 06
Carrots,	2	89.79	.147	9.22	.506	.062	.067	.023	.009	.093	.019	1 04
Parsnips,	1	80.34	.217	–	.617	.006	.088	.045	.005	.187	.019	1 48
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	1 03
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	49
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	6 37
Corn kernels and cobs (corn and cob meal),	29	8.96	1.409	–	.472	.059	.018	.176	.011	.571	.430	5 88
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	21 96
V. Flour and Meal.												
Corn meal,	2	13.52	2.050	1.42	.435	.064	.034	.187	.015	.707	.005	7 85
Hominy feed,	1	8.93	1.630	2.21	.490	–	.180	.280	–	.980	–	6 14
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	6 25
Wheat flour,	1	9.83	2.210	1.22	.540	–	.170	.050	–	.570	–	8 65
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	11 31
VI. By-products and Refuse.												
Linseed cake, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	21 49
Linseed cake, new process,	4	7.35	5.808	5.04	1.288	.823	.663	.655	.062	1.628	.345	22 80
Cotton-seed meal,	9	8.96	6.467	6.49	1.723	.291	.587	.589	.020	2.333	.457	26 25

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
VI. By-products and Refuse — Concluded.												
Wheat bran,	5	11.39	2.879	6.44	1.625	.159	.168	.899	.019	2.845	.141	$14 58
Wheat middlings,	1	9.18	2.630	2.30	.630	.110	.200	.210	–	.950	–	10 63
Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	8 46
Gluten meal,	4	8.53	5.430	.65	.045	.018	.050	.035	.069	.425	–	19 01
Spent brewer's grain,	1	6.98	3.050	6.15	1.550	.347	.296	.286	.159	1.260	1.770	12 14
Cocoa dust,	1	7.10	2.299	6.35	.630	–	.650	–	–	1.340	–	11 22
Broom-corn waste (stalks),	1	10.37	.870	4.70	1.858	–	.242	.170	–	.460	1.000	5 09
Cotton hulls,	3	10.63	.750	2.61	1.080	–	.200	.260	–	.180	.060	3 74
Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	90
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 44
Palmetto root,[1]	1	11.51	.540	.393	1.380	.345	.045	.004	.017	.157	.410	3 20

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12—15	3.09	-	-	-
Apple (Baldwin), ...	Oct. 9,	19.66	1.065	12—15	6.25	-	-	-
Apple (Baldwin), ...	Nov. 27,	-	1.075	12—15	10.42	-	-	-
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	-	-	-
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	-	-	-
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	-	-	-
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	12—15	4.77	-	-	-
Pear (Bartlett), ...	Sept. 7,	16.55	1.060	12—15	5.68	-	-	-
Pear (Bartlett), ...	Sept. 20,	-	1.065	12—15	8.62	-	-	-
Pear (Bartlett),‡	Sept. 22,	-	1.060	12—15	8.93	-	-	-
Cranberries, ...	-	10.71	1.025	15	1.35	-	-	-§
Cranberries, ...	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe), .	-	-	1.045	25	-	1.92	6.69	45
Early York Peach (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42.3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
Crawford Peach (mellow), .	-	11.36¶	1.055	18	-	1.70	8.94	76
Crawford Peach (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. *Analyses of Fruits* — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord, ...	July 17,	1.0175	31	8.30	.645	7.77	-
Concord, ...	July 20,	1.0150	31	8.10	.625	7.72	216
Concord, ...	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord, ...	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord, ...	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord, ...	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord, ...	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape, . . .	July 19,	1.020	31	9.00	.714	7.93	204
Purple Wild Grape, . . .	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Purple Wild Grape, . . .	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Purple Wild Grape, . . .	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape, . . .	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific, ...	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seedling, ...	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona, ...	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed), ...	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam, ...	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder, ...	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware, ...	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak, ...	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella, ...	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling, ...	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack, ...	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba, ...	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder, ...	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak, ...	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord, ...	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord, ...	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan, ...	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape, . . .	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled), .	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled), .	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2CO_3 in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled, .	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled, . .	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled, . . .	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled, ...	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled, . . .	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled, ...	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled, . . .	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled, ...	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled, ...	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled, ...	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled, . . .	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled, ...	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled, . . .	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled, ...	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled, . . .	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled, ...	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 PARTS OF GRAPES CONTAINED —			
		Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled, . . .	Sept. 23,	–	84.69	6.24	.75
Concord, girdled, ...	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled, . . .	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled, ...	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled, . . .	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled, ...	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled, . . .	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled, . . .	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled, ...	Oct. 9,	.54	85.15	9.12	.74

* One part of pure Na_2CO_3 in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	–	–	13.51	–	Fertilized.
Wild Purple Grape Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, . .	"	20.02	–	–	–	–	Unfertilized.
Wild White Grape Berries, . .	"	21.65	–	–	–	–	Fertilized.
Wild White Grape Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, . .	"	–	–	–	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62 65	.85	14.24	3.92	.53	13.18	4 63	Fertilized.
Concord Grapes, .	July 7,	41 73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. *Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 Parts of Ash contained —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit), . .	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice, . .	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice, . .	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp, . . .	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds, ...	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes, . .	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,* . .	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,† . . .	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Clinton Grape (fruit), . .	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple, . . .	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),‡ . .	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),§ . .	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines, . . .	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit), . . .	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines, . . .	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red, ...	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white, . . .	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound, . .	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,‖ .	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound, . . .	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,‖ . .	–	15.67	–	64.23	10.28	1.45	8.37	–
Asparagus stems, . . .	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots, . . .	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions, ...	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,*	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	Saxony,	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial, ...	Saxony, .	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	Saxony, .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, . .	Saxony, .	$1\frac{1}{2}$ to 2	13.10
II. White Magdeburg, . . .	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . . .	12.55	13.24	10.50
Kainite and superphosphate, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college)

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872–73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2.50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs.	15.4°	64° F.	11.38
Riviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda Solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,* . .	4.2	27	2.48	None	6.8	7.93
Aug. 16, .	No flower stalks in sight,* . .	5.8	24	4.06	None	9.0	11.10
Aug. 20, .	Flower stalks developed,* . .	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,* . . .	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12 8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* .	13.2	22	3.57	7.65	–	–
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18, .	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18, .	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21, .	Juice from the above,* . . .	13.0	21	–	–	–	–
Sept. 23, .	Juice from the above,* . . .	15.0	18	–	–	–	–
Sept. 25, .	Left on field 3 weeks,† . . .	19.8	21	11.91	6.27	–	–
Sept. 28, .	Left on field 3 weeks,† . . .	17.8	12	16.60	–	–	–
Oct. 4, .	Left on field 3 weeks,† . . .	16.1	17	8.62	6.16	12.0	–
Oct. 7, .	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8, .	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9, .	Freshly cut. Stripped two weeks,†	18.4	17	7.57	–	10.6	–
Oct. 14, .	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18, .	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19, .	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22, .	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23, .	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24, .	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 Parts of Cane contained —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October, .	Early Tennessee sorghum, mature, .	77.43	1.79	3.21	5.00	Grown on station grounds.
October, .	Price's new hybrid, ripe, . . .	77.80	2.92	3.78	6.70	
October, .	Kansas orange, green, . . .	80.67	2.38	3.63	6.01	
October, .	New orange, green, ...	78.30	2.96	3.85	6.81	
October, .	Honduras, green, ...	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

Variety.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,† . .	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,† . . .	1.052	–	4.85	5.70	20.38
Common sweet corn,‡ . . .	1.035	–	6.60	None.	–
Common yellow musk-melon,§ .	1.040	26	1.67	2.65	–
White-flesh water-melon, . . .	1.025	18	2.91	2.16	–
Red-flesh water-melon, . . .	1.025	22	3.57	2.18	–
Red-flesh water-melon, . . .	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖ . . .	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶ . . .	1.050	20	2.27	5.38	–
Nutmeg musk-melon,** . . .	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

		Solids.			Fat.			Curd.			Salt.			
	Analyses.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Ash.
Whole milk,	50	16.70	11.96	13.60	5.45	2.48	3.95	-	-	3.20	-	-	-	.70
Skim-milk,	-	-	-	10.19	-	-	.37	-	-	3.53	-	-	-	.80
Buttermilk,	-	-	-	8.18	-	-	.21	-	-	2.79	-	-	-	.80
Cream,	59	28.51	21.30	25.26	20.90	13.74	17.47	-	-	-	-	-	-	.02
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. Salt for Meat Packing and Dairy Purposes.

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.001	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	.316	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine salt, Bulletin 26, II.,	4 591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass ,	0.145	98.520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97.650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.016	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	
Royal salt,	.880	97.877	1.108	.016	.010	–	–	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	–	–	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	–	–	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	–	–	–	
Bradley salt,	.200	98.575	1.185	.029	.007	–	–	–	
Higgin's Eureka salt,	.855	98.891	.906	.293	.055	–	–	–	
Worcester refined salt,	.565	97.935	1.376	.097	.027	–	–	–	

METEOROLOGY.

1890.

The meteorological observations have been continued as in previous years. The temperature, the force and direction of the wind, and the amount of cloudiness, are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer is taken at these times. Instruments recording the maximum and minimum temperatures, and measuring the rainfall, are also used.

Besides our regular observations, records are made of casual meteorological phenomena, and the condition of farm crops, trees, etc., as affected by the weather or season.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society.

During the summer months we have sent weekly weather crop reports to the latter society, and have furnished a partial monthly report for the use of the secretary of the State Board of Agriculture.

The weather during January and February was exceptionally mild, even more so than during 1889. Considerable difficulty was experienced in getting ice. In this vicinity none was cut until February, when it reached a thickness of from six to eight inches.

There was hardly enough snow for good sleighing at any time during the winter. A snow-storm on the 20th of February gave sleighing for two or three days, and one on the 6th of March gave fair sleighing until the 10th. The temperature for March was lower than for either of the preceding months.

The total snow fall for March is recorded as seventeen inches, but with one exception it disappeared soon after falling.

The last heavy frost, during the spring, occurred April 29. Light frosts were reported on the 17th and 23d of May.

The weather during the early part of the season was, on the whole, favorable to the growth of farm crops. The first crop of hay was large, and most of it was secured in good condition during the dry weather preceding the heavy rain beginning July 24. The crop of rowen suffered somewhat on account of that drought, and other crops suffered to some extent. During the remainder of the growing season there was sufficient rain, most of the time an abundance.

Frost held off remarkably late, the first in the autumn occurring September 25, after which there was none until October 13.

The first trace of snow occurred November 11. There were 15.5 inches during December, with good sleighing most of the time.

The rainfall during the year was slightly above the average, and fairly distributed. The rains during April, June and November, however, were light, being less than two inches in each case.

The heaviest rain of the season occurred on the 24th, 25th and 26th of July, giving a rainfall of 4.65 inches.

From the 9th to the 15th of September it rained every day, giving 2.57 inches, and on the 17th of that month there was a fall of 1.50 inches. A storm on the 23d and 24th of October gave 2.30 inches.

During the year there were one hundred and fifty days recorded as "cloudy," seventy-one as "clear." The greatest number of cloudy days, seventeen, occurred in October, and the greatest number of clear days, nine, in November and December. In August there were but three clear days.

The prevailing wind during six months of the year was north-west. It was north-east during March, April and August, south-east during May and June, and south during July.

The mean annual temperature for the year, 46.43°, was about the average. The principal variations from the monthly average temperatures occurred in January, which has had a higher temperature during the period covered by the Amherst observation only in 1838, 1870 and 1880. February also was considerably warmer than usual. The average for December is the lowest since 1876.

The highest temperature during the year was 92°, occurring July 8; the lowest, — 9.5°, occurring March 7.

Summary of Meteorological Observations, 1890.

	Temperature, Degrees Fahrenheit.											Relative Humidity, Per Ct.				Precipitation, Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	26.7	35.1	30.1	30.5	39.8	21.5	18.3	61.5	2d	4.5	25th,	-	-	-	-	2.61	15th-16th
February,	26.6	36.0	30.4	30.8	39.9	22.5	17.4	59.5	26th	3.0	22d, 23d	-	-	-	-	4.01	8th
March,	25.1	35.6	30.0	30.2	38.9	21.6	17.3	59.5	12th	—9.5	7th	-	-	-	-	4.81	22d, 23d
April,	38.6	55.2	44.0	45.5	57.6	32.8	24.8	77.5	13th	22.0	19th	-	-	-	-	1.64	4th
May,	51.6	64.9	54.6	56.4	67.6	44.7	22.9	79.0	14th	32.0	2d, 12th	84.1	60.9	76.2	73.7	5.14	26th-27th
June,	60.2	73.2	62.5	64.6	76.3	53.1	23.2	86.5	30th	38.0	3d	83.7	57.4	78.4	73.2	1.48	5th-6th
July,	63.6	77.0	65.9	68.1	79.7	56.2	23.5	92.0	8th	41.0	10th, 21st	85.0	54.0	78.3	72.4	5.44	24th-26th
August,	62.5	74.3	64.3	66.3	76.6	57.2	19.4	86.0	4th, 6th	41.5	25th	89.8	61.1	83.6	78 2	4.60	19th-20th
September,	54.4	67.3	57.9	59.4	69.7	50.3	19.4	78.5	2d, 7th	29.5	25th	93.4	68.8	89.0	83.7	5.28	17th
October,	42.5	55.1	46.1	47.4	56.8	39.3	27.5	76.0	1st	26.5	22d	89.1	61 2	83.8	78.0	6.89	16th-17th
November,	32.4	43.2	34.7	36.3	46.0	27.5	18.5	60.0	6th	13.0	28th	-	-	-	-	1.24	17th
December,	18.6	25.1	21.6	21.7	36.2	5.4	30.8	42.5	23d	—5.5	30th	-	-	-	-	3.18	26th
Sums,	502.8	642.0	512.1	557.2	685.1	432.1	253.0	858.5	-	236.0	-	525.1	363 4	489.3	459.2	46.32	-
Means,	41.90	53.50	45.18	46.43	57.09	36.01	21.08	71.54	-	19.67	-	87.52	60.57	81.55	76.53	3.86	-

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.
January, . .	4, 19, 23,	10, 11, 23, 31,	1, 5, 6, 10, 11, 12, 13, 15, 16, 20, 27, 30.	-	-
February, . .	7, 14,	2, 7, 10, 20,	4, 7, 8, 14, 17, 18, 24, 25, 28.	-	1.
March, . .	24,	3, 5, 6, 15, 19, 28, 29, 31,	1, 11, 14, 21, 22, 23, 25, 26, 28.	28,	45, 24.
April, . . .	2, 3, 6, 8, 12, 16, 20, 21, 29.	-	4, 7, 8, 9, 25, 26, 27,	-	29.
May, . . .	17, 23,	-	1, 3, 4, 5, 6, 10, 11, 14, 15, 16, 17, 20, 26, 27, 28.	14, 28,	-
June, . . .	-	-	3, 4, 5, 6, 12, 13, 14, 15, 19.	5, 6,	-
July, . . .	-	-	3, 4, 7, 15, 19, 24, 25, 26, 31.	7, 19, 26, 31,	-
August, . .	-	-	1, 9, 10, 12, 17, 18, 19, 20, 21, 22, 23, 26, 27, 30.	17, 19,	-
September, . .	25,	-	5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 26.	17,	-
October, . .	13, 16, 22, 23,	-	4, 6, 7, 8, 10, 14, 16, 17, 19, 20, 23, 24, 25, 29, 30.	-	22, 25.
November, . .	1, 3, 4, 5, 6, 13, 14, 15, 21, 24, 26, 30.	-	2, 9, 11, 15, 17,	-	-
December, . .	2,	3, 5, 6, 26, 30,	3, 17, 18, 21,	-	16, 25.

C. A. GOESSMANN,
Director.

ANNUAL REPORT OF FRANK E. PAIGE,

TREASURER OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

For the Year ending Dec. 31, 1890.

RECEIVED.

Cash from Dr. J. P. Lynde, balance of last year,	$15 00	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from farm, etc.,	1,422 07	
Cash from fertilizer account,	1,905 00	
		$13,342 07

EXPENDED.

Cash paid salaries,	$4,478 03	
Cash paid laboratory supplies,	1,213 01	
Cash paid printing and office expenses,	838 34	
Cash paid farmer and farm labor,	2,050 10	
Cash paid farm stock and feed,	1,278 96	
Cash paid incidental expense,	899 93	
Cash paid construction and repairs,	599 22	
Cash paid expense of board of control,	75 62	
Cash paid fertilizer account,	1,565 00	
Cash on hand,	343 86	
		$13,342 07

SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

(*Dec. 31, 1890.*)

Buildings, etc.,	$30,702 00	
Farm inventory (live stock, crops, etc.),	2,299 45	
Office furniture (chemical laboratory),	1,456 75	
Chemicals and chemical apparatus (chemical laboratory),	2,605 95	
Furniture, herbariums and library (agricultural and physiological laboratory),	903 25	
Instruments, apparatus, etc. (agricultural and physiological laboratory),	822 10	
Total of inventory,		$38,789 50

BOSTON, MASS., Jan. 8, 1891.

This is to certify that I have examined the books and accounts of Frank E. Paige, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1890, and find them correct, and all disbursements properly vouched for, with a balance of cash in treasury of three hundred forty-three dollars and eighty-six cents, which is shown to be in bank.

W. R. SESSIONS,
Auditor.

INDEX

TO EIGHTH ANNUAL REPORT, 1890.

PUBLIC DOCUMENT . . . . No. 33.

NINTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1891.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
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18 POST OFFICE SQUARE.
1892.

Commonwealth of Massachusetts.

OFFICE OF THE SECRETARY, BOSTON, Jan. 14, 1892.

Hon. WILLIAM E. BARRETT, *Speaker of the House of Representatives.*

SIR: — I have the honor to transmit, for the use of the Legislature, the Ninth Annual Report of the Board of Control of the State Agricultural Experiment Station.

Very respectfully,

ISAAC H. EDGETT,
Deputy Secretary.

Boston, Jan. 13, 1892.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Ninth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
Secretary.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1891.

His Excellency William E. Russell,
Governor of the Commonwealth, President ex officio.

D. A. Horton of Northampton, ... Term expires, 1892.
C. L. Hartshorn of Worcester, ... Term expires, 1894.
Appointed by the State Board of Agriculture.

J. H. Demond of Northampton, ... Term expires, 1893.
T. P. Root of Barre, ... Term expires, 1891.
Appointed by the Board of Trustees of the Massachusetts Agricultural College.

F. H. Appleton of Peabody, ... Term expires, 1892.
Appointed by the Massachusetts Society for Promoting Agriculture.

Elbridge Cushman of Lakeville, . . . Term expires, 1892.
Appointed by the Massachusetts State Grange.

Wm. C. Strong of Newton Highlands, . . Term expires, 1894.
Appointed by the Massachusetts Horticultural Society.

H. H. Goodell, A.M., LL.D., Amherst,
President of the Massachusetts Agricultural College.

C. A. Goessmann, Ph.D., LL.D., Amherst,
Director of the Station.

Wm. R. Sessions, Hampden,
Secretary of the State Board of Agriculture.

Wm. R. Sessions, Hampden,
Secretary and Auditor.

Frank E. Paige, Amherst,
Treasurer.

STATION STAFF.

C. A. GOESSMANN, Ph.D., LL.D., *Director and Chemist*, . Amherst.
J. E. HUMPHREY, S.B., *Vegetable Physiologist (Mycologist)*, . Amherst.

ASSISTANTS.

R. B. MOORE, B.S., . . .	*General and Analytical Chemistry.*
C. S. CROCKER, B.S., . .	" " " "
B. L. HARTWELL, B.S.,* . .	" " " "
H. D. HASKINS, B.S., . .	" " " "
C. H. JONES, B.S., . . .	" " " "
F. L. ARNOLD, B.S., . .	" " " "
C. H. JOHNSON, B.S., . .	" " " "
W. A. PARSONS, B.S., . .	*Field Experiments and Stock Feeding.*
DAVID WENTZELL, . . .	*Farmer.*

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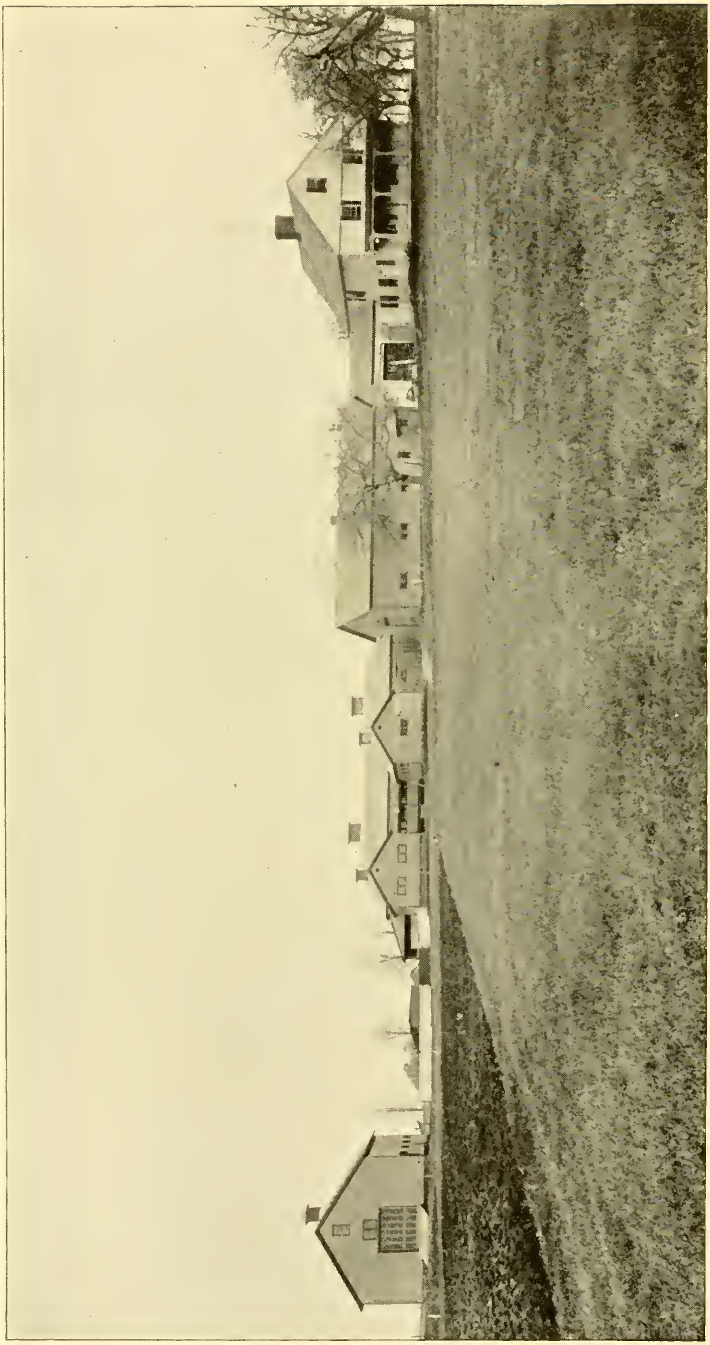
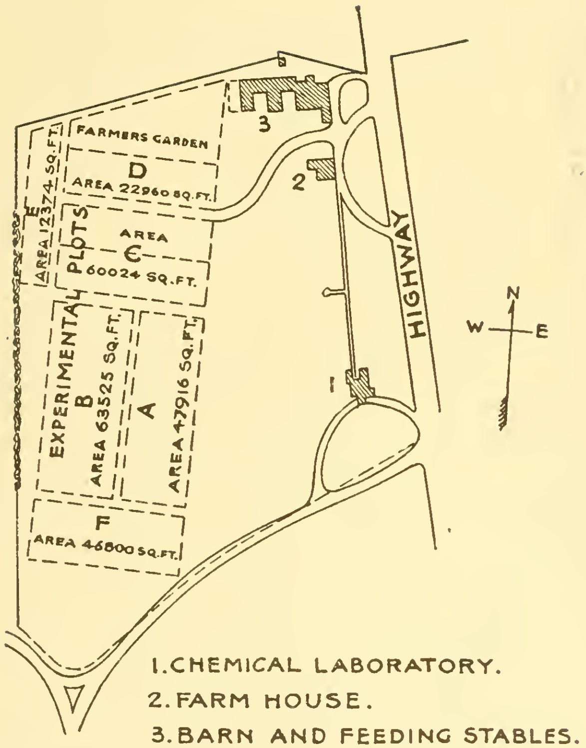
* Resigned June 1, 1891.





·MAP·OF·LAND·LEASED·TO·THE·

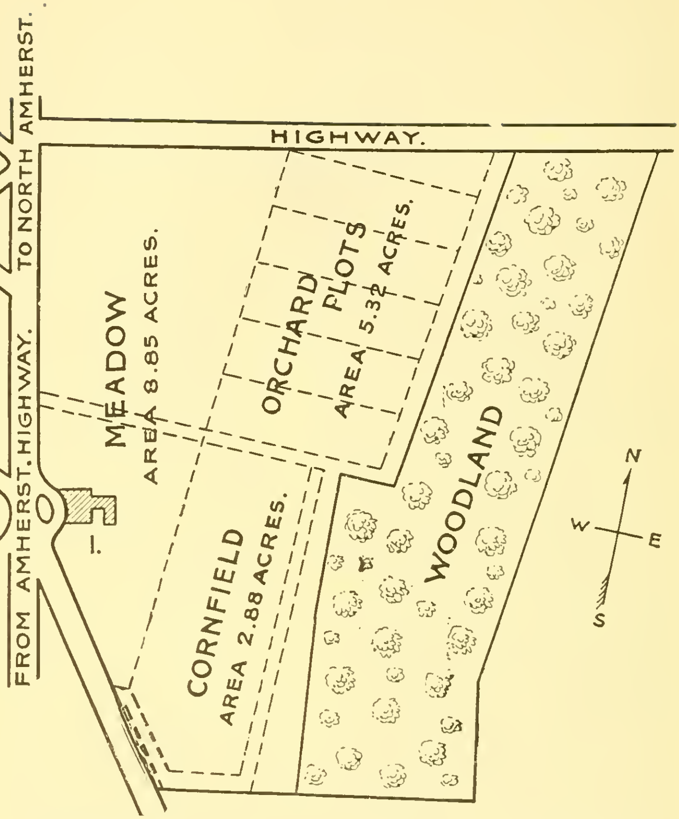
·MASSACHUSETTS·EXPERIMENT·STATION·

·FROM·THE·

·AGRICULTURAL·COLLEGE·FARM·

·WEST·OF·THE·HIGHWAY·

·AREA·TAKEN··17.72·ACRES·



1. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP·OF·LAND·LEASED·TO·THE
MASSACHUSETTS·EXPERIMENT·STATION
·FROM·THE·
AGRICULTURAL·COLLEGE·FARM
EAST·OF·THE·HIGHWAY
AREA·TAKEN·30.52·ACRES

NINTH ANNUAL REPORT OF THE DIRECTOR

OF THE

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The past year has been a prosperous one in the history of the Massachusetts State Agricultural Experiment Station.

The buildings have suffered no injury from any exceptional source and are in a well-preserved state, considering their respective age and previous condition.

The construction of a new barn, for storing separately in a desirable manner the products of the different experimental plats, has filled a serious want.

A favorable season has aided materially in a successful termination of a variety of field experiments as well as in a satisfactory general management of the farm work.

The different lines of investigation presented from time to time for your consideration have received their due attention as far as circumstances have rendered practicable. The amount of work accomplished in the field, the barn and the chemical laboratory compares well with the results of previous years. The introduction of the vegetation house for the purpose of studying, under well-defined circumstances, the influence of special articles of plant food on the growth and character of plants, besides other intricate questions of vegetable physiology, has added an important feature to our resources of efficient methods of observation for the advancement of an economical production of farm crops.

Prof. J. E. Humphrey has continued his observations regarding various diseases of fruit-trees and garden crops. An interesting description of his investigation during the past year forms part of this report (Part II. 9).

The details of the work carried on during the past year, 1891, are reported upon subsequent pages in the following order: —

Part I.

On Feeding Experiments — 1891.

I. Feeding Experiments with Milch Cows (three).
II. Feeding Experiments with Steers.
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (three).

I.

Feeding Experiments with Milch Cows — 1891.

1. Feeding experiments with milch cows: Old-process linseed meal *vs.* gluten meal (Chicago).
2. Feeding experiment with milch cows: Gluten meal (Chicago) *vs.* cotton-seed meal and old-process linseed meal.
3. Summer feeding experiment with milch cows: Green feed, — vetch and oats, soja bean and fodder corn. Grain feed, — corn meal, gluten meal (Chicago), with dried brewers' grain *vs.* wheat bran.
4. Creamery record of the station for 1890 and 1891.
5. Fodder analyses and valuation of fodder.

Part II.

On Field Experiments, and Observations in Vegetable Physiology and Pathology.

1. Effect of different kinds of nitrogen containing manurial substances on the yield of rye (Field A).
2. Experiments with prominent varieties of grasses and with grass mixtures to ascertain their comparative economical value under fairly corresponding circumstances (Field B).
3. Experiments with reputed fodder crops mostly new to our locality, and with a series of garden crops treated with different mixtures of commercial fertilizing ingredients (Field C).
4. Experiments with raising Stowell's evergreen sweet corn for ensilage (Field D).
5. Experiments with different commercial phosphates to study the economy of using natural phosphates or acidulated phosphates in farm practice (Field F).

6. Experiment with a Western variety of dent corn, Pride of the North, for ensilage (Field G).
7. Experiments with grass lands (meadows).
8. Report on general farm work in 1891.
9. Report of Prof. James Ellis Humphrey on plant diseases, etc., with observations in the field and in the vegetation house.

Part III.

Special Work in the Chemical Laboratory.

I. Communication on commercial fertilizers: —

1. General introduction.
2. Laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

Meteorological Observations.

The periodical publications of the station have been as numerous as during previous years. The applications for copies of bulletins and annual reports are steadily increasing. Our supply of bulletins I to XXX and of annual reports I to VI is exhausted.

In concluding this communication it gives me pleasure to acknowledge the industry and faithful assistance of all parties associated with me in the task assigned. With sincere thanks for your kind support and indulgence allow me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts State Agricultural Experiment Station.

PART I.

ON

FEEDING EXPERIMENTS,

1891.

I. Feeding Experiments with Milch Cows (three).
II. Feeding Experiments with Steers.
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (three).

I.

FEEDING EXPERIMENTS WITH MILCH COWS.

1891.

General introduction to our late feeding experiments with milch cows.

I. Feeding experiment with milch cows: Old-process linseed meal *vs.* gluten meal (Chicago variety).

II. Feeding experiment with milch cows: Gluten meal (Chicago variety) *vs.* cotton-seed meal and old-process linseed meal.

III. Summer feeding experiment with milch cows: Green feed, — vetch and oats, soja bean and fodder corn. Grain feed, — corn meal, gluten meal (Chicago variety), with dried brewers' grain *vs.* wheat bran.

IV. Creamery record of the station for 1890 and 1891, with a description of modes of analysis.

V. Analysis of fodder and valuation of fodder.

General Introduction. — In summing up in our late annual report the principal results obtained in connection with a series of feeding experiments with milch cows, carried on from 1885 to 1889 at the Massachusetts State Agricultural Experiment Station, special attention was called to the fact that until quite recently our main object has been to compare the economical value of some of our most prominent current *home-raised coarse fodder articles* when used for dairy purposes. English hay, rowen (hay of second cut of upland meadows), dry fodder corn, corn stover, corn ensilage and several varieties of roots (sugar beets and carrots) were the fodder articles of that description used. They were fed as far as practicable under otherwise corresponding circumstances.

To attain this end it became necessary to use in all cases alike the same kinds and the same quantities of grain feed in compounding the daily diet of the cows on trial. The selection among the various kinds of grain feed for the daily diet was, for obvious reasons, confined to but a few, — viz., corn meal or corn and cob meal, wheat bran and gluten meal (Chicago variety). (See Eighth Annual Report, pages 12–15.) These articles were at any time, in sufficient quantity and of good quality, at our disposal; they all enjoyed a fair reputation of fitness for milk production.

Having made ourselves, by actual trial, to a certain degree familiar with the comparative feeding effect and the special economical merits of the above-stated coarse fodder articles under specified conditions, *it was decided to institute a new series of feeding experiments with milch cows for the special purpose of studying the feeding effect and the general economy of some of our most prominent concentrated commercial feed stuffs, as old and new process linseed meal, cotton-seed meal and gluten meal, when fed in equal weights in place of each other and in connection with the same kinds of fine and coarse fodder articles.*

The results of one experiment, which was planned to ascertain the comparative merits of old and new process linseed meal as constituents of the daily diet of milch cows, under otherwise corresponding circumstances, has been already published in Bulletin 38, and in our last annual report, pages 15–24.

Three more recent experiments of a similar character, with Chicago gluten meal and old-process linseed meal, with Chicago gluten meal and cotton-seed meal, and with dried brewers' grain and wheat bran, are reported within a few subsequent pages, marked 1, 2, 3.

1. *Feeding Experiment with Milch Cows.*

Old-process linseed meal *vs.* gluten meal (Chicago variety), Oct. 21 to Dec. 31, 1889.

This feeding experiment was instituted as above intimated for the special purpose of comparing the effect of old-process linseed meal with that of gluten meal on the cost of feed and on the yield of milk, when fed in equal weights as substitutes of each other in connection with the same kinds and the same quantities of coarse and fine fodder articles. Six cows, grades, served in the trial; the observation lasted from ten to twelve weeks.

1. History of Cows.

NAME.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	Number of Months on Trial.
Juno, .	Grade Ayrshire, .	7	June 22, 1889,	11–12	2½
Flora, .	Grade Durham, .	6	Dec. 22, 1888,	9–10	2½
Eva, . .	Grade Jersey, .	10	Oct. 7, 1888,	7–8	2½
Elsie, .	Grade Holstein, .	7	Feb. 26, 1889,	7–8	2½
Jessie, .	Grade Jersey, .	6	Jan. 12, 1889,	8–9	2½
Annie, .	Grade Jersey, .	7	June 19, 1888,	8–9	2½

The cows thus far used in all our feeding experiments for the production of milk have been grades of more or less uncertain parentage. We secure them usually on the condition that they are new milch cows, from one to two weeks after calving when bought, and of fair milking quality, yielding from fifteen to sixteen quarts per day at this time. They serve usually in the trials until their daily yield of milk becomes unprofitable, from five to six quarts, when they are replaced by new milch cows.

2. Description of Fodder Articles.

The general character and chemical composition of the different fodder ingredients used in the preparation of the daily diet may be seen from the following statement: —

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Moisture at 100° C., . .	11.67	9.27	9.80	9.88	9.72
Dry matter, ...	88.33	90.73	90.20	90.12	90.28
	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.					
Crude ash, ...	1.89	7.47	1.25	7.39	6.43
" cellulose, . . .	1.44	9.75	1.75	8.74	32.28
" fat, ...	4.44	5.48	7.00	7.24	2.49
" protein, . . .	10.46	17.53	31.25	36.97	9.54
Non-nitrogenous matter, .	81.77	59.77	58.75	39.66	49.26
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents contained in the Various Fodder Articles used.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Moisture at 100° C.,	11.67	9.27	9.80	9.88	9.72
Nitrogen,	1.479	2.545	4.510	5.331	1.379
Phosphoric acid,	0.713	2.900	0.392	1.646	0.359
Potassium oxide,	0.430	1.637	0.049	1.162	1.572

3. *Mode of Feeding.*

The daily fodder rations contained per head throughout the entire experiment three and one-fourth pounds of corn meal and three and one-fourth pounds of wheat bran, with either three and one-fourth pounds of gluten meal (Chicago variety) or three and one-fourth pounds of old-process linseed meal as grain feed ration. A fair quality of English hay, first cut of upland meadows, served as the sole coarse feed during the entire experiment. The daily ration of hay was controlled by the appetite of each cow engaged in the trial. It varied from eighteen to twenty-two pounds per head in case of different animals.

One-half the above-stated grain feed ration was fed with some hay at the time of milking in the morning and the other half in a similar way during milking in the evening. The remainder of the hay was given at noon and after milking in the evening. Water was offered twice daily, as a rule, one and one-half to two hours after feeding the grain feed.

The daily fodder rations described farther on represent the *average composition* of the daily diet per head during the different succeeding feeding periods. The calculation of the cost of the daily fodder rations below stated is based on the contemporary local market price of the various fodder articles used in their combination.

Local Market Cost of the Various Fodder Articles used from Oct. 21 to Dec. 31, 1889.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Per 2,000 pounds,	$19 00	$17 50	$23 00	$27 00	$15 00
Per pound (cents),	0.95	0.875	1.15	1.35	0.75

Commercial Value of the Essential Fertilizing Constituents contained in the Above Fodder Articles.

Nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Moisture at 100° C.,	11.67	9.27	9.80	9.88	9.72
Nitrogen,	1.479	2.545	4.510	5.331	1.379
Phosphoric acid,	.713	2.900	0.392	1.646	0.359
Potassium oxide,	.430	1.637	0.049	1.162	1.572
Valuation per 2,000 pounds,	$6 27	$13 60	$15 85	$21 15	$6 53

Obtainable Manurial Value (per Ton), allowing a Loss of 20 Per Cent. contained in the Milk sold.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
	$5 02	$10 88	$12 68	$16 92	$5 22

Net Cost of Above Fodder Articles per 2,000 Pounds (obtained by deducting the Obtainable 80 Per Cent. of Manurial Value from their Market Cost).

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
	$13 98	$6 62	$10 32	$10 08	$9 78

Net Cost per Pound (Cents).

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
	0.699	0.331	0.516	0.504	0.489

Average Composition of the Daily Fodder Rations used during Different Periods of the Experiment.

I. and II.

Corn meal,	3.25	lbs.
Wheat bran,	3.25	"
Gluten meal,	3.25	"
Hay,	19.50	"
Total cost,	24.30	cts.
Net cost,	14.64	"
Manurial value obtainable,	9.66	"
Nutritive ratio,	1:6.35	

Average Composition, etc. — Concluded.

III.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Old-process linseed meal,	3.25 "
Hay,	18.50 "
Total cost,	24.18 cts.
Net cost,	14.06 "
Manurial value obtainable,	10.12 "
Nutritive ratio,	1:5.73

Summary of the Cost of the Daily Fodder Rations.

	PERIODS.		
	I.	II.	III.
	Cents.	Cents.	Cents.
Market cost,	24.30	24.30	24.18
Manurial value obtainable,	9.66	9.66	10.12
Net cost,	14.64	14.64	14.06

4. *Valuation of Feed.*

The commercial valuation of the feed stuffs used in the above-described fodder rations is based on their market price per ton of 2,000 pounds at Amherst during the time occupied by the experiment here under discussion, October, 1889, to January, 1890. The market cost of wheat bran, gluten meal and, in particular, of corn meal has since in an exceptional degree advanced, while that of old-process linseed meal and of English hay has remained materially the same. Accepting the above-stated market prices as well as the chemical analysis of the different fodder articles as the basis for our financial calculation we find that the market cost of the daily grain feed rations (periods I., II.), consisting of corn meal and wheat bran with gluten meal, three and one-fourth pounds each, amounts to 9.67 cents, while in case of a corresponding quantity of corn meal, wheat bran and old-process linseed meal it amounts to 10.32 cents, a difference of 0.63 cents in favor of the gluten meal containing daily grain feed ration.

Allowing on the other hand in our calculation the commercial value of 80 per cent. of the nitrogen, phosphoric acid and potassium oxide contained in the grain feed constituents of the different daily fodder rations as obtainable in form of the manurial refuse, we notice that the higher market price of the old-process linseed meal ($27 per ton) as compared with that of the gluten meal ($23 per ton), a difference of four dollars in favor of the latter, is practically offset by the higher commercial value of the manurial refuse obtained when feeding old-process linseed meal, pound for pound, in place of gluten meal in connection with an otherwise corresponding daily diet of milch cows. The net cost of the gluten meal containing daily grain feed ration (periods I., II.) amounts per head to 5.03 cents, while that of the old-process linseed meal containing grain feed portion of the daily fodder rations (period III.) amounts to 4.99 cents, a difference of 0.04 cents in favor of the latter, too small an amount to deserve serious consideration from a commercial stand-point.

Average Quantity of Milk per Day (Quarts).

[1 quart = 2.15 pounds.]

FEEDING PERIODS.	Juno.	Flora.	Eva.	Elsie.	Jessie.	Annie.
I.,	11.63	9.87	7.37	7.70	8.37	8.06
II.,	11.27	9.11	7.14	7.42	8.23	7.55
III.,	9.67	8.64	6.28	7.07	7.87	6.90
Average,	10.85	9.21	7.27	7.39	8.16	7.50

An examination of the above-stated average daily yield of milk in case of different cows shows a gradual decline from period to period. The decline in the daily yield of milk of the second period, as compared with that of the first period, varies in case of different cows from .14 to .76 quarts and averages per head 0.4 quarts for the entire herd. The difference in the decline of the daily yield of milk, when substituting pound for pound old-process linseed meal for gluten meal in the daily diet (period III.), is as a rule more marked and less uniform, as far as different animals are concerned, than will be noticed when comparing first and second feeding periods in the stated direction. The actual decline in average daily yield of milk when passing from II. into III. period varies in case of different cows from .35 to 1.6 quarts, and amounts to .71 quarts per head in case of the entire herd.

	I.*	II.†
Juno,	11.63 — 9.67	10.85
Flora,	9.87 — 8.64	9.21
Eva,	7.39 — 6.28	6.93
Elsie,	7.70 — 7.07	7.39
Jessie,	8.37 — 7.87	8.15
Annie,	8.06 — 6.90	7.50

* Variations in daily production of milk during the entire feeding experiment (quarts).

† Average quantity of milk per day for the entire feeding experiment (quarts).

Analyses of Milk (Per Cent.).

Juno.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	13.22	13.16	12.61	12.25	13.68
Fat,	4.03	3.56	3.75	3.62	4.33
Solids not fat,	9.19	9.60	8.86	8.63	9.35

Flora.

Solids,	13.35	14.04	13.68	13.38	13.36
Fat,	4.10	4.18	3.92	3.92	3.33
Solids not fat,	9.25	9.86	9.76	9.46	10.03

Eva.

Solids,	16.25	16.88	17.65	16.70	16.92
Fat,	6.10	6.18	6.18	6.18	6.15
Solids not fat,	10.15	10.70	11.47	10.52	10.77

Analyses of Milk (Per Cent.) — Concluded.

Elsie.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	12.82	13.42	12.55	12.80	13.00
Fat,	3.55	3.92	3.65	4.08	4.00
Solids not fat,	9.27	9.32	8.90	8.72	9.00

Jessie.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	14.74	14.96	15.08	14.96	14.12
Fat,	5.33	5.46	5.40	5.32	4.90
Solids not fat,	9.41	9.50	9.68	9.64	9.22

Annie.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	15.68	15.44	14.80	13.68	14.88
Fat,	5.18	5.24	5.29	3.77	5.11
Solids not fat,	10.50	10.20	9.51	9.91	9.77

Live Weight of Animals during the Feeding Periods (Pounds).

FEEDING PERIODS.	NAME OF COW.					
	Juno.	Flora.	Eva.	Elsie.	Jessie.	Annie.
I.,	1,064	980	1,086	1,200	868	954
II.,	1,089	992	1,098	1,207	880	969
III.,	1,070	1,000	1,092	1,220	888	981
Gain at close,	6	20	6	20	20	27

Conclusions. — The previously stated results of our inquiry into the comparative merits of gluten meal (Chicago variety) and of old-process linseed meal as constituents of the daily diet of milch cows lead us to the following conclusions: 1. The substitution of three and one-fourth pounds of gluten meal (Chicago variety) by the same weight of old-process linseed meal at stated local market prices, and under otherwise corresponding circumstances, raises the market cost of the daily fodder ration per head 0.65 cents. Taking in both instances the obtainable manurial value (80 per cent.) into consideration, the old-process linseed meal proves, in our case, 0.04 cents cheaper than gluten meal. The higher manurial value of the old-process linseed meal as compared with our sample of gluten meal fairly equals the difference in the local market cost of both articles. 2. The Chicago gluten meal leads in our case the old-process linseed meal in every instance, as far as the nutritive effect of both is concerned. The difference is not great, yet worthy of special notice under stated market conditions. 3. The quality of the milk as far ás its density is concerned shows no marked difference during the entire experiment.

FEEDING RECORD.

Feeding Periods.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Amount of Dry Vegetable Matter in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1. *Juno.*										
1889.										
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	21.90	28.52	11.63	2.45	1:6.51	1,064
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	21.81	28.42	11.27	2.52	1:6.51	1,089
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	18.95	25.84	9.67	2.67	1:5.76	1,070
2. *Flora.*										
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	17.90	24.91	9.87	2.52	1:6.25	980
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	18.86	25.78	9.11	2.83	1:6.31	992
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	19.43	26.27	8.64	3.04	1:5.79	1,000
3. *Eva.*										
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	18.86	25.78	7.39	3.49	1:6.31	1,086
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	19.71	26.54	7.14	3.72	1:6.37	1,098
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	18.19	25.15	6.28	4.00	1:5.70	1,092

4. Elsie.

Oct. 21 to Nov. 10,	3.25	3.25	3.25	–	19.33	25.83	7.70	3.35	1:6.34	1,200
Nov. 13 to Dec. 3,	3.25	3.25	3.25	–	18.95	25.86	7.42	3.49	1:6.32	1,207
Dec. 11 to Dec. 31,	3.25	3.25	–	3.25	17.93	24.92	7.07	3.52	1:5.68	1,220

5. Jessie.

Oct 21 to Nov. 10,	3.25	3.25	3.25	–	19.43	26.28	8.37	3.14	1:6.35	868
Nov. 13 to Dec. 3,	3.25	3.25	3.25	–	19.62	26.45	8.23	3.21	1:6.36	880
Dec. 11 to Dec. 31,	3.25	3.25	–	3.25	18.40	25.37	7.87	3.22	1:5.72	888

6. Annie.

Oct. 21 to Nov. 10,	3.25	3.25	3.25	–	17.62	24.65	8.06	3.06	1:6.24	954
Nov. 13 to Dec. 3,	3.25	3.25	3.25	–	17.95	24.95	7.55	3.30	1:6.25	969
Dec. 11 to Dec. 31,	3.25	3.25	–	3.25	17.69	24.70	6.90	3.58	1:5.66	981

TOTAL COST OF FEED PER QUART OF MILK.

Juno.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Old-process Linseed Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Hay consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents)
1889.									
Oct. 21 to Nov. 10,	244.19	11.63	68.25	68.25	–	68.25	460.00	$5 48	2.24
Nov. 13 to Dec. 3,	236.74	11.27	68.25	68.25	–	68.25	458.00	5 47	2.31
Dec. 11 to Dec. 31,	203.02	9.67	68.25	–	68.25	68.25	398.00	5 16	2.54
Flora.									
Oct. 21 to Nov. 10,	207.21	9.87	68.25	68.25	–	68.25	376.00	$4 85	2.34
Nov. 13 to Dec. 3,	191.28	9.11	68.25	68.25	–	68.25	396.00	5 00	2.61
Dec. 11 to Dec. 31,	181.50	8.64	68.25	–	68.25	68.25	408.00	5 23	2.88
Eva.									
Oct. 21 to Nov. 10,	155.23	7.39	68.25	68.25	–	68.25	396.00	$5 00	3.22
Nov. 13 to Dec. 3,	149.88	7.14	68.25	68.25	–	68.25	414.00	5 14	3.43
Dec. 11 to Dec. 31,	131.86	6.28	68.25	–	68.25	68.25	382.00	5 04	3.82

Elsie.									
Oct. 21 to Nov. 10,	161.63	7.70	68.25	68.25	–	68.25	406.00	$5 08	3.14
Nov. 13 to Dec. 3,	155.81	7.42	68.25	68.25	–	68.25	398.00	5 02	3.22
Dec. 11 to Dec. 31,	148.49	7.07	68.25	–	68.25	68.25	376.50	4 99	3.36
Jessie.									
Oct. 21 to Nov. 10,	175.81	8.37	68.25	68.25	–	68.25	408.00	$5 09	2.90
Nov. 13 to Dec. 3,	172.91	8.23	68.25	68.25	–	68.25	412.00	5 12	2.96
Dec. 11 to Dec. 31,	165.35	7.87	68.25	68.25	68.25	–	386.50	5 07	3.08
Annie.									
Oct. 21 to Nov. 10,	169.30	8.06	68.25	68.25	–	68.25	370.00	$4 81	2.84
Nov. 13 to Dec. 3,	158.60	7.55	68.25	68.25	–	68.25	374.00	4 84	3.05
Dec. 11 to Dec. 31,	145.00	6.90	68.25	68.25	68.25	–	371.50	4 96	3.42

Net Cost of Milk and Manurial Value of Feed.

Juno.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Pounds.
Oct. 21 to Nov. 10, .	$5 48	$2 72	$2 18	$3 30	1.35	1,085
Nov. 13 to Dec. 3, .	5 47	2 71	2 17	3 30	1.39	1,095
Dec. 11 to Dec. 31, .	5 16	2 69	2 15	3 01	1.48	1,034

Flora.

Oct. 21 to Nov. 10, .	$4 85	$2 45	$1 96	$2 89	1.39	980
Nov. 13 to Dec. 3, .	5 00	2 51	2 01	2 99	1.56	990
Dec. 11 to Dec. 31, .	5 23	2 72	2 18	3 05	1.68	1,015

Eva.

Oct. 21 to Nov. 10, .	$5 00	$2 51	$2 01	$2 99	1.93	1,085
Nov. 13 to Dec. 3, .	5 14	2 57	2 06	3 08	2.05	1,118
Dec. 11 to Dec. 31, .	5 04	2 63	2 10	2 94	2.23	1,098

Elsie.

Oct. 21 to Nov. 10, .	$5 08	$2 50	$2 00	$3 08	1.85	1,200
Nov. 13 to Dec. 3, .	5 02	2 52	2 02	3 00	1.93	1,200
Dec. 11 to Dec 31, .	4 99	2 62	2 10	2 89	1.95	1,220

Jessie.

Oct. 21 to Nov. 10, .	$5 09	$2 51	$2 01	$3 08	1.75	865
Nov. 13 to Dec. 3, .	5 12	2 53	2 02	3 10	1.79	880
Dec. 11 to Dec. 31, .	5 07	2 65	2 12	2 95	1.79	875

Annie.

Oct. 21 to Nov. 10, .	$4 81	$2 39	$1 91	$2 90	1.71	965
Nov. 13 to Dec 3, .	4 84	2 40	1 92	2 92	1.84	980
Dec. 11 to Dec 31, .	4 96	2 61	2 09	2 87	1.98	983

Analyses of Fodder Articles used in the Experiment.

Corn Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.67	233.40	–	–	
Dry matter,	88.33	1,766.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,					
" cellulose,	1.89	37.80	–	–	1 : 9.65
" fat,	1.44	28.80	9.79	34	
" protein (nitrogenous	4.44	88.80	67.49	76	
matter),	10.46	209.20	177.82	85	
Non-nitrogenous extract					
matter,	81.77	1,635.40	1,537.28	94	
	100.00	2,000.00	1,792.38	–	

Gluten Meal.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.80	186.00	–	–	
Dry matter,	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.25	25.00	–	–	
" cellulose,	1.75	35.00	11.90	34	1 : 2.60
" fat,	7.00	140.00	106.40	76	
" protein (nitrogenous matter),	31.25	625.00	531.25	85	
Non-nitrogenous extract matter,	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,754.05	–	

Old-process Linseed Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.88	197.60	–	–	1 : 1.70
Dry matter, ...	90.12	1,802.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.39	147.80	–	–	
" cellulose, ...	8.74	174.80	45.45	26	
" fat, ...	7.24	144.80	131.77	91	
" protein (nitrogenous matter), . .	36.97	739.40	643.28	87	
Non-nitrogenous extract matter, ...	39.66	793.20	721.81	91	
	100.00	2,000.00	1,542.31	–	

Hay (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.72	194.40	–	–	1 : 9.68
Dry matter, ...	90.28	1,805.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.43	128.60	–	–	
" cellulose, ...	32.28	645.60	374.45	58	
" fat, ...	2.49	49.80	22.91	46	
" protein (nitrogenous matter), . .	9.54	190.80	108.76	57	
Non-nitrogenous extract matter, ...	49.26	985.20	620.68	63	
	100.00	2,000.00	126.80	–	

2. *Feeding Experiment with Milch Cows.*

Gluten meal (Chicago variety) *vs.* cotton-seed meal and old-process linseed meal, November, 1890, to June 1891.

Below are briefly recorded the results of observations with cotton-seed meal and old-process linseed meal when fed as substitutes for gluten meal (Chicago variety) in an otherwise corresponding daily diet of milch cows. The experiment was instituted, as has been intimated above, mainly for the purpose of comparing the effect of cotton-seed meal and old-process linseed meal with that of gluten meal (Chicago variety) on the cost of the feed consumed and on the quantity and the quality of the milk produced, when fed each in equal weight as an ingredient of an otherwise corresponding daily diet of milch cows.

1. *History of Cows.*

Nine cows, grades of various descriptions and of different milking periods, served in the trial.

NAME OF COW.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	Number of Months on Trial.
1. Jessie, . .	Grade Jersey, .	7	Jan. 12, 1889,	6–7	5–6
2. Pearl, . .	Native, . .	6	Aug. 8, 1890,	10–11	7
3. Pink, . .	Native, . .	7	Jan. 23, 1890,	7–8	7
4. Roxy, . .	Grade Ayrshire,	7	Feb. 5, 1890,	6–7	2½
5. Buttercup, .	Grade Ayrshire,	5	Jan. 2, 1891,	13–14	4
6. Nancy, .	Native, . .	8	March 16, 1890,	8–9	4
7. Clarissa, .	Grade Durham,	7	March 18, 1891,	9–10	2
8. Juno, . .	Grade Ayrshire,	7	June 22, 1889,	7–8	3
9. Favorite, .	Grade Durham,	6	Feb. 20, 1891,	11–12	3

2. *Description of Fodder Articles.*

The daily fodder rations contained per head throughout the entire experiment, as fine or grain feed, three pounds of corn meal and three pounds of wheat bran; to these were added for stated reasons at different stages of the observation, per head, either three pounds of gluten meal, or three pounds of old-process linseed meal, or three pounds of cotton-seed meal to complete the daily ration of grain or fine feed.

The general character of the various kinds of grain feed used in the daily diet may be seen from the following analyses of the different articles of grain feed used: —

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.
Moisture at 100° C.,	13.26	12.11	9.77	8.72	10.90
Dry matter,	86.74	87.89	90.23	91.28	89.10
	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.					
Crude ash,	1.72	7.40	8.18	5.96	1.02
" cellulose,	2.28	12.17	7.74	8.23	1.28
" fat,	4.90	5.04	11.33	9.87	7.36
" protein,	12.94	18.48	44.41	36.19	34.79
Non-nitrogenous matter,	78.16	56.91	28.34	39.75	55.55
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents of the Above Fodder Articles.

Nitrogen, 15 cents per pound; phosphoric acid, 5½ cents; potassium oxide, 4½ cents.

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.
Moisture,	13.26	12.11	9.77	8.72	10.90
Nitrogen,	1.796	2.599	6.412	5.285	4.959
Phosphoric acid,	.707	2.845	2.333	1.780	.425
Potassium oxide,	.435	1.625	1.723	1.214	.045
Valuation per 2,000 pounds,	$6 56	$12 39	$23 36	$18 90	$15 38

The coarse feed used in compounding the daily diet in this connection consisted either of nothing but rowen, — hay of second cut of upland meadows, — or of rowen and a mixed ensilage, consisting of equal weights of green fodder corn and of green soja bean, or of nothing but corn stover. The same variety of dent corn, "Pride of the North," furnished the green fodder corn for the mixed ensilage and for the corn stover. The corn stover was obtained from the fully matured corn, while the corn used for the mixed ensilage had reached the stage of growth when the kernels begin to glaze.

The soja bean when used for ensilage had finished its growth and showed a liberal formation of seed pods. In both instances the entire plant was cut a few inches above ground.

The corn, — stalks, ears and leaves, — was reduced to pieces of from one to one and one-half inches in length, and the soja bean, — entire plant, — being still soft and succulent in the stated period of growth, was merely cut into two or three pieces. Both plants thus prepared were subsequently filled alternately, in layers one foot in thickness, into a silo. The filling of the silo was carried on as fast as the material could be conveniently secured. Each layer was carefully packed down and the whole finally covered with layers of tar paper and matched boards. The latter were held in place by barrels filled with sand. The silo was filled at the beginning of September, 1890, and opened for use during the succeeding January.

The mixed ensilage thus produced was of a yellowish green color, and less acid than a clear corn ensilage obtained from the same lot of fodder corn treated in the same manner and at the same time in an adjoining silo. The influence which in our case an addition of an equal weight of a nearly matured soja bean exerts on the composition of corn ensilage will be seen from a comparison of the following analyses of the two kinds of ensilage, No. 1 and No. 2.

The clear corn ensilage, No. 1, was obtained from the same lot of fodder corn which served for the production of the above-described mixed ensilage, No. 2. The silos were in both cases filled in the same way, and as far as practicable at the same time. They were of a corresponding size and contained fairly even quantities of vegetable matter. Both were opened for general use at about the same time, four months after filling. The samples that served for the analyses represent in each case the average of the ensilage obtained by cutting in a vertical direction through the contents of each silo.

Analyses of Dry Matter.

	No. 1. Corn Ensilage.	No. 2. Corn and Soja Bean Ensilage.
	Per Cent.	Per Cent.
Crude ash,	6.73	11.04
" cellulose,	26.90	27.84
" fat,	3.27	5.35
" protein,	8.97	15.27
Non-nitrogenous matter,	54.13	40.50
	100.00	100.00

The composition of the dry vegetable matter of the mixed ensilage, No. 2, compares well with that of a medium quality of red clover hay.

The successful cultivation of the soja bean upon the fields of the Massachusetts State Agricultural Experiment Station has been repeatedly pointed out in previous annual reports. The superior feeding effect of green soja bean as a coarse fodder constituent in the diet of milch cows has been shown in our summer feeding experiments of 1890. (See Eighth Annual Report, pages 39 to 54.) Our experience this year confirms our previous statement. The high economical value of this reputed fodder crop finds again a striking illustration in the experiment reported in detail upon some succeeding pages.

The general character of the different coarse fodder articles used on this occasion will be seen from the subsequent statement.

Fodder Analyses of the Different Coarse Fodder Articles used.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Moisture at 100° C.,	13.90	71.03	19.89
Dry matter,	86.10	28.97	80.11
	100.00	100.00	100.00
Analyses of Dry Matter.			
Crude ash,	8.28	11.04	6.33
" cellulose,	28.88	27.84	34.59
" fat,	3.91	5.35	1.28
" protein,	13.45	15.27	5.74
Non-nitrogenous extract matter,	45.48	40.50	52.06
	100.00	100.00	100.00

Fertilizing Constituents.

Nitrogen, 15 cents per pound; phosphoric acid, 5½ cents; potassium oxide, 4½ cents.

Manurial Constituents in the Above-stated Coarse Feed Stuffs.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Moisture,	13.90	71.03	19.89
Nitrogen,	1.853	.708	.735
Phosphoric acid,	.464	.420	.259
Potassium oxide,	1.966	.444	1.235
Valuation per 2,000 pounds,	$7 84	$2 98	$3 60

3. Mode of Feeding.

The daily grain feed ration contained per head throughout the entire experiment three pounds of corn meal and three pounds of wheat bran. To these were added, per head, at different stages of our observation, either three pounds of gluten meal, or three pounds of old-process linseed meal, or three pounds of cotton-seed meal, to complete the grain feed part of the daily diet. One-half of the grain feed was fed with some of the coarse feed at the time of milking in the morning and the other half in a similar way during milking in the evening. The remainder of the coarse fodder was given at noon and after milking in the evening.

The consumption of the coarse fodder constituents of daily diet, as far as quantity is concerned, was in most instances controlled by the appetite of each animal. To satisfy the latter, a small excess was offered and the remaining portion subsequently weighed back. This practice was adopted, in particular, in case of rowen when fed alone as coarse feed, and in case of mixed ensilage and of corn stover. Five pounds of rowen, however, were always fed per day to each cow whenever the mixed ensilage of corn and soja bean formed a prominent part of their daily diet. The daily fodder rations, which are described below in detail, represent the *average composition* of the daily diet used, per head, during the different succeeding feeding periods.

The subsequent record of the cost of the different fodder ingredients used in the daily fodder ration can assist in recognizing the basis for our calculations of the cost of the latter.

Local Market Cost of the Various Fodder Articles used from November, 1890, to June, 1891.

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Per 2,000 pounds,	$28 00	$25 00	$28 00	$26 00	$28 00	$15 00	$3 50	$5 00
Per pound (cents),	1.4	1.25	1.4	1.3	1.4	0.75	0.175	0.25

Commercial Value of the Essential Fertilizing Constitutents of the Above Fodder Articles.

Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

Moisture,	13.26	12.11	9.77	8.72	10.90	13.90	71.03	19.89
Nitrogen,	1.796	2.599	6.412	5.285	4.959	1.853	.708	.735
Phosphoric acid,	.707	2.845	2.333	1.780	.425	.464	.420	.259
Potassium oxide,	.435	1.625	1.723	1.214	.045	1.966	.444	1.235
Valuation per 2,000 pounds,	$6 56	$12 39	$23 36	$18 90	$15 38	$7 84	$2 98	$3 60

Obtainable Manurial Value (per Ton), allowing a Loss of 20 Per Cent. contained in the Milk sold.

	$5 25	$9 91	$18 69	$15 12	$12 30	$6 27	$2 38	$2 88

Net Cost of Above Fodder Articles per 2,000 Pounds (obtained by deducting the Obtainable 80 Per Cent. of Manurial Value from their Market Cost).

	$22 75	$15 09	$9 31	$10 88	$15 70	$8 73	$1 12	$2 12

Net Cost per Pound (Cents).

	1.14	0.75	0.465	0.54	0.78	0.44	0.056	0.106

Average Composition of the Principal Daily Fodder Rations used at Different Periods of the Experiment.

I.		II.	
Corn meal (pounds),	3.00	Corn meal (pounds),	3.00
Wheat bran,	3.00	Wheat bran,	3.00
Cotton-seed meal,	3.00	Gluten meal,	3.00
Rowen,	20.00	Rowen,	17.50
Total cost (cents),	27.15	Total cost (cents),	25.28
Net cost,	15.81	Net cost,	15.68
Manurial value obtainable,	11.34	Manurial value obtainable,	9.60
Nutritive ratio,	1:4.60	Nutritive ratio,	1:5.13

Average Composition, etc. — Concluded.

III.		IV.	
Corn meal (pounds), .	3.00	Corn meal (pounds), .	3.00
Wheat bran, ...	3.00	Wheat bran, ...	3.00
Old-process linseed meal, .	3.00	Cotton-seed meal, . .	3.00
Rowen, ...	17.40	Rowen, ...	5.00
Total cost (cents), . .	24.90	Corn and soja bean ensilage,	42.15
Net cost, ...	14.91	Total cost (cents), . .	23.28
Manurial value obtainable,	9.99	Net cost, ...	11.62
Nutritive ratio, . . .	1 : 4.83	Manurial value obtainable,	11.66
		Nutritive ratio, . . .	1 : 4.17

V.		VI.	
Corn meal (pounds), .	3.00	Corn meal (pounds), .	3.00
Wheat bran, ...	3.00	Wheat bran, ...	3.00
Gluten meal, ...	3.00	Gluten meal, ...	3.00
Rowen, ...	5.00	Corn stover, ...	13.90
Corn and soja bean ensilage,	46.15	Total cost (cents), . .	15.63
Total cost (cents), . .	23.98	Net cost, ...	9.52
Net cost, ...	12.80	Manurial value obtainable,	6.11
Manurial value obtainable,	11.18	Nutritive ratio, . . .	1 : 6.74
Nutritive ratio, . . .	1 : 4.70		

VII.		VIII.	
Corn meal (pounds), .	3.00	Corn meal (pounds), .	3.00
Wheat bran, ...	3.00	Wheat bran, ...	3.00
Cotton-seed meal, . .	3.00	Cotton-seed meal, . .	3.00
Corn stover, ...	14.00	Rowen, ...	17.60
Total cost (cents), . .	15.65	Total cost (cents), . .	25.35
Net cost, ...	8.57	Net cost, ...	14.77
Manurial value obtainable,	7.08	Manurial value obtainable,	10.58
Nutritive ratio, . . .	1 : 5.66	Nutritive ratio, . . .	1 : 4.49

IX.	
Corn meal (pounds), ...	3.00
Wheat bran, ...	3.00
Gluten meal, ...	3.00
Rowen, ...	17.40
Total cost (cents), ...	25.20
Net cost, ...	15.63
Manurial value obtainable, ...	9.57
Nutritive ratio, ...	1 : 5.12

Summary of the Cost of the Daily Fodder Rations (Cents).

	PERIODS.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Market cost,	27.15	25.28	24.90	23.28	23.98	15.63	15.65	25.35	25.20
Manurial value obtainable,	11.34	9.60	9.99	11.66	11.18	6.11	7.08	10.58	9.57
Net cost,	15.81	15.68	14.91	11.62	12.80	9.52	8.57	14.77	15.63

4. *On Valuation of Feed.*

The commercial valuation of the feed adopted in this report is based on the contemporary local market cost (November, 1890, to May, 1891) of the different fodder articles used, *i. e.*, their retail selling price at Amherst per ton. The market price of the coarse fodder constituents of the daily diet, as rowen, fodder corn, corn ensilage, soja beans and corn stover, is the same as during the preceding year for the same period, November, 1889, to May, 1890, while that of most of the grain feed constituents of the daily diet, as corn meal, wheat bran, gluten meal and cotton-seed meal, is exceptionally high as compared with that during the preceding year for corresponding months. Old-process linseed meal alone had suffered a slight reduction, one dollar per ton.

The changes in their market price were as follows: —

Local Market Price per Ton of 2,000 Pounds at Amherst, Mass.

	November, 1889, to June, 1890.	November, 1890, to June, 1891.
Corn meal,	$19 00	$28 00
Wheat bran,	17 50	25 00
Cotton-seed meal,	26 00	28 00
Old-process linseed meal,	27 00	26 00
Gluten meal (Chicago),	24 50	28 00
Rowen,	15 00	15 00
Corn and soja bean ensilage,	3 50	3 50
Corn stover,	5 00	5 00

The above-stated change in the market cost of corn meal, wheat bran, gluten meal and cotton-seed meal affects very materially the cost of the daily diet as compared with that of the preceding year. The daily *grain feed rations* which contain gluten meal as an ingredient (II., V., VI., IX.) are 3.32 cents higher than they would have been during the preceding year for the corresponding months; those which contain cotton-seed meal (I., IV., VII., VIII.) are 2.85 cents higher, and that which contains old-process linseed meal (III.) is 2.40 cents higher. This increase in cost is largely due to the exceptional high price of corn meal and wheat bran.

The substitution of gluten meal or of cotton-seed meal by old-process linseed meal, three pounds in each case, causes a reduction of but 0.3 cents in the market cost of the grain feed portion of the daily diet per head. *The market cost of the daily grain feed rations used per head during the entire experiment varies only from 11.85 cents to 12.15 cents, a difference of 0.3 cents.* Allowing, however, a proper recognition of the commercial value of the essential manurial substances, nitrogen, phosphoric acid and potassium oxide, contained in each of the grain feed constituents of the daily fodder rations, *we find in our case that the net cost of the cotton-seed meal containing daily grain feed rations (I.) amounts to 7.07 cents, while that of the old-process linseed meal containing daily grain feed rations (II.) is 7.29 cents, and that of gluten meal containing fine feed rations (III.) is 8.01 cents, a difference respectively of 0.22 to 0.94 cents per head.* This difference in net cost is due to the higher manurial value of cotton-seed meal and of old-process linseed meal as compared with gluten meal at stated market prices.

The choice of different coarse fodder articles in the daily diet exerts a much greater influence on the market cost of the latter than that of the different kinds of grain feed. The market cost of the coarse fodder portion of the daily diet averages 13.5 cents in case rowen alone (eighteen pounds) serves as coarse feed; it averages 11.5 cents in case forty-four pounds of mixed ensilage and five pounds of rowen are daily fed; and it amounts to from 4 to 4½ cents in case from sixteen to eighteen pounds of corn stover are used per day for that purpose. These facts find their expression in the above-stated market cost of the nine complete daily fodder rations used during the trial. The market cost of the complete daily fodder rations I., II., III., VIII., IX., containing rowen, averages 25.55 cents; rations IV., V., containing mixed ensilage with rowen, average 23.63 cents; and rations VI., VII., containing corn stover as coarse feed, average 15.64 cents. *The difference in the market cost of the above-described nine daily fodder rations, caused by the use of different coarse fodder constituents, rises in some instances as high as 9.91 cents.* This sum, it will be noticed, is three times as large as the difference due to an exceptional rise in the market cost of the grain feed portion of the various daily fodder rations used, accepting the ruling local market prices of feed stuff at the close of 1889 and of 1890 as the basis of our valuation.

Taking the manurial value of the different coarse fodder constituents used into consideration, we find the difference of their *net cost* not less striking than has been shown above to be the case in regard to their *market cost.*

	Market Cost.	Net Cost.	Manurial Value.
	Cents.	Cents.	Cents.
Rowen, 18 pounds, ...	13.5	7.92	5.57
Mixed ensilage, 44 pounds, rowen, 5 pounds, ...	11.45	4.66	6.79
Corn stover, 18 pounds, . . .	4.50	1.91	2.59

The high market price of two of our most prominent home-raised coarse fodder articles, first and second cut of upland meadow, — English hay and rowen, — affects seriously the degree of our financial results in the production of milk, as far as the cost of feed is concerned. We are in need of a cheaper source of supply of coarse fodder substances than a considerable proportion of our grass lands, pastures and meadows in their present state of productiveness can claim to give. More satisfactory results can be obtained, no doubt, in many cases by turning indifferently yielding dry grass lands, if at all capable of higher cultivation, to account for the production of some other suitable fodder crop than grasses. The good services of dry fodder corn, corn stover and a good corn ensilage, for a more economical production of milk, are deservedly from day to day more generally recognized. However gratifying this fact may be considered, it is not advisable, in the light of past experience, in a general farm management to raise one fodder crop at the exclusion of all others, however lucrative at the time this practice may prove; such a course can at best only offer a temporary relief. The introduction of a greater variety, in particular, of annual reputed fodder-crops promises a more permanent improvement in fodder supply. Such a course, wherever adopted, has not only resulted in cheapening the production of milk and beef, but has proved to be a most economical way to raise the general productiveness of farm lands to a higher standard.

Our local experience with a variety of annual leguminous fodder crops, as vetches, serradella and soja bean, has been very encouraging. The satisfactory results obtained in previous years are fully confirmed during the present season, when a mixed crop of vetch and oats and soja bean has served as the principal coarse fodder for milk production from the middle of June to the beginning of September.

5. *Average Quantity of Milk per Day* (*Quarts*).

	Feeding Periods.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
1. Jessie,	6.77	5.30	5.70	7.54	8.47	6.80	5.50	–	–
2. Pearl,	10.74	10.28	10.84	–	12.19	9.07	7.34	9.19	9.24
3. Pink,	7.55	7.42	–	8.07	8.30	7.05	6.56	7.48	7.63
4. Roxy,	6.87	5.64	5.25	–	–	–	–	–	–
5. Buttercup,	–	–	–	13.36	13.31	10.66	9.31	9.45	8.68
6. Nancy,	8.34	7.68	7.49	8.31	8.54	–	–	–	–
7. Clarissa,	–	–	–	–	–	–	9.47	10.04	11.37
8. Juno,	7.29	6.70	6.45	7.50	–	–	–	–	–
9. Favorite,	–	–	–	–	–	11.33	7.89	10.05	9.60

An examination of the above statements concerning the daily average yield of milk of the different cows on trial during the different feeding periods shows, almost without exception, that *our changes in the coarse fodder constituents of the daily diet have affected the results more seriously than our changes in the grain feed portion.* Among the coarse feed constituents used, ranks first mixed ensilage and rowen (periods IV., V.), then rowen (I., II., III., VIII., IX.) and dry corn stover last (VI., VII.), as far as the daily yield of milk is concerned.

The difference noticeable in the daily average yield of milk in case of rowen, as compared with corn stover, does in no instance deprive the latter of the claim to be the cheaper coarse fodder article of the two in our trial. Mixed ensilage, with rowen in place of corn stover, on the other hand, has raised in some instances the daily yield of milk more than three quarts (Pearl and Buttercup); allowing three cents per quart of milk makes the former the cheaper coarse fodder article of the two, under otherwise corresponding circumstances. These results are noticeable without reference to the particular combination of grain feed rations used in either case.

The influence of the various grain feed rations on the yield of milk in case of the same kind of coarse fodder ration is apparently, to a considerable degree, depending on the individual disposition of the animal on trial. Cotton-seed meal containing grain feed rations give in five out of six cases better results when fed with rowen than either gluten meal or old-process linseed meal ration, under otherwise corresponding conditions. Gluten meal and cotton-seed meal did equally well when fed with either mixed ensilage or corn stover. Old-process linseed meal has only been fed with rowen on the present occasion (I., II., III.); it compared well in yield of milk with gluten meal.

I. — Variations in daily production of milk during the entire feeding experiment (quarts).

II. — Average quantity of milk per day for the entire feeding experiment (quarts).

	I.	II.
Jessie,	5.30 — 8.48	6.58
Pearl,	7.34 — 12.19	9.86
Pink,	6.56 — 8.30	7.51
Roxy,	5.23 — 6.81	5.89
Buttercup,	8.69 — 13.36	10.80
Nancy,	7.49 — 8.54	8.07
Clarissa,	9.47 — 11.37	10.29
Juno,	6.45 — 7.50	6.99
Favorite,	7.89 — 11.33	9.72

Average Composition of Milk during Different Feeding Periods.

Periods.		1 Jessie.	2 Pearl.	3 Pink.	4 Roxy.	5 Buttercup.	6 Nancy.	7 Clarissa.	8 Juno.	9 Favorite.
I.,	Solids, per cent.,	15.62	12.62	15.37	14.79	–	13.13	–	13.91	–
	Fat, per cent.,	6.17	3.92	5.70	5.19	–	4.41	–	4.71	–
II.,	Solids, per cent.,	17.85	12.77	14.73	15.18	–	13.33	–	13.82	–
	Fat, per cent.,	7.39	4.00	5.13	5.12	–	4.31	–	4.36	–
III.,	Solids, per cent.,	17.69	13.50	–	15.31	–	14.47	–	14.30	–
	Fat, per cent.,	7.07	4.06	–	5.00	–	4.80	–	4.88	–
IV.,	Solids, per cent.,	17.61	–	15.90	–	12.64	14.68	–	14.34	–
	Fat, per cent.,	7.09	–	6.00	–	3.65	5.00	–	4.96	–
V.,	Solids, per cent.,	17.36	13.69	15.53	–	12.81	14.75	–	–	–
	Fat, per cent.,	7.02	4.27	5.74	–	3.79	5.00	–	–	–
VI.,	Solids, per cent.,	17.02	13.94	15.86	–	12.64	–	–	–	13.09
	Fat, per cent.,	6.47	4.48	5.67	–	3.96	–	–	–	4.35
VII.,	Solids, per cent.,	17.63	14.32	16.56	–	12.50	–	14.18	–	13.53
	Fat, per cent.,	7.26	5.04	6.09	–	4.05	–	5.01	–	4.58
VIII.,	Solids, per cent.,	–	13.74	15.82	–	12.98	–	14.18	–	12.78
	Fat, per cent.,	–	4.84	5.65	–	4.18	–	5.08	–	4.19
IX.,	Solids, per cent.,	–	13.66	15.54	–	13.45	–	13.79	–	12.40
	Fat, per cent.,	–	4.04	5.43	–	4.27	–	4.60	–	3.48

Live Weight of Animals during the Feeding Periods (Pounds).

Name.	Feeding Periods.									Gain at Close.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	
Jessie,	926	920	965	976	988	951	938	–	–	12
Pearl,	850	877	869	–	872	853	858	853	880	30
Pink,	910	932	–	914	948	947	952	956	973	63
Roxy,	1,010	1,016	992	–	–	–	–	–	–	—18
Buttercup,	–	–	–	781	797	795	785	766	775	—6
Nancy,	946	942	948	963	987	–	–	–	–	41
Clarissa,	–	–	–	–	–	–	833	856	848	15
Juno,	1,142	1,124	1,135	1,114	–	–	–	–	–	—28
Favorite,	–	–	–	–	–	826	775	809	801	—25

Conclusions. — A careful examination of the previously recorded results of our inquiry into the respective particular claims of cotton-seed meal, old-process linseed meal and gluten meal as constituents of the daily diet of milch cows, leads us to the following statements: —

1. The substitution of three pounds of gluten meal by either three pounds of cotton-seed meal or three pounds of old-process linseed meal, at stated market prices; and under otherwise corresponding circumstances, does not materially effect the *market cost* of the daily fodder ration used in our case. The difference in their market price amounts to 0.3 cents in favor of old-process linseed meal. Taking the obtainable manurial value into consideration, as far as the three stated grain feed constituents of the daily diet are concerned, three pounds of cotton-seed meal are 0.94 cents cheaper than three pounds of gluten meal and 0.22 cents cheaper than three pounds of old-process linseed meal.

2. The comparative nutritive effect of cotton-seed meal, gluten meal and old-process linseed meal, as far as their influence on the yield of milk is concerned, in case of otherwise corresponding fodder rations, depends evidently in a controlling degree on two distinctly different circumstances, namely, the individual disposition and constitution of the animal on trial, and on the particular kind of coarse fodder constituent of the daily diet. In case of rowen as coarse fodder constituent, cotton-seed meal leads, in five out of six cases, both gluten meal and old-process linseed meal, while in case mixed ensilage or corn stover served as coarse feed the gluten meal competes well with cotton-seed meal. Old-process linseed meal has only been tested with rowen on the present occasion; it stands but little behind the gluten meal.

3. The density of the milk in case of the same cow varies but little during the experiment; the notable changes are apparently, in a controlling degree, due to the particular condition and individuality of the cow engaged in the trial.

FEEDING RECORD.

1. *Jessie.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1890-91.													
Nov. 1 to Nov. 21,	3.00	3.00	3.00	–	–	17.81	–	–	23.28	6.77	3.44	1:4.51	926
Nov. 26 to Dec. 16,	3.00	3.00	–	–	3.00	16.23	–	–	21.88	5.30	4.13	1:5.09	920
Dec. 22 to Jan. 11,	3.00	3.00	–	3.00	–	17.91	–	–	23.40	5.70	4.11	1:4.85	965
Jan. 26 to Feb. 11,	3.00	3.00	3.00	–	–	5.00	43.94	–	24.99	7.54	3.31	1:4.19	976
Feb. 14 to March 4,	3.00	3.00	–	–	3.00	5.00	47.11	–	25.87	8.48	3.05	1:4.71	988
March 10 to March 25,	3.00	3.00	–	–	3.00	–	–	11.16	16.85	6.80	2.48	1:6.33	951
March 28 to April 12,	3.00	3.00	3.00	–	–	–	–	13.59	18.84	5.50	3.43	1:5.61	938

2. *Pearl.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 21,	3.00	3.00	3.00	–	–	21.19	–	–	26.19	10.74	2.44	1:4.65	850
Nov. 26 to Dec. 16,	3.00	3.00	–	–	3.00	17.81	–	–	23.24	10.28	2.26	1:5.14	877
Dec. 22 to Jan. 11,	3.00	3.00	–	3.00	–	18.26	–	–	23.70	10.84	2.19	1:4.86	869
Feb. 14 to March 4,	3.00	3.00	–	–	3.00	5.00	48.05	–	26.14	12.19	2.14	1:4.71	872
March 10 to March 25,	3.00	3.00	–	–	3.00	–	–	16.06	20.78	9.07	2.29	1:7.06	853
March 28 to April 12,	3.00	3.00	3.00	–	–	–	–	14.50	19.57	7.34	2.67	1:5.74	858
April 16 to May 6,	3.00	3.00	3.00	–	–	19.40	–	–	24.65	9.19	2.68	1:4.57	853
May 11 to May 31,	3.00	3.00	–	–	3.00	18.33	–	–	23.69	9.24	2.56	1:5.16	880

FEEDING RECORD — *Continued.*

3. *Pink.*

Feeding Periods.	Feed consumed (Pounds) per Day.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.					
1890-91.													
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	21.83	–	–	26.75	7.55	3.54	1:4.67	910
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	20.81	–	–	25.93	7.42	3.49	1:5.23	932
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	46.59	–	25.75	8.07	3.19	1:4.20	914
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	48.79	–	26.35	8.30	3.17	1:4.71	948
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	15.75	20.53	7.05	2.91	1:7.01	947
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	17.50	21.97	6.56	3.35	1:6.15	952
April 16 to May 6, . .	3.00	3.00	3.00	–	–	19.57	–	–	24.80	7.48	3.32	1:4.58	946
May 11 to May 31, . .	3.00	3.00	–	–	3.00	19.38	–	–	24.60	7.63	3.22	1:5.19	973

4. *Roxy.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	19.14	–	–	24.43	6.81	3.59	1:4.56	1,010
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	15.74	–	–	21.46	5.64	3.80	1:5.07	1,016
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	15.24	–	–	21.10	5.23	4.04	1:4.74	992

5. *Buttercup.*

Jan. 29 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	42.61	–	24.60	13.36	1.84	1:4.18	781
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	44.26	–	25.04	13.31	1.88	1:4.70	797
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	15.41	20.25	10.66	1.90	1:6.96	795
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	16.34	21.04	9.31	2.26	1:6.00	785
April 16 to May 6, . .	3.00	3.00	3.00	–	–	15.98	–	–	21.71	9.45	2.30	1:4.42	766
May 11 to May 31, . .	3.00	3.00	–	–	3.00	15.57	–	–	31.32	8.69	2.45	1:5.07	775

6. *Nancy.*

Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	20.83	–	–	25.88	8.34	3.10	1:4.63	946
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	18.45	–	–	23.80	7.68	3.10	1:5.16	942
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	18.19	–	–	23.64	7.49	3.16	1:4.86	948
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	41.41	–	24.26	8.31	2.92	1:4.17	963
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	42.63	–	24.57	8.54	2.88	1:4.69	987

7. *Clarissa.*

March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	14.31	19.41	9.47	2.05	1:5.72	833
April 16 to May 6, . .	3.00	3.00	3.00	–	–	18.48	–	–	23.86	10.04	2.38	1:4.54	856
May 11 to May 31, . .	3.00	3.00	–	–	3.00	19.43	–	–	24.64	11.37	2.17	1:5.19	848

FEEDING RECORD — *Concluded.*

8. Juno.

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1890-91.													
Nov. 1 to Nov. 21,	3.00	3.00	3.00	–	–	19.50	–	–	24.74	7.29	3.39	1:4.58	1,142
Nov. 26 to Dec. 16,	3.00	3.00	–	–	3.00	16.02	–	–	21.70	6.70	3.24	1:5.08	1,124
Dec. 22 to Jan. 11,	3.00	3.00	–	3.00	–	17.29	–	–	22.87	6.45	3.55	1:4.82	1,135
Jan. 26 to Feb. 11,	3.00	3.00	3.00	–	–	5.00	36.23	–	22.76	7.50	3.03	1:4.13	1,114

9. Favorite.

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 10 to March 25,	3.00	3.00	–	–	3.00	–	–	11.16	16.85	11.33	1.49	1:6.33	826
March 28 to April 12,	3.00	3.00	3.00	–	–	–	–	8.22	14.54	7.89	1.84	1:4.76	775
April 16 to May 6,	3.00	3.00	3.00	–	–	14.48	–	–	20.42	10.05	2.03	1:4.34	809
May 11 to May 31,	3.00	3.00	–	–	3.00	14.19	–	–	20.13	9.60	2.10	1:5.01	801

Total Cost of Feed per Quart of Milk.

1. *Jessie.*

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890-91.												
Nov. 1 to Nov. 21, . .	142.21	6.77	63.00	63.00	63.00	–	–	374.00	–	–	$5 36	3.77
Nov. 26 to Dec. 16, . .	111.40	5.30	63.00	63.00	–	–	63.00	313.00	–	–	5 12	4.60
Dec 22 to Jan. 11, . .	119.77	5.70	63.00	63.00	–	63.00	–	376.00	–	–	5 31	4.43
Jan. 26 to Feb. 11, . .	128.26	7.54	51.00	51.00	51.00	–	–	85.00	747.00	–	4 01	3.13
Feb. 14 to March 4, . .	161.02	8.48	57.00	57.00	–	–	57.00	95.00	895.00	–	4 69	2.91
March 10 to March 25, . .	108.72	6.80	48.00	48.00	–	–	48.00	–	–	178.50	2 39	2.20
March 28 to April 12, . .	88.02	5.50	48.00	48.00	48.00	–	–	–	–	217.50	2 48	2.82

2. *Pearl.*

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Nov. 1 to Nov. 21, . .	225.58	10.74	63.00	63.00	63.00	–	–	445.00	–	–	$5 89	2.61
Nov. 26 to Dec. 16, . .	215.81	10.28	63.00	63.00	–	–	63.00	374.00	–	–	5 36	2.48
Dec. 22 to Jan. 11, . .	227.56	10.84	63.00	63.00	–	63.00	–	383.50	–	–	5 37	2.37
Feb. 14 to March 4, . .	231.74	12.19	57.00	57.00	–	–	57.00	95.00	913.00	–	4 62	1.99
March 10 to March 25, . .	145.12	9.07	48.00	48.00	–	–	48.00	–	–	257.00	2 58	1.78
March 28 to April 12, . .	117.44	7.34	48.00	48.00	48.00	–	–	–	–	232.00	2 52	2.15
April 16 to May 6, . .	193.05	9.19	63.00	63.00	63.00	–	–	407.50	–	–	5 61	2.91
May 11 to May 31, . .	194.07	9.24	63.00	63.00	–	–	63.00	385.00	–	–	5 44	2.80

Total Cost of Feed per Quart of Milk — *Continued.*

3. *Pink.*

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890-91.												
Nov. 1 to Nov. 21, . .	158.49	7.55	63.00	63.00	63.00	–	–	458.50	–	–	$5 99	3.78
Nov. 26 to Dec. 16, . .	155.81	7.42	63.00	63.00	–	–	63.00	437.00	–	–	5 83	3.74
Jan. 26 to Feb. 11, . .	137.21	8.07	51.00	51.00	51.00	–	–	85.00	792.00	–	4 09	2.98
Feb. 14 to March 4, . .	155.79	8.30	57.00	57.00	–	–	57.00	95.00	990.00	–	4 75	3.05
March 10 to March 25, . .	112.79	7.05	48.00	48.00	–	–	48.00	–	–	252.00	2 57	2.28
March 28 to April 12, . .	105.00	6.56	48.00	48.00	48.00	–	–	–	–	280.00	2 64	2.51
April 16 to May 6, . .	157.09	7.48	63.00	63.00	63.00	–	–	411.00	–	–	5 63	3.58
May 11 to May 31, . .	160.23	7.63	63.00	63.00	–	–	63.00	407.00	–	–	5 60	3.49

4. *Roxy.*

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Nov. 1 to Nov. 21, . .	143.02	6.81	63.00	63.00	63.00	–	–	402.00	–	–	$5 57	3.89
Nov. 26 to Dec. 16, . .	118.49	5.64	63.00	63.00	–	–	63.00	330.50	–	–	5 03	4.25
Dec. 22 to Jan. 11, . .	109.77	5.23	63.00	63.00	–	63.00	–	320.00	–	–	4 89	4.45

5. *Buttercup.*

Jan. 29 to Feb. 11, . .	186.98	13.36	42.00	42.00	42.00	-	-	70.00	596.50	-	$3 27	1.75
Feb. 14 to March 4, . .	252.80	13.31	57.00	57.00	-	-	57.00	95.00	841.00	-	4 49	1.78
March 10 to March 25, . .	170.58	10.66	48.00	48.00	-	-	48.00	-	-	246.50	2 56	1.50
March 28 to April 12, . .	148.95	9.31	48.00	48.00	48.00	-	-	-	-	261.50	2 59	1.74
April 16 to May 6, . .	198.49	9.45	63.00	63.00	63.00	-	-	335.50	-	-	5 07	2.55
May 11 to May 31, . .	182.56	8.69	63.00	63.00	-	-	63.00	327.00	-	-	5 00	2.74

6. *Nancy.*

Nov. 1 to Nov. 21, . .	175.23	8.34	63.00	63.00	63.00	-	-	437.50	-	-	$5 83	3.33
Nov. 26 to Dec. 16, . .	161.28	7.68	63.00	63.00	-	-	63.00	387.50	-	-	5 46	3.39
Dec. 22 to Jan 11, . .	157.21	7.49	63.00	63.00	-	63.00	-	382.00	-	-	5 35	3.40
Jan. 26 to Feb. 11, . .	141.28	8.31	51.00	51.00	51.00	-	-	85.00	704.00	-	3 93	2.78
Feb. 14 to March 4, . .	162.33	8.54	57.00	57.00	-	-	57.00	95.00	810.00	-	4 44	2.73

7. *Clarissa.*

March 28 to April 12, . .	151.51	9.47	48.00	48.00	48.00	-	-	-	-	229.00	$2 51	1.66
April 16 to May 6, . .	210.81	10.04	63.00	63.00	63.00	-	-	388.00	-	-	5 46	2.59
May 11 to May 31, . .	238.72	11.37	63.00	63.00	-	-	63.00	408.00	-	-	5 61	2.35

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

8. *Juno.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890-91.												
Nov. 1 to Nov. 21, . .	153.14	7.29	63.00	63.00	63.00	–	–	409.50	–	–	$5 62	3.67
Nov. 26 to Dec. 16, . .	140.70	6.70	63.00	63.00	–	–	63.00	336.50	–	–	5 07	3.60
Dec. 22 to Jan. 11, . .	135.35	6.45	63.00	63.00	–	63.00	–	363.00	–	–	5 21	3.85
Jan. 26 to Feb. 11, . .	127.56	7.50	51.00	51.00	51.00	–	–	85.00	616.00	–	3 78	2.96

9. *Favorite.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
March 10 to March 25, . .	181.28	11.33	48.00	48.00	–	–	48.00	–	–	178.50	$2 39	1.32
March 28 to April 12, . .	126.30	7.89	48.00	48.00	48.00	–	–	–	–	131.50	2 27	1.80
April 16 to May 6, . .	211.05	10.05	63.00	63.00	63.00	–	–	304.00	–	–	4 83	2.29
May 11 to May 31, . .	201.51	9.60	63.00	63.00	–	–	63.00	298.00	–	–	4 79	2.38

Net Cost of Milk and Manurial Value of Feed Consumed.

1. Jessie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 36	$2 81	$2 25	$3 11	2.19	920
Nov. 26 to Dec. 16, .	5 12	2 42	1 94	3 18	2.85	947
Dec. 22 to Jan. 11, .	5 31	2 67	2 14	3 17	2.65	998
Jan. 26 to Feb. 11, .	4 01	2 53	2 02	1 99	1.55	973
Feb. 14 to Mar. 4, .	4 69	2 68	2 14	2 55	1.58	995
Mar. 10 to Mar. 25, .	2 39	1 15	0 92	1 47	1.35	940
Mar. 28 to Apr. 12, .	2 48	1 41	1 13	1 35	1.53	932
Total, . .	$29 36	$15 67	$12 54	$16 82	–	–

2. Pearl.

Nov. 1 to Nov. 21, .	$5 89	$3 08	$2 46	$3 43	1.52	864
Nov. 26 to Dec. 16, .	5 36	2 55	2 04	3 32	1.54	876
Dec. 22 to Jan. 11, .	5 37	2 70	2 16	3 21	1.41	876
Feb. 14 to Mar. 4, .	4 62	2 71	2 17	2 45	1.06	873
Mar. 10 to Mar 25, .	2 58	1 29	1 03	1 55	1.07	850
Mar. 28 to Apr. 12, .	2 52	1 44	1 15	1 37	1.17	865
Apr. 16 to May 6, .	5 61	2 94	2 35	3 26	1.69	842
May 11 to May 31, .	5 44	2 59	2 07	3 37	1.74	874
Total, . .	$37 39	$19 30	$15 43	$21 96	–	–

3. Pink.

Nov. 1 to Nov. 21, .	$5 99	$3 14	$2 51	$3 48	2.20	910
Nov. 26 to Dec. 16, .	5 83	2 80	2 24	3 59	2.30	950
Jan 26 to Feb. 11, .	4 09	2 60	2 08	2 01	1.47	922
Feb. 14 to Mar. 4, .	4 75	2 83	2 26	2 49	1.60	953
Mar. 10 to Mar. 25, .	2 57	1 28	1 02	1 55	1.37	940
Mar. 28 to Apr. 12, .	2 64	1 52	1 22	1 42	1.35	970
Apr. 16 to May 6, .	5 63	2 95	2 36	3 27	2.08	940
May 11 to May 31, .	5 60	2 68	2 14	3 46	2.16	973
Total, . .	$37 10	$19 80	$15 83	$21 27	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Continued.*

4. Roxy.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 57	$2 92	$2 34	$3 23	2.26	1,008
Nov. 26 to Dec. 16, .	5 03	2 38	1 90	3 13	2.64	1,034
Dec. 22 to Jan. 11, .	4 89	2 45	1 96	2 93	2.67	1,010
Total, . .	$15 49	$7 75	$6 20	$9 29	–	–

5. Buttercup.

Jan. 29 to Feb. 11, .	$3 27	$2 05	$1 64	$1 63	0.87	800
Feb. 14 to Mar. 4, .	4 49	2 60	2 08	2 41	1.29	797
Mar. 10 to Mar. 25, .	2 56	1 27	1 01	1 55	0.91	800
Mar. 28 to Apr. 12, .	2 59	1 49	1 19	1 40	0.94	795
Apr. 16 to May 6, .	5 07	2 66	2 13	2 94	1.48	753
May 11 to May 31, .	5 00	2 36	1 89	3 11	1.70	775
Total, . .	$22 98	$12 43	$9 94	$13 04	–	–

6. Nancy.

Nov. 1 to Nov. 21, .	$5 83	$3 06	$2 45	$3 38	1.93	925
Nov. 26 to Dec. 16, .	5 46	2 60	2 08	3 38	2.10	960
Dec. 22 to Jan. 11, .	5 35	2 70	2 16	3 19	2.03	972
Jan. 26 to Feb. 11, .	3 93	2 47	1 97	1 96	1.39	963
Feb. 14 to Mar. 4, .	4 44	2 56	2 05	2 39	1.47	985
Total, . .	$25 01	$13 39	$10 71	$14 30	–	–

7. Clarissa.

Mar. 28 to Apr. 12, .	$2 51	$1 43	$1 14	$1 37	0.90	843
Apr. 16 to May 6, .	5 46	2 86	2 29	3 17	1.50	835
May 11 to May 31, .	5 61	2 68	2 14	3 47	1.45	855
Total, . .	$13 58	$6 97	$5 57	$8 01	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

8. Juno.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 62	$2 95	$2 36	$3 26	2.13	1,130
Nov. 26 to Dec. 16, .	5 07	2 40	1 92	3 15	2.24	1,143
Dec. 22 to Jan. 11, .	5 21	2 62	2 10	3 11	2.30	1,150
Jan 26 to Feb. 11, .	3 78	2 34	1 87	1 91	1.50	1,105
Total, . .	$19 68	$10 31	$8 25	$11 43	–	–

9. Favorite.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Mar. 10 to Mar. 25, .	$2 39	$1 15	$0 92	$1 47	0.81	790
Mar. 28 to Apr. 12, .	2 27	1 26	1 01	1 26	0.99	785
Apr. 16 to May 6, .	4 83	2 53	2 02	2 81	1.33	782
May 11 to May 31, .	4 79	2 25	1 80	2 99	1.48	797
Total, . .	$14 28	$7 19	$5 75	$8 53	–	–

Composition of Fodder Articles fed during the Above-described Feeding Experiment.

Corn Meal (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.26	265.20	–	–	1 : 8.62
Dry matter, ...	86.74	1,734.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.72	34.40	–	–	
" cellulose, . . .	2.28	45.60	21.89	48	
" fat, ...	4.90	98.00	83.30	85	
" protein (nitrogenous matter), . . .	12.94	258.80	204.45	79	
Non-nitrogenous extract matter, ...	78.16	1,563.20	1,531.94	98	
	100.00	2,000.00	1,841.58	–	

Composition of Fodder Articles, etc. — Continued.

Wheat Bran (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.11	242.20	-	-	
Dry matter,	87.89	1,757.80	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	-	-	
" cellulose,	12.17	243.40	58.42	24	1 : 3.86
" fat,	5.04	100.80	71.57	71	
" protein (nitrogenous matter),	18.48	369.60	288.29	78	
Non-nitrogenous extract matter,	56.91	1,138.20	876.41	77	
	100.00	2,000.00	1,294.69	-	

Cotton-seed Meal (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	-	-	
Dry matter,	90.23	1,804.60	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	8.18	163.60	-	-	1 : 1.37
" cellulose,	7.74	154.80	-	-	
" fat,	11.33	226.60	199.41	88	
" protein (nitrogenous matter),	44.41	888.20	754.97	85	
Non-nitrogenous extract matter,	28.34	566.80	538.46	95	
	100.00	2,000.00	1,492.84	-	

Composition of Fodder Articles, etc. — Continued.

Old-process Linseed Meal.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.72	174.40	–	–	1 : 1.93
Dry matter, . . .	91.28	1,825.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	5.96	119.20	–	–	
" cellulose, . . .	8.23	164.60	42.79	26	
" fat, ...	9.87	197.40	179.63	91	
" protein (nitrogenous matter), . .	36.19	723.80	629.70	87	
Non-nitrogenous extract matter, ...	39.75	795.00	723.45	91	
	100.00	2,000.00	1,575.57	–	

Gluten Meal.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.90	218.00	–	–	1 : 2.44
Dry matter, . . .	89.10	1,782.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.02	20.40	–	–	
" cellulose, . .	1.28	25.60	15.87	62	
" fat, . . .	7.36	147.20	125.12	85	
" protein (nitrogenous matter), . .	34.79	695.80	549.68	79	
Non-nitrogenous extract matter, ...	55.55	1,111.00	1,011.01	91	
	100.00	2,000.00	1,701.68	–	

Composition of Fodder Articles, etc. — Continued.

Rowen (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C.,	13.90	278.00	-	-	1 : 6.35
Dry matter,	86.10	1,722.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	8.28	165.60	-	-	
" cellulose,	28.88	577.60	369.66	64	
" fat,	3.91	78.20	35.97	46	
" protein (nitrogenous matter),	13.45	269.00	166.78	62	
Non-nitrogenous extract matter,	45.48	909.60	600.34	66	
	100.00	2,000.00	1,172.75	-	

Corn and Soja Bean Ensilage.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.03	1,420.60	-	-	1 : 1.94
Dry matter,	28.97	579.40	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	11.04	220.80	-	-	
" cellulose,	27.84	556.80	339.65	61	
" fat,	5.35	107.00	69.55	65	
" protein (nitrogenous matter),	15.27	305.40	216.83	71	
Non-nitrogenous extract matter,	40.50	810.00	558.90	69	
	100.00	2,000.00	1,184.93	-	

Composition of Fodder Articles, etc. — Concluded.

Corn Stover.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.89	397.80	–	–	1 : 14.84
Dry matter,	80.11	1,602.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.33	126.60	–	–	
" cellulose,	34.59	691.80	498.10	72	
" fat,	1.28	25.60	19.20	75	
" protein (nitrogenous matter),	5.74	114.80	83.80	73	
Non-nitrogenous extract matter,	52.06	1,041.20	697.60	67	
	100.00	2,000.00	1,298.70	–	

3. *Summer Feeding Experiment with Milch Cows, July 6 to Sept. 26, 1891.*

Green feed: vetch and oats, soja beans and fodder corn.

Grain feed: corn meal, wheat bran, dried brewers' grain, gluten meal (Chicago).

The feeding experiment here under discussion is a continuation of similar ones carried on during the summer season in preceding years (since 1887) for the purpose of ascertaining the comparative feeding value and the general economy of various reputed green fodder crops in the dairy industry. Our late observation includes, of green crops, besides vetch and oats and soja beans of former years, as an addition the green fodder corn. The two first named green crops were cut for feed at the beginning of blooming, and they were fed until our supply was either exhausted or until they were fully matured yet still succulent. The green fodder corn was first cut for feed when the kernels were fully developed yet in the milk. The grain feed ration consisted throughout the entire experiment of corn meal and gluten meal, alternating either with wheat bran or dried brewers' grain. The daily ration of grain feed amounted throughout the entire experiment to nine pounds per head; three pounds of corn meal and three pounds of Chicago gluten meal *with either three pounds of wheat bran or with three pounds of dried brewers' grain, for the purpose of comparing the economical merits of these two articles in connection with the production of milk.*

The daily rations of coarse feed consisted of five pounds of rowen — hay of second cut of upland meadows — and of either a mixed green crop of vetch and oats, or of green soja bean or of green fodder corn. The daily consumption per head of grain feed and of hay, as far as quantity is concerned, remained the same in case of every animal during the entire experiment, while that of the green fodder crops was governed by the appetite of each animal on trial. The quantity daily consumed decreased as a rule with their advancing growth, on account of the steady increase of solid matter in the plants. The daily consumption of vetch and oats varied at different feeding periods from 45 to 35 pounds in case of the same animals, and that of soja beans from 44 to 38 pounds, while that of green fodder corn varied from 50 to 38 pounds in case of different animals (fifth feeding period).

A record of the composition and general character of the various fodder constituents of the daily diet will be found farther on.

Five cows, grades of various descriptions and in different milking periods, served in the trial.

The subsequent statement shows the average composition of the daily fodder rations used in the trial during five succeeding feeding periods into which the entire experiment was divided.

Statement of the Average Daily Fodder Rations used during the Different Feeding Periods.

I

Corn meal,	3.00 lbs.
Brewers' grain,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Vetch and oats (green),	47.24 "
Total cost,	22.39 cts
Net cost,	12.96 "
Manurial value obtainable,	9.43 "
Nutritive ratio,	1:6.17

Average Daily Fodder Rations, etc. — Concluded.

II.

Corn meal,	3.00 lbs.
Wheat bran,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Vetch and oats (green),	36.42 "
Total cost,	20.91 cts.
Net cost,	12.52 "
Manurial value obtainable,	8.39 "
Nutritive ratio,	1:6.29

III.

Corn meal,	3.00 lbs.
Wheat bran,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Soja beans (green),	51.28 "
Total cost,	27.18 cts.
Net cost,	17.32 "
Manurial value obtainable,	9.86 "
Nutritive ratio,	1:5.07

IV.

Corn meal,	3.00 lbs.
Brewers' grain,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Soja beans,	47.34 "
Total cost,	26.31 cts.
Net cost,	16.65 "
Manurial value obtainable,	9.66 "
Nutritive ratio,	1:4.76

V.

Corn meal,	3.00 lbs.
Brewers' grain,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Fodder corn (green),	39.22 "
Total cost,	20.80 cts.
Net cost,	12.67 "
Manurial value obtainable,	8.13 "
Nutritive ratio,	1:6.17

Local Market Cost of the Various Articles of Fodder used (per Ton).

Corn meal,	$31 00
Brewers' grain,	23 00
Wheat bran,	23 00
Gluten meal,	27 00
Rowen,	15 00
Vetch and oats (green),	2 75
Fodder corn (green),	2 50
Soja beans (green),	4 40

Essential Fertilizing Constituents of the Above Fodder Articles.

Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Brewers' Grain.	Wheat Bran.	Gluten Meal.	Rowen.	Vetch and Oats.	Fodder Corn.	Soja Beans.
Moisture, . .	15.31	12.00	12.99	11.11	13.90	67.49	71.86	74.23
Nitrogen, . .	1.651	3.299	2.249	4.741	1.853	.459	.343	.565
Phosphoric acid,	.693	1.192	2.793	.413	.464	.202	.195	.183
Potassium oxide,	.426	1.466	1.592	.044	1.966	.487	.430	.297
Valuation per 2,000 pounds, .	$6 10	$12 52	$11 25	$14 72	$7 84	$2 04	$1 63	$2 16

History of Cows (Grades).

NAME.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	No. of Months on Trial.
Cora, . . .	Grade Jersey, .	7	April 16, 1891,	11–12	3
Pearl, . .	Native, . .	6	Aug. 8, 1890,	8–9	3
Buttercup, . .	Grade Ayrshire,	5	Jan. 2, 1891,	8–9	3
Lucy, . . .	Grade Ayrshire,	5	June 2, 1891,	12–13	3
Clarissa, . .	Grade Durham,	7	March 14, 1891,	9–10	3

Yield of Milk during Different Feeding Periods (Quarts).

	Cora.	Pearl.	Buttercup.	Lucy.	Clarissa.
Period I., ...	11.29	8.11	8.34	12.26	9.49
Period II., ...	11.34	8.70	8.73	12.78	9.31
Period III., ...	11.24	8.63	8.76	12.85	10.37
Period IV., ...	11.57	8.95	8.85	13.26	10.99
Period V., ...	10.70	8.92	8.64	12.01	9.98
Average, ...	11.23	8.66	8.66	12.63	10.03

Conclusions. — The results of the past season obtained in this connection are very encouraging, as will be seen from the subsequent brief abstract when compared with those noticed in preceding years.

1. The yield of milk is well maintained during the entire experiment of three months. The average daily yield of milk of the various cows for the entire experiment is in four out of five cases *larger* than their yield at the beginning of the observation; in the fifth case there is practically no change (Cora). The largest average yield of milk was noticed, without any exception as to a particular cow, in case of soja bean as green fodder and dried brewers' grain as ingredient of the daily grain feed ration (fourth feeding period). Green fodder corn leads in three out of five cases the green vetch and oats when fed with dried brewers' grain.

2. The amount of dry vegetable matter consumed per quart of milk produced varies in case of different cows from 1.77 pounds (Cora) to 3.33 pounds (Pearl). The amount consumed in case of the same cows varies in different feeding periods from 1.77 to 2.25 pounds (Cora) and from 2.44 to 3.17 pounds (Buttercup).

3. The total cost of feed consumed per quart of milk produced differs in case of different animals for the same feeding period from 1.69 to 2.30 cents (Lucy and Pearl, fifth feeding period); as far as different feeding periods are concerned it varies in one case from 1.69 to 2.30 cents (Lucy) and in another case from 2.24 to 2.91 cents (Clarissa).

4. The net cost of feed per quart of milk produced varies from 1.01 to 1.43 cents for the same feeding period in case of different animals (Lucy and Pearl, second feeding period).

5. The obtainable manurial value amounts on an average to three-sevenths of the market cost of the feed consumed. The green vetch and oats leads in this connection.

6. The quality of the milk is in every instance improved in the percentage of solids during the experiment without showing any perceptible decrease in yield. Individuality of the animal and stage of lactation affect the results to a controlling extent.

7. Brewers' grain has served as an excellent substitute for wheat bran in our diet for milch cows.

FEEDING RECORD.

CORA: *Age, seven years; grade Jersey; last calf, April 16, 1891.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Brewers' Grain.	Wheat Bran.	Gluten Meal.	Rowen.	Vetch and Oats.	Soja Beans.	Fodder Corn.					Pounds.
1891.													
July 6 to July 21, . .	3.00	3.00	–	3.00	5.00	40.75	–	–	25.45	11.29	2.25	1 : 6.00	1,053
July 24 to Aug. 2, . .	3.00	–	3.00	3.00	5.00	24.30	–	–	20.02	11.34	1.77	1 : 5.91	1,039
Aug. 6 to Aug. 17, . .	3.00	–	3.00	3.00	5.00	–	44.67	–	23.63	11.24	2.10	1 : 5.05	1,025
Aug. 21 to Sept. 3, . .	3.00	3.00	–	3.00	5.00	–	42.86	–	23.25	11.57	2.01	1 : 4.74	1,013
Sept. 7 to Sept. 26, . .	3.00	3.00	–	3.00	5.00	–	–	37.45	22.74	10.71	2.12	1 : 6.13	1,030

PEARL: *Age, six years; native; last calf, Aug. 8, 1890.*

FEEDING PERIODS.	Corn Meal.	Brewers' Grain.	Wheat Bran.	Gluten Meal.	Rowen.	Vetch and Oats.	Soja Beans.	Fodder Corn.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
July 6 to July 18, . .	3.00	3.00	–	3.00	5.00	45.62	–	–	27.03	8.11	3.33	1 : 6.12	923
July 24 to Aug. 2, . .	3.00	–	3.00	3.00	5.00	35.90	–	–	23.79	8.70	2.73	1 : 6.29	928
Aug. 6 to Aug 17, . .	3.00	–	3.00	3.00	5.00	–	43.08	–	23.22	8.61	2.69	1 : 5.05	907
Aug 25 to Sept. 3, . .	3.00	3.00	–	3.00	5.00	–	38.70	–	22.17	8.95	2.48	1 : 4.72	890
Sept. 7 to Sept. 26, . .	3.00	3.00	–	3.00	5.00	–	–	37.35	22.71	8.92	2.55	1 : 6.13	864

BUTTERCUP: *Age, five years; grade, Ayrshire; last calf, Jan. 2, 1891.*

July 6 to July 21, . .	3.00	3.00	–	3.00	5.00	43.75	–	–	26.42	8.34	3.17	1:6.08	807
July 24 to Aug. 2, . .	3.00	–	3.00	3.00	5.00	29.60	–	–	21.74	8.73	2.49	1:6.09	840
Aug. 6 to Aug. 17, . .	3.00	–	3.00	3.00	5.00	–	42.17	–	22.99	8.76	2.62	1:5.05	816
Aug. 21 to Sept. 3, . .	3.00	3.00	–	3.00	5.00	–	36.58	–	21.63	8.85	2.41	1:4.70	826
Sept. 7 to Sept. 26, . .	3.00	3.00	–	3.00	5.00	–	–	33.90	21.74	8.64	2.52	1:6.00	864

LUCY: *Age, five years; grade, Ayrshire; last calf, June 2, 1891.*

July 6 to July 21, . .	3.00	3.00	–	3.00	5.00	49.38	–	–	28.25	12.26	2.30	1:6.23	762
July 24 to Aug. 2, . .	3.00	–	3.00	3.00	5.00	44.70	–	–	26.65	12.78	2.09	1:6.52	807
Aug. 6 to Aug. 17, . .	3.00	–	3.00	3.00	5.00	–	61.92	–	28.08	12.85	2.19	1:5.09	790
Aug. 21 to Sept. 3, . .	3.00	3.00	–	3.00	5.00	–	58.50	–	27.28	13.26	2.06	1:4.81	798
Sept. 7 to Sept. 26, . .	3.00	3.00	–	3.00	5.00	–	–	35.75	22.26	12.01	1.85	1:6.01	786

CLARISSA: *Age, seven years; grade, Durham; last calf, March 14, 1891.*

July 6 to July 21, . .	3.00	3.00	–	3.00	5.00	56.69	–	–	30.63	9.49	3.23	1:6.40	889
July 24 to Aug. 2, . .	3.00	–	3.00	3.00	5.00	47.60	–	–	27.59	9.31	2.96	1:6.59	923
Aug. 6 to Aug. 17, . .	3.00	–	3.00	3.00	5.00	–	64.58	–	28.76	10.37	2.77	1:5.10	890
Aug. 21 to Sept. 3, . .	3.00	3.00	–	3.00	5.00	–	60.07	–	27.68	10.99	2.52	1:4.81	882
Sept. 7 to Sept. 26, . .	3.00	3.00	–	3.00	5.00	–	–	51.65	26.73	9.98	2.68	1:6.57	909

TOTAL COST OF FEED PER QUART OF MILK.

Cord.

FEEDING PERIODS.		Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Brewers' Grain consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Beans consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1891.													
July 6 to July 21,	.	180.70	11.29	48.00	48.00	–	48.00	80.00	652.00	–	–	$3 44	1.90
July 24 to Aug. 2,	.	113.30	11.34	30.00	–	30.00	30.00	50.00	243.00	–	–	1 92	1.69
Aug. 6 to Aug. 17,	.	134.88	11.24	36.00	–	36.00	36.00	60.00	–	536.00	–	3 09	2.29
Aug. 21 to Sept. 3,	.	161.98	11.57	42.00	42.00	–	42.00	70.00	–	600.00	–	3 55	2.19
Sept 7 to Sept. 26,	.	214.19	10.71	60.00	60.00	–	60.00	100.00	–	–	749.00	4 12	1.92

Pearl.

FEEDING PERIODS.		Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Brewers' Grain consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Beans consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
July 6 to July 18,	.	105.46	8.11	39.00	39.00	–	39.00	65.00	593.00	–	–	$2 89	2.74
July 24 to Aug. 2,	.	86.98	8.70	30.00	–	30.00	30.00	50.00	359.00	–	–	2 08	2.39
Aug. 6 to Aug. 17,	.	103.60	8.63	36.00	–	36.00	36.00	60.00	–	517.00	–	3 05	2.94
Aug. 25 to Sept. 3,	.	89.53	8.95	30.00	30.00	–	30.00	50.00	–	387.00	–	2 44	2.73
Sept. 7 to Sept. 26,	.	178.49	8.92	60.00	60.00	–	60.00	100.00	–	–	747.00	4 11	2.30

Buttercup.

July 6 to July 21, .	133.50	8.34	48.00	48.00	–	48.00	80.00	700.00	–	–	$3 50	2.62
July 24 to Aug. 2, .	87.33	8.73	30.00	–	30.00	30.00	50.00	296.00	–	–	2 00	2.29
Aug. 6 to Aug. 17, .	105.12	8.76	36.00	–	36.00	36.00	60.00	–	506.00	–	3 02	2.86
Aug. 21 to Sept. 3, .	123.95	8.85	42.00	42.00	–	42.00	70.00	–	512.00	–	3 36	2.71
Sept. 7 to Sept. 26, .	172.79	8.64	60.00	60.00	–	60.00	100.00	–	–	678.00	4 03	2.33

Lucy.

July 6 to July 21, .	196.16	12.26	48.00	48.00	–	48.00	80.00	790.00	–	–	$3 63	1.85
July 24 to Aug. 2, .	127.79	12.78	30.00	–	30.00	30.00	50.00	447.00	–	–	2 20	1.72
Aug. 6 to Aug. 17, .	154.19	12.85	36.00	–	36.00	36.00	60.00	–	743.00	–	3 54	2.30
Aug. 21 to Sept. 3, .	185.58	13.26	42.00	42.00	–	42.00	70.00	–	819.00	–	4 03	2.17
Sept. 7 to Sept. 26, .	240.12	12.01	60.00	60.00	–	60.00	100.00	–	–	715.00	4 07	1.69

Clarissa.

July 6 to July 21, .	151.86	9.49	48.00	48.00	–	48.00	80.00	907.00	–	–	$3 79	2.50
July 24 to Aug. 2, .	93.14	9.31	30.00	–	30.00	30.00	50.00	476.00	–	–	2 24	2.40
Aug. 6 to Aug. 17, .	124.42	10.37	36.00	–	36.00	36.00	60.00	–	775.00	–	3 62	2.91
Aug. 21 to Sept. 3, .	153.84	10.99	42.00	42.00	–	42.00	70.00	–	841.00	–	4 08	2.65
Sept. 7 to Sept. 26, .	199.53	9.98	60.00	60.00	–	60.00	100.00	–	–	1,033.00	4 47	2.24

Net Cost of Milk and Manurial Value of Feed.

Cora.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1891.					Cents.	Pounds.
July 6 to July 21, .	$3 44	$1 78	$1 42	$2 02	1.12	1,080
July 24 to Aug. 2, .	1 92	0 93	0 74	1 18	1.04	1,055
Aug. 6 to Aug. 17, .	3 09	1 39	1 11	1 98	1.47	1,015
Aug. 21 to Sept. 3, .	3 55	1 62	1 30	2 25	1.39	1,032
Sept. 7 to Sept. 26, .	4 12	2 00	1 60	2 52	1.18	1,020
Total, . .	$16 12	$7 72	$6 17	$9 95	–	–

Pearl.

July 6 to July 18, .	$2 89	$1 50	$1 20	$1 69	1.60	972
July 24 to Aug. 2, .	2 08	1 05	0 84	1 24	1.43	945
Aug. 6 to Aug. 17, .	3 05	. 1 37	1 10	1 95	1.88	920
Aug. 25 to Sept. 3, .	2 44	1 12	0 90	1 54	1.72	920
Sept. 7 to Sept. 26, .	4 11	2 00	1 60	2 51	1.41	930
Total, . .	$14 57	$7 04	$5 64	$8 93	–	–

Buttercup.

July 6 to July 21, .	$3 50	$1 82	$1 46	$2 04	1.53	832
July 24 to Aug. 2, .	2 00	0 98	0 78	1 22	1.40	845
Aug. 6 to Aug. 17, .	3 02	1 36	1 09	1 93	1.84	812
Aug. 21 to Sept. 3, .	3 36	1 52	1 22	2 14	1.72	850
Sept. 7 to Sept. 26, .	4 03	1 94	1 55	2 48	1.44	858
Total, . .	$15 91	$7 62	$6 10	$9 81	–	–

Lucy.

July 6 to July 21, .	$3 63	$1 92	$1 54	$2 09	1.07	793
July 24 to Aug. 2, .	2 20	1 14	0 91	1 29	1.01	835
Aug. 6 to Aug. 17, .	3 54	1 61	1 29	2 25	1.46	785
Aug. 21 to Sept. 3, .	4 03	1 85	1 48	2 55	1 37	815
Sept. 7 to Sept. 26, .	4 07	1 97	1 58	2 49	1 04	765
Total, . .	$17 47	$8 49	$6 80	$10 67	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Clarissa.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1891.					Cents.	Pounds.
July 6 to July 21, .	$3 79	$2 04	$1 63	$2 16	1.42	911
July 24 to Aug 2,	2 24	1 17	0 94	1 30	1.40	930
Aug. 6 to Aug. 17, .	3 62	1 65	1 32	2 30	1.85	890
Aug. 21 to Sept. 3, .	4 08	1 88	1 50	2 58	1.68	907
Sept 7 to Sept. 26, .	4 47	2 23	1 78	2 69	1.35	905
Total, . .	$18 20	$8 97	$7 17	$11 03	-	-

Statement of the Average of Analyses of Milk made during the Different Feeding Periods.

PERIODS.		Cora.	Pearl.	Buttercup.	Lucy.	Clarissa.
I., . .	Solids, per cent.,	13.05	13.96	13.48	13.58	13.59
	Fat, per cent., .	4.24	4.26	3.92	4.29	4.58
II., . .	Solids, per cent.,	12.70	13.55	12.59	13.48	13.16
	Fat, per cent., .	3.98	3.83	3.28	4.26	4.17
III., . .	Solids, per cent.,	12.99	14.63	12.68	13.25	13.43
	Fat, per cent., .	4.39	4.87	3.67	4.27	4.59
IV., . .	Solids, per cent.,	13.68	14.67	12.99	13.98	14.54
	Fat, per cent., .	4.63	4.62	3.58	4.54	4.84
V., . .	Solids, per cent.,	13.30	14.92	13.55	14.33	14.65
	Fat, per cent., .	3.88	4.25	3.83	4.97	4.93

Corn Meal.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.31	303.20	–	–	1 : 9.23
Dry matter,	84.69	1,697.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.72	34.40	–	–	
" cellulose,	2.17	43.40	20.83	48	
" fat,	4.84	96.80	82.28	85	
" protein (nitrogenous matter),	12.18	243.60	192.44	79	
Non-nitrogenous extract matter,	79.09	1,581.80	1,550.16	98	
	100.00	2,000.00	1,845.71	–	

Gluten Meal.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.11	222.20	–	–	1 : 2.66
Dry matter,	88.89	1,777.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.65	33.00	–	–	
" cellulose,	0.73	14.60	9.05	62	
" fat,	9.22	184.40	156.74	85	
" protein (nitrogenous matter),	33.34	666.80	526.77	79	
Non-nitrogenous extract matter,	55.06	1,101.20	1,002.09	91	
	100.00	2,000.00	1,694.65	–	

Brewers' Grain.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C , . .	12.00	240.00	–	–	1 : 2.95
Dry matter, . . .	88.00	1,760.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	4.46	89.20	–	–	
" cellulose, . . .	15.31	306.20	122.48	40	
" fat, ...	6.10	122.00	101.26	83	
" protein (nitrogenous matter), . .	23.43	468.60	346.76	74	
Non-nitrogenous extract matter, ...	50.70	1,014.00	648.96	64	
	100.00	2,000.00	1,219.46	–	

Wheat Bran.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.99	259.80	–	–	1 : 4.73
Dry matter, . . .	87.01	1,740.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.23	124.60	–	–	
" cellulose, . . .	10.47	209.40	50.26	24	
" fat, ...	5.37	107.40	76.25	71	
" protein (nitrogenous matter), . .	16.16	323.20	252.10	78	
Non-nitrogenous extract matter, ...	61.77	1,235.40	951.26	77	
	100.00	2,000.00	1,329.87	–	

Vetch and Oats.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	64.77	1,295.40	–	–	1 : 10.01
Dry matter,	35.23	704.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.97	159.40	–	–	
" cellulose,	30.77	615.40	–	–	
" fat,	2.58	51.60	25.80	50	
" protein (nitrogenous matter),	8.83	176.60	105.96	60	
Non-nitrogenous extract matter,	49.85	997.00	997.00	100	
	100.00	2,000.00	1,128.76	–	

Soja Beans.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C.,	72.22	1,444.40	–	–	1 : 5.35
Dry matter,	27.78	555.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.39	127.80	–	–	
" cellulose,	31.49	629.80	365.28	58	
" fat,	3.39	67.80	9.49	14	
" protein (nitrogenous matter),	13.71	274.20	175.49	64	
Non-nitrogenous extract matter,	45.06	901.20	549.73	61	
	100.00	2,000.00	1,099.99	–	

Fodder Corn (Green).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.86	1,437.20	–	–	1 : 11.19
Dry matter,	28.14	562.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.78	75.60	–	–	
" cellulose,	25.67	513.40	369.65	72	
" fat,	2.24	44.80	33.60	75	
" protein (nitrogenous matter),	7.62	152.40	114.30	75	
Non-nitrogenous extract matter,	60.69	1,213.80	825.38	68	
	100.00	2,000.00	1,342.93	–	

4. Creamery Record of the Station for the Years 1890 and 1891.

The cost of feed consumed is based on the market price of the various ingredients, as is stated in the subsequent table.

The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are based on those given in the following table.

The local market value and the value ot the essential fertilizing constituents of the fodder articles used are reckoned for the year 1890, in order to render the results comparable.

Local Market Value per Ton of the Various Articles of Fodder used.

Corn meal,	$23 00
Wheat bran,	21 50
Gluten meal,	23 00
Brewers' grain,	22 00

Local Market Value per Ton, etc. — Concluded.

New-process linseed meal,	$26 00
Old-process linseed meal,	27 00
Cotton-seed meal,	26 00
Hay,	15 00
Rowen,	15 00
Corn fodder,	5 00
Corn stover,	5 00
Corn ensilage,	2 25
Corn and soja bean ensilage,	3 50
Soja bean (green),	4 40
Vetch and oats (green),	2 75
Fodder corn (green),	2 50
Carrots,	7 00
Sugar beets,	5 00
Cabbages,	2 50

Valuation of the Essential Fertilizing Constituents of the Various Articles of Fodder used.

Nitrogen, 16½ cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents per pound.

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Wheat bran,	2.82	3.05	1.49	14 24
Gluten meal,	5.22	0.40	0.05	17 75
Brewers' grain,	3.299	1.192	1.466	13 56
New-process linseed meal,	6.25	1.42	1.16	23 32
Old-process linseed meal,	5.33	1.64	1.16	20 54
Cotton-seed meal,	6.467	2.33	1.723	25 60
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Corn and soja bean ensilage,	0.708	0.42	0.444	3 22
Soja bean (green),	0.590	0.193	0.311	2 44
Vetch and oats (green),	0.23	0.09	0.79	1 54
Fodder corn (green),	0.343	0.195	0.43	1 73
Carrots,	0.14	0.10	0.54	1 04
Sugar beets,	0.29	0.03	0.18	1 15
Cabbages,	0.300	0.11	0.43	1 48

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved, for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream, and modes of analysis of milk, cream and butter.

Statement of Articles of Fodder used during 1890 (in Pounds).

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Beans.	Carrots.	Sugar Beets.
January,	604.50	604.50	-	604.50	-	-	1,016.00	-	-	-	7,737.50	-	-	-	-
February,	370.50	546.00	-	529.75	-	-	514.00	-	850.50	-	4,687.50	-	-	1,080.00	-
March,	-	604.50	-	604.50	-	-	-	-	1,132.00	1,665.00	-	-	-	3,680.00	-
April,	184.50	577.50	-	106.50	444.00	-	977.00	-	1,201.50	472.50	-	-	-	2,520.00	1,080.00
May,	604.50	604.50	-	340.50	262.50	-	2,656.50	360.00	-	-	-	-	-	-	3,240.00
June,	585.00	585.00	-	379.50	204.00	-	-	3,723.50	-	-	-	-	-	-	-
July,	604.50	604.50	-	-	604.50	-	725.50	613.00	-	-	-	7,463.00	-	-	-
August,	604.50	604.50	-	-	604.50	-	930.00	-	-	-	-	910.50	8,882.50	-	-
September,	585.00	585.00	-	-	585.00	-	120.00	2,935.00	-	-	-	-	1,767.00	-	-
October,	571.50	571.50	-	-	223.50	348.00	-	3,221.50	-	-	-	-	-	-	-
November,	450.00	450.00	120.00	-	-	330.00	-	3,555.50	-	-	-	-	-	-	-
December,	465.00	465.00	255.00	-	-	210.00	-	3,225.00	-	-	-	-	-	-	-

1. Statement of Articles of Fodder used during 1891 (in Pounds).

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Mixed Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.	Cabbages.
January,	541.50	541.50	-	244.50	297.00	-	-	2,355.00	-	-	1,614.00	-	-	840.00	-
February,	504.00	504.00	306.00	-	198.00	-	-	857.00	-	-	7,566.00	-	-	-	-
March,	558.00	558.00	450.00	-	108.00	-	-	169.00	-	2,153.50	1,269.00	-	-	-	-
April,	537.00	540.00	-	-	534.00	-	-	1,915.50	-	106.50	-	-	-	-	-
May,	558.00	558.00	450.00	-	108.00	-	-	3,295.00	-	-	-	-	-	-	-
June,	516.00	540.00	516.00	-	-	-	-	2,417.50	-	-	-	-	-	-	-
July,	555.00	180.00	555.00	-	-	378.00	-	1,052.00	-	-	-	7,285.00	-	-	-
August,	558.00	324.00	558.00	-	-	234.00	-	1,032.50	-	-	-	479.00	6,965.00	-	1,820.00
September,	540.00	-	540.00	-	-	540.00	-	690.00	4,504.50	-	-	-	1,011.00	-	1,800.00
October,	558.00	-	222.00	-	-	558.00	2,673.00	-	-	-	-	-	-	680.00	1,560.00

Record of Average Quality of Milk and of Fodder Rations (1890).

1890.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make one Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds). Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Bean.	Carrots.	Sugar Beets.
January,	14.18	4.72	1.45	1 : 6.25	3.25	3.25	–	3.25	–	–	5.00	–	–	–	44.74	–	–	–	–
February,	14.02	4.64	1.51	1 : 6.25	3.25	3.25	–	3.25	–	–	5.00	–	–	–	44.74	–	–	–	–
				1 : 5.14	–	3.25	–	3.25	–	–	–	–	13.74	–	–	–	–	20.00	–
March,	14.21	4.99	1.57	1 : 5.14	–	3.25	–	3.25	–	–	–	–	13.74	–	–	–	–	20.00	–
				1 : 5.14	–	3.25	–	3.25	–	–	–	–	–	16.00	–	–	–	20.00	–
April,	13.37	4.42	1.66	1 : 4.95	–	3.25	–	–	3.25	–	–	–	16.13	–	–	–	–	20.00	–
				1 : 5.22	3.25	3.25	–	–	3.25	–	15.90	–	–	–	–	–	–	–	20.00
May,	13.73	4.38	1.75	1 : 5.22	3.25	3.25	–	–	3.25	–	15.90	–	–	–	–	–	–	–	20.00
				1 : 5.60	3.25	3.25	–	3.25	–	–	15.67	–	–	–	–	–	–	–	20.00
June,	13.42	4.39	1.76	1 : 5.04	3.25	3.25	–	3.25	–	–	–	20.60	–	–	–	–	–	–	–
				1 : 4.73	3.25	3.25	–	–	3.25	–	–	20.75	–	–	–	–	–	–	–
July,	13.91	4.45	1.67	1 : 5.96	3.25	3.25	–	–	3.25	–	5.00	–	–	–	–	53.75	–	–	–
August,	14.65	4.95	1.61	1 : 4.69	3.25	3.25	–	–	3.25	–	5.00	–	–	–	–	–	55.00	–	–
September,	13.47	4.57	1.59	1 : 4.91	3.25	3.25	–	–	3.25	–	–	19.86	–	–	–	–	–	–	–
October,	13.84	4.82	1.56	1 : 4.91	3.25	3.25	–	–	3.25	–	–	19.86	–	–	–	–	–	–	–
				1 : 4.84	3.00	3.00	–	–	–	3.00	–	19.25	–	–	–	–	–	–	–
November,	14.24	5.02	1.57	1 : 4.60	3.00	3.00	–	–	–	3.00	–	20.00	–	–	–	–	–	–	–
December,	14.80	5.09	1.61	1 : 5.13	3.00	3.00	3.00	–	–	–	–	18.00	–	–	–	–	–	–	–
				1 : 4.83	3.00	3.00	–	–	–	3.00	–	18.00	–	–	–	–	–	–	–
Averages,	13.99	4.70	1.61	1 : 5.19															

2. *Record of Average Quality of Milk and of Fodder Rations (1891).*

1891.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja Bean Ensilage.	Vetch and Oats.	Soja Beans.
January,	14.99	5.19	1.54	1 : 4.83	3.00	3.00	–	3.00	–	–	–	18.00	–	–	–	–	–
				1 : 4.17	3.00	3.00	–	–	3.00	–	–	5.00	–	–	42.00	–	–
February,	14.71	5.09	1.76	1 : 4.17	3.00	3.00	–	–	3.00	–	–	5.00	–	–	42.00	–	–
				1 : 4.70	3.00	3.00	3 00	–	–	–	–	5.00	–	–	46.00	–	–
March,	14.82	5.00	1.62	1 : 6.74	3.00	3.00	3.00	–	–	–	–	–	–	14.00	–	–	–
April,	14.41	5.21	1.53	1 : 5.66	3.00	3.00	–	–	3.00	–	–	–	–	14.00	–	–	–
				1 : 4.49	3.00	3.00	–	–	3.00	–	–	18.00	–	–	–	–	–
May,	13.75	4.39	1.67	1 : 5.14	3.00	3.00	3.00	–	–	–	–	18.00	–	–	–	–	–
June,	–	–	1.76	–	–	–	–	–	–	–	–	–	–	–	–	–	–
July,	13.41	4.18	1.78	1 : 6.17	3.00	–	3.00	–	–	3.00	–	5.00	–	–	–	47.00	–
August,	13.42	4.22	1.86	1 : 5.07	3.00	3.00	3.00	–	–	3.00	–	5 00	–	–	–	–	51 00
				1 : 4.76	3.00	–	3.00	–	–	–	–	5.00	–	–	–	–	47.00
September,	13.90	4.15	1.75	1 : 6.17	3.00	–	3.00	–	–	3.00	–	5 00	39.00	–	–	–	–
October,	–	–	1.72	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Averages,	14.18	4.68	1.70	1 : 5.17													

3. Value of Cream at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1890.					
January,	$37 78	$23 07	$0 64	$15 35	$33 99
February,	32 19	19 62	0 69	13 26	36 93
March,	34 38	19 75	0 66	15 29	37 52
April,	38 54	19 75	0 68	19 47	32 40
May,	52 09	25 32	0 73	27 50	33 45
June,	48 63	30 05	0 72	19 30	30 66
July,	41 65	23 90	0 68	18 43	29 04
August,	49 09	27 52	0 73	22 30	39 27
September,	47 43	28 68	0 72	19 47	42 05
October,	44 48	27 82	0 65	17 31	39 92
November,	42 36	26 59	0 58	16 35	34 83
December,	40 20	24 89	0 54	15 85	32 84
Averages,	$42 40	$24 75	$0 67	$18 32	$35 24
1891.					
January,	$41 79	$26 14	$0 60	$16 25	$35 23
February,	36 98	26 85	0 61	10 74	25 49
March,	27 86	17 66	0 69	10 89	42 44
April,	35 96	23 22	0 63	13 37	37 36
May,	43 70	26 64	0 74	17 80	40 82
June,	35 80	21 51	0 68	14 97	32 40
July,	36 76	21 30	0 66	16 12	32 26
August,	44 88	25 92	0 68	19 64	36 26
September,	33 64	20 11	0 68	14 21	41 84
October,	43 18	22 30	0 63	21 51	39 48
Averages,	$38 06	$23 17	$0 66	$15 55	$37 36

4. Cost of Skim Milk at the Selling Price of Three Cents per Quart for Whole Milk.

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1890.								Cents.	
January,	1,404.1	971	285.6	1,118.5	3.50	2.42	$33 99	0.73	$8 13
February,	1,596.2	1,055	310.3	1,285.9	3.50	2.31	36 93	0.85	10 96
March,	1,594.8	1,014	298.2	1,296.6	3.70	2.35	37 52	0.80	10 32
April,	1,720.8	1,035	304.4	1,416.4	3.13	1.88	32 40	1.36	19 22
May,	1,946.7	1,115	327.9	1,618.8	3.00	1.72	33 45	1.54	24 95
June,	1,922.4	1,095	322.1	1,600.3	2.80	1.59	30 66	1.69	27 01
July,	1,727.0	1,037	305.0	1,422.0	2.80	1.68	29 04	1.60	22 77
August,	1,809.5	1,122	330.0	1,479.5	3.50	2.17	39 27	1.02	15 02
September,	1,747.4	1,098	322.9	1,424.5	3.83	2.41	42 05	0.73	10 37
October,	1,556.9	998	293.5	1,263.4	4.00	2.56	39 92	0.54	6 79
November,	1,413.5	893	262.6	1,150.9	3.90	2.46	34 83	0.66	7 57
December,	1,321.6	821	241.5	1,080.1	4.00	2.48	32 84	0.61	6 81
Averages,	1,646.7	1,021	300.3	1,346.4	3.47	2.17	$35 24	1.01	$14 16
1891.									
January,	1,413.5	915	269.1	1,144.4	3.85	2.49	$35 23	0.63	$7 18
February,	1,643.8	934	274.7	1,369.1	3.80	2.16	35 49	1.01	13 82
March,	1,700.2	1,048	308.2	1,392.0	4.05	2.50	42 44	0.62	8 57
April,	1,468.1	958	281.8	1,186.3	3.90	2.54	37 36	0.56	6 68
May,	1,889.7	1,134	333.2	1,556.5	3.60	2.16	40 82	1.02	15 87
June,	1,841.3	1,045	307.4	1,533.9	3.10	1.76	32 40	1.49	22 84
July,	1,791.2	1,008	296.5	1,494.7	3.20	1.80	32 26	1.44	21 48
August,	1,924.0	1,036	304.7	1,619.3	3.50	1.88	36 26	1.33	21 46
September,	1,826.9	1,046	307.8	1,519.1	4.00	2.29	41 84	0.85	12 97
October,	1,659.9	963	283.2	1,376.7	4.10	2.38	39 48	0.75	10 32
Averages,	1,715.9	1,009	296.7	1,419.2	3.71	2.20	$37 36	0.97	$14 12

5. Fertilizing Constituents of Cream.

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen (16½ cents per pound),	.54
Potassium oxide (4¼ cents per pound),	.123
Phosphoric acid (6 cents per pound),	.168

6. *Conclusions.*

1. The nutritive ratio of the feed varied in 1890 from 1 : 4.60 to 1 : 6.25, with an average of 1 : 5.19; in 1891 from 1 : 4.17 to 1 : 6.74, with an average of 1 : 5.17.

2. The amount of fat in the milk varied in 1890 from 4.38 per cent. to 5.09 per cent., with an average of 4.70 per cent.; in 1891 it varied from 4.15 per cent. to 5.21 per cent., with an average of 4.68 per cent.

3. The percentage of total solids varied in 1890 from 13.37 to 14.80; in 1891 from 13.41 to 14.99, with an average for 1890 of 13.99 and for 1891 of 14.18.

4. The total cost of feed for one quart of cream amounts in 1890 to 14.12 cents, and in 1891 to 12.83 cents.

5. The net cost of feed for one quart of cream amounts in 1890 to 6.10 cents, and in 1891 to 5.24 cents.

6. The value received for one space of cream varied in 1890 from 3 to 4 cents, with an average of 3.47 cents; in 1891 from 3.10 to 4.10 cents, with an average of 3.71 cents, which amounts per quart (average) in 1890 to 11.80 cents and in 1891 to 12.61 cents.

7. The number of quarts of milk required to produce one space of cream in 1890 was 1.61, and in 1891, 1.70, or 5.47 quarts of whole milk to produce one quart of cream in 1890 and 5.78 quarts to produce one quart of cream in 1891.

8. The net cost of feed per quart of cream averages in 1890, 6.10 cents and in 1891, 5.24 cents. We received per quart of cream in 1890, 11.80 cents and in 1891, 12.61 cents, thereby securing a profit of 5.70 cents per quart in 1890 and 7.37 cents in 1891.

From these statements it appears, as has already been claimed in previous reports, that close fodder rations tend to improve the quality of the milk as well as the condition of the animal. The introduction of dried brewers' grain and cotton-seed meal into the daily diet has apparently lowered to a considerable extent the net cost of feed.

For further details concerning results in preceding years, see seventh annual report, pages 82 to 84, and also eighth annual report, pages 54 to 65.

Our average statements for the current year apply in each case to only ten months, due to the fact that financial settlement with our local creamery is made two months after cream is furnished.

7. Creamery Record, 1891. — Analyses of Cream and Butter Fat.

Date of Sampling.	Analysis of Cream.			Analysis of Fat.		Average Daily Fodder Rations.
	Solids.	Fat.	Solids not Fat.	Volatile Acids.	Non-volatile Acids.	
1891.						
Jan. 20, .	27.14	18.54	8.60	7.54	84.49	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 10 pounds rowen, 16 pounds mixed ensilage (corn and soja beans).
" 30, .	29.35	19.60	9.75	6.72	86.98	
Feb. 3, .	27.57	18.60	8.97	6.78	86.48	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 5 pounds rowen, 45 pounds mixed ensilage.
" 10, .	27.53	19.17	8.36	7.43	86.25	
Feb. 17, .	28.26	19.88	8.38	7.49	86.30	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 5 pounds rowen, 50 pounds mixed ensilage.
" 24, .	27.41	20.76	6.65	7.32	86.10	
March 3, .	27.29	19.34	7.95	–	–	
March 11, .	26.82	18.98	7.84	–	–	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 15 pounds corn stover.
" 17, .	26.53	18.63	7.90	–	–	
" 24, .	24.65	16.73	9.92	–	–	
March 31, .	24.74	17.53	7.21	6.14	88.89	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 15 pounds corn stover.
April 7, .	26.63	18.58	8.05	6.24	87.89	
" 13, .	26.75	18.84	7.91	6.52	88.32	
April 21, .	25.95	18.09	6.86	–	–	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 20 pounds rowen.
" 28, .	26.61	18.98	7.63	–	–	
May 5, .	27.36	19.56	7.80	–	–	
May 12, .	26.32	18.63	7.69	–	–	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 18 pounds rowen.
" 19, .	25.68	18.11	7.57	–	–	
" 26, .	28.01	20.09	7.92	–	–	
July 14, .	24.65	17.30	7.35	–	–	3 pounds corn meal, 3 pounds brewers' grain (dry), 3 pounds gluten meal, 5 pounds rowen, 45 pounds vetch and oats (green).
" 23, .	24.27	16.45	7.82	–	–	
Aug. 11, .	25.21	18.12	7.09	–	–	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 5 pounds rowen, 42 pounds soja beans (green).
" 18, .	25.93	18.41	7.52	–	–	

Creamery Record, 1891. — Analyses of Cream of Butter.

Date of Sampling.	Solids.	Fat.	Solids not Fat.	Average Daily Fodder Rations.
1891.				
Aug. 25, .	27.44	19.27	8.17	3 pounds corn meal, 3 pounds brewers' grain (dry), 3 pounds gluten meal, 5 pounds rowen, 42 pounds soja beans (green).
Sept. 1, .	25.52	18.15	7.37	
Sept. 15, .	23.01	15.69	7.32	3 pounds corn meal, 3 pounds brewers' grain, 3 pounds gluten meal, 5 pounds rowen, 35 pounds fodder corn (green).
" 22, .	25.18	17.56	7.62	
Dec. 8, .	22.15	15.67	6.48	3 pounds maize feed, 3 pounds cotton-seed meal, 3 pounds wheat bran, 16 pounds sweet corn stover.
" 15, .	25.03	18.14	6.89	
" 22, .	24.33	17.71	6.62	
Dec. 29, .	25.97	18.66	7.31	3 pounds maize feed, 3 pounds cotton-seed meal, 3 pounds wheat bran, 14 pounds dent corn stover.

Method of Milk Analysis.

Total Solids. — Evaporate a known quantity of milk (approximately 5 grams) in a weighed porcelain dish, containing 15 to 20 grams of pure, dry sand, on the water bath until apparently dry, then transfer to the air bath and dry at 100° to 105° C. to a constant weight, weighing at intervals of about an hour. In case of cream, use 2.5 to 3 grams for evaporation.

Fat. — Pulverize the sand containing the solids without removing from the dish, subsequently transfer to a filter, and exhaust with anhydrous, alcohol-free ether. Dry the fat obtained on the evaporation of the ether in an air bath at 100° to 105° C. to a constant weight.

Ash. — A weighed quantity of milk is evaporated to dryness with a few drops of nitric acid, and burned in a muffle at a low red heat until free from carbon.

Methods of Butter Analysis.

(1) *Moisture.* — Two and five-tenths to 3 grams are dried at 100° C. in an air bath.

(2) *Salt.* — Six to 7 grams of the butter are washed into a separatory funnel with hot water, and are well shaken, and

allowed to stand until the fat has collected on top; the water is then drawn off, and a fresh quantity added, and shaken up with the butter. This is continued until 200 to 300 cubic centimetres of water have passed through the funnel. The washings are mixed, and made up to 500 cubic centimetres, and the chlorine determined in an aliquot part by means of silver nitrate. From the chlorine the salt is readily calculated.

(3) *Fat.* — Two and five-tenths to 3 grams of the fat freed from salt by the above operation (2), and from water by drying in the air bath, are dissolved in ether, and filtered from the curd into a tared flask. The ether is driven off, and the residual fat dried and weighed. In calculating the per cent., allowance is made for salt and water removed.

(4) *Casein.* — The residue remaining on the filter in (3) is tested for nitrogen by the Kjeldahl method. The factor 6.33 is used in reducing the per cent. of nitrogen found to casein.

Method for determining Volatile and Non-volatile Fatty Acids contained in Butter.

The sample is prepared by churning the cream in a suitable bottle, washing the butter well with cold water, melting at 50° C. and filtering from the curd through a hot-water funnel. The fat is then heated in the air bath until free from water.

The method pursued in the determination of the volatile and non-volatile fatty acids is essentially that described by L. F. Nilson, in "Zeit. f. Anal. Chemie," 28, 2, 176.

Two and eight-tenths cubic centimetres to 2.9 cubic centimetres (approximately 2.5 grams) are measured into a tared Erlenmeyer flask of 250 cubic centimetres capacity, and the exact weight determined. Saponification is accomplished by adding 1 gram of potassium hydrate dissolved in 2 cubic centimetres of water, and 5 cubic centimetres of strong (95 per cent.) alcohol. The flask is provided with a reflux condenser, and heated until saponification is complete. The alcohol is then driven off, the last traces being removed by means of the following device: the flask is provided with a double perforated rubber cork, one hole carrying a glass tube reaching nearly to the bottom of the flask and provided above with a short rubber tube carrying a pinch-cock, the other connected by means of a rubber tube with a suction pump. By alternately opening and closing the pinch-cock while the pump is working, the last traces of alcohol can be readily removed from the soap.

Dissolve the soap thus obtained in 30 cubic centimetres of warm water, decompose with 20 cubic centimetres of a 20 per cent. solution of orthophosphoric acid, distil off the volatile acids through a condenser, filtering the distillate, and titrate with decinormal sodium hydrate, using phenolphthalein as indicator. The volatile acids are expelled from the flask by a current of steam. When the distillate amounts to 500 cubic centimetres, the operation is considered to be complete. The volatile acids are calculated as butyric.

The condenser and connections are rinsed back into the flask with boiling water, and the non-volatile acids washed with hot water, and filtered when cool through the same filter that was used for the distillate. The washing is continued until no traces of phosphoric acid are left in the distillate. The filter is then exhausted with hot alcohol, allowing the solution to run into the flask. The alcohol is driven off on the water bath, and the non-volatile fatty acids dried at 100° C. in the air bath until they begin to gain weight.

5. *Some General Remarks on Analysis of Fodder and Fodder Analyses.*

The application of an intelligently devised system of chemical tests, for the purpose of ascertaining the amount and the relative proportions of the essential proximate constituents of our fodder articles, has rendered valuable services to practical agriculture. The chemical analysis of plants during their successive stages of growth has shown marked alterations in their composition, as far as the *absolute amount* of vegetable matter, as well as the *relative proportion* of the essential plant constituents, are concerned. It has rendered not less conspicuous the important influence which the soil in its varying state of fertility exerts on the quantity and the quality of the growth raised upon it. The lessons derived from this source of information have stimulated inquiries concerning the safest modes of manuring, of cultivating and of harvesting our different farm crops with the prospect of securing the most satisfactory returns under existing circumstances.

A better knowledge regarding the particular quality of the various articles of fodder at our disposal improves our chances of supplementing them judiciously and thus economically for different kinds of farm live-stock, as well as for different conditions and functions of the same kind. It furnishes, also, a safer basis for the explanation of the results obtained in actual feeding experiments. To study the nutritive value or feeding effect of any of our fodder articles by actual feeding experiments, without learning, as far as practicable, something more definite regarding its peculiar quality or composition, deprives the results obtained largely of their general interest, for they are secured under ill-defined circumstances. The chemical analysis of an article of fodder is for these reasons considered the first step required to render an intelligent interpretation of the results in feeding trials possible.

Food Constituents. — Actual feeding experiments have shown that *three groups of plant constituents*, namely, *nitrogenous*, *non-nitrogenous* and *mineral constituents*, are *needed* to successfully sustain animal life. No one or two of them, alone, can support it for any length of time. In case the food does not contain digestible non-nitrogenous substances, the fat and a portion of the muscles of the animal on trial will be consumed in the support of respiration before its life terminates. In case digestible nitrogenous constituents are excluded from the diet, the formation of new blood and flesh from the food consumed ceases; for the animal system, according to our present state of information, is not capable of producing its principal constituents from anything else than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances directly from the plants; carnivorous animals indirectly, by feeding on herbivorous animals. We feed, at present, our farm-stock too frequently, without a due consideration of the general natural law of nutrition; to deal out our fodder crops only with mere reference to name, instead of making ourselves more familiar with their composition and their particular quality, deprives us even of the chance of drawing an intelligent conclusion from our present system of feeding.

To compound the animal diet with reference to the particular organization of the animal, its age and its functions, is of no more importance than to select the fodder substances with reference to its special wants, as far as the absolute and relative quantity of the three essential groups of food constituents are concerned.

The peculiar character of our home-raised fodder articles is apt to conceal their special deficiency for the various purposes they are used for in general farm management. They all contain the three essential food constituents, yet in widely varying proportions; and they ought, therefore, to be supplemented in different directions to secure their full economical value. To resort to more or less of the same fodder article to meet the special wants may meet the case as far as an efficient support of the animal is concerned, yet it can only in exceptional cases be considered good economy.

Fodder Rations. — To satisfy the craving of the stomach and to feed a nutritious food are both requirements of a healthy animal diet, which, each in its own way, may be complied with. The commercial fodder substances — as oil-cakes, mill refuse brans, and our steadily increasing supply of refuse materials from breweries, starch works, glucose factories, etc. — are admirably fitted to supplement our farm resources for stock feeding; they can serve in regard to animal growth and support, in a similar way as the commercial fertilizers in the growth of our farm crops, by supplementing our home manurial resources. To feed an excess of food materials, as roots, potatoes, etc., which contain a large proportion of non-nitrogenous matter, as starch, sugar, digestible cellular substance, etc., means direct waste, for they are ejected by the animal, and do not even materially benefit the manure heap. In case of an excessive consumption of nitrogenous constituents, — as oil-cakes, brans, gluten meal, etc., — a part of the expense is saved in an increased value of the manure obtained, yet scarcely enough to recommend that practice beyond merely exceptional cases. The aim, therefore, of an economical stock-feeding must be to compound our various fodder materials in such a manner that the largest quantity of each of the three above-stated groups of fodder substances, which the animal is capable of assimilating, should be contained in its daily diet to meet the purpose for which it is kept.

To compound the fodder rations of our farm stock, with reference to the special wants of each class of them, is an essential requirement for a satisfactory performance of their functions; to supply these wants in an economical way controls the financial success of the industry. From these and similar considerations it will be apparent that the development of a more rational, and thus more economical, system of feeding farm live-stock requires the following kind of information: —

First. How much of each of the three essential groups of food constituents is contained in the fodder we feed?

Second. How much of each of these essential food constituents is digestible under existing circumstances, and is thus directly available to the particular animal on trial?

Third. How much of each of the three essential food constituents does each kind of animal require to secure the best results?

More than twenty-five years have passed by since these questions have seriously engaged the attention of skilful experimenters. Sufficient valuable information has been secured in the course of time to encourage the use of the adopted methods of observation, and to impart to many of the conclusions arrived at a just claim for a serious consideration on the part of practical agriculturists. The fact that much needs still to be learned to meet the reasonable expectations of those engaged in the development of a more economical system of feeding farm live-stock cannot be considered a valid reason why we should not make an intelligent use of what we have learned.

Fodder Analysis. — The chemical analysis of a fodder article is carried on with a view to determine the quantity of each group of its constituents, which is considered an essential ingredient of a complete food for the support of animal life. Our modes of analyzing articles of fodder are practically the same, wherever this work is carried out intelligently. The results obtained are, therefore, applicable for the determining of a comparative value wherever the identity of the material can be established.

The actual results of the analysis are usually reported under the following headings: —

1. Amount of moisture lost at 110° C., or 230° F., and amount of dry matter left behind.

2. Amount of mineral matter left behind after a careful incineration of the material.

3. Amount of organic nitrogenous matter, commonly called crude protein.

4. Amount of non-nitrogenous organic matter, exclusive of fat and of coarse cellulose substances.

The entire mass which any fodder substance leaves behind after being heated at one hundred and ten degrees, Centigrade thermometer, is called dry matter. An increase in dry substance in case of any plant or part of plant at the same stage of growth indicates usually a higher feeding value. To satisfy the cravings of the animal, a certain quantity or bulk of coarse, dry matter becomes an important consideration in making up the fodder rations for different classes of animals. In raising young stock for fattening purposes, a liberal supply is also desirable, to effect a proper distension of the digestive organs, to make them good feeders hereafter.

Nitrogenous substances, or protein matter, refer to several groups of nitrogen-containing compounds, of plants in particular, as albumin, fibrin, legumin, bascin, etc., which are essential for the formation of blood and tissues. Those contained in animal matter, as meat refuse, are frequently considered of a higher value than those in many plants.

Non-nitrogenous substances include, in particular, starch, sugars, organic acids, gums, fats and the digestible portion of the cellular matter of the fodder. These substances are readily transformed within the digestive organs into soluble compounds of a similar chemical character, and are thus assumed to serve an identical physiological purpose. As more recent investigations have shown a superior physiological value of fat, — one of the non-nitrogenous constituents, — two and one-half times as much as starch, sugar, and other representatives of that group, its amount is separately recorded. The same course, for similar reasons, has of late been adopted with reference to certain forms of nitrogenous organic constituents of fodder articles.

Fatty substances include all the various natural fats of the plant. Most plants contain more than was assumed at an earlier stage of inquiry. As the fat is separated by means of ether, the statements in the analyses do not exactly express the amount of fatty matter alone, but include more or less resinous substances, wax, etc., which are largely soluble in ether, and of a similar highly carbonaceous character. The fat of the fodder seems to serve, in case of judicious fodder rations, mainly to increase the stock of fat in the animal which consumes the fodder.

Digestibility of Fodder. — Wherever the article has been tested by actual feeding experiment under skilful observation, the amount of each essential group of food constituents which has been shown to be digestible is reported in connection with the chemical analysis, under the heading *Digestible Portion*, per hundred weight or per ton. The higher or lower degree of digestibility of a fodder article exerts a decided influence on its nutritive value. Different stages of growth affect the rates of digestibility of the various plant constituents. The same feature is noticed in regard to different parts of plants, as well as in case of different kinds of animals.

More than two hundred fodder articles have thus far been studied under varying circumstances, and most of our current kinds of fodders have been tested in Europe and elsewhere, in numerous well-conducted feeding experiments with a suitable selection of different kinds of farm live-stock. This fact imparts to many of the results recorded a sufficient importance to recommend them as a basis of new feeding trials, with feed stuffs raised in our climate, or obtained in our home industries.

Nutritive Ratio. — The last, but not least important, column of the statement of the chemical analysis — quite frequently found in the general record of a fodder for a practical agricultural purpose — is that of "Nutritive Ratio." These words are used to express the numerical relation of its *digestible nitrogenous substances* taken as one, as compared with the sum of its *digestible non-nitrogenous organic substances*, fat included. The information derived from that statement is very important; for it means to express the summary of results secured by actual feeding trials under specified conditions, and with the aid of the best endorsed chemical modes to account for the constituents of the food before and after it has served for the support of the animal on trial.

Experience has shown that different kinds of animals, as well as the same kind at different ages and for different functions, require a different proportion of the essential groups of food constituents to produce in each case the best results. A statement of the nutritive ratio of a fodder article — otherwise well adapted as an ingredient of a daily diet in the case under consideration — indicates the direction in which the material has to be supplemented to economize to a full extent its various constituents.

Practical trials with milch cows have demonstrated that they require for the highest production of a good milk and the maintenance of a healthy live weight, the most nutritious food we are in the habit of giving to full-grown farm animals. Careful examinations into the composition of an efficient diet for milch cows have shown that it contains one part of digestible nitrogenous matter to from five to five and a half parts of digestible non-nitrogenous organic matter. A due consideration of these facts renders it but natural that a good corn ensilage, which has a nutritive ratio of from 1 to 10 to 1 to 12, needs a liberal addition of substances like oil-cakes, wheat bran, gluten meal, etc., which have a nutritive ratio of 1 to from 2.5 to 4, to secure its full value as an ingredient of a daily diet in the dairy; or that good hay shows less the beneficial effects of an addition of these valuable waste products than that of an inferior quality. The nutritive ratio of hay may vary from 1 to 5.5 to from 1 to 9 or more.

Market Cost and Food Value. — *The value of an article of fodder may be stated from two different stand-points,* — that is, *with reference to its cost in the local market* and *with reference to its nutritive feeding value.* The *market price may be expressed by a definite sum for each locality; it depends on demand and supply in the market,* and it is beyond the control of the individual farmer. *The nutritive value,* or commonly called *food value, of the article cannot be expressed by a definite sum; it varies with a more or less judicious application,* and *depends also, to a considerable degree, on its adaptation under varying circumstances.* To secure the most satisfactory returns from feeding our home-raised fodder crops is as important a question as that of raising them in an economical manner. The great progress which has been made of late in regard to the proper mode of feeding plants ought to serve as an encouragement to undertake the task of inquiring more systemmatically into the proper mode of feeding our farm live-stock in the most profitable way.

Manurial Value of Fodder Articles. — Assuming a similar degree of adaptation of the various fodder articles offered for our choice, the question of cost deserves a serious consideration, when feeding for profit. *The actual cost of a fodder article does not depend merely upon its market price, but is materially affected by the value of the manurial refuse it leaves behind, when it has served its purpose as food.* The higher the percentage of nitrogen, phosphoric acid and potash a diet contains, the more valuable is the manure it furnishes, under otherwise corresponding circumstances. An excess, therefore, of any one or of all three in one diet, as compared with that of another, counts in favor of that particular diet as far as the net cost of feed is concerned; for it is admissible, for mere practical, economical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, or feeding them for the same purpose, a corresponding amount of nitrogen, phosphoric acid, potassium oxide, etc., will be retained, and, according to circumstances, either stored up in the growing animal or passed into the milk, etc. The commercial value of the three above-mentioned essential articles of plant food, contained in the manure secured in connection with our feeding experiments with milch cows, has differed in case of different diets from less than one-third to more than one-half of the market cost of feed consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the money value of the manurial refuse material secured in connection with the special farm industry carried on, it needs no farther argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer when devising an efficient and, at the same time, an economical diet for his live-stock. To assist in a due consideration of this important circumstance a compilation of analyses of a great variety of fodder articles made in the course of years at the Massachusetts Experiment Station has been added to this report in the form of an appendix.

Valuation of Concentrated Commercial Feed Stuffs. — Most of our concentrated feed stuffs, as oil-cakes, brans, middlings, maize feed, gluten meals, starch feed, etc., are by-products of various branches of industry. The articles contain, as a rule, a more liberal amount of nitrogenous food constituents than the materials from which they are obtained, and they are usually bought for the purpose of raising the nitrogen-containing food constituents of the daily diet of our farm live-stock to a desired proportion. This general practice is based on the circumstance that the larger portion of our home-raised coarse fodder articles, as meadow hay, fodder corn, corn stover, corn ensilage, roots, etc., is, comparatively speaking, quite deficient in nitrogen-containing food constituents, to meet, in an economical way, the requirement of an efficient daily diet for dairy stock, hard-worked animals, young farm live-stock of various kinds, etc. The concentrated commercial feed stuffs, if judiciously selected and in a proper mechanical condition, are admirably adapted to add to our home-raised coarse fodder articles that food constituent in which they are deficient, without increasing in an objectionable degree the bulk or volume of the daily fodder ration. They tend thereby to increase, as a rule, materially, the nutritive value of our home-raised coarse fodder articles. Farmers that do not raise a liberal proportion of clover-like fodder plants are, in a particular degree, in need of concentrated commercial feed stuffs rich in nitrogenous food constituents to turn the excess of the non-nitrogenous food constituents, which most of our current home-raised coarse fodder articles contain, to the best possible account.

As we buy, in the majority of cases, the concentrated commercial feed stuffs on account of their large proportion of nitrogen-containing food constituents, it becomes of special interest to know at what cost a given quantity of digestible nitrogen-containing food constituents can be bought in the form of different feed stuffs equally well adapted under existing circumstances. A change in the market cost of one and the same commercial feed stuff affects the cost of the nitrogen-containing food constituent, in particular as its supply is more limited than that of the non-nitrogenous food constituents, which our home-raised coarse fodder articles contain, as a rule, in abundance.

The subsequent tabular statement assumes a constant cost of digestible non-nitrogenous food constituents, — sugar, starch, fat, etc., — and shows thereby the variations in the cost of digestible nitrogen-containing food constituents in case of some prominent concentrated commercial feed stuffs in our local market.

The majority of the analyses stated is made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

Valuation of Fodder Articles on the following Basis.

Digestible cellulose and nitrogen free extract matter, 1.00 cent per pound; digestible fat. 2.50 cents per pound. The value of digestible protein determined the difference of the sum of both and the market cost of the fodder articles. (Calculation is based on dry matter, 2,000 pounds.)

	Market Cost.	Protein per Pound.
		Cents.
Corn meal,	$31 00	6.88
Corn meal,	29 00	5.84
Corn meal,	24 00	3.24
Corn meal,	23 00	2.72
Wheat middlings,	20 00	3.13
Spring wheat bran,	19 00	3.04
Winter wheat bran,	21 00	3.93
Chicago maize feed,	23 00	2.34
Dried brewers' grain,	22 00	3.37
Old-process linseed meal,	26 00	2.20
New-process linseed meal,	27 00	2.68
Chicago gluten meal,	28 00	2.46
Cotton-seed meal,	28 00	2.34
English hay,	12 00	1.36
English hay,	15 00	4.12
Rowen,	12 00	1.21
Rowen,	15 00	3.24
Corn stover,*	5 00	–
Corn ensilage,*	2 50	–
Mangold roots,*	3 00	–
Sugar beets,*	5 00	–

* The value of the digestible cellulose, nitrogen free extract matter and fat, on the above basis, exceeds the market cost.

	Corn Meal.				Wheat Middlings.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	15.31	–	–	1 : 9.23	10.07	–	–	1 : 4.54
Dry matter,	84.69	–	–		89.93	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	1.72	–	–		6.99	–	–	
" cellulose,	2.17	48	20.83		9.21	24	44.20	
" fat,	4.84	85	82.28		5.31	71	75.40	
" protein,	12.18	79	192.44		16.72	78	260.83	
N-free extract matter,	79.09	98	1,550.16		61.77	77	951.26	
	100.00	–	1,845.71		100.00	–	1,331.69	

	Spring Wheat Bran.				Winter Wheat Bran.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	12.74	–	–	1 : 4.48	13.06	–	–	1 : 4.36
Dry matter,	87.26	–	–		86.94	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	8.06	–	–		7.76	–	–	
" cellulose,	13.75	24	66.00		12.74	24	61.15	
" fat,	5.46	71	77.53		3.43	71	48.71	
" protein,	16.19	78	252.56		16.24	78	253.34	
N-free extract matter,	56.54	77	870.72		59.83	77	921.38	
	100.00	–	1,266.81		100.00	–	1,284.58	

	Chicago Maize Feed.				Brewers' Grain.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	9.75	–	–	1 : 4.49	10.19	–	–	1 : 3.15
Dry matter,	90.25	–	–		89.81	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	0.75	–	–		2.98	–	–	
" cellulose,	9.65	62	119.66		8.07	40	64.56	
" fat,	6.15	85	104.55		5.25	83	87.15	
" protein,	21.33	79	337.01		22.76	74	336.85	
N-free extract matter,	62.12	91	1,130.58		60.94	64	780.03	
	100.00	–	1,691.80		100.00	–	1,268.59	

	Old-process Linseed Meal.				New-process Linseed Meal.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	8.72	–	–	1 : 1.93	8.29	–	–	1 : 1.74
Dry matter,	91.28	–	–		91.71	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	5.96	–	–		5.91	–	–	
" cellulose,	8.23	26	42.79		9.43	26	49.04	
" fat,	9.87	91	179.63		4.08	91	74.26	
" protein,	36.19	87	629.70		35.03	87	609.51	
N-free extract matter,	39.75	91	723.45		45.55	91	829.01	
	100.00	–	1,575.57		100.00	–	1,561.82	

	Chicago Gluten Meal.				Cotton-seed Meal.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	11.11	–	–	1:2.66	9.77	–	–	1:1.37
Dry matter,	88.89	–	–		90.23	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	1.65	–	–		8.18	–	–	
" cellulose,	0.73	62	9.05		7.74	–	–	
" fat,	9.22	85	156.74		11.33	88	199.41	
" protein,	33.34	79	526.77		44.41	85	754.97	
N-free extract matter,	55.06	91	1,002.09		28.34	95	538.46	
	100.00	–	1,694.65		100.00	–	1,492.84	

	English Hay.				Rowen.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	9.72	–	–	1:9.68	13.53	–	–	1:6.93
Dry matter,	90.28	–	–		86.47	–	–	
	100 00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	6.43	–	–		6.81	–	–	
" cellulose,	32.28	58	374.45		28.31	58	328.40	
" fat,	2.49	46	22.91		3.81	46	35.05	
" protein,	9.54	57	108.76		12.94	57	147.52	
N-free extract matter,	49.26	63	620.68		48.13	63	606.44	
	100.00	–	1,126.80		100.00	–	1,117.41	

	Corn Stover.				Corn Ensilage.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	22.50	–	–	1 : 8.62	72.95	–	–	1 : 11.67
Dry matter,	77.50	–	–		27.05	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	3.97	–	–		6.48	–	–	
" cellulose,	34.96	72	503.42		26.33	72	379.15	
" fat,	1.54	75	23.10		5.17	75	77.55	
" protein,	9.76	73	142.50		7.64	73	111.54	
N-free extract matter,	49.77	67	666.92		54.38	67	728.69	
	100.00	–	1,335.94		100.00	–	1,296.93	

	Mangold Roots.				Sugar Beets.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio
Moisture,	87.75	–	–	1 : 9.94	85.27	–	–	1 : 11.80
Dry matter,	12.25	–	–		14.73	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	9.06	–	–		5.95	–	–	
" cellulose,	7.94	100	158.80		6.49	100	129.80	
" fat,	0.88	100	17.60		0.66	100	13.20	
" protein,	10.37	100	207.40		10.97	100	219.40	
N-free extract matter,	71.75	100	1,435.00		75.93	100	1,518.60	
	100.00	–	1,818.80		100.00	–	1,881.00	

Analyses of Fodder Articles sent on by Farmers.

Corn Meal.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.52
Dry matter,	86.48
	100.00

Analysis of Dry Matter.

Crude ash,	2.34
" cellulose,	2.47
" fat,	4.85
" protein (nitrogenous matter),	15.61
Non-nitrogenous extract matter,	74.73
	100.00

Corn and Cob Meal.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	19.11
Dry matter,	80.89
	100.00

Analysis of Dry Matter.

Crude ash,	2.05
" cellulose,	6.97
" fat,	3.46
" protein (nitrogenous matter),	10.51
Non-nitrogenous extract matter,	77.01
	100.00
Passed screen 144 meshes to square inch,	73.88

Hominy Chop.

[Sent on from Southborough, Mass.]

	Per Cent.
Moisture at 100° C.,	11.32
Dry matter,	88.68
	100.00

Analysis of Dry Matter.

Crude ash,	2.44
" cellulose,	5.12
" fat,	11.26
" protein (nitrogenous matter),	6.77
Non-nitrogenous extract matter,	74.41
	100.00

Wheat Bran.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.47	13.17
Dry matter,	89.53	86.83
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.19	7.95
" cellulose,	11.27	11.22
" fat,	4.80	4.86
" protein (nitrogenous matter),	18.93	17.31
Non-nitrogenous extract matter,	57.81	58.66
	100.00	100.00

I. Wheat Bran (St. Louis).
II. Spring Wheat Bran (Duluth, Minn.).

[Sent on from Warren, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.12	8.97
Dry matter,	89.88	91.03
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.94	7.68
" cellulose,	9.72	10.84
" fat,	4.95	5.37
" protein (nitrogenous matter),	18.08	19.54
Non-nitrogenous extract matter,	60.31	56.57
	100.00	100.00

Ground Barley.

[Sent on from Amherst.]

	Per Cent.
Moisture at 100° C.,	14.62
Dry matter,	85.38
	100.00

Analysis of Dry Matter.

Crude ash,	3.18
" cellulose,	5.04
" fat,	2.38
" protein (nitrogenous matter),	14.93
Non-nitrogenous extract matter,	74.47
	100.00

Gluten Meal.

[From Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	10.90
Dry matter,	89.10
	100.00

Analysis of Dry Matter.

Crude ash,	1.02
" cellulose,	1.28
" fat,	7.36
" protein (nitrogenous matter),	34.79
Non-nitrogenous extract matter,	65.55
	100.00

Cotton-seed Meal.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C,	9.07	9.06
Dry matter,	90.93	91.94
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.50	8.11
" cellulose,	6.81	8.69
" fat,	11.17	10.71
" protein (nitrogenous matter),	46.38	41.26
Non-nitrogenous extract matter,	28.14	31.23
	100.00	100.00

Cotton-seed Meal.

[I. sent on from Holden, Mass.; II. and III. sent on from Sunderland, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.90	8.50	9.37
Dry matter,	91.10	91.50	90.63
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.23	–	–
" cellulose,	7.15	–	–
" fat,	12.61	9.60	11.14
" protein (nitrogenous matter),	51.79	50.61	43.86
Non-nitrogenous extract matter,	20.22	–	–
	100.00	–	–

Cocoanut Meal.

[Sent on from Concord, Mass.]

	Per Cent.
Moisture at 100° C.,	9.33
Dry matter,	90.67
	100.00
Analysis of Dry Matter.	
Crude ash,	5.68
" cellulose,	18.80
" fat,	12.88
" protein (nitrogenous matter),	22.61
Non-nitrogenous extract matter,	40.03
	100.00

Hog Feed — Bakery Refuse.

[Sent on from North Hadley, Mass.]

	Per Cent.
Moisture at 100° C.,	13.34
Dry matter,	86.66
	100.00
Analysis of Dry Matter.	
Crude ash,	11.64
" cellulose,	0.43
" fat,	6.36
" protein (nitrogenous matter),	9.23
Non-nitrogenous extract matter,	72.34
	100.00

Hay from Salt Meadows.

[Sent on from Newbury, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	9.66	8.08	8.75
Dry matter,	90.34	91.92	91.25
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5.01	5.03	9.03
" cellulose,	27.84	27.82	31.41
" fat,	2.65	3.24	3.37
" protein (nitrogenous matter),	4.35	3.77	6.72
Non-nitrogenous extract matter,	60.15	60.14	49.47
	100.00	100.00	100.00

Methods of Analysis of Cattle Foods.

1. Moisture. — Dry 2 grams in an air-bath at 100–110° C. to a constant weight.

2. Ash. — Char 2 to 5 grams in a muffle furnace at a low red heat, cool and weigh. Digest for a short time with dilute hydrochloric acid; collect the residue insoluble in acid in a Gooch crucible, wash, dry and weigh. Subtract this from the total weight for pure ash.

3. Ether Extract. — Dry 2 grams at 100° C. for two hours. Exhaust with anhydrous, alcohol-free ether, until the extraction is complete. Dry the extract in the air-bath at 100° C. to a constant weight.

4. Crude Protein. — Determine nitrogen by the Kjeldahl or soda-lime method, and multiply the result by 6.25 for crude protein.

5. Albuminoid Nitrogen. — Determine by Stutzer's method, as given in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (pages 211 and 212), except that the protein-copper is dried before being introduced into the flask.

6. Crude Fibre or Cellulose. — The method is described in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (page 212). In this method 2 grams of the material, having been nearly or completely freed from fat, are boiled for thirty minutes with 200 cubic centimetres of $1\frac{1}{4}$ per cent. sulphuric acid, brought upon a linen filter and thoroughly washed with boiling water. It is then washed into the boiling-flask with a $1\frac{1}{4}$ per cent. solution of sodium hydrate, brought quickly to 100° C., and boiled for thirty minutes, when it is filtered through a Gooch crucible, or balanced filter-papers, washed with boiling water, alcohol and ether, dried at 100° C. for an hour, and weighed. The organic matter is then burned off, and the weight of the ash deducted for crude cellulose.

II.

FEEDING EXPERIMENTS WITH STEERS.

The question of a remunerative production of beef for the meat market, upon the farms of New England, has, for several years past, received a deserved attention at the Massachusetts State Agricultural Experiment Station, by carrying on feeding experiments, under well-defined circumstances, with growing steers. The results of observations in that direction during two preceding years are ready for publication. The work is to be continued with such modifications as suggest themselves during its progress, and the conclusions arrived at will be published hereafter, whenever they are found to be of a more general interest to the farming community.

The first experiment, December, 1889, to May, 1890, briefly described upon a few succeeding pages, was planned mainly with a view to determine *the cost of the feed* required for the production of beef for the meat market under existing local conditions, and with special reference to the contemporary local market price of the fodder articles at our disposal.

Current home-raised fodder articles, as fodder corn, corn stover, corn ensilage and sugar beets, served as coarse feed, while corn and cob meal, wheat bran, old-process linseed meal and gluten meal furnished the grain feed for daily diet of the animals on trial. The stated amount of grain feed was in each case a fixed quantity, while the consumption of coarse feed was governed by the appetite of the animal.

One and two year old grade Shorthorn steers, two of each kind, were chosen for the observation. The steers selected were, as far as possible, of a similar general character with reference to breed. They were chosen of a different age to offer a desirable chance to determine *the difference in the cost of the feed* for the production of a corresponding increase in the live weight of both one and two year old animals.

The same kinds of fodder articles served at the same stage of the experiment for all animals engaged in the experiment alike in the compounding of their daily diet; they were, however, given in different proportion and in different quantities to animals of different ages. The daily diet of one and two year old steers was compounded with a due consideration of the wants at the particular age of each lot. Their respective daily diet consequently differed essentially only in regard to quantity and proportion of the same fodder articles.

The local market price of the various fodder articles used at the time of the observation has been adopted as the basis of determining the cost of the daily fodder rations. A loss of eight per cent. of the essential fertilizing constituents contained in the food consumed has been assumed a fair compensation for the amount of nitrogen, phosphoric acid and potassium oxide retained in the growing animal, and thereby lost to the manurial resources of the farm. Accepting E. Wolff's statement of the chemical composition of a live steer as the basis in our calculation of the loss of the above-stated manurial substances, one hundred pounds of increase in the live weight of the steers, at the present market value of phosphoric acid, potassium oxide and nitrogen, represents a loss of from 52 to 55 cents to the manurial resources of the farm. From the previous statement, it will be noticed that ninety-two per cent. of the essential fertilizing constituents contained in the feed consumed are considered available in the manure produced in connection with raising steers for the meat market. The *net cost* of the feed stated in the subsequent report of our financial results represents, therefore, the cost of the feed consumed, after deducting from its original market price ninety-two per cent. of the money value of the essential fertilizing constituents, *i. e.*, nitrogen, phosphoric acid and potassium oxide, it contains.

The statements of the relative proportion of the digestible nitrogenous and non-nitrogenous food constituents of the daily diet (its nutritive ratio) are based on the mean of more recent observations in connection with actual feeding experiments elsewhere (Wolff).

The different daily fodder rations recorded below were compounded with a view to compare different combinations of well-known feed stuffs with reference to feeding effect and to influence on cost of feed. Those daily fodder rations which have given us the most satisfactory results in this connection may be seen below (rations I. and II.).

The general history of the management of the experiment and the financial results of the whole operation are published upon a few subsequent pages. It is for obvious reasons not advisable to enter at this early stage of our experiments upon a detailed critical discussion of the lessons which may be learned from the results obtained. Some facts, however, brought out in the course of the experiment, are apparently so well supported under existing circumstances that a brief statement concerning them may claim some special attention.

Results.

1. Corn ensilage, when fed either with wheat bran and gluten meal, or with wheat bran and old-process linseed meal, has produced in our case, without an exception, the highest gain in live weight, as compared with other fodder rations used in the experiment (see fodder rations I., II., below).

2. The increase in live weight per day, when feeding the ensilage fodder rations (I., II.) to one-year old steers, has in one instance (steer 2) exceeded three pounds, while in the case of two-year old steers it has averaged more than four pounds per day in one case (steer 4).

3. The original cost of the feed (corn ensilage, fodder rations I., II.) consumed per day has been from 12.82 cents to 14.72 cents in case of one-year old steers (1, 2),

and from 16.67 cents to 19.33 cents in case of two-year old steers (3, 4).

4. The net cost of the feed (corn ensilage, fodder rations I., II.) consumed per day has been from 4.81 cents to 5.26 cents in the case of one-year old steers (1, 2), and from 6.65 cents to 7.44 cents in case of two-year old steers.

5. The daily increase in the live weight of the one-year old steers during both periods of feeding ensilage fodder rations (I., II.) averages 2.9 pounds. The original market cost of that diet averages, per day, 13.29 cents, hence the original cost of the feed consumed per pound of live weight gained amounts to 4.8 cents, while the net cost of the feed consumed per pound of live weight gained amounts to 1.82 cents.

6. The daily increase in the live weight of the two-year old steers during both periods of feeding ensilage fodder rations (I., II.) averages 3.45 pounds. The original market cost of that daily diet averages for both periods, per day, 18 cents, hence the original market cost of the feed consumed for every pound of live weight produced amounts to 5.22 cents, while the net cost of the feed consumed per pound of live weight gained amounts to 2.08 cents.

7. The difference in the financial result presented above and of the subsequent financial summaries of the entire feeding experiment is due to the less profitable daily fodder ration used during the experiment in connection with the ensilage fodder rations (I., II.).

Local Market Value per Ton of the Various Articles of Fodder used, 1889-90.

Wheat bran,	$16 50
Gluten meal,	23 00
Old-process linseed meal,	27 50
Corn and cob meal,	16 50
Corn stover,	5 00
Corn ensilage,	2 75
Corn fodder,	7 50
Sugar beets,	5 00

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Nitrogen,	2.545	4.510	5.331	1.439	.923	.330	1.058	.184
Phosphoric acid,	2.900	.392	1.646	.603	.303	1.138	.510	.086
Potassium oxide,	1.637	.049	1.162	.441	1.320	.301	.760	.462
Valuation per 2,000 lbs.,	$13 60	$16 18	$21 15	$6 02	$4 69	$1 56	$4 89	$1 14

Daily Fodder Rations used.

I.

Wheat bran,	3.88	lbs.
Gluten meal,	3.88	"
Corn ensilage,	37.50	"
Nutritive ratio,	1:5.49	
Total cost,	12.82	cts.
Manurial value obtainable,	8.01	"
Net cost,	4.81	"

II.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn ensilage,	43.38	"
Nutritive ratio,	1:5.69	
Total cost,	14.76	cts.
Manurial value obtainable,	9.50	"
Net cost,	5.26	"

III.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn fodder,	9.00	"
Nutritive ratio,	1:4.93	
Total cost,	12.45	cts.
Manurial value obtainable,	7.65	"
Net cost,	4.80	"

Daily Fodder Rations used — Concluded.

IV.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn stover,	6.00	"
Nutritive ratio,	1:4.55	
Total cost,	10.58	cts.
Manurial value obtainable,	6.92	"
Net cost,	3.66	"

V.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn stover,	3.60	"
Sugar beets,	20.00	"
Nutritive ratio,	1:4.49	
Total cost,	14.98	cts.
Manurial value obtainable,	7.44	"
Net cost,	7.54	"

VI.

Wheat bran,	2.25	lbs.
Gluten meal,	2.25	"
Corn stover,	12.00	"
Nutritive ratio,	1:5.51	
Total cost,	7.45	cts.
Manurial value obtainable,	5.68	"
Net cost,	1.77	"

Steer 1 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31,	2.27	2.33	–	–	5.27	–	–	–	7.82	1 : 4.63	675	654	–1.40
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	37.89	–	–	16.72	1 : 5.51	667	708	2.16
Jan. 28 to Feb. 16,	4.00	–	4.00	–	–	42.20	–	–	19.30	1 : 5.63	725	783	2.90
Feb. 21 to March 11,	3.00	–	3.00	3.00	–	–	9.42	–	15.68	1 : 4.98	785	820	1.84
March 14 to April 21,	3.00	–	3.00	3.00	5.91	–	–	–	12.50	1 : 4.54	828	880	1.33
April 24 to May 9,	3.00	–	3.00	3.00	3.50	–	–	20.00	12.74	1 : 4.47	882	895	0.81

Total Amount of Feed consumed from Dec. 17, 1889, to May 9, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
465.50 pounds wheat bran, . . .	422.35	$3 84	$3 17
95.50 pounds gluten meal, . . .	86.14	1 10	0 77
371.00 pounds old-process linseed meal,	334.35	5 10	3 92
239.00 pounds corn and cob meal, .	219.64	1 97	0 72
243.50 pounds corn stover, . . .	177.88	0 61	0 57
1,927.00 pounds corn ensilage, . .	521.25	2 65	1 50
205.50 pounds corn fodder, . . .	163.54	0 77	0 50
350.00 pounds sugar beets, . . .	34.93	0 88	0 20
	1,960.08	$16 92	$11 35

	Pounds.
Live weight of animal at beginning of experiment, . . .	675.00
Live weight of animal at end of feeding, ...	895.00
Live weight gained during experiment, ...	220.00
Average gain in weight per day, ...	1.53
Dry matter consumed per pound of live weight gained, . .	8.91
Cost of feed per pound of live weight gained, ...	7.69 cents.
Net cost of feed per pound of live weight gained, allowing 8 per cent. loss of manurial value, ...	2.95 cents.

Steer 2 (Yearling).

FEEDING PERIODS	Feed consumed (Pounds) per Day.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31, . . .	2.00	2.07	–	–	5.27	–	–	–	6.53	1 : 4.76	600	590	-0.67
Jan. 4 to Jan. 22, . . .	3.88	3.88	–	–	–	37.32	–	–	16.54	1 : 5.47	610	674	3.37
Jan. 28 to Feb. 16, . . .	4.00	–	4.00	–	–	44.55	–	–	19.97	1 : 5.75	680	745	3.25
Feb. 21 to March 11, . . .	3.00	–	3.00	3.00	–	–	8.53	–	14.97	1 : 4.87	746	770	1.26
March 14 to April 21, . . .	3.00	–	3.00	3.00	6.00	–	–	–	12.56	1 : 4.55	776	826	1.28
April 24 to May 9, . . .	3.00	–	3.00	3.00	3.69	–	–	20.00	12.88	1 : 4.50	828	840	0.75

Total Amount of Feed consumed from Dec. 17, 1889, to May 9, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
465.50 pounds wheat bran,	422.35	$3 84	$3 17
95.50 pounds gluten meal,	86.14	1 10	0 77
371.00 pounds old-process linseed meal,	334.35	5 10	3 92
239.00 pounds corn and cob meal,	219.64	1 97	0 72
354.00 pounds corn stover,	258.60	0 89	0 83
1,942.00 pounds corn ensilage,	525.31	2 67	1 51
285.00 pounds corn fodder,	226.80	1 07	0 70
350.00 pounds sugar beets,	34.93	0 88	0 20
	2,108.12	$17 52	$11 82

	Pounds.
Live weight of animal at beginning of experiment,	600.00
Live weight of animal at end of feeding,	840.00
Live weight gained during experiment,	240.00
Average gain in weight per day,	1.67
Dry matter consumed per pound of live weight gained,	8.78
Cost of feed per pound of live weight gained,	7.30 cents.
Net cost of feed per pound of live weight gained, allowing 8 per cent. loss of manurial value,	2.77 cents.

Summary of Feeding Experiment with Steers One Year Old.

	No. 1.	No. 2.
Beginning of feeding experiment,	Dec. 17, 1889.	Dec. 17, 1889.
Close of feeding experiment,	May 9, 1890.	May 9, 1890.
Number of days of observation,	144	144
Live weight of animals at the beginning of observation,	675 lbs.	600 lbs.
Live weight of animals at the close of observation,	895 "	840 "
Total number of pounds of live weight gained during the experiment,	220 "	240 "
Average gain in live weight per day,	1.53 "	1.67 "
Amount of dry vegetable matter consumed per pound of live weight gained,	8.91 "	8.78 "
Total cost of feed consumed per day,	11.75 cts.	12.16 cts.
Manurial value of feed consumed per day,	7.87 "	8.20 "
Manurial value of feed consumed, allowing 8 per cent. loss,	7.24 "	7.54 "
Net cost of feed consumed per day, allowing a loss of 8 per cent. of manurial value for live weight gained,	4.51 "	4.62 "
Net cost of feed per pound of live weight gained,	2.95 "	2.77 "

Summary of Record of Steers No. 1 and No. 2, when left in the Pasture, May 10, 1889, to Sept. 30, 1889.

	No. 1.	No. 2.
Date of turning steers into pasture,	May 10, 1889.	May 10, 1889.
Date of closing pasturing,	Sept. 30, 1889.	Sept. 30, 1889.
Number of days of pasturing,	144	144
Live weight of steers when turned into pasture,	895 lbs.	840 lbs.
Live weight of steers at the close of pasturing,	1,020 "	923 "
Total weight gained during pasturing,	125 "	83 "
Average gain in weight per day,	0.87 "	0.58 "
Cost of feed per day, allowing 40 cents per week for use of pasture,	5.71 cts.	5.71 cts.
Cost of feed per pound of live weight gained,	6.58 "	9.91 "

Two-year Old Grade Shorthorn Steers.

[The same fodder articles as in the case of the one-year old steers served here.]

Daily Fodder Rations Used.

I.

Wheat bran,	3.88	lbs.
Gluten meal,	3.88	"
Corn ensilage,	65.50	"
Nutritive ratio,	1:6.54	
Total cost,	16.67	cts.
Manurial value obtainable,	10.02	"
Net cost,	6.65	"

II.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn ensilage,	76.60	"
Nutritive ratio,	1:6.75	
Total cost,	19.33	cts.
Manurial value obtainable,	11.89	"
Net cost,	7.44	"

III.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn and cob meal,	4.00	"
Corn fodder,	12.35	"
Nutritive ratio,	1:4.91	
Total cost,	16.73	cts.
Manurial value obtainable,	10.28	"
Net cost,	6.45	"

IV.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn and cob meal,	4.00	"
Corn stover,	13.00	"
Nutritive ratio,	1:4.99	
Total cost,	15.35	cts.
Manurial value obtainable,	10.30	"
Net cost,	5.05	"

V.

Wheat bran,	2.65	lbs
Gluten meal,	2.65	"
Corn stover,	18.00	"
Nutritive ratio,	1:5.84	
Total cost,	9.74	cts.
Manurial value obtainable,	7.51	"
Net cost,	2.23	"

Steer No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.					
1889-90.												
Dec. 10 to Dec. 31,	2.64	2.68	–	–	9.00	–	–	11.39	1:5.15	1,235	1,192	–1.95
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	68.95	–	24.60	1:6.64	1,210	1,297	4.58
Jan. 28 to Feb. 16,	4.00	4.00	–	–	–	80.10	–	30.13	1:6.89	1,310	1,362	2.60
Feb. 21 to March 11,	4.00	–	4.00	4.00	–	–	14.00	22.05	1:5.11	1,362	1,366	0.21
March 13 to March 25,	4.00	–	4.00	4.00	14.67	–	–	21.63	1:5.09	1,367	1,370	0.23

Total Amount of Feed consumed from Dec. 10, 1889, to March 25, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
387.50 pounds wheat bran, . . .	351.58	$3 20	$2 64
140.50 pounds gluten meal, . . .	126.73	1 62	1 14
248.00 pounds old-process linseed meal,	223.50	3 41	2 62
135.00 pounds corn and cob meal, .	124.07	1 11	0 41
392.00 pounds corn stover, . . .	286.36	0 98	0 92
3,542.00 pounds corn ensilage, . .	958.11	4 87	2 76
315.00 pounds corn fodder, . . .	250.68	1 18	0 77
	2,321.03	$16 37	$11 26

	Pounds.
Live weight of animal at beginning of experiment, . .	1,235.00
Live weight at time of killing, ...	1,370.00
Live weight gained during experiment, ...	135.00
Average gain in weight per day, ...	1.27
Dressed weight of animal, ...	886.00
Loss in weight by dressing, . . 484 pounds, or 35.33 per cent.	
Original cost of animal, 1,336 pounds, at 3½ cents, . . .	$46 76
Selling price of animal, 886 pounds, at 6 cents, . . .	53 16
Net cost of feed after deducting 8 per cent. of manurial value,	6 01
Dry matter required to produce 1 pound of live weight, .	17.19 pounds.
Cost of feed per pound gained, ...	12.13 cents.
Net cost of feed per pound gained after deducting 8 per cent of manurial value, ...	4.45 cents

Steer No. 4.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.					
1889-90.												
Dec. 10 to Dec. 31,	2.64	2.68	–	–	5.25	–	–	8.65	1 : 4.45	1,180	1,138	–1.91
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	62.21	–	20.92	1 : 6.43	1,162	1,250	4.63
Jan. 28 to Feb. 16,	4.00	4.00	–	–	–	73.10	–	28.13	1 : 6.70	1,246	1,317	3.55
Feb. 21 to March 11,	4.00	–	4.00	4.00	–	–	10.71	19.43	1 : 4.81	1,305	1,293	–0.63
March 13 to March 25,	4.00	–	4.00	4.00	11.25	–	–	19.63	1 : 4.89	1,297	1,300	0.23

Total Amount of Feed consumed from Dec. 10, 1889, to March 25, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
387.50 pounds wheat bran, . . .	351.58	$3 20	$2 64
140.50 pounds gluten meal, . . .	126.73	1 62	1 14
248.00 pounds old-process linseed meal,	223.50	3 41	2 62
135.00 pounds corn and cob meal, .	124.07	1 11	0 41
267.00 pounds corn stover, . . .	195.04	0 67	0 63
3,210.50 pounds corn ensilage, . .	868.44	4 41	2 50
238.00 pounds corn fodder, . . .	189.40	0 89	0 46
	2,078.76	$15 31	$10 40

	Pounds.
Live weight of animal at beginning of experiment, . . .	1,180.00
Live weight at time of killing, ...	1,300.00
Live weight gained during experiment, ...	120.00
Average gain in weight per day, ...	1.13
Dressed weight of animal, ...	859.00
Loss in weight by dressing, . . 441 pounds, or 33.92 per cent.	
Original cost of animal, 1,332 pounds, at 3½ cents, . . .	$46 62
Selling price of steer, 859 pounds, at 6 cents, ...	51 54
Net cost of feed after deducting 8 per cent. of manurial value,	5 74
Dry matter required to produce 1 pound of live weight, .	17.32 pounds.
Cost of feed per pound gained, ...	12.76 cents.
Net cost of feed per pound gained, after deducting 8 per cent. of manurial value, ...	4.78 cents.

Summary of Feeding Experiments, Steers Two Years Old, Nos. 3 and 4.

	No. 3.	No. 4.
Beginning of feeding experiment,	Dec. 10, 1889.	Dec. 10, 1889.
Close of observation,	Mar. 25, 1890.	Mar. 25, 1890.
Number of days of observation,	106	106
Live weight of animals at the beginning of observation,	1,235 lbs.	1,180 lbs.
Live weight of animals at close of observation,	1,370 "	1,300 "
Total number of pounds of live weight gained during experiment,	135 "	120 "
Average gain in live weight per day,	1.27 "	1.13 "
Amount of dry vegetable matter consumed per pound of live weight gained,	17.19 "	17.32 "
Total cost of feed consumed per day,	15.44 cts.	14.44 cts.
Manurial value of feed consumed per day,	10.62 "	9.82 "
Manurial value of feed consumed per day, allowing 8 per cent. loss,	9.77 "	9.03 "
Net cost of feed consumed per day, allowing a loss of 8 per cent. of manurial value,	5.67 "	5.41 "
Net cost of feed consumed per pound of live weight gained,	4.45 "	4.78 "
Selling price of dressed weight,	6.00 "	6.00 "
Per cent. of shrinkage in dressing beef for the market,	35.3	33.9

Analyses of Fodder Articles used in the Experiment.

Corn and Cob Meal.

1889-90.

	Per Cent
Moisture at 100° C.,	8.10
Dry matter,	91.90
	100.00

Analysis of Dry Matter.

Crude ash,	1.47
" cellulose,	5.63
" fat,	3.73
" protein (nitrogenous matter),	9.79
Non-nitrogenous extract matter,	79.38
	100.00
Passed screen, 144 meshes to square inch,	76.34

Wheat Bran (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.27	185.40	–	–	1:3.94
Dry matter, . . .	90.73	1,814.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.47	149.40	–	–	
" cellulose, . . .	9.75	195.00	39.00	20	
" fat, ...	5.48	109.60	87.68	80	
" protein (nitrogenous matter), . .	17.53	350.60	308.53	88	
Non-nitrogenous extract matter, ...	59.77	1,195.40	956.32	80	
	100.00	2,000.00	1,391.53	–	

Gluten Meal.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.80	196.00	–	–	1:2.60
Dry matter, . . .	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.25	25.00	–	–	
" cellulose, . . .	1.75	35.00	11.90	34	
" fat, ...	7.00	140.00	106.40	76	
" protein (nitrogenous matter), . .	31.25	625.00	531.25	85	
Non-nitrogenous extract matter, ...	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,754.05	–	

Old-process Linseed Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.88	197.60	–	–	1 : 1.70
Dry matter,	90.12	1,802.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.39	147.80	–	–	
" cellulose,	8.74	174.80	45.45	26	
" fat,	7.24	144.80	131.77	91	
" protein (nitrogenous matter),	36.97	739.40	643.28	87	
Non-nitrogenous extract matter,	39.66	793.20	721.81	91	
	100.00	2,000.00	1,542.31	–	

Sugar Beets.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.02	1,800.40	–	–	1 : 6.74
Dry matter,	9.98	199.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	11.84	236.80	–	–	
" cellulose,	8.20	164.00	164.00	100	
" fat,	.71	14.20	14.20	100	
" protein (nitrogenous matter),	11.53	230.60	230.60	100	
Non-nitrogenous extract matter,	67.72	1,354.40	1,354.40	100	
	100.00	2,000.00	1,763.20	–	

Corn Ensilage (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	72.95	1,459.00	–	–	1 : 11.67
Dry matter,	27.05	541.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6 48	129.60	–	–	
" cellulose,	26.33	526.60	379.15	72	
" fat,	5.17	103.40	77.55	75	
" protein (nitrogenous matter),	7.64	152.80	111.54	73	
Non-nitrogenous extract matter,	54.38	1,087.60	728.69	67	
	100.00	2,000.00	1,296.93	–	

Corn Fodder.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	20.42	408.40	–	--	1 : 9 80
Dry matter,	79.58	1,591.60	–	--	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	20.11	402.20	289.58	72	
" fat,	1.65	33.00	24.75	75	
" protein (nitrogenous matter),	8.31	166.20	121.33	73	
Non-nitrogenous extract matter,	62.53	1,250.60	837.90	67	
	100.00	2,000.00	1,273.56	–	

Corn Stover.

[From Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	19.89
Dry matter,	80.11
	100.00

Analysis of Dry Matter.

Crude ash,	6.33
" cellulose,	34.59
" fat,	1.28
" protein (nitrogenous matter),	5.74
Non-nitrogenous extract matter,	52.06
	100.00

III.

FEEDING EXPERIMENTS WITH LAMBS.

September 30, 1890, to April 20, 1891.

The feeding experiment with lambs described below is the second of a series devised to ascertain the influence of different fodder rations on the cost of feed when fattening lambs during the winter for the meat market.

The selection of animals was made from the temporary supply of our local market. Six lambs, wethers, grades of uncertain parentage, served for the trial; they were shorn before being weighed at the beginning of the observation. Each animal occupied a separate pen during the entire experiment. They received during the first week the same daily diet, and were subsequently divided into two lots of three each (lots A and B), to test the effect of different grain feed rations on the ultimate financial results of the operation.

1. *Weight of Lambs.*

		Original Live Weight of Lambs (Pounds).	Weight of Wool removed (Pounds).	Live Weight at the Beginning (Pounds).
Lot A.	1,	50.25	2.75	47.50
	2,	64.00	3.50	60.50
	3,	62.50	4.50	58.00
		176.75	10.75	166.00
Lot B.	4,	52.25	2.75	49.50
	5,	63.75	1.75	62.00
	6,	52.00	1.50	50.50
		168.00	6.00	162.00

2. *Cost of Lambs.*

The entire lot was bought at 5 cents per pound of live weight, and the sum paid for the entire original live weight of 344.75 pounds amounted to $17.24.

The wool subsequently secured before the beginning of the feeding experiment was sold at 25 cents per pound, or $4.19 for 16.75 pounds of wool.

Deducting the sum of $4.19 obtained for the wool removed from the first cost of the lambs, which was $17.24, it will be noticed that their actual cost was but $13.05, or 3.98 cents per pound of live weight. Their live weight after the removal of the wool amounted to 328 pounds.

Lot A.	1.	47.50 pounds, at 3.98 cents,	$1 89	$6 61
	2.	60.50 pounds, at 3.98 cents,	2 41	
	3.	58.00 pounds, at 3.98 cents,	2 31	
Lot B.	4.	49.50 pounds, at 3.98 cents,	$1 97	$6 44
	5.	62.00 pounds, at 3.98 cents,	2 46	
	6.	50.50 pounds, at 3.98 cents,	2 01	

3. *Character and Cost of Fodder Articles used.*

The grain feed rations of the daily diet contained, at different times and in varying proportions, corn meal, wheat bran, old-process linseed meal and Chicago gluten meal; while rowen — hay of second cut of upland meadows — and corn ensilage furnished its coarse feed constituent. The corn ensilage was produced from a dent corn variety, Pride of the North, which was cut when the kernels began to glaze.

The grain feed stuffs were bought in our local market; they were fair articles of their kind. Their relative composition and general economical value will be seen from the subsequent statements.

ANALYSES OF FODDER ARTICLES USED.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.
Moisture at 100° C.,	13.26	12.11	8.72	10.90	13.90	80.53
Dry matter,	86.74	87.89	91.29	89.10	86.10	19.47
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash,	1.72	7.40	5.96	1.02	8.28	6.73
" cellulose,	2.28	12.17	8.23	1.28	28.88	26.90
" fat,	4.90	5.04	9.87	7.36	3.91	3.27
" protein (nitrogenous matter),	12.94	18.48	36.19	34.79	13.45	8.97
Non-nitrogenous extract matter,	78.16	56.91	39.75	55.55	45.48	54.13
	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

Moisture,	13.26	12.11	8.72	10.90	13.90	80.53
Nitrogen,	1.796	2.599	5.285	4.959	1.853	.279
Phosphoric acid,	.707	2.845	1.780	.425	.464	.101
Potassium oxide,	.435	1.625	1.214	.045	1.966	.226
Valuation per 2,000 pounds,	$6 56	$12 39	$18 90	$15 38	$7 84	$1 15

Local Market Value per Ton of the Various Articles of Fodder used (1890–1891).

Corn meal,	$28 00
Wheat bran,	25 00
Old-process linseed meal,	26 00
Gluten meal,	28 00
Rowen,	15 00
Corn ensilage,	2 75

4. *Mode of Feeding.*

The time occupied by the experiment amounted to two hundred and two days; it was divided into four feeding periods. The first feeding period extended over fourteen days, the second lasted ninety-eight days, the third thirty-four days and the fourth forty-one days. Eight days were usually allowed to pass by between succeeding feeding periods before the results accompanying the changes made in the diet were recorded. Each animal was kept in a separate pen; all received during the first period the same daily diet. This course was adopted to give each a fair chance in feed, and to bring all animals as far as practicable into a desirable uniform condition for a subsequent comparative test regarding the merits and good economy of different grain feed rations for meat production. They received their feed twice a day. At the close of the first feeding period a division of the lambs into two lots, A and B, each numbering three, was made for the purpose of *testing different grain feed rations in connection with the same article of coarse feed.*

The daily grain feed ration during *the first feeding period* consisted of a mixture of two weight parts of wheat bran and one weight part of old-process linseed meal. Eight ounces of this mixture were fed, per head, for every pound of rowen consumed. The amount of the grain feed mixture consumed daily per head varied from twelve to fourteen ounces, and that of rowen from one and one-half pounds to one and three-quarters pounds in case of different animals. *Subsequently two different combinations of grain feed were fed to the two lots of lambs* (A and B).

The daily grain feed ration in case of Lot A (1, 2 and 3) consisted of a mixture of ten weight parts of corn meal, two weight parts of wheat bran and one weight part of Chicago gluten meal. Lot B (4, 5 and 6) received as daily grain feed ration, during the same time, a mixture of two weight parts of wheat bran and one weight part of Chicago gluten meal.

Rowen and rowen with corn ensilage furnished alternately for both lots at corresponding periods the coarse feed portion of their daily diet. *Both lots of lambs received as their daily diet eight ounces of their respective grain feed mixture* in connection with *one pound of rowen* or *one-third of one pound of rowen, with all the corn ensilage they would consume* (2¾ to 3 pounds). The daily diet of both lots differed essentially in regard to the relative proportion of digestible nitrogenous and non-nitrogenous food constituents they contained.

The fodder rations fed to lambs 1, 2, 3 were *less rich* in nitrogenous constituents (1 : 6.50 to 1 : 7.40) than those fed to lambs 4, 5, 6 (1 : 4.50 to 1 : 5.00). The subsequent statement contains the average composition of the daily fodder ration (per head) during the succeeding periods. Twenty per cent. of the phosphoric acid, potassium oxide and nitrogen contained in the feed consumed has been allowed as stored up in the increased live weight of the animal, and otherwise lost to the manurial refuse.

Average Daily Fodder Rations used for Lambs Nos. 1, 2 and 3.

I.

Wheat bran,	0.50 lbs.
Old-process linseed meal,	0.25 "
Rowen,	1.40 "
Nutritive ratio,	1:4.32
Total cost,	2.00 cts.
Net cost,	0.99 "
Manurial value obtainable,	1.01 "

II.

Corn meal,	0.60 lbs.
Wheat bran,	0.12 "
Gluten meal,	0.06 "
Rowen,	1.35 "
Nutritive ratio,	1:6.51
Total cost,	2.08 cts.
Net cost,	1.30 "
Manurial value obtainable,	0.78 "

III.

Corn meal,	0.60 lbs.
Wheat bran,	0.12 "
Gluten meal,	0.06 "
Rowen,	0.38 "
Corn ensilage,	3.56 "
Nutritive ratio,	1:7.40
Total cost,	1.85 cts.
Net cost,	1.23 "
Manurial value obtainable,	0.62 "

Average Daily Fodder Rations, etc. — Concluded.

IV.

Corn meal,	0.73 lbs.
Wheat bran,	0.15 "
Gluten meal,	0.07 "
Rowen,	1.64 "
Nutritive ratio,	1:6.50
Total cost,	2.53 cts.
Net cost,	2.14 "
Manurial value obtainable,	0.39 "

Average Daily Fodder Rations used for Lambs Nos. 4, 5 and 6.

I.

Wheat bran,	0.53 lbs.
Old-process linseed meal,	0.27 "
Rowen,	1.42 "
Nutritive ratio,	1:4.27
Total cost,	2.08 cts.
Net cost,	1.02 "
Manurial value obtainable,	1.06 "

II.

Wheat bran,	0.56 lbs.
Gluten meal,	0.28 "
Rowen,	1.48 "
Nutritive ratio,	1:4.55
Total cost,	2.20 cts.
Net cost,	1.14 "
Manurial value obtainable,	1.06 "

III.

Wheat bran,	0.48 lbs.
Gluten meal,	0.24 "
Rowen,	0.38 "
Corn ensilage,	3.33 "
Nutritive ratio,	1:5.01
Total cost,	1.69 cts.
Net cost,	0.94 "
Manurial value obtainable,	0.75 "

IV.

Wheat bran,	0.60 lbs.
Gluten meal,	0.30 "
Rowen,	1.34 "
Nutritive ratio,	1:4.51
Total cost,	2.17 cts.
Net cost,	1.13 "
Manurial value obtainable,	1.04 "

Summary of Cost of Above-stated Fodder Rations.

A.—Lambs 1, 2 and 3.

FEEDING PERIODS.	I. Cents.	II. Cents.	III. Cents.	IV. Cents.
Total cost of feed consumed, . . .	2.00	2.08	1.85	2.53
Manurial value obtainable (80 per cent.), .	1.01	0.78	0.62	0.39
Net cost of feed, ...	0.99	1.30	1.23	2.14
B.—Lambs 4, 5 and 6.				
Total cost of feed consumed, . . .	2.08	2.20	1.69	2.17
Manurial value obtainable (80 per cent.), .	1.06	1.06	0.75	1.04
Net cost of feed, ...	1.02	1.14	0.94	1.13

5. *Gain in Live Weight during Experiment.*

Lot A.

	Live Weight at the Beginning of Experiment (Pounds).	Live Weight at Close of Experiment (Pounds).	Gain in Live Weight during Experiment (Pounds).
1, ...	47.50	93.50	46.00
2, ...	60.50	98.75	38.25
3, ...	58.00	109.75	51.75
Average, ...	55.33	100.67	45.33
Lot B.			
4, ...	49.50	81.25	31.75
5, ...	62.00	101.25	39.25
6, ...	50.00	103.00	53.00
Average, ...	53.83	95.17	41.33

Lot A gained in live weight per head, on an average, 0.224 pounds.

Lot B gained in live weight per head, on an average, 0.205 pounds.

Amount of Raw Wool secured after the Close of the Experiment.

Lot A.

	Live Weight with Wool (Pounds).	Live Weight after Shearing (Pounds).	Amount of Wool obtained (Pounds).
1, ...	93.50	89.00	4.50
2, ...	98.75	93.25	5.50
3, ...	109.75	104.00	5.75
	302.00	286.25	15.75

Lot B.

	Live Weight with Wool (Pounds).	Live Weight after Shearing (Pounds).	Amount of Wool obtained (Pounds).
4, ...	81.25	76.00	5.25
5, ...	101.25	97.00	4.25
6, ...	103.00	97.75	5.25
	285.50	270.75	14.75

6. *Financial Statement.*

The wool was sold at 25 cents per pound and the pelt at 12.5 cents. The difference between the live weights of the animals 1, 2 and 3 at the close of the experiment, and their dressed weights, varied from 49 per cent. to 52 per cent., and averaged per head 51.2 per cent.; in case of animals 4, 5 and 6 it varied from 45 per cent. to 52 per cent., and averaged per head 48.6 per cent.

Yield of Dressed Weight.

1. 47.00 pounds, at 11 cents, ...	$5 17
2. 48.00 pounds, at 11 cents, ...	5 28
3. 52.25 pounds, at 11 cents, ...	5 75
147.25 pounds, ...	$16 20
4. 42.00 pounds, at 11 cents, ...	$4 62
5. 55.50 pounds, at 11 cents, ...	6 11
6. 49.00 pounds, at 11 cents, ...	5 39
146.50 pounds, ...	$16 12

Yield of Dressed Weight — Concluded.

Lot A.

	1.	2.	3.	Total.
Cost of lambs,	$1 89	$2 41	$2 31	
Cost of feed consumed,	4 30	4 46	5 21	$20 58
	$6 19	$6 87	$7 52	
Value received for meat,	$5 17	$5 28	$5 75	
Value received for wool and pelt,	1 25	1 50	1 56	
Value of obtainable manure,	1 41	1 46	1 69	$25 07
	$7 83	$8 24	$9 00	

Lot B.

	4.	5.	6.	Total.
Cost of lambs,	$1 97	$2 46	$2 01	
Cost of feed consumed,	3 49	5 26	5 67	$20 86
	$5 46	$7 72	$7 68	
Value received for meat,	$4 62	$6 11	$5 39	
Value received for wool and pelt,	1 44	1 19	1 44	
Value of obtainable manure,	1 44	2 17	2 34	$26 14
	$7 50	$9 47	$9 17	

Market Cost of Fodder Articles for 1890–91, as compared with 1889–90.

	1889-90.	1890-91.
	Per Ton.	Per Ton.
Corn meal,	$19 00	$28 00
Wheat bran,	17 00	25 00
Old-process linseed meal,	27 00	26 00
Gluten meal,	23 00	28 00
Corn ensilage,	2 75	2 75
Rowen,	15 00	15 00

Total Cost of Feed consumed, counted on Basis of 1889–90 and of 1890–91.

	1889-90.	1890-91.
Sheep 1,	$3 61	$4 30
Sheep 2,	3 74	4 46
Sheep 3,	4 38	5 21
Sheep 4,	3 00	3 49
Sheep 5,	4 54	5 26
Sheep 6,	4 93	5 67
	$24 20	$28 39

Conclusions.

1. The increase in live weight during the first feeding period is, in four out of six cases, lower than in any other period, and affects seriously the financial results of the whole experiment.

2. The total increase per head in live weight per day averages for the entire time of the experiment .23 pounds for Lot A (1, 2 and 3), and .22 pounds for Lot B (4, 5 and 6). In one case it amounts to .39 pounds per day (Lot A, 2, Period IV.); in nine cases it rises above .25 pounds.

3. The market cost of the daily individual fodder rations varies in different feeding periods from 1.69 cents to 2.53 cents. The rations that contain from three to four pounds of corn ensilage, in place of three-fourths of the rowen of other rations, furnish the cheapest daily diet (Period III., Lot A, 1.85 cents, and Lot B, 1.69 cents).

4. The market cost of the feed consumed during the experiment by the lambs of Lot A amounts per head to $4.66, and in case of Lot B to $4.81, — a difference of 15 cents. The three lambs of Lot A cost $6.62, those of Lot B cost $6.47; making cost of lambs and of the feed consumed $20.58 in case of the former, and $20.86 in case of the latter.

5. Dressed lambs, wool and pelts, brought, in case of Lot A, $20.51, and in case of Lot B, $20.19.

6. The obtainable manurial value of the feed consumed by the lambs of Lot A averages per head $1.52, or one-third of the market cost of the feed, and amounts to $1.95 per head, or two-fifths of the market cost of the feed consumed in case of the lambs of Lot B, — a difference of $0.45 per head in favor of the latter, or $4.56 for Lot A and $5.95 for Lot B, — a difference of $1.39 in favor of the latter.

7. The value of the obtainable manure, amounting from ten to eleven dollars for the entire operation, represents the profits of the experiment, aside from disposing of our home-raised fodder articles at a liberal retail market price.

8. The advance on the market cost of the concentrated commercial feed stuffs used in the experiment of 1890–91, as compared with that of 1889–90, amounts to $4.19 as far as the feed consumed is concerned, or 70 cents per head.

Sheep No. 1.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.45	0.23	–	1.25	–	1.68	0.11	15.27	1:4.30	47.50
Oct. 14 to Jan. 19,	0.61	0.12	–	0.06	1.39	–	1.89	0.20	9.45	1:6.50	60.00
Jan. 27 to March 2,	0.58	0.12	–	0.06	0.40	3.53	1.69	0.21	8.05	1:7.39	74.50
March 10 to April 20,	0.73	0.15	–	0.07	1.63	–	2.22	0.33	6.73	1:6.51	86.50

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
118.27 pounds corn meal, ...	102.59	$1 66	$0 39
29.98 pounds wheat bran, ...	26.35	0 37	0 19
3.17 pounds old-process linseed meal, .	2.89	0 04	0 03
11.83 pounds gluten meal, ...	10.54	0 17	0 09
247.25 pounds rowen, ...	212.88	1 85	0 97
155.00 pounds corn ensilage, ...	30.18	0 21	0 09
	385.43	$4 30	$1 76

	Pounds.
Live weight of animal at beginning of experiment, ...	47.50
Live weight at time of killing, ...	93.50
Live weight gained during experiment, ...	46.00
Average gain in weight per day, ...	0.23
Dressed weight of animal, ...	47.00
Loss in weight by dressing, ... 46.5 pounds, or 49.73 per cent.	
Pounds of dry matter fed produced 1 pound of live weight, .	8.38
Cost of feed per pound of live weight gained, ...	9.35 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.83 cents.

Sheep No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.46	–	1.97	0.07	28.14	1:4.30	60.50
Oct. 14 to Jan. 19,	0.60	0.12	–	0.06	1.33	–	1.83	0.13	14.08	1:6.51	69.00
Jan. 27 to March 2,	0.63	0.13	–	0.06	0.50	3.80	1.88	0.28	6.71	1:7.38	80.00
March 10 to April 20,	0.75	0.15	–	0.08	1.73	–	2.34	0.39	6.00	1:6.50	92.50

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
121.73 pounds corn meal, ...	105.59	$1 70	$0 40
31.75 pounds wheat bran, ...	27.91	0 40	0 20
3.70 pounds old-process linseed meal, .	3.38	0 05	0 03
12.17 pounds gluten meal, ...	10.84	0 17	0 09
254.00 pounds rowen, ...	218.69	1 91	1 00
169.50 pounds corn ensilage, ...	33.00	0 23	0 10
	399.41	$4 46	$1 82

	Pounds.
Live weight of animal at beginning of experiment, ...	60.50
Live weight at time of killing, ...	98.75
Live weight gained during experiment, ...	38.25
Average gain in weight per day, ...	0.19
Dressed weight of animal, ...	48.00
Loss in weight by dressing, . . . 50.75 pounds, or 51.39 per cent.	
Pounds of dry matter fed produced 1 pound of live weight, .	10.44
Cost of feed per pound of live weight gained, . . .	11.66 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	7.29 cents.

Sheep No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.	Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.50	–	2.00	0.27	7.41	1:4.36	59.75
Oct. 14 to Jan. 19,	0.69	0.14	–	0.07	1.63	–	2.18	0.24	9.08	1:6.50	72.00
Jan. 27 to March 2,	0.75	0.15	–	0.08	0.50	4.91	2.24	0.24	9.31	1:7.43	90.75
March 10 to April 20,	0.90	0.18	–	0.09	2.05	–	2.79	0.27	13.33	1:6.50	104.75

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds)	Cost.	Manurial Value.
141.54 pounds corn meal, . . .	122.77	$1 98	$0 46
35.71 pounds wheat bran, . . .	31.39	0 45	0 22
3.70 pounds old-process linseed meal, .	3.38	0 05	0 03
14.15 pounds gluten meal, . . .	12.61	0 20	0 11
299.25 pounds rowen, ...	256.66	2 24	1 17
209.50 pounds corn ensilage, . . .	40.79	0 29	0 12
	467.60	$5 21	$2 11

	Pounds.
Live weight of animal at beginning of experiment, . . .	58.00
Live weight at time of killing, ...	109.75
Live weight gained during experiment, ...	51.75
Average gain in weight per day, ...	0.25
Dressed weight of animal, ...	52.25
Loss in weight by dressing, . . 57.50 pounds, or 52.39 per cent.	
Pounds of dry matter fed produced 1 pound of live weight, .	9.04
Cost of feed per pound of live weight gained, ...	10.07 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	6.32 cents.

Sheep No. 4.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	-	0.50	0.25	-	1.21	-	1.71	0.18	9.50	1:4.20	50.25
Oct. 14 to Jan. 19,	-	0.44	-	0.22	0.98	-	1.42	0.13	10.92	1:4.42	59.00
Jan. 27 to March 2,	-	0.42	-	0.21	0.41	3.00	1.48	0.21	7.05	1:5.09	68.25
March 10 to April 20,	-	0.57	-	0.28	1.42	-	1.98	0.26	7.62	1:4.51	78.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
95.33 pounds wheat bran, . . .	83.79	$1 19	$0 59
3.50 pounds old-process linseed meal, .	3.19	0 05	0 03
44.17 pounds gluten meal, . . .	39.36	0 62	0 34
193.25 pounds rowen, ...	166.39	1 45	0 76
130.50 pounds corn ensilage, . . .	25.41	0 18	0 08
	318.14	$3 49	$1 80

	Pounds.
Weight of animal at beginning of experiment, ...	49.50
Live weight at time of killing, ...	81.25
Live weight gained during experiment, ...	31.75
Average gain in weight per day, ...	0.16
Dressed weight of animal, ...	42.00
Loss in weight by dressing, . . 39.25 pounds, or 48.31 per cent.	
Pounds of dry matter fed produced 1 pound live weight, . .	10.02
Cost of feed per pound of live weight gained, . . .	10.99 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.76 cents.

Sheep No. 5.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.57	0.29	–	1.71	–	2.23	0.21	10.62	1:4.36	62.50
Oct. 14 to Jan. 19,	–	0.67	–	0.33	1.78	–	2.41	0.19	12.68	1:4.56	76.00
Jan. 27 to March 2,	–	0.65	–	0.33	0.43	4.76	2.16	0.29	7.45	1:5.02	90.50
March 10 to April 20,	–	0.72	–	0.36	1.87	–	2.56	8.24	10.66	1:4.53	100.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
136.50 pounds wheat bran,	119.97	$1 71	$0 85
4.00 pounds old-process linseed meal,	3.65	0 05	0 04
64.25 pounds gluten meal,	57.25	0 91	0 49
308.50 pounds rowen,	265.62	2 31	1 21
202.00 pounds corn ensilage,	39.33	0 28	0 12
	485.82	$5 26	$2 71

	Pounds.
Live weight of animal at beginning of experiment,	62.00
Live weight at time of killing,	101.25
Live weight gained during experiment,	39.25
Average gain in weight per day,	0.19
Dressed weight of animal,	55.50
Loss in weight by dressing,	45.75 pounds, or 45.16 per cent.
Pounds of dry matter fed produced 1 pound of live weight,	12.38
Cost of feed per pound of live weight gained,	13.40 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value,	7.06 cents.

Sheep No. 6.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.34	–	1.87	0.14	13.36	1:4.24	50.50
Oct. 14 to Jan. 19,	–	0.67	–	0.33	1.89	–	2.51	0.27	9.30	1:4.61	65.50
Jan. 27 to March 2,	–	0.67	–	0.33	0.50	5.23	2.33	0.29	8.03	1:5.15	84.00
March 10 to April 20,	–	0.87	–	0.43	2.50	–	3.29	0.27	12.19	1:4.62	96.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
142.74 pounds wheat bran, ...	125.45	$1 78	$0 88
3.70 pounds old-process linseed meal, .	3.38	0 05	0 03
67.67 pounds gluten meal, ...	60.29	0 95	0 52
345.75 pounds rowen, ...	297.69	2 59	1 36
220.00 pounds corn ensilage, ...	42.83	0 30	0 13
	529.64	$5 67	$2 92

	Pounds.
Live weight of animal at beginning of experiment, ...	50.00
Live weight at time of killing, ...	103.00
Live weight gained during experiment, ...	53.00
Average gain in weight per day, ...	0.26
Dressed weight of animal, ...	49.00
Loss in weight by dressing, . . . 54.00 pounds, or 52.43 per cent.	
Pounds of dry matter fed produced 1 pound of live weight, .	9.99
Cost of feed per pound of live weight gained, ...	10.70 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.62 cents.

Fodder Articles used in the Experiment.

Corn Meal (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C.,	13.26	265.20	–	–	
Dry matter,	86.74	1,734.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.72	34.40	–	–	
" cellulose,	2.28	45.60	21.89	48	1 : 8.62
" fat,	4.90	98.00	83.30	85	
" protein (nitrogenous matter),	12.94	258.80	204.45	79	
Non-nitrogenous extract matter,	78.16	1,563.20	1,531.94	98	
	100.00	2,000.00	1,841.58	–	

Wheat Bran (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.11	242.20	–	–	
Dry matter,	87.89	1,757.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	12.17	243.40	58.42	24	1 : 3.86
" fat,	5.04	100.80	71.57	71	
" protein (nitrogenous matter),	18.48	369.60	288.29	78	
Non-nitrogenous extract matter,	56.91	1,138.20	876.41	77	
	100.00	2,000.00	1,294.69	–	

Old-process Linseed Meal.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.72	174.40	–	–	1 : 1.93
Dry matter,	91.28	1,825.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.96	119.20	–	–	
" cellulose,	8.23	164.60	42.79	26	
" fat,	9.87	197.40	179.63	91	
" protein (nitrogenous matter),	36.19	723.80	629.70	87	
Non-nitrogenous extract matter,	39.75	795.00	723.45	91	
	100.00	2,000.00	1,575.57	–	

Gluten Meal.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.90	218.00	–	–	1 : 2.44
Dry matter,	89.10	1,782.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.02	20.40	–	–	
" cellulose,	1.28	25.60	15.87	62	
" fat,	7.36	147.20	125.12	85	
" protein (nitrogenous matter),	34.79	695.80	549.68	79	
Non-nitrogenous extract matter,	55.55	1,111.00	1,011.01	91	
	100.00	2,000.00	1,701.68	–	

Rowen (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.90	278.00	–	–	1 : 6.35
Dry matter,	86.10	1,722.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.28	165.60	–	–	
" cellulose,	28.88	577.60	369.66	64	
" fat,	3.91	78.20	35.97	46	
" protein (nitrogenous matter),	13.45	269.00	166.78	62	
Non-nitrogenous extract matter,	45.48	909.60	600.34	66	
	100.00	2,000.00	1,172.75	–	

Corn Ensilage.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.53	1,610.60	–	–	1 : 9.26
Dry matter,	19.47	389.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.73	134.60	–	–	
" cellulose,	26.90	538.00	387.36	72	
" fat,	3.27	65.40	49.05	75	
" protein (nitrogenous matter),	8.97	179.40	134.55	75	
Non-nitrogenous extract matter,	54.13	1,082.60	736.17	68	
	100.00	2,000.00	1,307.13	–	

IV.

THREE FEEDING EXPERIMENTS WITH PIGS (THOROUGHBREDS).

1890-1891.

Breeds: Small Yorkshires, Berkshires, Poland Chinas, Tamworths.

Feed: Creamery buttermilk, home skim-milk, corn meal, wheat bran, gluten meal (Chicago variety).

The general management of these experiments was similar to that adopted in our late pig-feeding experiments with grades. From two to three animals of each breed served in our trial.

Three experiments were carried on in succession. The Small Yorkshires were kindly furnished by Messrs. Warren Heustis & Sons, Belmont, Mass.; Berkshires by Col. Henry L. Russell, Milton, Mass.; Poland Chinas by Mr. Smith Harding, South Deerfield, Mass.; Tamworths by Mr. Joshua M. Sears, Boston, Mass.

Weight of Animals at the Beginning of the Experiments.

I.	Small Yorkshires,	24 to 26 pounds.
	Berkshires,	26 to 36 pounds.
	Poland Chinas,	20 to 22 pounds.
	Tamworths,	21 to 24 pounds.
II.	Small Yorkshires,	42 to 52 pounds.
	Berkshires,	20 to 23 pounds.
	Poland Chinas,	42 to 50 pounds.
	Tamworths,	34 to 38 pounds.
III.	Small Yorkshires,	26 to 27 pounds.
	Berkshires,	23 to 26 pounds.
	Poland Chinas,	23.5 to 24 pounds
	Tamworths,	38 to 42 pounds.

Average Composition of Fodder Rations used during the Three Feeding Periods of Each Feeding Experiment.

Experiment I.

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Skim-milk.	Buttermilk.
	Ounces.	Ounces.	Ounces.	Quarts.	Quarts.
I., ...	10	3½	7	–	5
II., ...	29½	9½	9½	–	5
III., ...	57	13½	13½	5	–

Experiment II.

I., ...	6	6	12	3	–
II., ...	22½	8½	8½	3½	–
III., ...	35	5½	5½	4	–

Experiment III.

I., ...	11	6	12	5½	–
II., ...	31½	11½	11½	5	–
III., ...	52	11	11	5	–

The amount of milk used was controlled by our daily supply and by the number of pigs under observation. During the first experiment creamery buttermilk was fed during the two first feeding periods; during the remaining time home-made skim-milk alone was used. As a general rule during the entire experiment the following system was adopted for compounding the daily diet in different feeding periods: —

Period I. For each one quart skim-milk to two ounces of corn meal.

Period II. For each, one quart skim-milk to four ounces of corn meal.

Period III. For each, one quart skim-milk to six ounces of corn meal.

The daily quantity of this feed was governed by the appetite of each animal. Whenever the supply of either kind of milk, or of both kinds, was exhausted, the additional feed called for was prepared in the following manner: —

		Nutritive Ratio.
Period I.	Wheat bran, one weight part, ... Gluten meal, two weight parts, ...	1 : 2.80
Period II.	Corn meal, one weight part, ... Wheat bran, one weight part, ... Gluten meal, one weight part, ...	1 : 3.80
Period III.	Corn meal, two weight parts, ... Wheat bran, one weight part, ... Gluten meal, one weight part, ...	1 : 4.35

The entire management of the feeding was divided, as will be noticed, into three periods, as far as the nutritive character of the daily diet was concerned.

	Live Weight.	Nutritive Ratio.
Period I., ...	20 to 90 pounds, . .	1 : 2.80
Period II., ...	90 to 130 pounds, . .	1 : 3.80
Period III., ...	130 to 200 pounds, . .	1 : 4.35

During the summer season the feed was given twice a day; during the winter season, three times. Whenever the milk did not satisfy the thirst of the animals warm water was added to the grain to meet the temporary wants.

The results of the two first experiments, being more of an experimental character, are subsequently given in a brief abstract; the third experiment is reported also in regard to all details of a special interest. Those animals which for more than a few days refused to consume a fair share of their daily diet are excluded from the record, in common with a few losses soon after their arrival during our first and second experiment.

Summary of Experiment I. (May 13 to Oct. 15, 1890).

	Corn Meal (Pounds).	Buttermilk (Quarts).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Small Yorkshires, 2 pigs, .	560.35	1,129.00	355.00	153.74	187.18	367.25	311.75	4.79
Poland China, . . .	305.10	558.50	177.50	95.65	116.38	215.50	180.00	4.57
Berkshires, 3 pigs, . .	721.71	1,491.50	532.50	211.42	250.36	512.25	415.50	4.80
Tamworths, 2 pigs, . .	478.53	889.00	355.00	137.29	156.50	354.75	283.75	4.52

Local Market Cost of Fodder Articles used during Experiment I.

Corn meal, per ton, ...	$24 00
Wheat bran, per ton, ...	19 00
Gluten meal, per ton, ...	25 00
Buttermilk, per gallon, ...	1 cent.
Skim-milk, per gallon, ...	1 8 cents.

Valuation of essential fertilizing constituents in the above articles of fodder used: Nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Butter-milk.	Skim-milk.
Moisture, ...	12.39	11.52	8.48	93.34	89.78
Nitrogen, ...	1.466	2.600	5.358	.391	.520
Phosphoric acid, ...	.707	2.870	.425	.135	.190
Potassium oxide, ...	.435	1.620	.045	.143	.200
Valuation per 2,000 pounds,	$6 22	$13 71	$19 13	$1 62	$2 18

Summary of Experiment II. (Nov. 18, 1890, to April 19, 1891).

	Corn Meal (Pounds).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Berkshire, No. 1, ...	159.54	511.00	43.80	60.49	136.50	112.77	5.19
Berkshire, No. 2, ...	149.08	511.00	35.65	50.46	129.50	105.14	5.20
Poland China, No. 1, . . .	223.54	488.50	69.96	84.96	157.00	132.35	5.50
Poland China, No. 2, . . .	170.68	491.00	48.94	63.75	114.00	95.73	6.28
Small Yorkshire, No. 1, . .	215.40	515.00	60.01	71.82	151.75	127.11	5.53
Small Yorkshire, No. 2, . .	218.84	515.00	63.70	82.26	146.00	123.56	5.84

Local Market Value of the Various Articles of Fodder used during Experiment II.

Corn meal, per ton, ...	$27 00
Skim-milk, per gallon, ...	1.8 cents.
Wheat bran, per ton, ...	$25 00
Gluten meal, per ton, ...	28 00

Valuation of essential fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, $5\frac{1}{2}$ cents; potassium oxide, $4\frac{1}{2}$ cents per pound.

	Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture, ...	13.26	89.78	12.11	10.90
Nitrogen, ...	1.796	.520	2.599	4.959
Phosphoric acid, ...	.707	.190	2.845	.425
Potassium oxide, ...	.435	.200	1.625	.045
Valuation per 2,000 pounds, . .	$6 56	$1 95	$12 39	$15 38

Summary of Experiment III. (May 12 to Sept. 7, 1891).

	Corn Meal (Pounds).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Berkshire, No. 1,	237.70	631.00	80.46	105.07	177.50	142.96	6.20
Berkshire, No. 2,	221.66	631.00	70.82	94.51	169.25	141.04	5.93
Small Yorkshire, No. 1,	215.60	680.00	53.45	67.93	156.00	126.86	6.25
Small Yorkshire, No. 2,	268.53	794.00	58.68	73.16	174.00	145.36	6.46
Poland China, No. 1,	208.44	589.00	59.29	75.16	171.50	136.61	5.54
Poland China, No. 2,	204.31	589.00	61.10	74.42	156.50	124.77	6.03
Tamworth, No. 1,	210.07	510.00	73.24	92.38	143.00	126.33	6.06
Tamworth, No. 2,	206.57	510.00	72.46	91.73	141.75	114.90	6.59

Local Market Value of the Various Articles of Fodder used during Experiment III.

Corn meal, per ton,	$31 00
Skim-milk, per gallon,	1.8 cents.
Wheat bran, per ton,	$23 00
Gluten meal, per ton,	27 00

Valuation of the essential fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	15.31	91.18	12.99	11.11
Nitrogen,	1.651	.445	2.249	4.741
Phosphoric acid,	.693	.163	2.793	.413
Potassium oxide,	.426	.172	1.592	.044
Valuation per 2,000 pounds,	$6 10	$1 67	$11 25	$14 72

Summary of the Three Feeding Experiments, regarding the Character and Quantity of Feed consumed per Pound of Live Weight and Dressed Weight produced.

BREED.	Number of Animals on Trial.	Nutritive Ratio, Period I.	Nutritive Ratio, Period II.	Nutritive Ratio, Period III.	Dry Matter consumed per Pound of Live Weight (Pounds).	Dry Matter consumed per Pound of Dressed Weight (Pounds).
I. May to October, 1890.						
Small Yorkshire,	2	1:2.79	1:3.90	1:4.49	2.82	3.32
Berkshire,	3	1:2.82	1:3.85	1:4.47	2.69	3.31
Poland China,	1	1:2.76	1:3.84	1:4.50	2.67	3.20
Tamworth,	2	1:2.85	1:3.85	1:4.48	2.50	3.13
II. November, 1890, to April, 1891.						
Small Yorkshire,	2	1:2.88	1:3.80	1:4.38	2.87	3.42
Berkshire,	2	1:2.89	1:3.76	1:4.35	2.49	3.04
Poland China,	1	1:2.85	1:3.74	1:4.39	2.80	3.32
Tamworth,	–	–	–	–	–	–
III. May to September, 1891.						
Small Yorkshire,	2	1:3.14	1:4.19	1:4.80	2.77	3.36
Berkshire,	2	1:3.13	1:4.22	1:4.89	2.71	3.31
Poland China,	2	1:3.14	1:4.23	1:4.90	2.49	3.12
Tamworth,	2	1:3.12	1:4.26	1:4.93	2.94	3.48

Summary of the Three Feeding Experiments, regarding Gain in Weight, Cost of Feed and Rate of Shrinkage of Pork dressed for the Market.

BREED.	Number of Animals on Trial.	Average Live Weight of Animals on Trial at Beginning.	Average Live Weight of Animals at Time of Killing.	Number of Days on Trial.	Average Gain in Live Weight during Experiment (Pounds).	Average Gain in Live Weight per Day (Pounds).	Average Cost of Feed per Pound of Dressed Pork (Cents).	Average Shrinkage in Weight by Dressing (Per Cent.).
I.								
Small Yorkshire,	2	26.80	212.10	156	185.60	1.19	4.79	15.09
Berkshire,	3	21.50	192.00	142	170.70	1.20	4.80	18.87
Poland China,	1	26.25	241.75	156	215.50	1.38	4.57	16.44
Tamworth,	2	22.75	199.90	128	177.00	1.38	4.52	20.01
II.								
Small Yorkshire,	2	47.38	196.20	148	148.80	1.01	5.19	15.80
Berkshire,	2	21.12	154.12	148	133.0	0.90	4.80	18.01
Poland China,	1	46.00	207.00	141	157.0	1.11	4.98	15.87
Tamworth,	–	–	–	–	–	–	–	–
III.								
Small Yorkshire,	2	26.25	191.25	144.5	165.0	1.15	5.61	17.57
Berkshire,	2	24.12	197.50	128	173.4	1.35	5.32	18.06
Poland China,	2	23.60	187.60	119	163.5	1.38	5.09	20.37
Tamworth,	2	39.60	182.00	100	142.3	1.42	5.52	15.30

Basis of valuation per ton: Corn meal, $24; wheat bran, $19; gluten meal, $25; skim-milk, per gallon, 1.8 cents; buttermilk, per gallon, 1.0 cent.

Summary of Cost of Feed consumed for the Production of One Pound of Dressed Pork, based on the Ruling Market Price of the Fodder Articles when used.

BREED.	Experiment I.			Experiment II.			Experiment III.		
	Total Cost.	Net Cost.	Obtainable Manurial Value.	Total Cost.	Net Cost.	Obtainable Manurial Value.	Total Cost.	Net Cost.	Obtainable Manurial Value.
	Cents.	Cents	Cents.	Cen's.	Cents	Cents.	Cents.	Cents.	Cents.
Small Yorkshire, . . .	4.79	3.14	1.65	5.68	4.14	1.54	6.36	4.86	1.50
Berkshire, ...	4.80	3.13	1.67	5.20	3.74	1.46	6.07	4.59	1.48
Poland China, . . .	4.57	2.98	1.59	5.50	4.00	1.50	5.79	4.40	1.39
Tamworth, ...	4.52	2.97	1.55	–	–	–	6.33	4.78	1.55

Local Market Cost of the Various Articles of Fodder used during the Three Experiments.

	Experiment I.	Experiment II.	Experiment III.
Corn meal, per ton, . .	$24 00	$27 00	$31 00
Wheat bran, per ton, . .	19 00	25 00	23 00
Gluten meal, per ton, . .	25 00	28 00	27 00
Buttermilk, per gallon, . .	0 01	–	–
Skim-milk, per gallon, . .	0 018	0 018	0 018

Relative Cost of Feed per Pound of Dressed Pork (Cents), based on the Lowest and Highest Market Price.

	I.	II.
Corn meal, per ton, ...	$24 00	$31 00
Wheat bran, per ton, ...	19 00	23 00
Gluten meal, per ton, ...	25 00	27 00
Skim-milk, per gallon, ...	1.8 cents.	1.8 cents.
Buttermilk, per gallon, ...	1.0 cent.	1.0 cent.

I.

	Experiment I.	Experiment II.	Experiment III.
	Cents.	Cents.	Cents.
Small Yorkshire, No. 1, . .	4.79	5.04	5.53
Small Yorkshire, No. 2, . .		5.34	5.68
Berkshire, No. 1, ...	4.80	4.78	5.43
Berkshire, No. 2, ...		4.81	5.21
Berkshire, No. 3, ...		–	–
Poland China, No 1, . .	4.57	4.98	4.87
Poland China, No. 2, . .	–	–	5.30
Tamworth, No. 1, . . .	4.52	–	5.28
Tamworth, No. 2, . . .		–	5.76

II.

	Experiment I.	Experiment II.	Experiment III.
Small Yorkshire, No. 1, . .	5.58	5.80	6.25
Small Yorkshire, No. 2, . .		5.30	6.46
Berkshire, No. 1, ...	5.57	5.40	6.20
Berkshire, No. 2, ...		5.42	5.93
Berkshire, No. 3, ...		–	–
Poland China, No. 1, . .	5.33	5.75	5.54
Poland China, No. 2, . .	–	–	6.03
Tamworth, No. 1, . . .	5.26	–	6.06
Tamworth, No. 2, . . .		–	6.59

Conclusions.

1. *The average amount of dry matter consumed* per pound of dressed pork produced differs for different breeds as follows: First experiment, in case of Tamworths and Poland Chinas, from 3.13 to 3.20 pounds; in case of Berkshires and Small Yorkshires, from 3.31 to 3.32 pounds. Second experiment, in case of Berkshires and Small Yorkshires, from 3.04 to 3.42 pounds; Poland Chinas, 3.32 pounds; Tamworths ruled out, on account of sickness in the second experiment. Third experiment, in case of Poland Chinas and Tamworths, from 3.12 to 3.48 pounds; and in case of Berkshires and Small Yorkshires, from 3.31 to 3.36 pounds. Summing up the results of the three experiments in this connection, it appears that in our case the larger build breeds lead the smaller breeds in two out of three cases. The difference between breeds is apparently not more marked than the difference between animals of the same breed.

2. *The average gain in live weight per day* differs in the first trial, between Small Yorkshires and Berkshires, from

1.19 to 1.20 pounds; Poland Chinas and Tamworths are even, 1.38 pounds; in the second experiment, Small Yorkshires 1.01 to Berkshires .9 pounds; Poland Chinas 1.01 pounds; in the third experiment, Small Yorkshires 1.15, Berkshires 1.35, Poland Chinas 1.38 and Tamworths 1.42 pounds. The Berkshires lead the Small Yorkshires in two out of three experiments, while the Poland Chinas and Tamworths show practically no difference in that respect.

3. *The cost of feed per pound of dressed pork produced* varies in case of different breeds in the successive experiments as follows: First experiment, Small Yorkshires and Berkshires, from 4.79 to 4.80 cents, and Tamworths and Poland Chinas 4.52 to 4.57 cents; second experiment, Berkshires and Small Yorkshires 4.80 to 5.19 cents, Poland Chinas 4.98 cents; third experiment, Berkshires and Small Yorkshires from 5.32 to 5.61 cents, and Poland Chinas and Tamworths from 5.09 to 5.52 cents. The Berkshires lead the Small Yorkshires in two out of three trials, and the Poland Chinas and Tamworths compare well with each other in two trials. The cost of feed in the previous statement is based on the contemporary market price of the different grain feeds, which during the third experiment were exceptionally high, as may be seen from previous reports.

4. The average net cost of the feed consumed per pound of dressed pork produced, allowing a loss of 30 per cent. of the essential manurial constituents of the feed consumed, compares as follows: First experiment, Small Yorkshires, 3.14 cents; Berkshires, 3.13 cents; Poland Chinas, 2 98 cents; Tamworths, 2.92 cents. Second experiment, Small Yorkshires, 4.14 cents; Berkshires, 4.70 cents; Poland Chinas, 4.00 cents. Third experiment, Small Yorkshires, 4.86 cents; Berkshires, 4.59 cents; Poland Chinas, 4.40 cents; and Tamworths, 4.78 cents. The value of the obtainable manure averages in the first experiment, per pound of dressed pork sold, 1.61 cents; second experiment, 1.50 cents; and in the third experiment, 1.48 cents, — which is equal to from one-quarter to one-third of the total cost of the feed consumed. The commercial value of the manurial constituents of the feed consumed during our three feeding experiments amounts to $12.39, of which from eight to nine dollars' worth may be saved.

Detailed Statement of Third Experiment.

Small Yorkshire, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period (Pounds).
1891.								
April 28 to June 22, .	37.88	303.00	14.48	28.96	1:3.14	26.00	83.25	1.02
June 23 to July 27, .	63.53	175.00	19.75	19.75	1:4.19	83.25	127.00	1.25
July 28 to Sept. 7, .	114.19	202.00	19.22	19.22	1:4.82	127.00	182.00	1.31

Total Amount of Feed consumed from April 28 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
215.60 pounds corn meal, . . .	182.59	$3 34	$0 66
680.00 quarts skim-milk, . . .	130.14	3 06	1 23
53.45 pounds wheat bran, . .	46.51	0 61	0 30
67.93 pounds gluten meal, . .	60.38	0 92	0 50
	419.62	$7 93	$2 69

	Pounds.
Live weight of animal at beginning of experiment, ...	26.00
Live weight at time of killing, ...	182.00
Live weight gained during experiment, ...	156.00
Dressed weight at time of killing, ...	148.00
Loss in weight by dressing, . . . 34 pounds, or 18.68 per cent.	
Dressed weight gained during experiment, ...	126.86

2.69 pounds of dry matter fed yielded 1 pound of live weight, and 3.31 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.25 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.77 cents.

Detailed Statement of Third Experiment — Continued.

Small Yorkshire, No. 2 (Experiment III.)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
April 28 to June 22, .	37.88	303.00	14.48	28.96	1:3.14	26.50	77.75	0.92
June 23 to July 27, .	63.50	175.00	19.75	19.75	1:4.19	77.75	119.50	1.19
July 28 to Sept. 30, .	167.15	316.00	24.45	24.45	1:4.78	119.50	200.50	1.25

Total Amount of Feed consumed from April 28 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
268.53 pounds corn meal, . . .	227.42	$4 16	$0 82
794.00 quarts skim-milk, . . .	151.97	3 57	1 44
58.68 pounds wheat bran, . .	51.06	0 67	0 33
73.16 pounds gluten meal, . .	65.03	0 99	0 54
	495.48	$9 39	$3 13

	Pounds.
Live weight of animal at beginning of experiment, ...	26.50
Live weight at time of killing, ...	200.50
Live weight gained during experiment, ...	174.00
Dressed weight at time of killing, ...	167.50
Loss in weight by dressing, . . . 33 pounds, or 16.46 per cent.	
Dressed weight gained during experiment, ...	145.36

2.85 pounds of dry matter fed yielded 1 pound of live weight, and 3.41 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.46 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.95 cents.

Detailed Statement of Third Experiment — Continued.

Berkshire, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 26 to July 20, . .	34.25	280.00	24.61	49.22	1:3.12	25.50	88.50	1.13
July 21 to Aug. 17, . .	53.63	132.00	21.88	21.88	1:4.23	88.50	129.00	1.45
Aug. 18 to Sept. 30, . .	149.82	219.00	33.97	33.97	1:4.91	129.00	203.00	1.72

Total Amount of Feed consumed from May 26 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
237.70 pounds corn meal, . . .	201.31	$3 68	$0 72
631.00 quarts skim-milk, . . .	120.77	2 84	1 14
80.46 pounds wheat bran, . .	70.01	0 93	0 45
105.07 pounds gluten meal, . .	93.40	1 42	0 77
	485.49	$8 87	$3 08

	Pounds.
Live weight of animal at beginning of experiment, . .	25.50
Live weight at time of killing, ...	203.00
Live weight gained during experiment, ...	177.50
Dressed weight at time of killing, ...	163.50
Loss in weight by dressing, . . 39½ pounds, or 19.46 per cent.	
Dressed weight gained during experiment, ...	142.96

2.74 pounds of dry matter fed yielded 1 pound of live weight, and 3.40 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.20 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.69 cents.

Detailed Statement of Third Experiment — Continued.

Berkshire, No. 2 (Experiment III).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 26 to July 20, . .	35.00	280.00	23.69	47.38	1:3.13	22.75	85.50	1.12
July 21 to Aug. 17, . .	52.25	132.00	20.87	20.87	1:4.21	85.50	121.50	1.29
Aug. 18 to Sept. 30, . .	134.41	219.00	26.26	26.26	1:4.86	121.50	192.00	1.60

Total Amount of Feed consumed from May 26 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
221.66 pounds corn meal, . . .	187.72	$3 44	$0 68
631.00 quarts skim-milk, . . .	120.77	2 84	1 14
70.82 pounds wheat bran, . .	61.62	0 81	0 40
94.51 pounds gluten meal, . .	84.01	1 28	0 70
	454.12	$8 37	$2 92

	Pounds.
Live weight of animal at beginning of experiment, . .	22.75
Live weight at time of killing, ...	192.00
Live weight gained during experiment, ...	169.25
Dressed weight at time of killing, ...	160.00
Loss in weight by dressing, . . . 32 pounds, or 16.67 per cent.	
Dressed weight gained during experiment, ...	141.04

2.68 pounds of dry matter fed yielded 1 pound of live weight, and 3.22 pounds of dry matter yielded 1 pound dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.93 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.49 cents.

Detailed Statement of Third Experiment — Continued.

Poland China, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 12 to July 6, . .	35.25	282.00	15.88	31.75	1:3.14	23.75	90.00	1.18
July 7 to July 27, . .	41.88	105.00	15.63	15.63	1:4.23	90.00	122.00	1.52
July 28 to Sept. 7, . .	131.31	202.00	27.78	27.78	1:4.89	122.00	195.25	1.74

Total Amount of Feed consumed from May 12 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
208.44 pounds corn meal, . . .	176.53	$3 23	$0 64
589.00 quarts skim-milk, . . .	112.73	2 65	1 07
59.29 pounds wheat bran, . .	51.59	0 68	0 33
75.16 pounds gluten meal, . .	66.81	1 01	0 55
	407.66	$7 57	$2 59

	Pounds.
Live weight of animal at beginning of experiment, . .	23.75
Live weight at time of killing, ...	195.25
Live weight gained during experiment, ...	171.50
Dressed weight at time of killing, ...	155.50
Loss in weight by dressing, . . 40 pounds, or 20.46 per cent	
Dressed weight gained during experiment, ...	136.61

2.38 pounds dry matter fed yielded 1 pound live weight, and 2.98 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.54 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.22 cents.

Detailed Statement of Third Experiment — Continued.

Poland China, No. 2 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-Milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 12 to July 6,	35.25	282.00	13.31	26.63	1:3.14	23.50	77.50	0.96
July 7 to Aug. 3,	56.13	140.00	22.38	22.38	1:4.23	77.50	121.50	1.57
Aug. 4 to Sept. 7,	112.93	167.00	25.41	25.41	1:4.91	121.50	180.00	1.67

Total Amount of Feed consumed from May 12 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
204.31 pounds corn meal,	173.03	$3 17	$0 62
589.00 quarts skim-milk,	112.73	2 65	1 07
61.10 pounds wheat bran,	53.16	0 70	0 34
74.42 pounds gluten meal,	66.15	1 00	0 55
	405.07	$7 52	$2 58

	Pounds.
Live weight of animal at beginning of experiment,	23.50
Live weight at time of killing,	180.00
Live weight gained during experiment,	156.50
Dressed weight at time of killing,	143.50
Loss in weight by dressing,	36½ pounds, or 20.28 per cent.
Dressed weight gained during experiment,	124.77

2.59 pounds of dry matter fed yielded 1 pound of live weight, and 3.25 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.03 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.58 cents.

Detailed Statement of Third Experiment—Continued.

Tamworth, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 5 to June 8, . .	24.50	196.00	19.15	38.29	1:3.12	41.50	90.00	1.39
June 9 to July 6, . .	58.00	140.00	23.00	23.00	1:4.25	90.00	123.50	1.20
July 7 to Aug. 12, . .	127.57	174.00	31.09	31.09	1:4.94	123.50	184.50	1.65

Total Amount of Feed consumed from May 5 to Aug. 12, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
210.07 pounds corn meal, . . .	177.91	$3 26	$0 64
510.00 quarts skim-milk, . . .	97.61	2 30	0 92
73.24 pounds wheat bran, . .	63.73	0 84	0 41
92.38 pounds gluten meal, . .	82.12	1 25	0 68
	421.37	$7 65	$2 65

	Pounds.
Live weight of animal at beginning of experiment, . .	41.50
Live weight at time of killing, ...	184.50
Live weight gained during experiment, ...	143.00
Dressed weight at time of killing, ...	163.00
Loss in weight by dressing, . . 21½ pounds, or 11.65 per cent.	
Dressed weight gained during experiment, ...	126.33

2.95 pounds of dry matter fed yielded 1 pound of live weight, and 3.34 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.06 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.58 cents.

Detailed Statement of Third Experiment — Continued.

Tamworth, No. 2 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).*	Gain in Weight per Day during Period (Pounds).
1891.								
May 5 to June 8, .	24.50	196.00	19.27	38.54	1:3.12	37.75	85.50	1.36
June 9 to July 6, .	59.69	140.00	24.69	24.69	1:4.26	85.50	122.50	1.32
July 7 to Aug. 12, .	122.38	174.00	28.50	28.50	1:4.92	122.50	179.50	1.54

Total Amount of Feed consumed from May 5 to Aug. 12, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
206.57 pounds corn meal, . .	174.94	$3 20	$0 63
510.00 quarts skim-milk, . . .	97.61	2 30	0 92
72.46 pounds wheat bran, .	63.05	0 83	0 41
91.73 pounds gluten meal, . .	81.54	1 24	0 68
	417.14	$7 57	$2 64

	Pounds.
Live weight of animal at beginning of experiment, . . .	37.75
Live weight at time of killing, ...	179.50
Live weight gained during experiment, ...	141.75
Dressed weight at time of killing, ...	145.50
Loss in weight by dressing, . . . 34 pounds, or 18.94 per cent.	
Dressed weight gained during experiment, ...	114.90

2.94 pounds of dry matter fed yielded 1 pound of live weight, and 3.63 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.59 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent of manurial value of feed, 4.98 cents.

Detailed Statement of Third Experiment — Concluded.

Summary of Gain in Weight (Experiment III.).

SUMMER, 1891.	Live Weight at Beginning (Pounds.)		Live Weight when Killed (Pounds)		Gain in Live Weight (Pounds).	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
Small Yorkshires,	26.00	26.50	182.00	200.50	156.00	174.00
Poland Chinas, .	23.75	23.50	195.25	180.00	171.50	156.50
Berkshires, . .	25.50	22.75	203.00	192.00	177.50	169.25
Tamworths, . .	41.50	37.75	184.50	179.50	143.00	141.75

SUMMER, 1891.	Number of Days of Feeding.		Gain in Live Weight per Day (Pounds).	
	No. 1.	No. 2	No. 1.	No. 2.
Small Yorkshires, ...	133	156	1.17	1.12
Poland Chinas, . . .	119	119	1.44	1.32
Berkshires, ...	128	128	1.39	1.32
Tamworths, ...	100	100	1.43	1.42

Fodder Analyses.

Corn Meal (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.39	247.80	–	–	1 : 9.70
Dry matter, ...	87.61	1,752.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.80	36.00	–	–	
" cellulose, ...	1.80	36.00	12.24	34	
" fat, ...	5.01	100.20	76.15	76	
" protein (nitrogenous matter), . . .	10.46	209.20	177.82	85	
Non-nitrogenous extract matter, ...	80.93	1,618.60	1,521.48	94	
	100.00	2,000.00	1,787.69	–	

Fodder Analyses — Continued.

Wheat Bran (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.52	230.40	–	–	1 : 3.71
Dry matter, ...	88.48	1,769.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.13	142.60	–	–	
" cellulose, . . .	10.63	212.60	42.52	20	
" fat, ...	5.62	112.40	89.92	80	
" protein (nitrogenous matter), . .	18.36	367.20	323.14	88	
Non-nitrogenous extract matter, ...	58.26	1,165.20	932.16	80	
	100.00	2,000 00	1,387.74	–	

Gluten Meal (Experiment I).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.48	169.60	–	–	1 : 2.22
Dry matter, ...	91.52	1,830.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	0.76	15.20	–	–	
" cellulose, . . .	0.68	13.60	4.62	34	
" fat, ...	11.14	222.80	169.33	76	
" protein (nitrogenous matter), . .	36.59	731.80	622.03	85	
Non-nitrogenous extract matter, ...	50.83	1,016.60	955.60	94	
	100.00	2,000.00	1,751.58	–	

Fodder Analyses — Continued.

Buttermilk (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	93.34	1,866.80	-	-	1 : 1.72
Dry matter,	6.66	133.20	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	7.51	150.20	-	-	
" fat,	4.80	96.00	96.00	100	
" protein (nitrogenous matter),	36.64	732.80	732.80	100	
Non-nitrogenous extract matter,	51.05	1,021.00	1,021.00	100	
	100.00	2,000.00	1,849.80	-	

Skim-milk (Experiments I. and II.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C,	89.78	1,795.60	-	-	
Dry matter,	10.22	204.40	-	-	1 : 2.13
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	6.85	137.00	-	-	
" fat,	3.82	76.40	76.40	100	
" protein (nitrogenous matter),	31.60	632.00	632.00	100	
Non-nitrogenous extract matter,	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	-	

NOTE. — The analysis of the grain feed used during the second experiment is the same as of these articles stated in connection with the preceding corn-feeding experiment for the same period of time.

Fodder Analyses — Continued.

Corn Meal (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.31	303.20	–	–	1 : 9.23
Dry matter,	84.69	1,697.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.72	34.40	–	–	
" cellulose,	2.17	43.40	20.83	48	
" fat,	4.84	96.80	82.28	85	
" protein (nitrogenous matter),	12.18	243.60	192.44	79	
Non-nitrogenous extract matter,	79.09	1,581.80	1,550.16	98	
	100.00	2,000.00	1,845.71	–	

Wheat Bran (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.99	259.80	–	–	1 : 4.73
Dry matter,	87.01	1,740.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.23	124.60	–	–	
" cellulose,	10.47	209.40	50.26	24	
" fat,	5.37	107.40	76.25	71	
" protein (nitrogenous matter),	16.16	323.20	252.10	78	
Non-nitrogenous extract matter,	61.77	1,235.40	951.26	77	
	100.00	2,000.00	1,329.87	–	

Fodder Analyses — Concluded.

Gluten Meal (*Experiment III.*).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.11	222.20	–	–	1 : 2.66
Dry matter,	88.89	1,777.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.65	33.00	–	–	
" cellulose,	0.73	14.60	9.05	62	
" fat,	9.22	184.40	156.74	85	
" protein (nitrogenous matter),	33.34	666.80	526.77	79	
Non-nitrogenous extract matter,	55.06	1,101.20	1,002.09	91	
	100.00	2,000.00	1,694.65	–	

Skim-milk (*Experiment III.*).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	91.18	1,823.60	–	–	1 : 2.16
Dry matter,	8.82	176.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.80	136.00	–	–	
" fat,	4.20	84.00	84.00	100	
" protein (nitrogenous matter),	31.52	630.40	630.40	100	
Non-nitrogenous extract matter,	57.48	1,149.60	1,149.60	100	
	100.00	2,000.00	1,864.00	–	

PART II.

ON

FIELD EXPERIMENTS

AND

OBSERVATIONS IN VEGETABLE PHYSIOLOGY

AND

PATHOLOGY.

1. Effect of Different Kinds of Nitrogen-containing Manurial Substances on the Yield of Rye (Field A).
2. Experiments with Prominent Varieties of Grasses and with Grass Mixtures, to ascertain their Comparative Economical Value under fairly Corresponding Circumstances (Field B).
3. Experiments with Reputed Fodder Crops mostly new to our Locality, and with a Series of Garden Crops treated with Different Mixtures of Commercial Fertilizing Ingredients (Field C).
4. Experiment with raising Stowell's Evergreen Sweet Corn for Ensilage (Field D).
5. Experiments with Different Commercial Phosphates, to study the Economy of using Natural Phosphates or Acidulated Phosphates in Farm Practice (Field F).
6. Experiments with a Western Variety of Dent Corn, Pride of the North, for Ensilage (Field G).
7. Experiments with Grass Lands (Meadows).
8. Report on General Farm Work in 1891.
9. Report of Prof. James Ellis Humphrey on Plant Diseases, etc., with Observations in the Field and in the Vegetation House.

1. Field Experiment to ascertain the Effect of Different Combinations of Nitrogen — i. e., Sodium Nitrate, Chili Saltpetre, Ammonium Sulphate and Nitrogen-containing Organic Matter, under Otherwise Corresponding Circumstances — on Rye (1891).

Field A.

The well-authenticated and unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each) of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection, from year to year forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

The most conspicuous result of the field experiments carried on upon Field A during the years 1884 to 1888 consists in the very striking illustration of a marked deficiency of the soil on trial on available potash, as compared with other essential articles of plant food.

Since 1889 the main object of observations upon the same field has been to study the influence of both an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial. The treatment of the soil adopted in preceding years favored this new project for field observations.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years: namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied, in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid and from 40 to 50 pounds of available nitrògen were supplied per acre.

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

This course in the general management of the experiment has been followed thus far for three successive years — 1889, 1890 and 1891 — in connection with different crops: —

Corn (maize), in 1889 (see seventh annual report); oats, in 1890 (see eighth annual report); rye, in 1891 (see ninth annual report).

The following tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were slightly harrowed under before the seed was planted in rows by a seed drill. Each plat received the same amount of seed.

NUMBER OF PLAT.	Annual Supply of Manurial Substances.
Plat 0, .	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2, .	29 lbs. sodium nitrate (= 4 to 5 lbs nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 3, .	43 lbs dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4, .	25 lbs muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs available phosphoric acid).
Plat 5, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs muriate of potash (= 12 to 13 lbs potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8 5 lbs available phosphoric acid).
Plat 8, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs available phosphoric acid).
Plat 9, .	25 lbs muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8 5 lbs. available phosphoric acid).
Plat 10, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8 5 lbs. available phosphoric acid).

1891. — The soil of the field being brought by ploughing and harrowing into a good mechanical condition for planting, the entire area was seeded with winter rye Sept. 5, 1890. Each plat received five and one-half pounds of rye in drills two feet apart. The second largest plate was used in the seeding machine.

The young plants appeared above ground October 1. The growth upon Plat 6 and on 8 in particular presented soon after a yellowish-green appearance; otherwise the crop promised well.

The late winter season was somewhat unfavorable to winter crops, — a fact noticed quite generally in our vicinity on grass lands. The rye crop showed signs of winter-killing; the growth upon Plat 2 had apparently suffered more than that on any other plat. The following tabular record shows the rate of growth upon the different plats at different periods of the season, — May 12 to June 16: —

	May 12.	May 19.	May 27.	June 2.	June 10.	June 16.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Plat 0, . .	19	26	42	61	65	66
Plat 1, . .	21	27	44	60	66	66
Plat 2, . .	21	27	44	60	65	66
Plat 3, . .	21	27	46	63	67	67
Plat 4, . .	17	24	40	58	65	65
Plat 5, . .	19	23	40	59	64	66
Plat 6, . .	8	16	32	50	64	65
Plat 7, . .	20	26	46	60	68	68
Plat 8, . .	6	14	30	44	55	58
Plat 9, . .	19	28	40	61	66	66
Plat 10, . .	22	27	47	62	67	67

The differences noticeable in the above table regarding the rate of growth upon different plats are not less marked than were the variations in the color of the vegetation upon different plats at different stages of the season. The growth upon plats 4, 7, 10, and in particular 9, was of a light-green color; while upon plats 1 and 2 it was of a marked deep-green shade. This feature in the appearance of the vegetation over the entire area was quite marked during the entire season until the crop began to mature. Plats 4, 7 and 9 turned yellow, while plats 1, 2, 5, 6 and 8 were still green (July 9). The entire crop was cut July 16, and carried into the barn July 18. The subsequent tables show the difference in moisture of the crop from different plats when carried into the barn, as compared with a more uniform condition in that direction after two months' storing in the barn: —

	Weight when Harvested (July 18, 1891).	Weight when Threshed (Sept. 22, 1891).	Loss of Moisture.
	Pounds.	Pounds.	Per Cent.
Plat 0,	695	470	32.37
Plat 1,	790	570	27.85
Plat 2,	700	525	25.00
Plat 3,	605	475	21.49
Plat 4,	490	390	20.41
Plat 5,	660	530	19.70
Plat 6,	505	400	20.79
Plat 7,	495	450	9.09
Plat 8,	–	–	–
Plat 9,	495	425	14.14
Plat 10,	520	425	18.27

Plat 8 is excluded from the statement on account of a partial destruction of the crop by insects. The total yield of straw and grain obtained from different plats varies from 390 to 570 pounds in weight.

The relation of the grain to the straw and chaff will be found in the statement below: —

	Grain and Straw.	Grain.	Straw and Chaff.	Percentage of Grain.	Percentage of Straw and Chaff.
	Pounds.	Pounds.	Pounds.		
Plat 0,	470	142	328	30.21	69.79
Plat 1,	570	154	416	27.02	72.98
Plat 2,	525	134	391	25.52	74.48
Plat 3,	475	130	345	27.37	72.63
Plat 4,	390	107	283	27.44	72.56
Plat 5,	530	145	385	27.36	72.64
Plat 6,	400	102	298	25.50	74.50
Plat 7,	450	109	341	24.22	75.78
Plat 8,	–	–	–	–	–
Plat 9,	425	109	316	25.65	74.35
Plat 10,	425	125	300	29.41	70.59
	4,875	1,303	3,572	–	–

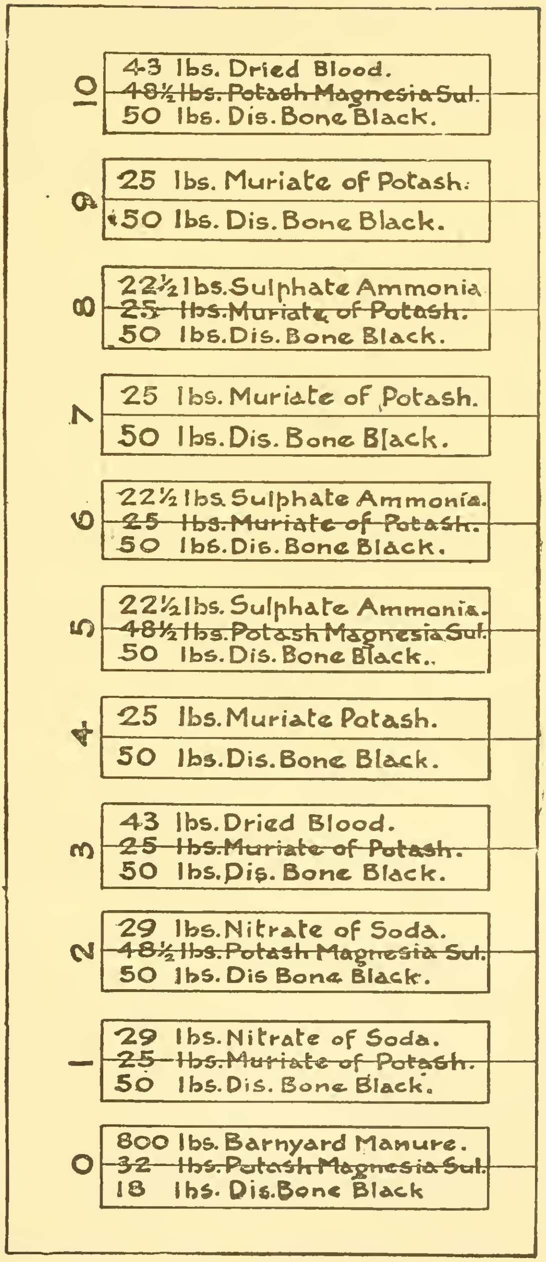
The yield of the grain for the entire field in case of the air-dry crop averages 26.72 per cent. and that of the straw and chaff 73.28 per cent. The yield of the grain upon different plats varies from 102 pounds to 154 pounds. Plat

2 differs in yield from Plat 1, probably on account of a more serious degree of winter-killing, as has been stated on a previous page. Plat 6 shows still the serious influence of several years' fallow (1885 to 1888), without the application of manure and without the cultivation of a crop (black fallow), on the productiveness of the soil thus treated. The low yield of grain (107 to 109 pounds) upon plats 4, 7 and 9, which did not receive any nitrogen-containing manurial matter, is a very significant result. The belief in the beneficial influence of a liberal supply of nitrogen on the quantity and the quality of grain crops is evidently well sustained by the results of the above-described experiment.

Summary of Three Years' Observations upon Field A (1889–91).

Number of Plat.	MANURIAL MATTER APPLIED.	1889. Yield of Dry Fodder Corn.	1890. Yield of Oats. Crop (Pounds).	1890. Percentage of Grain.	1890. Percentage of Straw and Chaff.	1891. Yield of Rye. Crop (Pounds).	1891. Percentage of Grain.	1891. Percentage of Straw and Chaff.	1891. Yield of Grain (Pounds).	1891. Yield of Straw (Pounds).
		Pounds.								
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash magnesia sulphate and 18 lbs. of dissolved bone-black, ...	-	315	38.10	61.90	470	30.21	69.79	142	328
Plat 1,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	648	362	35.36	64.64	570	27.02	72.98	154	416
Plat 2,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	577	365	35.34	64.66	525	25.52	74.48	134	391
Plat 3,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 25 lbs muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	618	345	33.62	66.38	475	27.37	72.63	130	345
Plat 4,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	381	260	34.61	63.39	390	27.44	72.56	107	283
Plat 5,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 48.5 lbs potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	488	360	39.20	60.80	530	27.36	72.64	145	385
Plat 6,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	542	385	32.21	67.79	400	25.50	74.50	102	298
Plat 7,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	526	320	34.40	65.60	450	24.22	75.78	109	341
Plat 8,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	359	220	26.82	73.18	-	-	-	-	-
Plat 9,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	476	290	34.83	65.17	425	25.65	74.35	109	316
Plat 10,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	640	395	35.44	64.56	425	29.41	70.59	125	300

FIELD "A," 1891.



SCALE, 4 RODS TO 1 INCH.

RYE PLATS.

2. Field Experiment with Prominent Varieties of Grasses, to study Their Composition under fairly Corresponding Conditions, as far as Soil and Manure are concerned, and to compare Their Economical Value when raised by Themselves as well as in Case of Mixtures (1891).

Field B.

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. Plats 11, 13, 15, 19 and 21 were annually manured as stated, and plats 12, 14, 16, 18 and 20 received no manurial matter of any description during that period (1884 to 1889). The space of five feet left between the different succeeding plats has been kept clean from any growth by a constant use of the cultivator, and received at no time any kind of manure.

The details of the work carried on upon Field B have been thus far reported from year to year in our annual reports. The chemical analyses of the crops raised upon this field, on account of the amount of work involved, have been quite frequently published in later bulletins or in annual reports of the succeeding year.

A material change in the above-stated management of the field was made in 1889, with reference to the previously unmanured plats, 12, 14, 16, 18 and 20; they were subsequently annually manured in exactly the same manner as the remaining plats, receiving per acre 600 pounds of fine-ground bone and 200 pounds of muriate of potash. The character of the crops raised upon the various plats since 1888 to date may be seen from the following tabular statement: —

PLATS.	1888.	1889.	1890.	1891.
Plat 11 (fertilized), .	Kentucky blue-grass (*Poa pratensis*), . . .	Kentucky blue-grass, . . .	Kentucky blue-grass, sown Sept. 24, 1889, ...	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12 (unfertilized),	Kentucky blue-grass, .	Kentucky blue-grass, . . .	Kentucky blue-grass, sown Sept. 24, 1889, ...	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 13 (fertilized), .	Italian rye-grass, . . English rye-grass, . .	Red-cob ensilage corn, . . .	Red top, sown Sept. 24, 1889, . .	English rye-grass, north, sown Sept. 29, 1889. Italian rye-grass, south, sown Sept. 29, 1889.
Plat 14 (unfertilized),	Italian rye-grass, . . English rye-grass, . .	Red-cob ensilage corn, . . .	Red top, sown Sept. 24, 1889, . .	English rye-grass and red top, sown Sept. 29, 1890.
Plat 15 (fertilized), .	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*), Sainfoin (*Onobrychis sativa*), .	Bokhara clover, sown May 8, 1889, . Sainfoin, sown May 8, 1889, . .	Herds grass and red top, sown April 23, 1890.
Plat 16 (unfertilized),	Soja bean, ...	Bokhara clover, ... Sainfoin, ...	Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889, ...	Italian rye-grass and red top, sown April 23, 1890.
Plat 17 (fertilized), .	Meadow fescue, . .	Meadow fescue, ...	Meadow fescue, sown September, 1887,	Meadow fescue, sown September, 1887.
Plat 18 (unfertilized),	Alsike clover, . . . Medium red clover, . .	Red-cob ensilage corn, . . .	Meadow fescue, sown September, 1889,	Meadow fescue, sown Sept. 29, 1890.
Plat 19 (fertilized), .	Alsike clover, . . . Medium red clover, . .	Alsike clover, ... Medium red clover, . . .	Herds grass, sown September, 1889, .	Herds grass, sown Sept. 25, 1889.
Plat 20 (unfertilized),	Mammoth red clover, . Alfalfa, ...	Red-cob ensilage corn, . . .	Red top and herds grass mixed, sown September, 1889, . . .	Herds grass and red top, sown Sept. 29, 1890.
Plat 21 (fertilized), .	Mammoth red clover, . Alfalfa, ...	Corn (variety, Clark), . . .	Meadow fescue and herds grass, mixed, sown September, 1889, .	Meadow fescue and red top, sown Sept. 29, 1890.

1891. — Previous to the year 1891 other crops than grasses have been cultivated upon some plats at times. Of late none but single grasses or mixtures of reputed grasses have been planted. The single grasses are raised as in previous years in rows two feet apart; grass mixtures are seeded down broadcast. The manure in case of single grasses is applied by hand between the rows, and is subsequently slightly ploughed in by means of a cultivator; in case of grass mixtures the manure is applied as top dressing early in the spring. In both cases the first manure is applied broadcast and ploughed under before seeding down the grass.

Plat 11, Kentucky blue-grass (*Poa pratensis*), sown Sept. 24, 1889, in rows. The grass looked well in the spring; the growth between the rows was removed with the cultivator and the hoe, to secure as far as practicable a clean crop. The grass began to bloom June 5, when 27 inches high; it was cut when the seed began freely to set (June 17).

Plat 12, Kentucky blue-grass (*Poa pratensis*), sown Sept. 24, 1889. The grass on this plat showed signs of winter-killing. The crop was cut June 17. The yield of both plats, 11 and 12, amounted to 260 pounds of hay (975 pounds per acre) when removed to the barn. This plat (12) was ploughed July 8, 1891, the sod thoroughly cut up with a wheel harrow, properly harrowed and seeded down Sept. 18, 1891, with a mixture of four pounds each of Kentucky blue-grass and red top. The grass was well above ground Sept. 28, 1891.

Plat 13, English rye-grass (*Lolium perenne*) and Italian rye-grass (*Lolium Italicum*), each occupying one-half of the plat. Both were sown in rows Sept. 29, 1890. The Italian rye-grass was in better condition at the beginning of the spring than the English rye-grass. The latter had suffered in a considerable degree from winter-killing. The winter-killed spots were re-seeded at an early date. Both grasses bloomed fairly June 18; they were cut June 24. The first cut of hay amounted to one hundred pounds in each case (1,500 pounds per acre). The second cut of the English rye-grass yielded 120 pounds (1,800 pounds per acre) August 18, while the Italian rye-grass yielded 90 pounds (1,350 pounds per acre).

Plat 14, a mixture of English rye-grass and of red top, equal weights, sown broadcast Sept. 29, 1890. The crop was cut June 24; red top was not yet in bloom. The first crop amounted to 355 pounds of hay (2,662 pounds per acre); the second cut, August 31, yielded 90 pounds of hay (675 pounds per acre).

Plat 15, herds grass (*Phleum pratense*) and red top (*Agrostis vulgaris*), sown broadcast April 23, 1890. The crop was to such an extent infested with shepherd's purse that no record of yield was kept. The growth upon the plat was mowed whenever the weeds showed themselves above the grasses, to ascertain whether a repeated cutting during the first season will free the plat from that particular trouble.

Plat 16, Italian rye-grass and red top, sown broadcast April 23, 1890. The growth upon this plat suffered from the same causes as the preceding plat, — namely, from shepherd's purse, — and from the seeding down of grasses during spring time. The seeding down of grass lands in the spring is known to be an objectionable practice. Our experiment is made to furnish an illustration in that direction, and also to point out if possible some remedies.

Plat 17, meadow fescue (*Festuca pratensis*), sown in rows two feet apart, Sept. 25, 1887. The crop looked healthy every way throughout the season. It was in bloom June 15, when 38 inches high. The first cut, June 16, amounted to 450 pounds of hay (3,375 pounds per acre); and the second cut, September 1, to 140 pounds (1,050 pounds per acre).

Plat 18, meadow fescue, sown in rows two feet apart, Sept. 29, 1890. The grass looked healthy and vigorous during the entire period of growth. It bloomed June 20 and was cut June 25. The first cut yielded 190 pounds of hay (1,425 pounds per acre); and the second cut, September 1, yielded 170 pounds (1,275 pounds per acre).

Plat 19, herds grass (*Phleum pratense*), sown in rows two feet apart, Sept. 25, 1889. The growth looked well throughout the season; it began to bloom June 25 and was cut July 1. The hay obtained weighed 630 pounds (4,725 pounds per acre).

Plat 20, mixture of herds grass and red top, sown broadcast Sept. 29, 1890. The herds grass was in bloom June 30; red top showed no flower at that time. The crop was cut July 1, and yielded 430 pounds of hay (3,225 pounds per acre).

Plat 21, meadow fescue (*Festuca pratensis*) and red top (*Agrostis vulgaris*), sown broadcast Sept. 29, 1890. The growth did not correspond to the seeds named. The first cut yielded, June 25, 650 pounds of hay (4,875 pounds per acre). The plat was ploughed, and the soil after thorough mechanical preparation was re-seeded September 18 with a mixture of four pounds of meadow fescue and four pounds of red top.

From the previous statements it will be seen that our present observation upon this field is confined to the following grasses and grass mixtures: —

Kentucky blue-grass.
English rye-grass.
Italian rye-grass.
Red top.
Herds grass.
Meadow fescue.
Kentucky blue-grass and red top.
English rye-grass and red top.
Italian rye-grass and red top.
Red top and herds grass.
Herds grass and meadow fescue.

FIELD "B," 1891.

11	Kentucky Blue Grass.
12	Kentucky Blue Grass.
13	English Rye Grass. Italian Rye Grass.
14	English Rye Grass and Red Top
15	Herds Grass and Red Top.
16	Italian Rye Grass and Red Top.
17	Meadow Fescue.
18	Meadow Fescue.
19	Herdsgrass.
20	Herdsgrass and Red Top.
21	Meadow Fescue and Red Top.

3. Experiments with Field and Garden Crops (1891).

Field C.

The area occupied by this piece of land is 328 feet long and 183 feet wide (60,024 square feet). The field is divided into two parts, running from west to east, making thus a north and south division, each 328 feet long and 90 feet wide, with three feet of unoccupied space between them. The soil consists of a good light loam, several feet in thickness. The manure annually applied during preceding years (1884–90) to the entire area consisted of 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The north division had been used for years for the raising of miscellaneous farm and garden crops, for the purpose of studying their adaptation to our clime. Upon the south division during the same period grain and leguminous crops were raised alternately, to serve as fodder.

1891. — Both divisions were ploughed during the preceding autumn, and again in the spring. The *north division* was manured at an early date with bone and potash, as in preceding years, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The fertilizer was applied broadcast, and subsequently ploughed in before harrowing and seeding.

The *south division* was subdivided into five plats of a uniform size and shape, with an unoccupied and unmanured space of from four to five feet between adjoining plats. Each plat running across the south division from north to south covered an area of sixty-two by eighty-eight feet. Each plat received a separate distinct mixture of fertilizing substances, to test the effect on the quality and quantity of different kinds of garden crops.

1. *North Division, Field and Forage Crops.*

The field was prepared and manured as above stated, and served as in preceding years for the cultivation of a variety of field crops. The work was instituted for the purpose of studying the acclimatization of a series of more or less reputed farm plants new to our section of the country, and also to serve as an object lesson to our visitors, regarding their general characteristics. The benefit derived from this practical illustration of our possibilities in the choice of valuable additions to our field crops has been so manifest during preceding years that it will receive increased attention on our part in the future. Some of the plants here cultivated during previous seasons have already been introduced into our farm industry on a sufficiently extensive scale to enable us to form a decided opinion regarding their special local economical value. Foremost among them are some fodder crops, Southern cow-pea, serradella, some vetches, and black and white soja bean. Successful feeding experiments with green vetch and oats and with green soja bean, as well as with a mixed ensilage of soja bean and green fodder corn, have been already noted in our preceding report (eighth). The satisfactory results of preceding years were fully confirmed during the late summer season. A detailed description of this experiment may be found in this report, under the heading, "Summer Feeding Experiment with Milch Cows," page 59.

Statement of crops raised upon the north division of Field C: —

White soja bean (*Soja hispida*), four rows. The seed was raised upon the station grounds in 1890. It was sown in rows three feet and three inches apart, May 18; the young plants appeared above ground May 30, and began to bloom during the middle of July. The lower leaves began to dry up September 4. The crop was pulled to collect the seed September 25.

Black soja bean, four rows. This variety is of a lighter-green color, and seems to be somewhat more vigorous than the former. It is still green when the white variety has turned yellow. We have raised for several years, successfully, large crops of both varieties of soja bean, and consider them for our locality a most valuable addition to our forage crops.

Serradella (*Ornithopus sativus*), eight rows, three feet three inches apart. Sown May 14; began to bloom July 20; appeared somewhat affected by blight September 3, but recovered from this trouble towards the close of September, and was in a healthy condition by October 6. The crop was light, compared with results of previous years; it resisted cold spells to an exceptional degree, being still green October 23. The serradella has furnished us in previous years an exceptionally valuable green fodder, at the rate of from ten to eleven tons of green feed per acre.

Bokhara clover (*Melilotus alba*), four rows, three feet three inches apart. Sown May 23, and had reached a height of over three feet June 16, when it was cut, not yet in bloom. The second growth was much lighter than the first, and was blooming August 7. The plants were not affected by frost October 13. The Bokhara clover furnishes a luxuriant growth, and has a pleasant aromatic odor. It deserves a trial as ensilage, when cut before blooming.

Spring vetch (*Vicia sativa*), four rows, three feet three inches apart. The seed was sown May 14. The young plants appeared above ground May 23, and began to bloom July 2. The crop was cut when beginning to dry, August 17. This plant has a well-established reputation as an excellent fodder crop for dairy purposes. We have for several years raised, very satisfactorily, a mixed crop of vetch and oats, to serve as green fodder for our cows. The yield is liberal, and makes a good hay when properly dried.

Winter vetch, four rows. This variety proved to be somewhat later in blooming, otherwise it showed no particular difference from the former.

Kidney vetch, four rows, two feet apart. The seed was sown May 14; the young plants were noticed above ground May 23. The growth was very slow, the plants measuring only three inches in height September 19. They failed to develop blossoms.

Sainfoin (*Onobrychis sativa*), four rows, three feet three inches apart. Sown May 23, 1890; began blooming May 25. The growth was twenty inches high and almost through blooming when cut, July 17. The second crop was light. Frosts during October did not affect the foliage. Several years' trial shows that the growth is frequently seriously winter-killed.

Yellow trefoil, four rows, three feet three inches apart.

Sown May 14; was up May 27. The growth was very slow, being about four inches high September 19. The first blossoms appeared sparingly October 6. The plants withstood less successfully the October frosts, as compared with some of the previously described crops.

Yellow lupine (*Lupinus lutens*), four rows, three feet three inches apart. Sown May 15; came up May 25. The plants were ten inches high July 14; began blooming when sixteen inches high, July 20. They reached the height of two feet September 18, when an abundance of seed-pods were formed.

White lupine (*Lupinus alba*), four rows, three feet three inches apart. Sown May 15; came up May 23; began to bloom July 4, when twenty-eight inches high. The plants were thirty-eight inches high July 21, and still continued to grow. This crop when in its succulent state (July) has served in preceding years in a superior degree as efficient green manure for winter crops and exhausted grass lands.

Forest pea (*Lathyrus sylvestris*), four rows, two feet six inches apart. Sown May 15; the plants came up sparingly June 10. The growth was very slow, being only four inches high September 19. Frosts did not affect it as late as October 13. This plant is new as a forage crop in Germany and England. Our seed was imported from the latter place, and not the best kind. As it is a biennial plant, another year is needed to form an opinion regarding its economical value.

Common buckwheat (*Fagopyrum esculentum*), four rows, two feet apart. Sown May 14. It began to bloom June 20, and was cut for fodder when the seeds began to set, July 27.

Japanese buckwheat, four rows, two feet apart. Sown May 14; blossomed June 23, and was cut for fodder, like the former variety, July 27. The plants are somewhat more hardy than the common buckwheat.

Silver-hull buckwheat; four rows. Sown May 14; bloomed June 20, and showed a liberal formation of seed-pods July 27, when the crop was cut. A second lot, seeded down June 25, began to bloom July 21, and had finished blossoming August 26. In regard to the weight of the crop harvested, the buckwheats ranked in this order: silver-hull, Japanese, common variety.

Stachys tubers (*Stachys affinis*), little tubers sent on by the Department of Agriculture in Washington, were planted (one row) April 21. They came up May 1; had reached a growth of nine and one-half inches September 19, when suckers came out. Frost did not affect the foliage before October 28. The tubers were left in the ground for observations during the coming year. The tubers are considered a substitute for potatoes in the south of France.

Chinese potato bulblets, sent on for trial as a potato substitute by the United States Department of Agriculture. They were planted April 21, two feet apart in the row; came up May 30, and were from two to three inches high July 14. The plants send out runners from eighteen to twenty inches in length. Leaves suffered from frost October 1. The bulblets were left in the ground for observations during the coming year.

Prickly comfrey (*Symphytum officinale*), one row. The roots for planting were kindly presented by Col. J. D. W. French, and were put in the ground Oct. 11, 1890, two feet apart in the row. They produced a luxuriant growth during the late spring; began to blossom June 5, and reached a height of twenty inches, with numerous highly foliaceous branches. The blossoms were removed, to prevent a seeding out. The plants kept green until the middle of October.

English rye-grass (*Lolium perenne*), three rows. This variety of grass has been raised for a number of years on various fields of the station farm, to ascertain its degree of resistance to the influence of our winter climate. After repeated trials, it is safe to say that it is in an exceptional degree liable to winter-killing in our locality. One-half of the field was winter-killed during the previous winter.

Campbell's spring wheat, three rows, two feet apart. Sown May 4; appeared above ground May 22, and was ripe for cutting August 22. It made a rather light growth.

Winter wheat, twelve varieties, sent on from London, Eng. (Nos. 1–12 below). Each variety occupied five feet in the row, with one foot of space between them. They were sown Sept. 30, 1890. In connection with the English samples were sown two samples of winter wheat sent on by the United States Department of Agriculture (Nos. 13 and 14). Names of varieties: 1. Carter's Millers' Delight; 2. Carter's Stand Up; 3. Carter's Earliest of All; 4. Carter's Anglo-Canadian; 5. Carter's Pride of the Market; 6. Carter's Pearl; 7. Carter's Bird Proof; 8. Carter's Prince of Wales; 9. Carter's Queen; 10. Carter's Hundred Fold; 11. Carter's Flour Ball; 12. Carter's Holborn Wonder; 13. Hybride Dattel; 14. Hybride Larned. No. 4 was badly winter-killed; Nos. 8, 9, 10 and 11 suffered somewhat less from winter-killing; Nos. 1 and 2 were both in good condition. Most of the varieties began to blossom June 21. Nos. 1 and 3 matured first. They were cut July 21. Nos. 2, 5, 7, 8 and 14 were cut August 5, Nos. 6 and 11 were cut August 8, and Nos. 4 and 13 were cut August 12. Our last year's experience with winter wheat has been discouraging, on account of serious damage by frost in all parts of the field.

Kansas king corn, one row. Sown with seed sent on for trial May 20. It was above ground May 30, reached nine feet in height September 19, and was killed by frost October 13, without being matured.

Jerusalem corn, one row, on trial. Sown May 20; appeared above ground May 30; was five inches high July 14; blossomed September 19, when sixty-two inches high, and was killed by frost October 13, when still immature.

Sugar beets, five European varieties. The seeds were received from the United States Department of Agriculture for trial. Five rows of each variety were planted May 20. The young plants were above ground May 27; they were thinned out (from six to eight inches apart) June 22. The crop looked well until the beginning of September, when a brown fungous growth appeared on the leaves. The roots were harvested October 19. They yielded as follows: —

	Pounds.
Florimond Desprez's Richest,	710
Bulteau Desprez's Richest,	690
Dippe's Kleinwanzleben,	600
Dippe's Vilmorin,	620
Simon Le Grand's White Improved,	550

Analysis of Sugar Beet Roots, raised 1891.

VARIETY.	Date of Test.	Average Weight of Beets (Grams).	Moisture at 100° C.	Temperature of Juice.	Degrees, by Brix.	Sugar in Juice, by Fehling's Test (Per Cent.).
Florimond Desprez's Richest, . .	Dec. 3, .	508.06	85.87	18° C.	14.3	13.35
Bulteau Desprez's Richest, . .	Dec. 2, .	498.10	84.54	17° C.	14.4	13.06
Dippe's Kleinwanzleben, . . .	Dec. 2, .	463.52	83.59	19° C.	15.2	13.88
Dippe's Vilmorin, ...	Dec. 1, .	522.00	83.75	19.5° C.	15.6	12.54
Simon Le Grand's White Improved,	Dec. 3, .	435.22	81.49	20° C.	16.8	15.67

2. *South Division, Garden Crops.*

This part of Field C, 328 feet long and 88 feet wide (28,864 square feet), was subdivided as above stated during the spring of 1891 into five plats of a uniform size and shape (88 feet by 62 feet, one-eighth of an acre), running from north to south across the main field. These were separated from each other by an unmanured space of from four to five feet in width. The soil was several feet deep, and consisted of a rather light loam in a good state of cultivation as far as its mechanical condition is concerned. No other manurial matter but fine-ground bone and muriate of potash, 600 pounds of the former and 200 pounds of the latter per acre, was used before 1891. The field slopes very gently from west to east. The plats were numbered 1, 2, 3, 4, 5, beginning on the east end of the field. Each plat received, spring of 1891, a manurial mixture of its own as fertilizer. The difference of the fertilizers applied consisted essentially in the circumstance that nitrogen and potash were used in several of them in different forms. All plats received practically the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent. purity). The subsequent tabular statement shows the quantities of the manurial substances applied to different plats: —

Plat 1, . . .	75 pounds dried blood. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 2, . . .	47 pounds nitrate of soda. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 3, . . .	38 pounds sulphate of ammonia. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 4, . . .	47 pounds nitrate of soda. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.
Plat 5, . . .	38 pounds sulphate of ammonia. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.

		Pounds.
Per acre:	Phosphoric acid, ...	50.4
	Nitrogen, ...	60.0
	Potassium oxide, ...	120.0

The different fertilizers were applied broadcast, and subsequently slightly ploughed under in all cases on the same day (April 22, 1891). All plats were planted in the same order with the same kind of garden crops (eight). Every plat was either planted with young plants or was sown with the seed, as circumstances dictated, each kind on the same day and in the same manner. The young plants used for the experiment were raised under corresponding conditions from seed in the hot-bed. The seeds used were in several cases sent on for trial. The different kinds of garden crops were arranged in the following order, beginning on the east side of each plat: —

Lettuce, White Tennis Ball, one row.
Spinach, Long Standing and Bloomingdale, one row each.
Beets, Egyptian and Dewings, one row each, or two of a kind.
Celery, White Plume, one row.
Kohlrabi, two rows.
Cabbage, Red Dutch and several white varieties, three rows in all.
Tomatoes, Boston Market, two rows.
Potatoes, Beauty of Hebron, five rows.

Spinach, beets and potatoes were raised from seeds upon the different plats. Lettuce, celery, kohlrabi, cabbage and tomatoes were sown in a hot-bed and subsequently transferred when of suitable size, each kind for all plats on the same day, as will be found farther on. All crops were kept clean during the growing season by a timely use of the cultivator and the hoe.

Lettuce, White Tennis Ball, set out May 1. The growth was in the beginning slow, on account of cold and dry weather, but subsequently recovered rapidly and produced a good yield, judging from the general appearance of the crop. Plats 4 and 5 produced the best results, Plat 2 came next and plats 1 and 3 last.

Spinach, sown May 1. Bloomingdale grew more rapidly than Long Standing. Plats 4 and 5 gave best results, Plat 2 next and plats 1 and 3 last.

Beets, Dewings and Egyptian, each one row, sown May 21. The young plants appeared above ground June 1; they were thinned out July 11 and harvested October 17, with the following results, Plat 4 leading: —

Plats.	Dewings.	Egyptian.	Total.
	Pounds.	Pounds.	Pounds.
Plat 1, ...	225	140	365
Plat 2, ...	240	155	395
Plat 3, ...	240	180	420
Plat 4, ...	245	240	485
Plat 5, ...	220	190	410

Celery, White Plume, one row, set out June 1. The plants were banked August 20; they were taken out October 28. Plats 4 and 5 showed best and plats 2 and 3 worst.

Kohlrabi, two rows, planted with young plants from the hot-bed May 18; they were harvested July 16, with the following results: —

	Pounds.
Plat 1,	105
Plat 2,	120
Plat 3,	115
Plat 4,	145
Plat 5,	152

Cabbage, Red Dutch in all plats, varieties of other kinds only here and there in different plats. Judging from the general appearance of the crop, it seemed that plats 1, 2 and 3 were leading. On the whole the yield was quite satisfactory. No weights were taken, on account of the different varieties in the plats.

Tomatoes, Boston Market, two rows, set out May 30. Plats 2 and 3 showed the poorest development of the plants; they had the first few ripened tomatoes August 5. The following weights of ripe and healthy tomatoes were collected from different plats during the season: —

DATE.	PLATS				
	1	2	3	4	5
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
August 25,	67.0	44.0	92.5	124.0	118.0
August 31,	65.0	11.5	63.0	211.0	257.0
September 8,	67.0	30.5	95.0	211.0	168.0
September 17,	99.5	65.0	84.0	101.5	98.0
Total,	298.5	150.0	334.5	647.5	641.0

Potatoes, Beauty of Hebron, five rows, were planted in each plat May 1. The rows were three feet three inches apart and the hills two feet apart in the row. The young plants appeared above ground quite uniformly May 21.

The vines in all plats looked healthy throughout the season; they began to turn yellow first on Plat 2. The potatoes on all plats were harvested August 11 and 12, when the leaves were dead but the stems still green. They were smooth and free from scab. The different plats yielded the following weights of large, marketable potatoes and of small potatoes: —

PLATS.	Large Potatoes.	Small Potatoes.	Total.
	Pounds.	Pounds.	Pounds.
Plat 1, ...	540	130	670
Plat 2, ...	550	110	660
Plat 3, ...	660	90	750
Plat 4, ...	670	110	780
Plat 5, ...	620	115	735
	3,040	555	3,595

This experiment will be continued during the coming season with the same crops and with the same mixtures of fertilizing ingredients, making such alterations as the experience of the past season suggests. The results of the first year are above presented without any further comment.

A critical discussion of the results is deferred to a later period in our investigation, when the experience of several years will furnish a safer basis for deduction.

4. Experiments with Stowell's Evergreen Sweet Corn for Ensilage (1891).

Field D.

The area occupied by this field is 328 feet long and 70 feet wide (22,960 square feet, or .53 of an acre). It runs parallel with Field C from east to west, and is separated from the latter by an unmanured strip of grass land 20 feet wide. The land has served in previous years for various field and garden crops, and was manured annually for several years back with 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The soil consists of a light loam, is fairly uniform and several feet in depth. It was ploughed during the autumn of 1890 and reploughed April 17, 1891. The same amount of fine-ground bone and muriate of potash as in preceding years was applied broadcast April 24 (315 pounds of the former and 105 pounds of the latter).

The entire field was planted May 2 with Stowell's Evergreen sweet corn; the seed did not come up very satisfactorily.

New seed corn was planted May 25 with good success; yet the crop remained late throughout the season.. The crop with ears well developed, kernels in the milk, was cut for ensilage September 10. The total yield amounted to 17,800 pounds, or 16.9 tons per acre.

The whole plant was cut into pieces of from one to two inches in length, and without delay carefully packed into a silo in a way similar to that described in previous reports. The ensilage is designed to serve during the present winter season in feeding experiments, to compare its merits with ensilage prepared from a dent corn variety, Pride of the North, raised under similar conditions and of a corresponding state of maturity.

Field E.

This field was divided during the past year into two parts. The larger part was manured and planted in the same manner as Field D, with Stowell's Evergreen. The remainder was sown with several species of medicinal plants sent on for trial by the United States Department of Agriculture. The corn proved a success, and after being fully matured was cut. The ripe air-dry ears were subsequently collected; they weighed 729 pounds. The air-dry stover (2,520 pounds) served for a comparative feeding experiment with milch cows.

The majority of the seeds of the medicinal plants proved a failure. Opium poppy (*P. somnifera*), Russian rhubarb (*Rheum officinale*) and castor bean (*Ricinus communis*) did well.

Fodder Corn (Stowell's Evergreen), Station, Field D.
(Cut Sept. 10, 1891.)

	Per Cent.
Moisture at 100° C.,	83.91
Dry matter,	16.09
	100.00

Analysis of Dry Matter.

Crude ash,	6.73
" cellulose,	26.03
" fat,	3.26
" protein (nitrogenous matter),	8.09
Non-nitrogenous extract matter,	55.89
	100.00

5. Experiments to study the Economy of using Different Commercial Sources of Phosphoric Acid for Manurial Purposes in Farm Practice.

Field F.

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under, and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella), followed each other in the order stated.

1890. — The land had been ploughed during the preceding fall, and again April 19, 1890. The field was subdivided subsequently into five plats of definite size, each running from east to west. These plats were separated from each other by a space eight feet wide.

The plats and spaces between them were ploughed and harrowed alike. The plats were fertilized at stated times; the spaces which separated them received at no time any kind of manurial matter.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, apatite, South Carolina phosphate (floats), and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value, in its particular kind of phosphate.

	Cost per Ton.
Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Ground apatite (Canada),	6 25
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I. Phosphatic slag; II. Mona guano; III. Apatite; IV. South Carolina phosphate (floats); V. Dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	0.47	12.52	0.09	0.39	15.96
Ash,	–	75.99	–	–	61.46
Calcium oxide,	46.47	37.49	–	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	–	5.78	–
Total phosphoric acid,	19.04	21.88	36.08	27.57	15.82
Soluble phosphoric acid,	–	0.00	–	0.00	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	9.55	9.04	6.26

The following fertilizers were applied to the different plats April 17, 1890: —

Plat I. (south side), 6,494 square feet, { 127 pounds of ground phosphatic slag.
43 pounds of nitrate of soda.
58 pounds of potash-magnesia sulphate.

Plat II., 6,565 square feet, { 128 pounds of ground Mona guano.
43½ pounds of nitrate of soda.
59 pounds of potash-magnesia sulphate.

Plat III., 6,636 square feet, .	304 pounds of ground apatite. 44 pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.
Plat IV., 6,707 square feet, .	131 pounds of South Carolina phosphate. 44½ pounds of nitrate of soda. 60 pounds of potash-magnesia sulphate.
Plat V., 6,778 square feet, .	78 pounds of dissolved bone-black. 45 pounds of nitrate of soda. 61 pounds of potash-magnesia sulphate.

The phosphatic slag, Mona guano and South Carolina floats were applied at the rate of 850 pounds per acre, apatite at the rate of 2,000 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. These figures represent approximately the equal local cash values of the different sources of phosphoric acid applied. Nitrate of soda corresponds in all cases to an application of 290 pounds per acre, and the potash-magnesia sulphate to that of 390 pounds per acre.

The field was planted with potatoes, Beauty of Hebron; the large-sized ones were cut in halves, and the small ones left whole, when planted, May 1, 1890. The rows were three feet three inches apart, and the hills in the rows eighteen inches. Each plat had sixteen rows. The young plants came up quite uniformly; they were cultivated and hoed June 2. Several applications of Paris green with plaster were made during the season, to prevent damage by potato bugs. The crop looked well until the middle of July, when the effects of a serious drought showed itself to such an extent that the maturing seemed to be hastened on by it.

The potatoes were harvested from all the plats August 12 to 14. They were assorted in the field into marketable ones and small ones. The former were sold at sixty cents per bushel; the latter were used for chicken feed, at twenty cents per bushel, — our local market prices.

No. of Plat.	Total Yield of Potatoes (Pounds).	Marketable Potatoes (Pounds)	Small Potatoes (Pounds)
I. (south end), . .	1,600	1,215	385
II., ...	1,415	915	500
III., ...	1,500	1,070	430
IV., ...	1,830	1,380	450
V. (west end), . . .	2,120	1,590	530

Yield per Acre.

I. Phosphatic slag, .	10,671	8,087	2,584
II. Mona guano, . .	9,388	6,071	3,317
III. Ground apatite, . .	9,845	7,023	2,822
IV. South Carolina phosphate. . . .	11,886	8,963	2,923
V. Dissolved bone-black,	13,626	10,218	3,408

Statement of Percentages.

Plats.	Marketable Potatoes (Per Cent).	Small Potatoes (Per Cent).
I., ...	75.78	24.22
II., ...	64.66	35.34
III., ...	71.32	28.68
IV., ...	75.40	24.60
V., ...	74.91	25.09

Money Value of Crop.

[One bushel = 60 pounds.]

Plat.	Marketable Potatoes, at 60 Cents per Bushel.	Small Potatoes, at 20 Cents per Bushel.	Total Sum.
I., .	134.6 bushels = $80 76	43.0 bushels = $8 60	$89 36
II., .	101.2 bushels = 60 72	55.3 bushels = 11 06	71 78
III., .	117.1 bushels = 70 26	47.1 bushels = 9 42	79 68
IV., .	149.3 bushels = 89 58	48.7 bushels = 9 74	99 32
V., .	170.3 bushels = 102 18	56.8 bushels = 11 36	113 54

As a first year's results, the above statements were published without any further comment beyond the remark that the exceptional dryness of the season might have favored a superior action of the soluble phosphoric acid as compared with the insoluble one. Attention was also called to the important circumstance that an accumulation of phosphoric acid in the soil might eventually affect the results as time advances. The largest yield of potatoes had only removed 3.4 pounds of phosphoric acid from the soil.

Plat I. received 24.18 pounds of phosphoric acid.
Plat II. received 28.01 pounds of phosphoric acid.
Plat III. received 109.68 pounds of phosphoric acid.
Plat IV. received 36.12 pounds of phosphoric acid.
Plat V. received 12.34 pounds of phosphoric acid.

Tabular Statement of the Approximate Amount of Nitrogen, Phosphoric Acid and Potash in the Crop raised.

PLATS.	Pounds of Potatoes per Plat.	Pounds of Nitrogen in Tubers.	Pounds of Phosphoric Acid in Tubers.	Pounds of Potassium Oxide in Tubers.
I., ...	1,600	5.440	2.560	9.280
II., ...	1,415	4.811	2.364	8.207
III., ...	1,500	5.100	2.400	8.700
IV., ...	1,830	6.222	2.928	10.614
V., ...	2,120	7.208	3.392	12.296

The calculation is based on E. Wolff's average analyses, 1,000 pounds of potatoes containing: nitrogen, 3.4 pounds; phosphoric acid, 1.6 pounds; and potassium oxide, 5.8 pounds.

1891. — The experiment was continued by selecting winter wheat as the next crop to be raised. For this purpose the soil was ploughed soon after the potatoes had been harvested, and subsequently manured and harrowed, as in case of the preceding crop. The change in the mode of manuring the different plats was confined to Plat III., which received no ground apatite, for the reason that none could be obtained from the party that furnished our first supply of this article. No other form of phosphoric acid was substituted.

The following table shows the kind and amount of fertilizers applied to the plats: —

Plat I. (south side), 6,494 square feet,	127 pounds of ground phosphatic slag. 43 pounds of nitrate of soda 58 pounds of potash-magnesia sulphate.
Plat II, 6,565 square feet,	128 pounds of ground Mona guano. 43½ pounds of nitrate of soda 59 pounds of potash-magnesia sulphate.
Plat III., 6,636 square feet,	44 pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.
Plat IV., 6,707 square feet,	131 pounds of South Carolina phosphate. 44½ pounds of nitrate of soda 60 pounds of potash-magnesia sulphate.
Plat V., 6,778 square feet,	78 pounds of dissolved bone-black. 45 pounds of nitrate of soda 61 pounds of potash-magnesia sulphate.

The wheat — two new French varieties of winter wheat, Hybrid Dattel and Hybrid Larned, sent on for trial by the United States Department of Agriculture — was sown Sept. 26, 1890. The young plants came up well, but were found winter-killed in the succeeding spring. The entire field was reploughed and seeded down with summer wheat in rows two feet apart May 11, 1891. The seed proved good and the crop did well during the entire season. A marked difference in the general character of the growth upon different plats could be noticed as the season advanced. Plats I. and V. were leading throughout the season, while Plat III. was least promising and matured last.

Following is a statement showing the height of the crop on the different plats at different periods of the season: —

PLATS.	June 16 (Inches).	June 23 (Inches).	June 30 (Inches).	July 7 (Inches).	July 14 (Inches).	July 21 (Inches).	Aug. 11 (Inches).
Plat I,	12	20	29	31	46	48	48
Plat II.,	11	18	25	29	40	42	42
Plat III.,	7	11	17	22	28	34	34
Plat IV.,	12	18	25	29	41	45	45
Plat V.,	12	20	27	31	47	48	48

The crop upon plats I., II., IV. and V. was cut August 14, and that on Plat III. August 18. The entire yield was moved into the barn August 20, where it remained stored until September 25, when the product of each plat was weighed and threshed, with the following results:—

PLATS.	Grain and Straw (Pounds).	Grain (Pounds).	Straw and Chaff (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.
Plat I, . . .	380	67	313	17.63	82.37
Plat II., . . .	340	73	267	21.47	78.53
Plat III., . . .	215	38	177	17.67	82.33
Plat IV., . . .	380	78	302	20.53	79.47
Plat V., . . .	405	59	346	14.57	85.43
	1,720	315	1,405		

An examination of the above tables shows that the total yield of wheat was highest upon Plat V., and lowest upon Plat III. The larger yield of Plat V. (dissolved bone-black) is in an exceptional degree due to the large production of straw and chaff, as compared with that of the grain. Plats II. (Mona guano) and IV. (South Carolina phosphate) yield the largest percentage of grain.

6. Experiments with a Western Variety of Dent Corn, Pride of the North, for Ensilage.

Field G.

This field is a part of a former meadow. Grass has been raised here for more than fifteen years in succession. A moderate top-dressing of barn-yard manure has kept the land in a fair condition for the production of hay. Eight years ago a row of drain pipes four inches in diameter was laid along its whole length. Branch drains pass into it in several places, to prevent the accumulation of water from surrounding localities. The land is nearly a level, and the soil a loam several feet in depth, here and there underlaid with a hardened clay. The area is 700 feet long and 75 feet wide, running from north to south to the east of Field A. During the fall of 1890 the sod was turned under and left over winter to disintegrate. During the late spring the soil was again ploughed and the remaining sod cut up with a wheel harrow. After subsequent harrowing it was planted May 13 with a dent corn variety, Pride of the North, in rows three feet three inches apart, the hills being two feet apart in the row. No manure was applied on that occasion, the object being to reduce the stored-up plant food, and thereby prepare the soil for future field experiments with special fertilizers.

The young plants came up well and made a handsome growth. At the time when the kernels began to glaze ten and two-thirds tons were cut to be converted into ensilage September 10. The remainder of the crop was cut September 16, to secure matured ears and corn stover. The air-dried stover thus obtained weighed, October 19, 4,185 pounds, and the ears 2,500 pounds.

The area used for ensilage corn, 25,650 square feet, yielded at the rate of eighteen tons and three hundred pounds per acre. The area turned to account for ears and stover, 26,850 square feet, produced at the rate of 4,056 pounds of ears and 6,782 pounds of stover per acre.

Fodder Corn (Pride of the North), Station, Field G.
(Cut Sept. 10, 1891.)

	Per Cent.
Moisture at 100° C.,	71.86
Dry matter,	28.14
	100.00

Analysis of Dry Matter.

Crude ash,	3.78
" cellulose,	25.67
" fat,	2.24
" protein (nitrogenous matter),	7.62
Non-nitrogenous extract matter,	60.69
	100.00

7. Experiments with Grass Land (Meadows).

The permanent grass lands are by their location arranged into two divisions, west and east of a public highway. They cover at present a space of sixteen to seventeen acres.

The *west side division* consists of old meadows, kept for over twenty years in grass. The area has for years been steadily reduced in size by turning, as circumstances advised, more or less at a time into plats for field experiments. In their present condition they surround our main field for experimental purposes. They are in part underdrained, and are kept, by a moderate annual top-dressing with barn-yard manure, in a fair state of production, considering the condition of the sod. The area comprises to-day approximately not more than seven acres. Thirteen tons of hay, first cut, and two and three-quarters tons of rowen, hay of second cut, was the yield in 1891.

The *east side division* of meadows comprises an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion, and covered with weeds and sedges in its lower section. The improvement of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886, and in others (south end) in 1887. For the details of this work, as well as of the subsequent seeding down into permanent grass land, I have to refer to preceding annual reports.

It will suffice, for the appreciation of the present yield of these new meadows, to call attention once more to the following circumstances.

1886. — As soon as the drain tiles were covered and the ditches as far as practicable levelled, the entire area was ploughed, and the main depressions filled up with stones and earth, or earth, as circumstances advised, and left in that condition over winter.

1887. — The succeeding spring a wheel harrow was used to break up the rotten sod. The soil was subsequently repeatedly ploughed and harrowed, until it showed the desirable mechanical condition required for a successful cultivation of summer grain crops.

Barley and oats were chosen as the first crops in case of the meadow north of the new roadway. Both were seeded in drills, with rows two feet apart, to permit a thorough destruction of an objectionable foul growth by a frequent use of the cultivator and hoe.

As soon as these crops were harvested, one ton of wood ashes per acre was ploughed in, to assist in the disintegration of the excess of organic peaty matter, and to serve as a general fertilizer. Ploughing once more and smoothing the surface by means of a brush harrow, the entire area was seeded down into grass to serve as meadow. The latter was subsequently cut into two, by a road built for communication to more remote fields. This arrangement caused a division into a northern and southern meadow.

1888. — In case of the land south of the roadway, leguminous plants, as soja bean, Southern cow-pea and serradella, served as first crop. The system of drainage and of seeding down remained the same as before. The meadow north of the road covers an area of somewhat more than six acres, and that south of the road is about three acres in size. The meadow north of the road was sown for the first time in the fall of 1887, with grass, and the one south of the roadway in the fall of 1888.

The more elevated portions of both were seeded down with the following mixture of grass seeds, at the rate of from two to two and one-half bushels per acre : —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

Early in the succeeding spring a mixture of equal weights of medium red clover and alsike clover was added broadcast, at the rate of from five to six pounds per acre.

The lower and still more wet portion of the meadow was seeded down with the following mixture of grass seeds : —

Twenty pounds of soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

1889. — From four to five pounds of alsike clover per acre were added by broadcast seeding early in the succeeding spring (1889).

The seed came up well, and suffered but here and there in wet spots during the first winter. Barren spots were reseeded.

Both meadows were cut but once during the first summer season, somewhat later than usual; the majority of grasses did not, as might be expected, head out.

As soon as the first crop of hay was secured, a system of manuring was planned, which would illustrate the comparative manurial effect of top-dressing, as follows: —

By barn-yard manure.
By ground bones and muriate of potash.
By unleached wood ashes.

The northern meadow, consisting of six and one-half acres, was subdivided into three plats, I., II., III., running from east to west, leaving a space of twenty feet in width between them without any manurial matter.

The southern meadow was divided into two plats, IV., V. (south end). Plats I., II., III. were sown down in grass during September, 1887, and plats IV. and V. during September, 1888. The subsequent stated system of manuring began in the autumn of 1888, on all plats at the same time.

Plat I. (north end of the field) is equal to 1.92 acres. It was top-dressed during the fall and early spring with barn-yard manure, at the rate of eighteen tons per acre (1888–89).

Plat II. covers a similar area to Plat I. (83,640 square feet). It received at the same time a top-dressing of barn-yard manure, at the rate of eight tons per acre (1888).

The coarsest part of the barn-yard manure was subsequently removed from both plats before the growing grass interfered with its being raked off.

Plat III., about 2.41 acres, received, May 3, 1889, a top-dressing of six hundred pounds of fine-ground steamed bone and two hundred pounds of muriate of potash per acre.

Plat IV. (south of roadway), an area of 2.11 acres, received the same dressing, in the same proportion and at the same rate (six hundred pounds ground bone and two hundred pounds muriate of potash) per acre as Plat III. (1889).

Plat V., equal to .91 acres, received, as top-dressing, April 23, 1889, one ton of unleached Canada wood ashes, from our local market (1889).

Yield of Hay in Case of Plats I., II. and III. (Second Year after Seeding), and of Plats IV. and V. (First Year after Seeding).

PLAT I.	First Cut.	Second Cut.
1.92 acres, . .	10,500 pounds, June 24.	4,370 pounds, August 26.
Total yield per acre, 7,745 pounds, or 3.87 tons.		

PLAT II.	First Cut.	Second Cut.
1.92 acres, . .	9,130 pounds, June 24.	4,650 pounds, August 26.
Total yield per acre, 7,177 pounds, or 3.59 tons.		

PLAT III.	First Cut.	Second Cut.
2.41 acres, . .	12,200 pounds, June 24.	4,950 pounds, August 26.
Total yield per acre, 7,116 pounds, or 3.56 tons.		

Plat IV. (2.11 acres); Plat V. (.91 acres): The first year's hay consisted nearly entirely of herds grass, which was almost the only variety which had headed out in June. The yields of both plats were harvested together.

First Cut.	Second Cut.	Total Yield per Acre.
8,130 pounds, June 24.	3,105 pounds, August 31.	3,720 pounds, or 1.86 tons.

1890. — The different plats were prepared in a similar manner for the season of 1890 as they had been for the preceding season, 1889.

Plats I. and II. received a top-dressing of barn-yard manure during the months of October and November; the former at the rate of fourteen tons per acre, and the latter at the rate of eleven tons.

Plat III. was treated in April, 1890, as before, with a mixture of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash.

Plats IV. and V. were merged into one plat, and received a top-dressing of unleached wood ashes, at the rate of one ton per acre, April 19, 1890.

Barren spots in this plat, it being the second year after seeding down, were reseeded by the same seed mixture which had been used before.

The entire meadow received an addition of from two to three pounds of alsike clover seed, broadcast, per acre.

All plats were cut as far as practicable at the same time.

Yield of Hay in 1890.

Plat I.	First Cut.	Second Cut.
1.92 acres, . .	14,625 pounds, July 1.	3,790 pounds, Sept. 1.
Total yield of hay, 18,415 pounds. Yield per acre, 9,591 pounds, or 4.80 tons.		

Yield of Hay in 1890 — Concluded.

PLAT II.	First Cut.	Second Cut.
1.92 acres, . .	12,480 pounds, July 1.	3,105 pounds, Sept 3.

Total yield of hay, 15,585 pounds.
Yield per acre, 8,117 pounds, or 4.06 tons.

PLAT III.	First Cut.	Second Cut.
2.41 acres, . .	14,460 pounds, June 26.	3,535 pounds, September.

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

PLAT IV. (IV. and V., 1889.)	First Cut.	Second Cut.
3 acres, . . .	13,380 pounds, July 1.	4,080 pounds, Sept 3.

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons.

The total yield of hay on plats I., II. and III. averages 4.19 tons per acre. The total yield on Plat IV. averages 2.91 tons per acre.

The weight of the second cut of hay (rowen) averages about one-fourth of that of the first cut. The dryness of the season during the latter part of July affected seriously the yield of the second cut. The wet season of 1889, as compared with the dry season of 1890, as well as the difference in the age of the two meadows, renders further comparison not advisable at this early stage of our investigation.

1891. — The same system of manuring the different plats was adopted as in the preceding years; some reduction, however, was made, with reference to the quantity of barn-yard manure applied per acre to plats I. and II., to ascertain the limit of its usefulness. Plat I. was top-dressed with barn-yard manure at the rate of 8 tons and Plat II. at the rate of 6 tons per acre. Plat III. received, as in previous years, as top-dressing 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The barn-yard manure was applied during the autumn and winter; the bone and potash early in the spring. Plat IV. received, as before, a top-dressing of wood ashes at the rate of 1 ton per acre early during the spring.

All plats were cut as far as practicable at the same time, with the following results: —

Yield of Hay for the Year 1891.

PLATS.	First Cut.	Second Cut.
	Pounds.	Pounds.
Plat I., per acre,	6,528	1,446
Plat II., per acre,	5,988	1,440
Plat III., per acre,	4,641	1,015
Plat IV., per acre,	3,750	1,610

The dry season has evidently seriously reduced the yield, as compared with the preceding year.

8. Report on General Farm Work (1891).

Aside from the farm work connected with the different field experiments previously described, much has been accomplished in other directions.

Considerable progress has been made in perfecting the arrangement for a system of co-operative work in the vegetation house and upon the experimental plats in the field.

The new orchard for testing the influence of different systems of fertilization on the health and general condition of fruit trees has received the needed attention. More young trees have been planted, and suitable crops have been raised over the entire area to economize the ground while the trees are still small.

Some reputed fodder crops comparatively new to our locality have been raised on a sufficiently large scale to serve for feeding experiments. Most prominent among them are a mixed crop of spring vetch and oats, and soja bean, both for green fodder.

Several acres have been planted with oats, barley and Indian corn, besides some varieties of roots and potatoes to furnish fodder for our farm live-stock.

Two silos are filled, one with Stowell's Evergreen sweet corn and the other with a dent corn, Pride of the North, to compare their feeding value as well as their general economical merits under fairly corresponding conditions.

A new barn has been built, to allow a proper separation of the crops obtained in connection with different field experiments.

A liberal production of fodder crops for the support of the farm live-stock has been for economical reasons a leading object in the management of the farm.

The improvement of the general condition of the various parts of the farm, wherever circumstances admitted a free choice of means, has received at all times deserved attention.

The following statement is an enumeration of the principal crops raised on different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the station or undergoing a course of preparation for future experiments.

	Tons.
Hay (first cut),	$38\frac{1}{2}$
Rowen (second cut),	$10\frac{1}{2}$
Fodder corn (green),	22
Corn stover (dry),	4
Roots (sugar beets, $2\frac{1}{2}$; carrots, $1\frac{1}{2}$; mangolds, 3 tons),	7
Rye (1,303 pounds grain, 3,572 pounds straw),	$2\frac{1}{4}$
Barley (1,838 pounds grain, 3,647 pounds straw),	$2\frac{1}{4}$
Oats (2,094 pounds grain, 5,532 pounds straw),	$3\frac{3}{4}$
Wheat (315 pounds grain, 1,405 pounds straw),	$\frac{4}{5}$
Potatoes,	$1\frac{4}{5}$
Vetch and oats (green),	$5\frac{1}{3}$
Soja bean (green),	$4\frac{1}{3}$
Miscellaneous crops,	2

9. Department of Vegetable Physiology.

Report by Prof. Jas. Ellis Humphrey.

During the past year the work of this department has gone on steadily, and with some interesting results. According to the plan indicated in our last report, the chief subjects of investigation during the winter and spring have been certain diseases of winter crops under glass. It is proposed to continue this line of work in the study of other such diseases, both because the equipment of the station affords facilities for such work, and because the extent of the green-house interest in Massachusetts renders such investigations appropriate and desirable. The writer will be glad to communicate with any person who suffers from any disease of plants grown under glass, and to receive diseased plants for study, as well as to render any service in his power to losers by open-air diseases in summer.

A very decided gain has been observable during the year in the importance and amount of the correspondence of the department and in the promptness and fulness with which inquiries addressed to persons who could furnish practical information to the department have been answered. This is gratifying, because it indicates that the efforts of the station to advance knowledge and disseminate information in the field of vegetable pathology, as well as in other lines in which its work has been longer established, are coming to be appreciated. As in the past, all correspondence will receive prompt attention.

The details of the year's work here reported are grouped under the following heads : —

1. The Rotting of Lettuce.
2. The Powdery Mildew of the Cucumber.
3. Various Diseases.
4. Preventive Treatment.
    a. In Genearl.
    b. For Smuts.

As heretofore, reference to the "General Account of the Fungi," in the seventh report of this station, will be found helpful to an understanding of these discussions.

The Rotting of Lettuce. — *Botrytis vulgaris* Fr.*

Gardeners who cultivate lettuce as a winter crop usually suffer somewhat and often lose extensively by the rotting of the plant while still only partially grown. The trouble ordinarily appears first upon the stem of the plant, about at the surface of the soil. Here may be seen at first a soft, dark, decayed spot, which rapidly spreads, penetrating the stem and involving next the bases of the lower leaves. The latter, being thus cut off from the plant by the decay of their bases, usually dry up. With the further progress of the decay, the centre of the head, with the tender inner leaves, becomes attacked, and soon collapses into a fetid, slimy mass. In the decaying tissues one can often recognize fungus threads; and, if they are left undisturbed, there appear on the decayed remains the fruiting threads and spores of a fungus, always the same. When portions of the attacked tissues are removed and placed in a moist chamber after being thoroughly washed, I have found that the same fungus develops promptly and abundantly, and is never accompanied by any other. The study of specimens from various sources has led always to the same result.

Infection experiments with the fungus on healthy plants have been attended with little success; but the most that can be said is that their results indicate that the fungus requires for its attack conditions not yet determined. They do not negative the very strong evidence furnished by the constant association of the fungus with the decay. These experiments have not been carried so far as is desirable, on account of a lack of sufficient suitable material, and further cultures which I hope to make this winter may show that we have here a case similar to that described by DeBary,† in which the fungus threads require to be nourished saprophytically for a time before they can gain sufficient vigor to enable them to attack and live parasitically upon their host.

The fungus in question is one of the imperfect forms known as *Botrytis* or *Polyactis*, and agrees in many respects

* Two plates which had been prepared to illustrate the first two articles of this report, and delivered to the lithographer, were unaccountably lost in the mail before their engraving had been completed. It was impossible to duplicate the drawings in season for this report, but they will be prepared and published as soon as practicable.

† Botan Zeitung, 1886, Nos. 22–27.

with that described by Marshall Ward* as causing a disease of garden lilies. It appears to be able to live saprophytically upon decaying vegetable substances, and is often found upon them; but I have never been able to detect any traces of decay in lettuce in a house where the fungus was not abundantly to be found. These facts point to the conclusion that this *Botrytis* is the *cause* of the rotting, and not merely an accompaniment of decay due to some other cause. It seems doubtful, however, if the affection can be called a disease in the sense that the fungus is able to attack perfectly sound, healthy lettuce under ordinary conditions. I have never seen the decay begin elsewhere than at the lower part of the stem; and it is possible that some injury or imperfection at that place is necessary to furnish a point of attack.

The structure of the fungus is very simple. From the creeping vegetative threads arise the erect spore-bearing ones, which branch sparingly toward their tips. The ends of the branches become slightly swollen, and from each is developed a number of short, peg-like projections. Each of these now begins to swell at its tip into a globular body, which increases in size and finally becomes elliptical in form. This is the spore, which, when ripe, falls from its attachment. The spores germinate promptly in water or a nutrient solution, by pushing out one or more threads each. These threads, when supplied with nourishment, grow rapidly into a much-branched mycelium. In a few days the erect spore-bearing threads begin again to be formed, as above described. Well-nourished specimens growing in a moist atmosphere may, after the first spore cluster has been formed, put out a new branch from the fertile thread, just below the cluster of spores. This thread then grows to a considerable length and then develops at its tip a new spore cluster; and this process may be several times repeated. The result of such a course of development is to produce what appear to be very long, fertile threads, with spore clusters scattered at intervals along them.

Instead of a spore cluster, a thread may produce, apparently only when it comes in contact with some solid substance, a compact cellular mass, which clings closely to the

* Annals of Botany, Vol. II., p. 319.

surface with which it is in contact. These "organs of attachment" have been observed by several students of these fungi, but their real significance is not yet understood. The compact mass is formed by the interweaving and growing together of numerous short branches of the filament on which they are formed. I have noticed, also, that an abundant development of these organs is usually associated with the formation of few conidia, and *vice versa*. But the conditions which determine the preponderance of one or the other are very uncertain; for, in case of two parallel cultures prepared in the same way and carried on under apparently identical conditions, one produced abundant conidia and few attachment organs, while in the other the former were few and the latter were very numerous.

The history and structure of this fungus, as above described, would lead to the expectation that there will be found among the remains of the decayed plants the small, black masses of compacted threads known as *sclerotia*, which constitute the resting states of related fungi, and from which, finally, the perfect fructification is developed under favoring conditions. Careful examination of a quantity of material has failed to show any of these bodies; but it is by no means certain that they may not be formed, at least in some cases

In its development, so far as observed, and in the details of its structure, this fungus appears to agree with the form known as *Botrytis* (*Polyactis*) *vulgaris* Fr., and is with little doubt the conidial stage of some sclerotium-producing *Peziza* (*Sclerotinia*).

From what has been said, it is evident that the thorough and careful culture and vigilant supervision of the plants are essential to the control of the disease in question. The nature of the crop forbids the trial of fungicides, and chief attention must be devoted to the healthy growth of the plants. The soil should be rich and mellow enough to insure a rapid and vigorous growth. The temperature of the houses should not be allowed to rise above the rather low point which is most favorable to the growth of lettuce, since a higher temperature diminishes the vigor of the plant and at the same time favors the development of the fungus. Too high a night temperature is probably a common cause of the rapid progress of the disease. All diseased plants and all refuse on which the fungus can live and increase should be removed at once from the greenhouse and burned. For this purpose the boiler furnace is conveniently at hand. Every bit of vegetable remains should be often and scrupulously cleaned up and destroyed. A house which has been badly infested by the disease should be thoroughly cleaned, fumigated with burning sulphur and supplied with fresh soil, before a new season's crop is started. A coat of paint or whitewash over the whole interior may also be a useful precaution. With a house thus disinfected and a crop well nourished and well cared for, one may legitimately expect practical freedom from loss by rotting.

THE POWDERY MILDEW OF THE CUCUMBER. — *Erysiphe cichoracearum* DC.*

So far as I know, the first announcement of a powdery mildew on cucumbers, in America, was made in Bulletin No. 40 of this station in August last. It has long been known in Europe and has been observed in Australia. It is not known to me to attack cucumbers cultivated in the open air, but is probably not uncommon on plants forced in the greenhouse for a winter crop. It has been sent to this department by Dr. Jabez Fisher of Fitchburg and by Prof. L. H. Bailey of Cornell University, Ithaca, N. Y.

The disease ordinarily first appears on the upper surfaces of the leaves, and sometimes on the stems, of the host-plants, in the form of small, roundish, white spots, which have the peculiarly powdery appearance which has given to this group of fungi their name. These young spots suggest the effect of scattered splashes of flour upon the plant. Microscopic study shows that the white substance consists of the threads and spores of the parasite. The surface of the host-plant is covered by a close layer of flattened cells, the epidermis, and the vegetative threads of the parasite develop close to this outer surface. They are thus truly external, instead of ramifying among the internal cells of the host, as is the case with the cucumber mildew described in the last report

* See note, p. 219.

of this station (p. 210), and with most parasitic fungi. The only penetration of the host by this fungus occurs where its creeping vegetative threads send out, from slight lateral projections, short branches which grow downward, piercing the outer walls of the epidermal cells and swelling into club-shaped bodies within the cavities of these cells. By means of these club-shaped organs, the *haustoria*, the parasite obtains its nourishment by the absorption of the contents of the invaded cells.

The superficial threads grow and branch freely, and soon begin to send up erect, vertical threads, from which, after they have reached a certain length, spores are formed by the cutting off of the tip and of successively lower portions by consecutively formed cell-walls. Each oblong segment becomes, in its turn, rounded off at the angles and somewhat enlarged at the middle, and then falls from its support, ready for germination. On a well-developed thread one may thus see a chain of spores in all stages of development. These spores may vary considerably in size in specimens from the same source; but they do not usually, if ever, differ so widely as do those from Dr. Fisher's and Professor Bailey's specimens. Between the two there is a considerable difference in form as well as in size, which may point to a specific difference in the parasites from the two sources. The remarks concerning treatment of the disease of cucumbers will apply equally to both forms, whether they represent variations of the same species or not. These spores, when fully ripe, germinate readily in water, but do not develop far. Each gives rise to a germ-tube, usually near one of the original corners of the spore; but this tube rarely reaches a length greater than twice the short diameter of the spore. On nutrient gelatine, prepared with an infusion either of prunes or of cucumber leaves, the spores will develop no farther than in water; but in a drop of water on the surface of a living cucumber leaf they send a branch of the germ-tube downward, as a haustorium, into the underlying epidermal cell, and then grow and branch freely, until a considerable mycelium, forming a spot upon the leaf, is developed. From the readiness with which the leaf and stem and all succulent parts of the plant are attacked in this way, the disease spreads rapidly, or may be artificially communicated to healthy plants.

Under favoring conditions of heat and moisture the spots increase very rapidly in size and in numbers. Those upon a leaf may become confluent and involve the whole leaf. The attacked tissues soon become yellow and then brown and dry, and the plants are rendered worthless, if not utterly killed. The parasite is not limited in its attacks to weak or poorly nourished plants; but on strong and vigorous ones it often progresses more slowly, and less completely overcomes its host than when the latter is enfeebled from some other cause. This can readily be seen in plants grown respectively on poor and rich soils, but otherwise under similar conditions.

The structure of the summer-spore stage described shows plainly that this parasite is one of the *Powdery Mildews*, and heretofore its perfect or winter form has been unknown. It has therefore been impossible to say to what particular species of the group it should be referred. It has been known as the variety *Cucurbitarum* of *Oidium erysiphoides* Fries, which embraces various undetermined summer-spore stages of this group. But during last December, on several of the leaves of cucumber plants on which the disease had been allowed for six weeks to run its course, and which were covered by the summer spores of the fungus, there appeared smoky spots perhaps half an inch in diameter. On these spots were seen the young yellow and brown spore-fruits or *perithecia* of the winter stage. These soon reached maturity, and furnished the means for specific identification of the parasite. The dark-brown ripe perithecia are provided with irregular brownish appendages around their bases, and contain several spore-sacs each. Each spore-sac contains typically and most commonly two spores; but this number is often reduced to one, and less often rises to three or even four. A careful comparison of this fungus with the described species of the genus *Erysiphe*, to which it plainly belongs, shows it to agree in all essential details of structure, perithecia, haustoria, etc., with *E. cichoracearum* DC. The appendages of the perithecia are distinctly brown in mature specimens, but less deeply colored than is usually the case with those of this species developed in the open air. This difference may, however, well be due to the different conditions under which they have developed.

It is interesting to find that this parasite, so destructive under the given conditions, is the same with one of our commonest out-of-door species in summer and fall on various *Compositæ*, asters, golden-rods and sunflowers, on *Verbenas*, on *Phlox*, and on various other host-plants, to which it does comparatively little harm.

Professor Bailey and Dr. Fisher, as well as the writer, have found that this disease may be kept in check in the greenhouse by spraying the plants as often as is necessary with a solution of sulphide of potassium (liver of sulphur) in water, an ounce of the sulphide to four gallons of water. A stronger solution injures the plants and fruits. Spraying with the ammoniacal carbonate of copper has been found even more effective. But Professor Bailey finds more effective than either exposure to sulphur vapor. This is accomplished by closing the house as tightly as possible for half an hour or an hour at a time, while it is filled by the vapor arising from a vessel of sulphur kept a little above the melting point on a small oil stove. The vessel should be porcelain lined, to protect the iron from the action of the sulphur. This vapor appears to be harmless to the host-plants while fatal to surface parasites like the powdery mildews. Great care must be taken to avoid the ignition of the sulphur, since a few minutes' exposure to the fumes of burning sulphur would be fatal to a house full of plants; but, with reasonable care in protecting the sulphur from contact with the flame and in preventing the temperature from rising too high, there should be no danger of such a catastrophe.

A house in which this disease has been troublesome should be thoroughly disinfected by burning sulphur before a similar crop is again started. The soil should be entirely removed and replaced by fresh. But that removal of the earth is not alone sufficient has been clearly shown during the past season. The house in which the study of this disease was carried on during the winter and spring of 1891 remained dry and unused during August, and early in September the soil was wholly removed. New bottoms were put in the benches, which were then filled with fresh soil. A lot of new cucumber plants were started, and in October were abundantly and spontaneously attacked by the fungus in question. There is little doubt, however, that thorough fumigation will render a house clean, so far as fungi are concerned.

Various Diseases.

A New Potato Disease.—Late in July last, Mr. G. D. Howe of North Hadley brought to the station some specimens of potato plants whose leaves bore spots in many respects strongly resembling those produced by the rot-fungus in the early stages of that disease. He reported that the disease was spreading over an extensive field and killing the plants. A visit to the field confirmed these statements, and showed that those plants which suffered most were those which were nearest maturity, although the foliage had not yet turned yellow from natural causes. Some rows of late potatoes, which were still vigorously growing and very green, although between infected rows, were almost free from the disease. The field had been lately sprayed as a protection against rot; and another spraying of certain rows was recommended, to test the possibility of checking the spread of the disease by this means. But its spread was so rapid that the plants were killed before time could be found to make the application. The tubers were not affected in any case beyond a probable slight loss of growth, and remained perfectly marketable. A pretty thorough and careful examination of the diseased leaves showed the constant presence in the spots of mycelium, from which were developed, on the lower surface of the leaves, spore threads and spores of the form-genus *Macrosporium*. This was clearly not simply a saprophytic form following the attack of some parasite, but occurred on the very young spots with a truly internal mycelium, and had all the appearance of a true parasite.

Circumstances made it impossible to study the disease further at the time; but it seems probable that we have here a new disease of potatoes which may prove of considerable importance. Mr. Howe is confident that the same disease attacked some of his potatoes in 1890, though in a less serious form. It attacked, during August, as Mr. Howe informs me, many other fields in Hadley, where it appears to have been quite general. The report from various parts of the State of the appearance of potato "blight" without the "rot" leads one to ask if this disease may not have been much more widely spread than is known; and the especial object of this note is to call the attention of others to it, and to ask readers of this report to forward at once to the station specimens of any potato plants which are observed to be attacked in this way. A careful watch will be kept in Hadley for the disease, and arrangements will be made to give it the attention it deserves should it reappear.

Another Disease of Cucumbers. — In connection with the study of the powdery mildew of the cucumber, above described, there were received from Dr. Jabez Fisher of Fitchburg specimens of cucumber plants which were attacked by a still more serious disease than the mildew, and one apparently much more difficult to control.

This disease is characterized by a dwarfed and stunted appearance of the shoots attacked. The young fruits become deformed and distorted, and some of the leaves which reach a considerable size, perhaps because they are attacked late, turn yellow and die. Sometimes a plant will push out a new and vigorous shoot which may grow for a time, but sooner or later is pretty sure to succumb. Over the lower surface of these yellow leaves may be seen, on close examination, a delicate, white, glairy film, which recalls by its appearance a very thin dried streak of some albuminous substance. Microscopic study of this film shows it to be a web of very fine interlacing fungus threads, closely adherent to the surface of the leaf. No spore formation was ever observed on the leaves as they come from the forcing-house; but when a fresh leaf, covered with a well-developed film, was placed in a moist chamber, the threads gave rise in two or three days to numerous short, erect stalks, irregularly scattered along their sides. These stalks taper somewhat toward their tips, which are rounded or slightly knobbed, and bear the elliptical or rather kidney-shaped spores of the fungus. These spores, when placed in water, swell up by absorption of water until they become nearly or quite spherical in form, and then germinate by extending a germ-tube nearly as large as the average of the vegetative filaments of the fungus. Lack of suitable material has prevented the culture of this fungus on nutrient media or attempts to inoculate cucumber plants with the fungus, but everything points to this fungus as the cause of the trouble.

From the description given it is evident that it is one of the numerous uncertain and little-known fungus forms; and, according to our present system of classification, it must be placed in or very near the form-genus *Acremonium*. Should the disease reappear the comming winter, special attention will be given to it and especially to the determination of its etiological relation to the disease in question.

The present incomplete note is here inserted as a preliminary record of a new disease of cucumbers and of what has been observed in connection with it, with the primary object of calling the attention of other pathologists and of growers of cucumbers under glass to it. It is especially requested that any person who observes this or any similar disease will promptly notify the writer of its presence, and send specimens and all possible details concerning its appearance and spread. Dr. Fisher states that this disease reduces the yield of badly attacked plants to ten per cent. of the normal. It seems difficult to combat, as it steadily increased in his houses in spite of applications of all the most efficient fungicides.

Rye Fungi. — The winter rye on the station plots was attacked severely by three fungi. In June many of the leaves showed the swelling and distorting effect of the leaf smut (*Urocystis occulta* Wallr.), further details concerning which will be found in another part of this report. It has not as bad a reputation and is not as well known as the grain smuts, but it undoubtedly does much harm in weakening the plant and so in reducing the production of both grain and straw.

At the same time with the smut there appeared in extensive orange patches on the leaves the summer spores of one of the grain rusts (*Puccinia rubigo-vera* (DC.) Wint.), so abundantly that they arose in clouds when the plants were shaken. Later the leaves of summer wheat on adjoining plots were very badly affected. In July this stage of the fungus had largely disappeared, and the leaves of the rye were blackened by the winter-spore pustules of the same fungus.

The life-histories of this and the related species of rusts are not yet fully understood, and our only protection at present is in destroying as completely as possible the stubble and all refuse which can harbor their spores in the field. Observations by the writer, made as his share in certain co-operative studies of the grain rusts, seem to indicate that this rust does not survive the winter in its host-plant, but depends upon fresh infection in the spring. On our plots the summer-spore pustules on rye seedlings survived the early frosts, and seemed vigorous until the heavy frosts and first snowfalls. The plots were then covered continuously by snow until spring. When they were again exposed, the discolored spots where the spore-pustules had been could be readily observed, and examination showed a mycelium to be present in the spot. But it was apparently dead, for repeated examination of the plots failed to detect new spores breaking out from any of these old spots. The fungus was not observed after growth was resumed until early in June, when a few warm and moist days increased the amount present from a few scattered spots to a general epidemic.

The virulence of this attack of rust caused a marked weakening of the plants, as was shown by the yellow color of their leaves and by the abundant presence upon the leaves — most abundant on the weakest ones — of the saprophytic fungus form known as *Cladosporium herbarum* (Pers.) Lk. The sooty patches of this with the orange masses of the rust pretty completely covered the leaves and left little or no normal tissue.

It is noteworthy, as illustrating the general principle repeatedly laid down in these reports, that on those plots which had been supplied with abundant and readily available nitrogen the effects of the fungi were much less serious than where the supply of nitrogen was deficient in quantity or in availability. The difference was especially striking in respect to the discoloration of the leaves, which was less in proportion to the amount of rust present on the well-fed plants.

The Club Root of Cabbages (*Plasmodiophora Brassicæ* Wor.) appeared for the first time on a part of the station grounds during the past season. The first specimens were obtained when the largest leaves were about six inches long. At this time, in the worst specimens the main root and its lateral branches were attacked and swollen into a nearly solid mass of the size of a hen's egg. The parts of the affected plants above ground did not at this time differ essentially in appearance from their neighbors, and were recognizable chiefly by the fact that in warm, sunny weather the foliage became wilted from the lack of sufficient root hairs on their swollen roots to absorb the necessary water to supply the demands of active transpiration. These plants failed entirely to form "heads," and were therefore rendered worthless by the disease. Microscopic examination of the diseased roots at different times showed the various stages in the development ot the parasite as they have been described and figured by Woronin.

Early in the season, just after the spring ploughing, soil was taken from a field which had been planted to cabbages the previous season and had produced a considerable number of "stump-footed" ones. This soil was placed in a flower-pot in the greenhouse and sown with cabbage seed. In due time some of the seedlings were attacked by the club root fungus in characteristic fashion, this showing the survival in the soil and their probable pretty general distribution through it, after ploughing, since a single flower-pot full taken at random contained at least several of them.

It is a matter of general observation among market gardeners and others that on some soils, especially heavy and moist ones, it is not profitable to plant cabbages two years in succession, on account of the prevalence of club root the second year. But it has also been remarked that two crops equally free from disease may be raised in one season. This fact is interesting as a practical demonstration of the fact that the spores of the club-root fungus are *resting spores*, and require a season of quiescence before they are able to germinate and reproduce the disease.

After a year or two of other than cruciferous crops (cabbages, turnips, radishes, etc.), the danger from the disease is past, and the latter may again be planted for a year.

The Blight of Celery, which forms spots on the leaves, is due to a parasitic fungus form which bears summer spores, known as *Cercospora Apii* Fres. That this represents merely an imperfect form of some fungus whose perfect form probably lives saprophytically, cannot be doubted; but no other form has thus far been connected with it. I have observed on celery, from the farms of Messrs. W. D. Philbrick of Newton Centre and A. H. Smith of West Springfield, that, after the brown blight spots have spread over the leaves and they have collapsed upon the ground, there appear upon them the tiny black pustules of one of the pycnidial forms known as *Septoria*. From the analogy of other cases and from the evidence of a series of specimens in different stages of the disease kindly sent by Mr. Smith, it is easy to believe that the *Septoria* form represents another stage in the history of the same fungus to which the Cercospora form belongs, although I have not been able to make cultures. One would, however, expect little additional evidence except from cultures of the perfect spore-form, which we do not yet know.

Since there have already been described several so-called species of *Septoria* on various umbelliferous plants which differ in no essential particulars from this form and from each other, it would be worse than superfluous to add here another to the already large list of names which have been given to what must eventually be shown to be a single form. And especially so since this form is undoubtedly merely an imperfect stage in the life cycle of some fungus for which, when its whole course of development is known, only a single name can stand; while the host of names inconsiderately given to its various imperfect forms will constitute only a cumbrous and useless synonymy. So far as it has been possible to examine material and descriptions, it appears that this form on celery is separated by no distinct features from the following previously described ones on *Umbelliferae*: *S. Sii* Rob. & Desm., *S. Cryptotaeniae* E. & Rau, *S. Saniculae* E. & E., *S. Dearnessii* E. & E. and *S. Petroselini* Desm.

Our form may be described as follows : Pycnidia appearing on the brown leaves after the coalescence of *Cercospora* spots, amphigenous, black, scattered, 100 to 160 mmm. in diameter ; flattened when of the larger, globular when of the smaller, diameter ; pycnospores somewhat curved, slightly tapering to both ends, usually 3-septate, rarely, 2- or 4-septate, 24.-34. x 1.7-2. mmm.

It remains much to be desired that the perfect form of this fungus should be discovered. It will probably be found eventually on blighted celery leaves which have lain on the ground through the winter, or on rubbish near by, in spring.

Note. — Since the above was written Mr. F. D. Chester, of the Delaware Experiment Station, has described * what is doubtless this form as occurring on celery in that State, and thinks it may be that known in Europe as *Septoria Petroselini* Desm., var. *Apii* Briosi.

Clover Fungi. — Two fungi annually cause much damage to the clover on the station meadows and elsewhere in Amherst and in other parts of the State. One of these is the rust fungus (*Uromyces Trifolii* (Hedw.) Lév.), which is most harmful in its summer and winter spore stages, which are developed almost simultaneously in June and July. They appear in the form of pustules of different shades of brown, which burst through either surface of the leaf, and consist of the closely packed spores of the fungus.

The other fungus is the black mould (*Polythrincium Trifolii* Kze.), which appears in thickly scattered black spots over the under surface of the leaves. This form is often followed by the development of black crusts on the affected leaves, which have been named *Phyllachora Trifolii* Pers., and are supposed to represent the perfect form of the fungus ; but the winter spores which should develop in them have never been described.

Both of these fungi reduce the fodder value of the clover to a minimum, and cause considerable reduction in the size of the leaves and in the general vigor of the plant, and are therefore real pests and sources of real loss.

A Fish-hatchery Fungus. — Early last spring I received from the Northampton fish-hatching establishment, through

* Bulletin Torrey Bot. Club, December, 1891, p. 373.

Dr. J. B. Paige of the Agricultural College, specimens of trout eggs attacked by fungous filaments. These filaments were not in the fruiting stage; but when dead flies were thrown into the water containing the eggs, they were promptly attacked by similar filaments, which soon developed both non-sexual and sexual reproductive organs, from which the fungus was readily determined as *Achlya racemosa* Hild. I am informed by H. E. Maynard, Esq., of Northampton, that the eggs suffer most when first placed in the hatching trays. It is generally believed that only dead eggs are attacked; yet the fact, which is commonly observed, that, if the eggs are not removed from the trays as fast as they die, the fungus will extend to all the eggs, shows plainly that this cannot be the case. If it were able to attack only dead eggs, the fungus could not be a source of harm, and its presence in the trays could not endanger living eggs. It does not, as far as I can learn, attack the young fry after hatching.

The only effective means of preventing the spread of this affection lies in the frequent removal of all dead eggs from the hatching trays.

Rust of Poplars. — The European black poplar (*Populus nigra* L.) has been considerably planted on the grounds of the Agricultural College and elsewhere in Amherst.

The trees are attacked annually in September by the poplar rust (*Melampsora populina* (Jacq.) Lév.), and during the past two seasons the attacks have been very severe. The disease first shows itself in the yellowing of the lower leaves, due partly to the fading of their natural color in consequence of the presence of the parasite, and partly to the development on their lower sides of the abundant deep-yellow summer-spore masses of the rust. There now follows a definite upward progress of the disease, and when the middle part of the tree is reached, the lower leaves are falling in great numbers and the lower limbs soon become stripped of foliage. This results in two to three weeks after the first appearance of the disease. By the time they fall the leaves have become brown in color, from the further degeneration of their pigment and the replacement of the summer spores by the brown crusts of compacted winter spores. The leaves then lie upon the ground until spring, when the winter spores germinate and infect the new season's foliage.

It is evident that much of the harm done by this rust in rendering the trees unsightly and in causing premature defoliation can be avoided by thoroughly cleaning up and burning all the fallen leaves before snow falls, while the winter spores are still incapable of germination.

Anthracnose of Chestnut. — Since the cultivation of the chestnut is beginning to receive attention in some quarters, and bids fair to be attended with considerable success, it may be worth while to mention a fungus which, from its prevalence on wild chestnuts about Amherst, seems likely to prove troublesome to the cultivated plant. This fungus, which must be known as *Marsonia ochroleuca* (B. & C.), causes an anthracnose of the leaves in the form of small, thin, bleached spots, on which the spore pustules are formed. These spots are sometimes so abundantly developed as to cause the leaves to shrivel and die; and the fungus may be expected to do much greater harm to trees growing under the artificial conditions of cultivation.

The Black Knot of the Plum. — The study of this disease has been continued during the past year, both theoretically and practically. Some trees in an advanced stage of the disease have been put in charge of this department for treatment, and progress has been made in both lines of study. But the results obtained have not been so complete as was hoped for, partly on account of the limited material at my disposal and partly because a large amount of time was required for other studies reported here. Therefore it seems best to reserve the results obtained until they can be combined with those hoped for during the coming year, in a more complete and hence more satisfactory account.

Diseases of Tobacco. — This department has communicated with some leading tobacco growers in the Connecticut valley during the past fall, with a view to the investigation of the various diseases or affections to which tobacco is subject in the curing shed. These are known chiefly under three names, white vein, pole sweat and pole rot. How far these names represent affections due to distinct causes it is impossible to say, since they have apparently caused no loss in this State during the past season, and it has not been possible to obtain material for study. The purpose of the present note is to call the attention of tobacco growers to the fact that the department is desirous of studying the diseases named, and to ask them to notify the writer of the existence of any such in their barns next season. It seems very probable that much can be done towards a better understanding of the nature and means of prevention of these sources of loss. The writer desires here to thank those growers who have so promptly replied to his inquiries, and hopes to be as promptly informed of the existence of opportunities for the study of these diseases.

Preventive Treatment.

A somewhat extended account of the principles underlying the preventive treatment of fungous diseases of plants, with detailed directions for the preparation and application of the most efficient fungicides, was issued as Bulletin 39 of this station, in April last. That interest in this subject is being awakened was shown by the demand for the bulletin and for further information; but it is impossible to say to what extent its recommendations were acted upon, as very few persons have communicated to the department any report of such treatment or its results. The bulletin named can still be furnished, on request; but the more important points of the discussion are given below.

Since a plant which is once fairly attacked by a fungus is lost, treatment must be directed toward preventing the development of fungi upon the plants to be saved. Protective measures may be of two sorts; those which remove possible sources of infection from the plants, and those which fortify the plants against infection. The latter of these objects is accomplished by the use of *fungicides;* the former may be largely accomplished by *hygienic treatment.*

There are definite laws of health for plants as well as for animals, and in one case, as in the other, neglect of those laws invites disease. In the first place, plants which are expected to grow and thrive must be furnished with an abundance of the materials necessary to growth. Weak, poorly nourished plants suffer the attacks of parasites of all sorts, and have no power to resist them. Secondly, where a crop has suffered from a fungous disease in one season and a good crop of the same kind is desired in the following season, every tangible trace of the disease must be removed. For example, if a vineyard has suffered from *mildew* or *black rot*, all diseased leaves and berries should be collected at the end of the season with scrupulous care and wholly burned; and the same advice applies to a large list of cases. Thus incalculable numbers of the spores of the fungi of the respective diseases will be prevented from infesting the next season's crop. In some cases where the spores remain in the soil, as in the *stump foot* of cabbages or the *smut* of onions, the attacks of the disease can only be avoided by rotation with crops upon which the fungus in question cannot live. Thirdly, wild plants, which, being nearly related to a given cultivated one, may be subject to the same disease, or which bear a complementary spore form of a pleomorphic fungus, should be carefully excluded from the neighborhood of cultivated ones. Thus, wild cherries or plums, which are equally subject to the *black knot*, should be kept away from plum orchards; and spinach fields should be kept free of pig-weed, since both plants are attacked by the same *mildew;* and again, since red cedars bear one spore-form of a fungus whose other form is the *rust* of apple leaves, it is plain that they should not be allowed to grow near an apple orchard.

The importance of these preventives is often underrated by persons who understand and use successfully other forms of treatment. It is evident, however, that, in removing as completely as is possible the conditions which favor the abundance and increase of a fungus in the vicinity of its host plant, half the battle is won. When this has been done, we may protect the plants by the external application of *fungicides.*

These preparations, when properly prepared and when applied at the right times and in the right way, have been abundantly proved to be of the greatest value, and often to determine the difference between a full crop from plants on which they are used and practically no crop where they are not applied.

But the fact cannot be too strongly emphasized that everything depends upon how they are prepared, and upon *how* and *when* they are applied. The following pages attempt to give somewhat full instruction *how* to prepare and apply the most valuable fungicides, and such general hints *when* to apply them, as will be of service. The proper times for their application vary so much with special conditions, however, that instructions on this point must form an important part of the special directions for any particular case.

Preparation. — The protective quality of most of the best fungicides lies in the fact that they contain a certain proportion of copper; and, of the four recommended as applicable to most cases of fungous diseases, three contain it as the essential constituent.

The Bordeaux Mixture requires six pounds sulphate of copper, four pounds quicklime (fresh) and twenty-two gallons water. The sulphate of copper, known to the trade also as blue vitriol or blue-stone, is dissolved in two gallons of water. The solution will be hastened if the water be heated and the sulphate pulverized. After the solution is complete, fourteen gallons of water are added to it. The quicklime is slaked in six gallons of water, and stirred thoroughly until it forms a smooth, even mixture. After standing for a short time it is again stirred and added gradually to the sulphate solution, which is thoroughly stirred meanwhile. The mixture is then ready for use, though some experimenters recommend further dilution to twenty-five or thirty gallons, for certain uses. It should not be prepared until needed, and should be used fresh, as it deteriorates with keeping. Since the lime remains merely in suspension and is not dissolved, the mixture should be strained through fine gauze before entering the tank of the spraying machine, so that all of the larger particles which might clog the sprayer may be removed.

Ammoniacal carbonate of copper, in its improved form, is prepared from three ounces carbonate of copper, one pound carbonate of ammonia and fifty gallons water. Mix the carbonate of copper with the carbonate of ammonia, pulverized, and dissolve the mixture in two quarts of hot water. When they are wholly dissolved, add the solution to enough water to make the whole quantity fifty gallons. This preparation has been found to be better and cheaper than that made according to the original formula, which is as follows: Dissolve three ounces carbonate of copper in one quart aqua ammonia (22° B.),* and add the solution to twenty-five gallons of water.

Dr. Thaxter, formerly of the Connecticut Experiment Station, has suggested that a very large saving may be made by preparing the carbonate of copper by the following method, instead of buying it, as its market price is much greater than that of the materials necessary for its preparation: Take two pounds of sulphate of copper and dissolve it in a large quantity of hot water; in another barrel or tub dissolve two and one-half pounds of carbonate of soda (sal-soda) in hot water. When both are dissolved and *cooled*, pour the soda solution into the copper solution, stirring rapidly. There will result a blue-green precipitate of carbonate of copper, which must be allowed to settle to the bottom of the vessel. Now draw off the clear liquid above the sediment, fill the vessel with fresh water and stir up the contents thoroughly. After the copper carbonate has once more settled to the bottom, again draw off the clear fluid above. The carbonate may now be removed from the vessel and dried, when it is ready for use. From the amount of blue-stone and sal-soda given above will be produced one pound of copper carbonate, and the amount of each necessary to produce any given amount of copper carbonate is easily calculated.

Sulphate of copper is used in solutions of varying strength for certain special cases.

Sulphide of potassium, known also as sulphuret of potassium or liver of sulphur, has been found useful in the treatment of diseases caused by those fungi known as powdery mildews, especially on plants grown under glass. It is ordinarily used in the proportion of half an ounce of the sulphide to one gallon of water.

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* Dealers usually handle ammonia water of a strength of 24° B. (= 22.5% ammonia) or of 26° B. (= 26.5% ammonia). To reduce these to the required strength, 22° B. (= 19% ammonia), add *four* parts of water to *ten* of aqua ammonia of 26°, or *two* parts of water to *ten* parts of 24° aqua ammonia.

Materials. — For the convenience of persons who may wish to purchase the necessary materials for the preparation of fungicides, the writer has communicated with several reliable houses in some of the larger cities of the State, and has received from those named below favorable replies as to their readiness to fill orders promptly, and as to prices. He can, therefore, recommend these firms to persons wishing fungicide supplies, without in any respect implying that there are not many others equally reliable : —

Weeks and Potter Company, 360 Washington Street, Boston.

Messrs. E. & F. King, Boston.

Talbot Dyewood and Chemical Company 24 and 26 Middle Street, Lowell.

Jerome Marble & Co., Worcester.

Messrs. H. & J. Brewer, 463 Main Street, Springfield.

Concerning the cost of the various materials named above no very exact figures can be given, since prices vary with the state of the market and according to the quantity ordered. Prices per pound are considerably higher for small quantities than for larger ones, and the substances cost *much* less in original packages than in smaller lots. A large saving can be affected if several persons will combine in ordering what they need, both in the cost per pound of the chemicals and in cost of transportation. The following quotations may be given as the approximate prices of the various substances in *small* lots, at retail, and discounts from these prices will increase with the amount of the order : —

	Cents per Pound.
Copper sulphate,	8
Copper carbonate,	60
Ammonium carbonate,	15
Sodium carbonate,	3
Aqua ammonia (24°),	10
Potassium sulphide,	25

Application. — In the case of diseases caused by fungi which spread from plant to plant during the growing season, the necessary protection is afforded by applying the fungicides in the form of a very fine spray to the surface of the plants until they are thoroughly wetted. This, drying, leaves a thin film over the plants, which is fatal to fungus spores that may fall upon it. Suitable spraying apparatus is of the first importance to success in the use of fungicides, especially a nozzle which shall allow the escape of only the finest spray. The ordinary spraying nozzles used with hose or with small hand pumps are utterly unsuited to this purpose. The best form is, perhaps, that known as the Vermorel nozzle, which is furnished with many pieces of apparatus, or may be purchased separately. This nozzle gives a very fine and steady spray, which may be instantly cut off, and is the best suited for the Bordeaux mixture, since it has an attachment for promptly freeing it of clogging particles. Another excellent nozzle for the other fungicides described, which are clear solutions, is the Nixon nozzle.

For supplying the necessary pressure to drive the liquid through the nozzle in the form of spray, some form of force pump is necessary. The form chosen must depend on the amount of work to be done and the character of the plants to be treated. We may distinguish three general types. The *knapsack* type is suitable for almost any small job, the importance of which does not justify the purchase of a more expensive apparatus, and is especially adapted to use upon low-growing plants cultivated in hills or rows. These machines have a tank holding a few gallons with a pump worked by a lever with one hand, while the other hand directs the nozzle, the apparatus being strapped upon the back of the operator. The *hand-cart* type of pump consists of a large reservoir, representing the body of the cart, connected with a force pump, and the whole mounted on two or three wheels with a handle for pulling or pushing. The *horse-cart* type of machine includes a larger reservoir and more powerful pump, capable of throwing several streams, mounted on wheels, to be drawn through the field or orchard by horse-power.

For information concerning the details and prices of the numerous spraying machines on the market, the reader is referred to the catalogues, which will be sent on application, of the Nixon Nozzle and Machine Company, Dayton, O.; The Goulds Manufacturing Company, Seneca Falls, N. Y.; Albinson & Co., 2026 Fourteenth Street, Washington, D. C.;

Adam Weaber and Son, Vineland, N. J.; Rumsey & Co., Seneca Falls, N. Y.; Field Force Pump Company, Lockport, N. Y., or W. & B. Douglas, Middletown, Conn.

When to Apply. — As has been said, this question is of the first importance in dealing with any disease, but the answer varies with the case in hand. In general, however, let it be remembered that all treatment is preventive, that plants once attacked are lost, and that spraying must therefore be prompt and early. In the case of a disease of an herbaceous crop like potatoes, the first spraying should be given *at once* on the appearance of the disease in any part of the field or a neighboring field. The same applies to diseases of woody plants which have previously been free from disease; but where grapes or apples, for instance, were attacked last year, treatment should begin with the beginning of growth, and should proceed on the assumption that the disease will reappear if not prevented. In any case, after spraying is begun it must be repeated until danger is past, — a very variable period, — at intervals which may average ten days or two weeks, but will vary according to circumstances, depending especially on the amount of rainfall, which washes the copper salts from the plants and renders a new application necessary. It is always best to leave an occasional plant or row of plants untreated among the treated ones to furnish a basis for judgment as to the efficacy of the treatment.

Quantities Needed. — It is very difficult to give any statement of the amount of a fungicide required to properly spray any of the various plants on which it may be used.

The size and leaf surface of plants of the same kind vary so much with their age, the conditions of cultivation, and other controlling factors, that it is hardly possible to say what is an average plant of any sort. Besides this, very few experimenters have published statements as to the quantities used in their work. Yet one of the first questions asked by a beginner is, "How much do I need?"

With these facts understood, the following figures may be given as approximate statements of the amount of a preparation required for properly spraying the crops named, when a suitable and economical nozzle is used. For another plant the amount can be roughly estimated by a comparison of its leaf surface with that of one of these; For apple-trees, one and one-half to two gallons to a good-sized tree; for grape-vines, one gallon to six or eight well-grown vines; for potatoes, one hundred to one hundred and twenty-five gallons per acre.

A Caution. — Certain observations of the writer and certain well-known incidents in the fruit trade during the past season show that the use of fungicides, like every other good thing, may be carried to extremes by inexperienced or incautious beginners or by over-zealous friends. It is undeniably true that the free use of copper preparations has been recommended far too promiscuously and too inconsiderately in certain quarters for every fungous ill which vegetable "flesh is heir to." It is, or ought to be, self-evident that, on plants whose foliage is to be eaten, like lettuce, these preparations should *never* be used. On plants like the potato, which are cultivated for subterranean parts, their use is perfectly safe; while to fruit-trees and vines the Bordeaux mixture, at least, should not be applied after the fruit has begun to ripen. If, from its nature or through favoring conditions, a disease makes its appearance after the fruit has begun to color, much can be done to prevent its spread by removal of diseased parts and rigid hygienic precautions. But, from the point of view of profit and loss alone, it is not worth while to save a crop to be seized by some vigilant board of health, which can afford to err only on the side of safety. Our present methods of treatment, while sufficient and unobjectionable for certain cases, must be regarded as only temporary and for the present better than nothing, in many other cases. For many diseases our only remedy yet known is quite as bad as the disease, and it is not to be expected that public sentiment will long tolerate the use of poisonous insecticides and fungicides where such use involves any possible danger.

Some Experiences. — The responses to the offers of assistance contained in this bulletin, while not so numerous as they should have been, were yet encouraging. They show that our most progressive farmers and gardeners are beginning to appreciate what this department is glad to do for them. It is not known to what extent many of those who wrote for further information and advice practically applied it; but reports have been received from some which speak for themselves. Such is that of Mr. J. N. Pardee of South Billerica, who sprayed his apple trees only twice with Bordeaux mixture, containing Paris green, once on the 1st and once on the 13th of June. In each case the spraying was followed, the next day, by a heavy shower. Thinking the rains must have washed off the combined fungicide and insecticide, and that it was too late for further treatment to be effective, he did nothing more. Concerning results, he writes: "The fruit from the sprayed trees and parts of trees did not drop off as freely as from the unsprayed trees, and is uniformly fair, with clean, smooth skin, and two-thirds grade as choice No. 1, while the other third brings a good price as seconds. It is fair, but wormy. The fruit from the unsprayed trees and parts of trees is almost uniformly covered with black spots. The sound apples will not grade as first-class No. 1, while the wormy apples go for cider, and less than one-third of the fruit is sound. As all other conditions, soil, care, etc., have remained the same, I do not know what to attribute the difference to, except to the spraying. The cost of the material for the two sprayings was about fifteen cents per tree, and the time taken to spray thirty trees twice was about three hours for two men and a horse." It is evident that the secret of the efficacy of this slight treatment is to be found in the fact that it was applied at just the right time in the development of the fruit, and that the preparation was not washed off by the rains which immediately followed its application.

Mr. N. E. Baker of Lawrence has sprayed his carnations with the improved form of ammoniacal carbonate of copper both before and since putting them in the house, as a protection against the leaf-spot fungus (*Septoria Dianthi* Desm.), and reports that the new growth is vigorous and healthy.

These examples serve to show what may fairly be expected from the proper use of fungicides well applied, and it is hoped that they may encourage many others to try them next season. As a further stimulus in this direction it is proposed to give annually in these reports special detailed instructions for the treatment of some group of diseases caused by fungi whose life histories are so similar that the same directions will apply to all. The symptoms of each disease and its effect on the diseased plants will be described, and enough of the life history of the parasite will be given to make clear the reasons for the treatment prescribed.

The group chosen for the present report is one of the best known as to the life history of its members, some of which are among the most easily avoided of all the fungi. It will, therefore, serve as an excellent introduction to the subject. Furthermore, the simplicity of the preventive treatment for some of these diseases will serve to tempt the reader to undertake it, and its striking efficacy will encourage the beginner to try the more laborious treatment for other troubles. The diseases in question are those known as SMUTS. (See Plate I.)

Of the large number of smut fungi which attack plants of all sorts, the number of those which are sources of loss to Massachusetts farmers to such an extent as to deserve mention here is five or six. They are those which cause the diseases known as the loose smuts of oats, barley and corn, and the leaf smuts of rye and of onions.

The loose smuts are peculiarly harmful, because the black smut-masses are formed only in the seeds or grains, the very part for which the plants are cultivated. These smuts of oats, barley and wheat have been regarded until lately as belonging to a single species known as *Ustilago segetum* (Bull.) Ditm.; but those who have studied them most carefully now consider that they include four species, distinguished by differences in spore germination, and by their restriction to particular hosts and their inability to attack others. They are called respectively *Ustilago Avenae* (Pers.), on oats, *U. Hordei* (Pers.) and *U. nuda*, (Jensen) K. & Sw., on barley, and *U. Tritici* (Pers.), on wheat. As the *oat smut* has been studied most and is best known, and is also perhaps the form which causes most loss in Massachusetts, it may be described here as a general type (Fig. 1.)

This fungus can penetrate only the very young tissues of its host plant, and is harmless to tissues whose outer cell walls have begun to harden. To be effective, the fungus-threads must reach the growing tip of the host and develop with it; thus giving no sign of their presence until the plant is well grown and the heads are formed. But the growing point can only be reached when the very young seedling is attacked; therefore all attacks at a late period in the life of the host are soon overcome and outgrown. Now the tuft of hairs or "beard" and the "hulls" of the grain afford very convenient lodging places for smut spores, which are thus sown with the seed, germinate with it, and are ready to attack the young seedling at just the time when their attack is most effectual. Besides, these spores germinate most freely in fresh manure, and produce multitudes of germs which can attack the host plant under favorable circumstances. As it is probable that the spores can pass through the animal body unharmed, the manure from animals which have eaten smutted grain must be a very important source of infection. But it has been shown that the reproductive power of these germs becomes exhausted in the course of a year in manure; therefore old and well rotted manure, while otherwise better for the crop, is also harmless as a carrier of disease.

Professor Kellerman, formerly of the Kansas Agricultural College, has estimated that in Kansas the average annual loss of oats from this disease is equal to six or seven per cent. of the crop, and there is no reason to suppose that this estimate is too high for our own State. On the basis of the statistics of the United States Department of Agriculture this would give an annual loss in Massachusetts of $20,000 from this single smut. Nearly the whole of this amount might very easily be saved, if our farmers would apply the very simple treatment which will certainly limit the disease to an occasional stalk. This consists in soaking the seed for fifteen minutes in hot water, kept at a temperature of 132° F., or for twenty-four hours in a solution of one pound of potassium sulphide (liver of sulphur) in twenty-four gallons of water. Neither of these treatments injures the seed, but, on the contrary, distinctly increases the crop.

Of the *barley smuts* (Fig. 2) one seems to yield readily to the same treatment, while the other seems not to be prevented by it; but, as both forms commonly occur on the same field, at least a considerable decrease in the loss from smut may be expected to follow the treatment of barley with hot water before planting.

Wheat is not a crop of sufficient importance in Massachusetts to make any extended mention necessary here. It is subject not only to the loose smut mentioned above (Fig. 3), but also to the so-called hard or stinking smut or "Bunt" (*Tilletia* sp., Fig. 6). The latter of these is completely controlled by the hot-water treatment, but the former seems not to be affected by it.

A few practical directions for applying the hot-water treatment may be useful here. The seed should first be thoroughly wetted in cold water, and all imperfect seeds and other bodies which float on the top skimmed off. Two kettles of water should be provided, that in one at a temperature of 110° to 120°, and that in the other at the temperature required for the treatment, 132°. The latter should be kept as nearly as possible at the same temperature throughout the treatment, by the addition of hot or cold water whenever the thermometer shows it to be necessary. The seed is taken in lots of perhaps half a bushel at a time in a basket of wire gauze or a bag of very loosely woven material, and plunged first into the cooler water, lifted out and plunged again until it is thoroughly wetted and warmed. This is important, that the seed may not cool the hotter water too much. Now the basket or bag is transferred to the latter and allowed to remain fifteen minutes, during which it is occasionably lifted and lowered and turned about, to ensure the complete wetting of every grain. When the seed is removed it is quickly cooled with cold water and spread out until it is dry enough to be sown.

In the case of the *corn smut* it is not merely the young grains which are attacked, but the pustules may be found upon any part of the plant; and an infection of any part sufficiently young to be penetrated by the fungus gives rise in a few weeks to smut pustules. Thus the plant is not beyond liability to infection until all its tissues are hardened; that is, until the "tassel" appears.

The only treatment for this trouble which can be confidently recommended is the prompt removal and destruction of all smutted parts as soon as they appear. It should hardly be necessary to call attention to the fact that to throw them into the compost heap is not to destroy them, but is often the surest means of perpetuating and disseminating the disease.

Fig. 5 shows a portion of a "tassel" of corn attacked by smut.

The leaf-smut of rye (Fig. 4) forms its black masses on the leaves and stems of rye, which are often considerably distorted by it. It does not, therefore, cause a direct loss of grain, but indirectly reduces the crop by weakening the plants which are attacked.

The same is true of the *onion smut*, which forms its pustules on both leaves and bulbs, and commonly kills its host. If the attack is not too severe, however, the plant may recover, though greatly weakened and never producing a strong bulb. It appears that only the young seedlings are susceptible to attack. This smut is propagated by means of the soil, and its spores may retain their vitality in the earth for several years. Treatment must consist in sowing with the onion seed some fungicidal substance which shall prevent the development of the smut spores in its vicinity, and the consequent infection of the seeding onions. The substance which gives most promise in this line at present is flowers of sulphur, although its protective effect is not all that can be desired. When a field becomes badly infected it should be used for some other crop, and the onion crop transferred to fresh ground for several years, at least.

For the assistance of any who may not feel certain as to the identify of the diseases here discussed, a plate is appended showing the characteristic appearance of the various smuts here mentioned, except that of onions. This plate was made from a photograph taken directly from specimens of diseased plants, and shows the effects of the various fungi on their respective host plants very clearly. With its help one should be able to identify the diseases represented without doubt.

EXPLANATION OF PLATE I.

Appearance of Some Smut Diseases.

(*All figures of natural size.*)

Fig. 1. Loose Smut of Oats, *Ustilago Avenæ* (Pers.) Jens.

Fig. 2. Loose Smut of Barley, naked form, *U. nuda* (Jens.) Kell. & Sw.

Fig. 3. Loose Smut of Wheat, *U. Tritici* (Pers.) Jens.

Fig. 4. Leaf Smut of Rye, *Urocystis occulta* (Wallr.) Rabh.

Fig. 5. Smut of Corn in the staminate flowers or "tassel," *Ustilago maydis* (DC.) Cda.

Fig. 6. Stinking Smut or "Bunt" of Wheat, *Tilletia fœtens* (B. & C.) Trel.


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PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on Commercial Fertilizers.

1. General introduction.
2. State laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers and dealers for May 1, 1890, to May 1, 1891.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

1. General Introduction.

The sale of commercial manurial substances, compound and simple, has been quite active in our State. Forty-eight manufacturers and dealers have applied and received a license for the sale of their various brands in our State. Twenty-six of them are residents of other States.

One hundred and ninety-two samples of licensed articles have been collected in all parts of the State by a duly authorized agent of the station. One hundred and fifty-eight of them have been carefully analyzed at the chemical laboratory of the station with the following results: six samples contained all three essential constituents above the highest guarantee; eighteen samples contained two of the essential constituents above the highest guarantee; forty-two samples contained one of the essential elements above the highest guarantee; sixty-one samples contained all three essential elements at the lowest guarantee; fifty samples contained two elements at the lowest guarantee; thirteen samples contained one element at the lowest guarantee; no samples contained all three essential elements below the stated lowest guarantee; nine samples contained two elements below the stated lowest guarantee; forty-two samples contained one element below the lowest stated guarantee.

The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others. The variations in the market price of the various prominent fertilizer constituents have been during the year within the usual limits. The most serious fluctuations were noticed in case of Chili saltpetre, nitrate of sodium, with a slight advance for corresponding months.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate* in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not unfrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does not express *their respective agricultural value*, i. e., their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (i. e., the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals (1891).

	Cents per Pound.
Nitrogen in ammoniates,	18½
Nitrogen in nitrates,*	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	15½
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine-ground bone and tankage,	15
Organic nitrogen in fine-ground medium bone and tankage,	12
Organic nitrogen in medium bone and tankage,	9½
Organic nitrogen in coarser bone and tankage,	7½
Organic nitrogen in hair, horn shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,	7½
Phosphoric acid in dry ground fish, fine bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	5½
Phosphoric acid in medium bone and tankage,	4½
Phosphoric acid in coarse bone and tankage,	3
Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc.,	5½
Potash as kainite,	4½
Potash as muriate,	4½

* The price of nitrate of soda has of late advanced, on account of the civil war in Chili.

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1891, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. *The Provisions of the Act are as follows:*

[Chapter 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc , as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials Used for Manurial Purposes in Massachusetts.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

3. List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in this State during the Past Year, and the Brands licensed by Each.

Ames Fertilizer Company, Peabody, Mass. : —
    Animal Fertilizer.

E. Frank Coe, New York, N. Y. : —
    High-grade Ammoniated Bone Superphosphate.
    Gold Brand Excelsior Guano.
    Potato Fertilizer.
    Blue Brand Excelsior Guano.
    Red Brand Excelsior Guano.

Cleveland Linseed Company, Worcester, Mass. : —
    Steam-cooked Linseed Meal.

H. J. Baker & Bro., New York, N. Y. : —
    A. A. Ammoniated Superphosphate.
    Pelican Bone Fertilizer.
    Special Potato Manure.
    Special Grass Manure.

Whittemore Bros., Wayland, Mass. : —
    Whittemore's Complete Manure.

J. M. Butman, Lowell, Mass. : —
    Lowell Bone Fertilizer.

Edmund Hersey, Hingham, Mass. : —
    Ground Bone.

J. A. Tucker & Co., Boston, Mass. : —
    Original Bay State Bone Superphosphate.
    Imperial Bone Superphosphate.

J. C. Dow & Co., Boston, Mass. : —
    Nitrogenous Superphosphate.
    Ground Bone Fertilizer.
    Fine-ground Bone.

Cumberland Bone Company, Portland, Me. : —
    Cumberland Bone Superphosphate.
    Seeding-down Fertilizer.
    Potato Fertilizer.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

C. A. Bartlett, Worcester, Mass.: —
Pure Ground Bone.
Animal Fertilizer.

Leander Wilcox, Mystic Bridge, Conn.: —
Dry Ground Fish Guano.
Potato Manure.
Ammoniated Bone Superphosphate.
High-grade Fish and Potash.

W. E. Fyfe & Co., Clinton, Mass.: —
Unleached Wood Ashes.

Daniel T. Church, Tiverton, R. I.: —
Fish and Potash.
Church's Special.
Church's Standard.
Pure Dry Ground Menhaden Guano.

Williams & Clark Fertilizer Company, Boston, Mass.: —
Americus Superphosphate.
Potato Phosphate.
Bone Meal.
High-grade Special.
Tobacco Grower.
Sulphate of Potash.
Muriate of Potash.
Dry Ground Fish.

Cleveland Dryer Company, Boston, Mass.: —
Cleveland Potato Phosphate.
Cleveland Superphosphate.

W. D. Stewart & Co., Boston, Mass.: —
Soluble Pacific Guano.
Special Potato Manure.

Munroe, Judson & Stroup, Oswego, N. Y.: —
Unleached Canada Wood Ashes.

N. Ward Company, Boston, Mass.: —
High-grade Animal Fertilizer.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Standard Fertilizer, Success.
Ammoniated Dissolved Bone Phosphate.
Potato Fertilizer.
Ground Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

G. E. Holmes, Worcester, Mass. : —
Steamed Bone.

A. Lee & Co., Boston, Mass. : —
Lawrence Fertilizer.
Ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Wheat and Corn Phosphate.
Niagara Phosphate.
Ammoniated Practical Phosphate.

F. C. Sturtevant, Hartford, Conn. : —
Tobacco and Sulphur Fertilizer.

Read Fertilizer Company, Syracuse, N. Y. : —
H. G. Farmers' Friend.
Standard Phosphate.
Bone, Fish and Potash.
Strawberry and Small Fruit Special.

Bradley Fertilizer Company, Boston, Mass. : —
X. L. Phosphate.
B. D. Sea-fowl Guano.
Coe's Original Superphosphate of Lime.
Fish and Potash.
Pure Fine-ground Bone.
Bradley's Complete Manures : —
For Potatoes and Vegetables.
For Corn and Grain.
For Top-dressing Grass and Grain
Bradley's Potato Manure.
Nitrate of Soda.
Sulphate of Ammonia.
Muriate of Potash.
Dissolved Bone-black.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Quinnipiac Fertilizer Company, New London, Conn. : —
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash.
- Quinnipiac Market-garden Manure.
- Quinnipiac Bone Meal.
- Quinnipiac Tobacco Fertilizer.
- Muriate of Potash.
- Sulphate of Potash.

Standard Fertilizer Company, Boston, Mass. : —
- Standard Fertilizer.
- Standard Superphosphate.

Sanford Winter, Brockton, Mass. : —
- Pure Ground Bone.

Forest City Wood Ash Company, London, Ont. : —
- Unleached Wood Ashes.

Benjamin Randall, East Boston, Mass. : —
- Market-garden Fertilizer.
- Standard Ground Bone.

Great Eastern Fertilizer Company, Rutland, Vt. : —
- Great Eastern General, for Grain and Grass.
- Great Eastern Vegetable, Vine and Tobacco Fertilizers.
- Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

E. H. Smith, Northborough, Mass. : —
- Steamed Bone.

John G. Jefferds, Worcester, Mass. : —
- Jefferds' Animal Fertilizer.
- Jefferds' Fine-ground Bone.

James E. McGovern, Lawrence, Mass. : —
- West Andover Market Bone Phosphate.
- Fine-ground Bone.

Thos. Hersom & Co., New Bedford, Mass. : —
- Meat and Bone.
- Pure Fine-ground Bone.

3. List of Dealers who have secured Certificates, etc. — Continued.

Adams & Thomas, Springfield, Mass. : —
- Adams' Market Bone Fertilizer.

Hargrave Manufacturing Company, Fall River, Mass. : —
- Steamed Bone.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
- The Mapes Bone Manures.
- Peruvian Guano.
- Mapes Superphosphate.
- Mapes Special Crop Manures.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
- Darling's Animal Fertilizer.
- Extra Bone Phosphate.
- Potato and Root Crop Manure.
- Fine Bone.
- Dissolved Bone.
- Fertilizer for Lawns and Gardens.

Bowker Fertilizer Company, Boston, Mass. : —
- Stockbridge Manures.
- Hill and Drill Phosphate.
- Lawn and Garden Phosphate.
- Ammoniated Bone Fertilizer.
- Fish and Potash.
- Dry Ground Fish.
- Gloucester Fish and Potash.
- Fresh Ground Bone.
- Plain Superphosphate.
- Kainite.
- Nitrate of Soda.
- Dried Blood.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.
- Breck's Lawn and Garden Dressing.

Lucien Sanderson, New Haven, Conn. : —
- Formula A.
- Pulverized Bone Meal.
- Dissolved Bone-black.
- Sulphate of Potash.

3. *List of Dealers who have secured Certificates, etc.* — Concluded.

Prentiss, Brooks & Co., Holyoke, Mass.: —
- H. L. Phelps' Complete Manures.
- Dry Fish.
- Muriate of Potash.
- Nitrate of Soda.
- Dissolved Bone-black.
- H. L. Phelps' Superphosphate.
- Fish and Potash.
- Guano and Potash.
- Tankage.

The Le Page Company, Boston, Mass.: —
- Red Star Brand 203 Fertilizer.
- Red Star Brand Special Potato Manure.

John S. Reese & Co., Baltimore, Md.: —
- Bay State Fertilizer.
- New England Favorite.
- Bay State Fertilizer, G. G.
- May Flower Guano.
- Pilgrim Fertilizer.
- Great Planet, A.
- Columbus, A.
- Potato and Corn.
- Fish and Potash.
- Dry Ground Fish.

Thomas Joynt, St. Helens, Ont.: —
- Canada Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn.: —
- Chittenden's Complete Fertilizer.
- Chittenden's Fish and Potash.
- Chittenden's Universal Phosphate.
- Ground Bone.

W. J. Brightman & Co., Tiverton, R. I.: —
- Fish and Potash.
- Ground Acidulated Fish Guano.
- Ammoniated Bone Superphosphate.

4. *Analyses of Commercial Fertilizers collected during 1891, in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
1	Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Worcester.
5	Mapes Manure for Corn,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
6	Mapes Manure for Tobacco,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
7	Mapes Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
11	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
12	Stockbridge's Manure for Potatoes and Vegetables,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
15	Bradley's X. L. Superphosphate,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
16	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
18	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
19	Quinnipiac Phosphate,	The Quinnipiac Company, Boston, Mass.,	Northampton.
20	Quinnipiac Fish and Potash (crossed fish brand),	The Quinnipiac Company, Boston, Mass.,	Northampton.
26	Quinnipiac Dry Ground Fish,	The Quinnipiac Company, Boston, Mass.,	Hatfield.
36	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
37	Animal Fertilizer,	Ames Fertilizer Company, Peabody, Mass.,	West Acton.
38	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
	Bones.		
2	Pure Ground Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
3	Jefferds' Fine-ground Bone,	John G. Jefferds, Worcester, Mass.,	Worcester.
4	Fine-ground Bone,	Gilbert E. Holmes, Worcester, Mass.,	Worcester.
33	Bowker's Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Concord.
40	Chittenden's Ground Bone,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
52	Ground Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
59	Steamed Bone,	E. H. Smith, Northborough, Mass.,	Amherst.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide Guaranteed.
	Compound Fertilizers.												
1	Animal Fertilizer,	5.06	5.30	3.3—4.12	.50	8.29	4.25	13.04	16—18	8.79	-	7.99	7—8
5	Mapes Manure for Corn,	4.95	3.60	3.71—4.12	4.99	4.68	.83	10.50	10—12	9.67	8—10	6.53	6—7
6	Mapes Manure for Tobacco,	11.95	5.64	6.18	.78	3.13	1.96	5.87	4.5	3.91	-	10.21	10.50*
7	Mapes Manure for Potatoes,	11.37	3.56	3.71—4.12	6.78	1.13	1.43	9.34	8—10	7.91	8	7.80	6—8*
11	Stockbridge's Manure for Onions,	11.45	3.10	3—4	4.11	5.32	1.61	11.04	8—10	9.43	7—8	5.75	5—6
12	Stockbridge's Manure for Potatoes and Vegetables,	10.34	3.48	3.25—4.25	4.72	4.68	2.06	11.46	8—10	9.40	7—8	5.48	5—6
15	Bradley's X. L. Superphosphate,	14.20	2.83	2.5—3.25	7.42	2.54	1.75	11.71	11—14	9.96	9—11	2.72	2—3*
16	Bradley's Potato Manure,	13.25	4.29	2.5—3.25	4.34	5.42	2.34	12.10	8—11	9.76	6—8	4.30	5—6*
18	Adams' Market Bone Fertilizer,	10.02	4.49	2.5—3.5	.61	6.46	3.80	10.87	8—10	7.07	6—8	4.85	3—5
19	Quinnipiac Phosphate,	14.15	2.95	2.47—3.3	5.55	4.65	1.02	11.22	10—15	10.20	9—12	2.41	2—3
20	Quinnipiac Fish and Potash (crossed fish brand),	20.16	3.60	3.3—4.12	.23	2.23	6.18	8.64	5—9	2.46	4—6	4.82	4—6*
26	Quinnipiac Dry Ground Fish,	9.26	8.60	7.41—9.06	.26	3.01	4.16	7.43	7—9	3.27	-	-	-
36	Lowell Bone Fertilizer,	13.23	2.46	2—2.5	6.17	3.78	1.05	11.00	10—16.5	9.95	9—13.5	2.94	2—3.5
37	Animal Fertilizer,	16.58	3.35	3.3—4.12	3.94	5.68	.40	10.02	9—12	9.62	8—10	3.22	2.75—3.5
38	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	14.76	3.42	3.3—4.12	3.40	4.82	2.72	10.94	8—10	8.22	6—8	6.98	6—8

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analysis. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
2	Pure Ground Bone,	5.40	2.77	2—3	.41	14.32	12.05	26.78	25—27	14.73	-	56.92	19.79	17.32	5.97
3	Jefferds' Fine-ground Bone,	10.39	1.85	2.47—4.12	.20	13.90	11.54	25.63	25—30	14.10	-	69.59	24.99	5.42	-
4	Fine-ground Bone,	4.40	2.71	2.5—3.5	.26	12.20	12.60	25.06	22—24	12.46	-	49.00	32.86	14.29	3.85
33	Bowker's Fresh Ground Bone,	9.76	3.17	2.47—3.3	2.69	12.17	4.18	19.04	18—22	14.86	5—7	45.29	25.30	22.35	7.06
40	Chittenden's Ground Bone,	6.06	3.80	2.88—3.71	.29	5.96	14.42	20.67	20—24	6.25	-	41.24	25.19	19.19	14.38
52	Ground Bone,	4.70	3.78	3—4	.29	6.65	14.35	21.29	19—25	6.94	-	46.87	37.72	14.04	1.37
59	Steamed Bone,	6.61	4.03	3.86	.25	5.00	17.21	22.46	22.69	5.25	5.84	49.19	27.20	21.16	2.45

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
28	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
35	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	South Acton.
39	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
41	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Framingham.
42	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Concord.
46	Crocker's Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
50	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	West Acton.
60	Williams & Clark Fertilizer Company's Potato Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
72	Church's Fish and Potash (D brand),	Joseph Church & Co., Tiverton, R. I.,	Springfield.
74	Complete Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
78	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
79	E. Frank Coe's High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Lee.
88	Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md.,	Pittsfield.
95	Pulverized Meat and Bone,	Lucien Sanderson, New Haven, Conn.,	Hadley.
104	Soluble Pacific Guano,	W. D. Stewart, Boston, Mass.,	Sunderland.
107	Bradley's High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
109	Cleveland Potato Phosphate,	Cleveland Dryer Company, Boston, Mass.,	South Deerfield.
114	Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
115	Soluble Pacific Guano,	W. D. Stewart, Boston, Mass.,	Barre Plains.
127	Brightman & Co.'s Dry Ground Menhaden Fish Guano,	Wm. J. Brightman & Co., Tiverton, R. I.,	Fall River.
130	Meat and Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
132	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	New Bedford.
139	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Wayland.
140	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Saxonville.
145	Church's Fish and Potash (D brand),	Joseph Church & Co., Tiverton, R. I.,	Taunton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
28	Bowker's Hill and Drill Phosphate, . . .	15.52	2.83	2.5—3.25	6.15	2.88	2.57	11.60	12—14	9.03	8—10	2.14	2—3
35	Dow's Nitrogenous Superphosphate, . .	16.48	2.34	2.06—2.88	3.97	5.17	2.32	11.46	-	9.14	8—10	3.14	3—4
39	Chittenden's Ammoniated Bone Superphosphate,	20.55	2.14	1.65—2.47	6.37	2.56	1.69	10.62	9—11	8.93	7—9	2.96	2—4
41	Original Bay State Bone Superphosphate, .	19.06	2.56	2.47—2.88	.91	6.78	3.30	10.99	10—12	7.69	9—9.5	2.78	2—3
42 / 132	Tobacco and Sulphur Lawn Fertilizer, . .	17.17	1.76	1.96	-	-	-	.81	.75	-	-	8.06	7.66
46	Crocker's Ammoniated Wheat and Corn Phos.,	17.25	3.12	2—3	5.56	5.36	4.14	15.06	-	10.92	10—13	3.10	1.75—2.92*
50	Cumberland Superphosphate, ...	16.20	3.30	2—3	4.62	5.60	3.88	14.10	12—14	10.22	9—12	3.14	2—3
60	Williams & Clark Fertilizer Co.'s Potato Phos.,	13.68	3.24	2.47—3.30	5.42	.78	2.65	8.85	-	6.20	6—9	5.55	5—6*
72 / 145	Church's Fish and Potash (D brand), . .	25.11	4.28	3.30—4.12	.84	4.30	1.05	6.19	5—6	5.14	-	4.32	3—4
74	Complete Potato Manure, ...	11.52	3.40	3.30	4.44	2.38	1.24	8.06	-	6.82	5.75	11.34	10
78	Great Eastern Vegetable, Vine and Tob. Fer.,	17.00	2.10	2.06—2.88	5.94	2.21	1.93	10.08	-	8.15	8—12	6.48	6—8
79	Coe's High-grade Ammoniated Bone Sup'rph.,	15.59	2.50	2—2.5	7.68	2.50	2.20	12.38	11—13	10.18	9—12	2.08	2*
88 / 114	Pilgrim Fertilizer, ...	7.56	1.56	1—1.45	3.70	5.20	1.77	10.67	7.5—11.5	8.90	6.5—8.5	3.51	2.5—3.5
95	Pulverized Meat and Bone, ...	1.95	5.85	4.94—5.77	.77	8.85	7.70	17.32	18—20	9.62	-	-	-
104 / 115	Soluble Pacific Guano, ...	16.27	3.00	2.25—3	7.22	2.68	2.02	11.92	10.5—16	9.90	8.5—12	4.64	3.70—6.50
107	Bradley's High-grade Tobacco Manure, . .	9.06	5.46	5.77—6.59	1.43	3.04	2.05	6.52	4—5	4.47	-	9.62	10.80—12.40*
109	Cleveland Potato Phosphate, ...	18.31	2.37	2.05—2.85	7.19	2.18	2.09	11.46	-	9.37	8—10	3.66	3.25—4.25*
127	Brightman & Company's Dry Gr. Men. F. G.,	10.51	7.96	8.24—9.89	1.15	3.43	3.77	8.35	6.87—9.16	4.58	-	-	-
130	Meat and Bone, ...	4.81	4.48	4.24	.38	6.85	11.55	18.78	19.52	7.23	6.73	-	-
139	Whittemore's Complete Manure, . . .	15.90	2.58	2.47—3.30	4.41	8.45	3.28	16.14	18—14	12.86	8—12	4.68	3—4
140	Standard Fertilizer, ...	17.23	2.95	2—3	7.00	4.90	1.84	13.74	10—15	11.90	8—12	3.19	2—3*

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
48	Bone Superphosphate for Vegetables,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
54	Bowker's Bone-black,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
61	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
67	The H. L. Phelps Superphosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
75	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
92	Dissolved Bone-black,	Lucien Sanderson, New Haven, Conn.,	Hadley.
99	Wilcox Potato Manure,	Leander Wilcox, Mystic, Conn.,	Amherst.
123	Darling's Animal Fertilizer,	Darling Fertilizer Co., Pawtucket, R. I.,	Worcester.
133	Strawberry Special,	Read Fertilizer Company, New York, N. Y.,	Dighton.
147	Fish and Potash,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
150	Randall's Market-garden Fertilizer,	Benj. Randall, East Boston, Mass.,	East Boston.
155	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Newburyport.
156	Red Star Brand Special Fertilizer for Potatoes, Cabbages, etc.,	Le Page Company, Boston, Mass.,	Boston.
162	Lister's Success Standard Fertilizer,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
177	Huanillos Peruvian Guano,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Boston.
185	Fish and Potash,	Read Fertilizer Company, Syracuse, N. Y.,	Northampton.
190	Lister's Ammoniated Dissolved Bone,	Lister Agricultural and Chemical Works, Newark, N. J.,	
	Bones.		
62	Fine Pure Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
117	Pure Ground Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
167	Lavery's Pure Ground Bone,	William Lavery, Amesbury, Mass.,	Amesbury.
170	West Andover Ground Bone,	James E. McGovern, Lawrence, Mass.,	Lawrence.
181	S. Winter's Pure Ground Bone,	Sanford Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
48 } 155 }	Bone Superphosphate for Vegetables,	11.64	5.52	5—6	3.42	4.11	1.30	8.83	-	7.53	6—7	6.72	6—8*
54	Bowker's Bone-black,	18.64	-	-	13.43	2.38	.59	16.40	-	15.81	15—18	-	-
61	Americus Brand Ammon. Bone Superphosphate,	14.42	2.68	2.47—3.30	7.77	1.75	2.46	11.98	-	9.52	9—11	1.90	2—3*
67	The H. L. Phelps Superphosphate,	15.72	2.62	2.47—3.30	9.11	-	.75	9.86	10—12	9.11	8—10	3.25	3—4
75	A. A. Ammoniated Superphosphate,	8.01	3.86	2.47—3.30	8.12	.27	1.10	9.49	-	8.39	10—12	2.03	2—3
92	Dissolved Bone-black,	17.30	-	-	15.94	.51	.46	16.91	-	16.45	16—18	-	-
99	Wilcox Potato Manure,	20.61	3.82	3.25—4.25	5.23	1.77	.52	7.52	8—9	7.00	7—8	6.10	6—7
123	Darling's Animal Fertilizer,	15.82	3.40	3.30—4.94	3.39	3.04	4.89	11.32	10—12	6.43	-	4.28	4—6
133	Strawberry Special,	17.50	3.62	3.30—4.94	3.61	1.49	2.10	7.20	6—8	5.10	5—6	6.80	6—8*
147	Fish and Potash,	14.04	4.00	2.47—4.11	6.79	2.70	1.54	11.03	7—10	9.49	6.5—8	4.64	3—5
150	Randall's Market-garden Fertilizer,	22.40	3.92	1.65—2.88	7.06	3.83	.82	11.71	10—16	10.89	8—11	2.09	2—4
156	Red Star Brand Special Fertilizer for Potatoes, etc.,	16.05	3.98	3—4	5.26	2.39	1.45	9.10	8—10	7.65	6—8	5.80	5—6*
162	Lister's Success Standard Fertilizer,	21.86	1.89	.91—1.65	8.32	2.11	1.07	11.50	10.5—12	10.43	-	1.53	1.5—2*
177	Huanillos Peruvian Guano,	14.63	1.18	1.58	.18	4.65	21.57	26.40	27.56	4.83	-	.25	.29
185	Fish and Potash,	19.31	2.60	2.47—3.30	3.36	.89	1.38	5.63	5—6	4.25	4—5	4.48	4—5*
190	Lister's Ammoniated Dissolved Bone,	11.89	2.48	1.81—2.06	6.67	2.18	5.35	14.20	11—13	8.85	9—10	1.69	2—3*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
62	Fine Pure Ground Bone,	10.03	3.34	3.30—3.91	-	2.37	21.62	23.97	22—26	2.35	-	.03	10.79	82.40	6.78
117	Pure Ground Bone,	6.68	2.88	2.50—2.80	.67	13.75	10.69	25.13	25—27	14.44	-	36.37	22.23	18.60	22.80
167	Lavery's Pure Ground Bone,	9.25	2.52	-	.18	9.16	5.97	15.31	-	9.34	-	47.05	32.38	18.51	2.06
170	West Andover Ground Bone,	10.24	2.02	-	-	12.76	10.59	23.35	-	12.76	-	63.20	26.60	8.34	1.86
181	S. Winter's Pure Ground Bone,	8.07	2.56	3.16	.45	12.26	13.29	26.00	23.60	12.71	11.28	53.72	26.35	15.73	4.20

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
66	Fish and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
69	Tankage,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
77	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Pittsfield.
84	Extra Fine-ground Bone with Potash (circle brand),	Bradley Fertilizer Company, Boston, Mass.,	Pittsfield.
89	Reese's May Flower Guano,	John S. Reese & Co , Baltimore, Md.,	Pittsfield.
93	Blood, Meat and Bone,	Lucien Sanderson, New Haven, Conn.,	Hadley.
102	Wilcox's Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
112	Blue Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	South Deerfield.
122	Reese's May Flower,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
124	Complete Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
128	Fish Pomace,	W. J. Brightman & Co., Tiverton, R. I.,	Taunton.
138	Quinnipiac Market Garden Fertilizer,	The Quinnipiac Company, Boston, Mass.,	Fall River.
148	Dry Ground Fish,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
166	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Woburn.
172	Dow's Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Boston.
175	Standard Guano,	Standard Fertilizer Company, Boston, Mass.,	Boston.
186	B. D. Sea Fowl Guano,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.
	Bones.		
80	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
86	Quinnipiac Pure Bone Meal,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
91	Quinnipiac Pure Bone Meal,	The Quinnipiac Company, Boston, Mass.,	Springfield.
131	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
151	Standard Ground Bone,	Benj. Randall, East Boston, Mass.,	East Boston.
154	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Newburyport.
161	Lister's Celebrated Ground Bone,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
192	Dow's Ground Bone,	John C. Dow & Co., Boston, Mass.,	

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
66	Fish and Potash,	9.91	4.38	3.30—4.12	1.46	2.15	1.97	5.58	5—6	3.61	-	4.80	4—5
69	Tankage (Prentiss, Brooks & Co.),	5.14	6.32	5.77	-	7.04	3.07	10.11	10—11	7.04	-	-	-
77	New Rival Ammoniated Superphosphate,	13.81	1.39	1.2—2.05	3.40	6.20	2.83	12.43	-	9.60	10—12	2.27	1.6—2.7*
84	Bone and Potash (Bradley),	10.86	2.34	1.85—2.68	.99	4.74	6.83	12.56	8—12	5.73	-	2.22	2—3
89	Reese's May Flower Guano,	15.46	2.10	1.65—2.06	2.97	7.70	.86	11.53	9.5—12.5	10.67	8—9	1.93	2—2.5
93	Blood, Meat and Bone,	6.00	6.46	5.77—7.41	.26	5.30	5.40	10.96	10—12	5.56	-	-	-
102	Wilcox's Dry Ground Fish Guano,	8.32	8.76	8—10	.77	4.21	3.12	8.10	-	4.98	4—6	-	-
112	Blue Brand Excelsior Guano,	10.06	6.08	6—7	6.40	1.82	2.05	10.27	-	8.22	7—10	3.56	3*
122	Reese's May Flower,	9.25	2.00	1.8—2.05	3.08	6.95	.93	10.96	10—13	10.03	8.5—10	2.49	2.25—3
124	Baker's Complete Grass Manure,	13.26	3.24	3.71	6.05	.41	.26	6.72	5	6.46	-	8.95	7.5
128	Brightman's Fish Pomace,	38.09	4.87	-	.19	.64	2.85	3.68	-	.83	-	-	-
138	Quinnipiac Market Garden Fertilizer,	12.33	3.44	3.30—4.12	7.45	1.94	1.37	10.76	9—13	9.39	8—11	7.14	7—8*
148	Reese's Dry Ground Fish,	7.38	8.72	8.65	.41	2.40	4.55	7.36	-	2.81	-	-	-
166	Bowker's Lawn and Garden Dressing,	12.87	4.02	4—5	5.88	2.23	2.02	10.13	6—8	8.11	5—6	6.88	5—6*
172	Dow's Ground Bone Fertilizer,	3.80	2.46	2.06—2.47	.84	5.97	14.35	21.16	18—22	6.81	-	3.53	3—4
175	Standard Guano,	16.89	2.29	1—2	7.06	3.19	1.28	11.53	10—15	10.25	8—12	2.08	2—3*
186	B. D. Sea Fowl Guano,	15.75	2.58	2.5—3.25	6.63	3.28	2.35	12.26	11—14	9.91	9—11	2.03	2—3*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen. Found.	Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analysis. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
80, 154	Crocker's Pure Ground Bone,	7.51	3.74	2.9—3.7	.23	4.94	17.35	22.52	25	5.17	-	23.17	31.76	26.06	19.01
86, 91	Quinnipiac Pure Bone Meal,	11.93	2.49	2.47—4.12	.10	6.08	15.38	21.56	20—25	6.18	-	62.67	35.32	2.01	-
131	Pure Fine-ground Bone,	7.59	2.00	2.8	.50	8.91	19.80	29.21	29.42	9.41	13.62	62.59	16.67	17.40	3.34
151	Standard Ground Bone,	11.89	2.64	2—3	3.04	5.94	5.26	14.24	14—16	8.98	5—7	35.18	40.25	30.32	4.25
161	Lister's Celebrated Ground Bone,	8.05	2.90	2.7—2.9	.32	4.95	6.88	12.15	12—14	5.27	-	38.75	29.10	17.15	15.00
192	Dow's Ground Bone,	5.80	1.81	1.65—2.47	.16	8.21	18.06	26.43	24—26	8.37	-	64.17	35.83	-	-

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
13	Stockbridge's Manure for Top-dressing,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
17	Hampden Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
32	Stockbridge's Manure for Top-dressing,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
34	Stockbridge's Manure for Strawberries and Small Frui s,	Bowker Fertilizer Company, Boston, Mass.,	Concord.
44	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
47	Crocker's Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
49	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	South Acton.
63	The H. L. Phelps' Complete Manure for Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
71	Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
81	Crocker's Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
82	Quinnipiac Potato Manure,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
83	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
87	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Company, Boston, Mass.,	Pittsfield.
98	Quinnipiac Grass Fertilizer,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
100	Wilcox's High-grade Fish and Potash,	Leander Wilcox, Mystic, Conn.,	Amherst.
101	Wilcox's Ammoniated Bone Phosphate,	Leander Wilcox, Mystic, Conn.,	Amherst.
105	Bradley's Complete Manure for Top-dressing,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
106	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
110	Cleveland Superphosphate,	Cleveland Dryer Company, Boston, Mass.,	South Deerfield.
111	Red Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	South Deerfield.
113	Bay State Fertilizer G. G.,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
116	Concentrated Potato and Corn Manure,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
118	Church's Special Fertilizer,	Josepn Church & Co., Tiverton, R. I.,	Dighton.
120	Darling's Fertilizer for Gardens and Lawns,	Darling Fertilizer Company, Pawtucket, R. I.,	Worcester.
129	Church's Pure Dry Fish,	Joseph Church & Co., Tiverton, R. I.,	Dighton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
13, 32	Stockbridge's Manure for Top-dressing,	5.76	5.05	5—6	3.20	.83	6.33	10.36	6—7	4.03	3—4	6.51	5—6
17	Hampden Lawn Dressing,	9.40	4.54	3.30—4.12	2.53	2.77	1.33	6.63	7—9	5.30	6—8	2.23	2—3
34	Stockbridge's Manure for Strawberries and Small Fruits,	10.47	3.08	2.50—3.25	7.01	1.28	2.51	10.80	7—9	8.29	6—7	3.18	4.32—5.40*
44	English Lawn Fertilizer,	8.94	5.10	4.95—5.78	2.99	2.88	1.09	6.96	6—8	5.87	5—7	3.01	2.50—3.50
47, 81	Crocker's Special Potato Manure,	11.58	3.36	3.70—4.50	5.44	1.23	2.00	8.67	9—11	6.67	8—9	6.97	5—6*
49, 83	Ammoniated Bone Superphosphate,	11.45	2.60	2.90—3.70	4.96	3.23	3.91	12.10	10—12	8.19	10—13	1.76	1—2*
63	The H. L. Phelps' Complete Manure for Grass,	11.62	4.70	4.12—4.94	4.91	1.73	.47	7.11	6—8	6.64	3—4	7.76	8—10
71	Guano and Potash,	11.65	3.64	3.30—4.12	1.07	3.34	2.97	7.38	5—6	4.41	-	5.03	5—7
82	Quinnipiac Potato Manure,	14.52	3.10	2.47—3.30	2.88	3.09	3.71	9.68	7—11	5.97	6—9	4.90	5—6*
87	Stockbridge's Manure for Seeding Down,	11.95	2.36	2.47—3.30	5.27	5.27	2.30	12.84	12—14	10.54	6—8	8.38	5.05—6.32
98	Quinnipiac Grass Fertilizer,	12.91	3.58	3.30—4.12	4.25	1.80	2.69	8.74	7—10	6.05	6—8	4.81	5—7*
100	Wilcox's High-grade Fish and Potash,	22.50	4.00	3.25—4.25	2.65	1.89	2.05	6.59	6—7	4.54	5—6	4.21	4—5
101	Wilcox's Ammoniated Bone Phosphate,	21.50	4.00	3.25—4.25	3.63	2.05	2.10	7.78	7—8	5.68	6—7	5.07	5—6
105	Bradley's Complete Manure for Top-dressing,	8.21	5.16	6—7	1.92	2.78	2.02	6.72	6—9	4.70	5—7	2.90	2.50—3.50*
106	Bradley's Complete Manure for Potatoes and Vegetables,	11.36	4.08	3.73—4.52	4.30	5.06	2.56	11.92	9—13	9.36	8—11	4.72	6—7
110	Cleveland Superphosphate,	14.62	2.80	2.05—2.85	5.82	2.88	2.94	11.65	11—14	8.70	9—11	2.26	2—3*
111	Red Brand Excelsior Guano,	12.33	2.96	3.50—4	7.00	.18	3.28	10.46	10—14	7.18	9—12	5.08	6*
113	Bay State Fertilizer G. G.,	19.33	1.92	1.80—2.50	2.61	8.16	.77	11.54	10—13	10.77	8.5—10	2.34	2.25—3
116	Concentrated Potato and Corn Manure,	15.61	3.28	2.97—3.80	3.83	4.63	.42	8.88	7—10	8.46	6—8	7.61	7.50—9.50
118	Church's Special Fertilizer,	13.99	5.16	4.94—5.77	4.35	2.77	1.96	9.08	12—13	7.12	-	6.72	6—7
120	Darling's Fertilizer for Gardens and Lawns,	10.53	5.08	4.94—6.59	1.69	6.53	3.89	12.11	10—12	8.22	-	4.95	5—6
129	Church's Pure Dry Fish,	10.10	9.35	8.24—9.89	.10	4.06	3.16	7.32	6.87—11.45	4.16	-	-	-

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
29	Stockbridge's Manure for Corn, Grain and Fodder Corn,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
103	Gold Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Sunderland.
143	Bradley's Dry Ground Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Taunton.
144	Bradley's Fish and Potash,	Bradley Fertilizer Company, Boston, Mass.,	Taunton.
146	New England Favorite,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
149	Columbus A. Manure,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
153	The Lawrence Fertilizer,	A. Lee & Co., Lawrence, Mass.,	Lawrence.
163	Williams & Clark Company's Royal Bone Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
164	Williams & Clark Company's Prolific Crop Producer,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
171	Breck's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass., Licensees,	Boston.
173	Mayo's Superphosphate,	Clarence E. Mayo & Co., Boston, Mass.,	Woburn.
174	N. Ward Company's High-grade Animal Fertilizer,	The N. Ward Company, Boston, Mass.,	Boston.
182	Read's Standard Phosphate,	Read Fertilizer Company, Syracuse, N. Y.,	Greenfield.
184	High-grade Farmers' Friend,	Read Fertilizer Company, Syracuse, N. Y.,	Northampton.
	Chemicals.		
21	Dissolved Bone-black,	Quinnipiac Fertilizer Company, Boston, Mass., Licensees,	Northampton.
23	Muriate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass., Licensees,	Northampton.
55	High-grade Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
57	Sulphate of Ammonia,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
58	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
65	Dissolved Bone-black,	Prentiss, Brooks & Co., Holyoke, Mass ,	Holyoke.
70	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
94	Sulphate of Potash,	Lucien Sanderson, New Haven, Conn.,	Hadley.
96	Muriate of Potash,	Lucien Sanderson, New Haven, Conn.,	Hadley.
	Wood Ashes.		
14	Canada Wood Ashes,	Forest City Wood Ash Company, London, Ontario, Canada,	South Deerfield.
51	Canada Wood Ashes,	Wm. E. Fyfe & Co., Clinton, Mass., Licensees,	Concord.
180	Unleached Canada Wood Ashes,	Monroe, Judson & Stroup, Oswego, N. Y.,	N. Amherst City.
189	Canada Hard-wood Ashes,	Thomas Joynt, St. Helen's, Ontario, Canada,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
29	Stockbridge's Manure for Corn, Grain and Fodder Corn,	12.86	3.30	3.25—4.25	5.63	2.97	2.61	11.21	9—11	8.60	8—9	4.83	4.42—5.69
103	Gold Brand Excelsior Guano,	10.62	2.86	2.5—3	5.88	5.56	2.25	13.69	-	11.44	8—11	5.03	6—8*
143	Bradley's Dry Ground Fish Guano,	9.08	8.54	8.24—9.89	.58	3.42	4.80	8.80	6—8	4.00	-	-	-
144	Bradley's Fish and Potash,	19.51	3.20	2.48—3.50	3.79	2.91	1.82	8.52	7.5—9.5	6.70	6—8	2.35	2—3*
146	New England Favorite,	18.45	3.30	2.47—3.30	3.07	6.89	.79	10.75	10—14	9.96	9—12	2.62	2—3
149	Columbus A. Manure,	14.65	3.63	3.29—4.11	3.33	3.68	1.05	8.06	8—11	7.01	7—9	9.40	9.5—11
153	The Lawrence Fertilizer,	12.96	2.71	2.06—2.88	6.12	4.37	1.84	12.33	10—12	10.49	-	2.82	2—3
163	Williams & Clark Co.'s Royal Bone Phosphate,	17.18	1.58	1.03—1.65	3.43	3.00	3.15	9.58	8—11	6.43	7—9	2.13	2—3*
164	Williams & Clark Co.'s Prolific Crop Producer,	15.70	1.96	.82—1.65	4.95	3.33	2.10	10.38	7—11	8.28	6—9	1.65	1—2*
171	Breck's Lawn and Garden Dressing,	9.21	4.02	4.12—4.94	6.01	1.73	5.03	12.77	-	7.74	5—6	4.95	5—6
173	Mayo's Superphosphate,	13.67	2.84	2.05—2.85	6.65	3.43	2.61	12.69	10—14	10.08	9—11	2.82	2.5—3.5
174	N. Ward Co.'s High-grade Animal Fertilizer,	6.80	3.55	2.88—3.70	6.18	6.34	.70	13.22	-	12.52	12—14	4.41	4—5
182	Read's Standard Phosphate,	15.62	1.48	.82—1.65	7.01	1.73	1.15	9.89	10—12	8.74	8—10	3.08	4—6*
184	High-grade Farmers' Friend,	11.96	3.45	3.30—4.12	3.68	2.18	3.02	8.88	-	5.86	5—6	9.46	10—11
	Chemicals.												
21	Dissolved Bone-black,	18.82	-	-	12.84	1.81	.38	15.03	-	14.65	15—18	-	-
23	Muriate of Potash,	1.13	-	-	-	-	-	-	-	-	-	49.00	50.54—53.70
55	High-grade Sulphate of Potash,	1.55	-	-	-	-	-	-	-	-	-	48.32	51.88
57	Sulphate of Ammonia,	2.53	19.98	19.77—20.57	-	-	-	-	-	-	-	-	-
58	Nitrate of Soda,	1.81	15.76	15.65—16.14	-	-	-	-	-	-	-	-	-
65	Dissolved Bone-black,	17.73	-	-	16.14	.27	.14	16.45	-	16.41	17.50	-	-
70	Muriate of Potash,	1.35	-	-	-	-	-	-	-	-	-	51.72	53.70
94	Sulphate of Potash,	3.77	-	-	-	-	-	-	-	-	-	26.52	27.02—29.72
96	Muriate of Potash,	1.33	-	-	-	-	-	-	-	-	-	50.64	50.54—53.70
	Wood Ashes.												
14	Canada Wood Ashes,	11.15	-	-	-	-	-	1.65	1.5—2.5	-	-	5.37	4.5—8
51	Canada Wood Ashes,	4.70	-	-	-	-	-	1.02	1—3	-	-	7.00	5—8
180	Unleached Canada Wood Ashes,	24.69	-	-	-	-	-	1.56	1—2.5	-	-	4.48	4.5—7
189	Canada Hard-wood Ashes,	16.52	-	-	-	-	-	1.57	-	-	-	4.64	5—7

* Sulphate of potash, the source of potash.

Methods of Fertilizer Analysis.

Preparation of Sample. — The entire available sample is spread upon a smooth, hard surface, and intimately mixed without grinding, all lumps being broken up with a spatula. Unnecessary loss or gain of moisture is to be avoided. *Moisture:* dry 2 grams in the air-bath at 100 to 110° C. to constant weight.

1. *Total Phosphoric Acid.* — Weigh out 2 grams in a platinum crucible, and destroy the organic matter by carefully burning in a muffle. Weigh when cool, to determine the "organic and volatile matter." Digest the crucible and contents with dilute hydrochloric acid, until the solution of the latter is complete. Filter, and evaporate the filtrate to complete dryness. The "insoluble matter" on the filter is burned and weighed. The residue left from the evaporation is taken up with dilute nitric acid, if the molybdic method is to be followed, but with hydrochloric acid if method (2) is preferred. The solution after filtering is made up to a volume of 200 cubic centimetres with distilled water.

(1) The molybdic method: 25 cubic centimetres of the solution are digested in a water-bath at 65° C. from one to two hours, with an excess of molybdic solution. The precipitate is brought upon a filter, and washed with water containing a little molybdic solution. It is then dissolved in ammonia water, the solution nearly neutralized with hydrochloric acid, and magnesia mixture added slowly, with constant stirring. The precipitate is allowed to stand at least three hours, when it is filtered through a Gooch crucible, washed with dilute ammonia, ignited and weighed.

(2) The following method is occasionally employed when phosphates of iron and alumina are present in small quantities only: To 50 cubic centimetres of the hydrochloric acid solution add ammonia in slight excess. After standing a few minutes, acidify with acetic acid, and filter off the phosphates of iron and alumina, washing carefully with water. To the filtrate add sufficient oxalate of ammonia to precipitate all the lime; digest for several hours at a temperature below boiling, and filter through double filters which have previously been washed with oxalate of ammonia, washing

thoroughly with water. Dissolve the phosphates of iron and alumina on the filter with warm dilute hydrochloric acid, and wash into a beaker containing a small quantity of powdered tartaric acid. When the latter has gone into solution, mix with the filtrate from the oxalate of ammonia. The phosphoric acid is precipitated with magnesia mixture, and treated as in (1).

Soluble phosphoric acid: Weigh out 2 grams into a beaker, cover with 10 to 15 cubic centimetres of water, and allow it to stand for fifteen minutes, stirring three times at equal intervals. Decant the solution through a filter into a graduated cylinder. Add another like quantity of water, and let it stand fifteen minutes more, stirring as before. Filter the solution into the cylinder, and wash the residue on the filter until the filtrate amounts to 200 cubic centimetres. The phosphoric acid is determined in an aliquot part of the solution as under total phosphoric acid.

Insoluble phosphoric acid: Add 100 cubic centimeters of neutral ammonia citrate (sp. gr. 1.09) to the beaker in which the digestion with water has been made. Put in a water-bath and heat to 65° C. Drop in the filter containing the residue from the above operation, and digest for thirty minutes, stirring every five minutes. Filter and wash thoroughly, using the suction pump. Dry, and burn. The ash is then treated as under total phosphoric acid.

Reverted phosphoric acid: The sum of the soluble and insoluble substracted from the total gives the reverted or citrate-soluble phosphoric acid.

Reagents: The reagents used in the estimation of phosphoric acid are prepared according to directions given in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (pages 228 and 229).

For ammonium citrate, 370 grams of citric acid are dissolved in 1,500 cubic centimetres of water, nearly neutralized with crushed carbonate of ammonia, heated to expel carbonic acid, exactly neutralized with ammonia, and brought to a specific gravity of 1.09.

The molybdic solution is prepared by dissolving 100 grams of molybdic acid in 417 cubic centimetres of ammonia of specific gravity .96. Pour this solution into 1,250 cubic centimetres of nitric acid of specific gravity 1.20, and set in a warm place for several days, or until a portion heated to 40° C. deposits no yellow precipitate.

The magnesia mixture is prepared by dissolving 110 grams of crystallized magnesium chloride and 280 grams of ammonium chloride in 700 cubic centimetres of ammonia of specific gravity .96, and bringing to a volume of two liters.

2. *Methods of Determining Nitrogen.* — The Kjeldahl and soda-lime methods recommended by the Association of Official Agricultural Chemists, in their "Proceedings," 1890, pages 190 and 191, are employed, with occasional control analyses by the absolute cupric oxide mode.

3. *Method for Determining Potash.* — Weigh out two grams of the material in a platinum crucible, and char thoroughly at a temperature just below red heat. Digest for several hours with very dilute hydrochloric acid, on the water-bath. Filter into a graduated cylinder, and make up to 200 cubic centimetres. Take 50 cubic centimetres for each test. Warm, and add in small quantities at a time, an excess of barium hydrate. Digest for one or two hours at a temperature of 70° to 90° C., filter, washing carefully, and add to the filtrate a few drops of ammonium hydrate, and enough ammonium carbonate to precipitate the excess of barium hydrate. Filter, and bring the filtrate to dryness on the water-bath in a platinum dish. Heat carefully in the covered platinum dish at a temperature just below red heat, until compounds of ammonia cease to come off. Take up the residue in water, filtering if necessary, and add an excess of platinum tetrachloride. Evaporate to dryness on the water-bath, add a small quantity of 80 per cent. alcohol, and allow it to stand for a few hours. Filter through a Gooch crucible, washing with alcohol, dry, and weigh; or filter through paper, wash as before, dry, and brush the potassium platinic chloride upon a weighed watch glass, with a camel's-hair brush, and weigh. If very impure, the double salt is washed with the strong solution of ammonium chloride, saturated with potassium platinic chloride, as recommended in the "Proceedings of the Association of Official Agricultural Chemists," 1890, page 210.

5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

Wood Ashes.

[I., Canada wood ashes, sent on from Stow, Mass ; II , Home-made ashes, sent on from Stow, Mass.; III. and IV., sent on from North Amherst, Mass.; V., sent on from North Hatfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	14.88	0.25	29.49	30.69	8.68
Calcium oxide,	33.42	37.16	28.79	24.75	33.19
Magnesium oxide,	2.89	6.31	3.74	2.04	4.21
Ferric oxide,	1.03	2.26	0.84	0.97	1.03
Potassium oxide,	6.17	6.58	2.32	2.78	6.58
Phosphoric acid,	2.19	5.58	1.58	1.84	2.01
Insoluble matter (before calcination),	13.67	27.45	11.72	16.66	14.66
Insoluble matter (after calcination),	11.07	22.93	10.37	13.08	12.21

Wood Ashes.

[I., sent on from Lawrence, Mass ; II , sent on from Hadley, Mass.; III., sent on from Hudson, Mass.; IV., sent on from Clifton, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.71	13.18	18.00	15.94
Calcium oxide,	36.95	34.06	33.25	31.65
Magnesium oxide,	2.90	2.88	1.84	2.59
Ferric oxide,	0.07	1.32	1.42	1.62
Potassium oxide,	5.77	4.56	4.51	4.71
Phosphoric acid,	1.38	1.66	1.18	1.43
Insoluble matter (before calcination),	13.15	13.60	12.99	13.38
Insoluble matter (after calcination),	11.88	11.16	10.84	10.62

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., from North Amherst, Mass.; II., from North Hadley, Mass.; III., Railroad tie ashes, from Winchester, Mass ; IV., from Hudson, Mass.; V., from North Amherst, Mass.; VI., from Lawrence, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	11.47	3.46	4.70	18.10	10.38	16.12
Calcium oxide,	37.51	35.76	2.51	31.75	23.84	30.38
Magnesium oxide,	3.20	4.32	1.22	2.59	3.05	2.64
Ferric oxide,	0.24	0.55	4.23	0.77	5.89	1.32
Potassium oxide,	4.22	4.21	0 92	3.32	2.93	3.94
Phosphoric acid,	1.40	2.01	0.56	1.34	1.14	1.52
Insoluble matter (before calcination),	18.84	17.19	84.51	12.53	35.27	17.52
Insoluble matter (after calcination),	16.11	14.85	80.20	10.53	33.73	13.10

Wood Ashes.

[I., sent on from East Whately, Mass.; II., III., IV. and V., sent on from Concord, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.52	3.60	21.40	13.75	15.14
Calcium oxide,	37.07	33.78	29.65	33.39	–
Magnesium oxide,	3.46	6.66	4.16	3.38	–
Ferric oxide,	0.72	1.51	0.78	0.49	–
Potassium oxide,	6.48	9.62	5.22	7.24	5.75
Phosphoric acid,	1.43	4.25	1.54	1.53	1.69
Insoluble matter (before calcination),	9.70	9.98	9.87	10.96	13.44
Insoluble matter (after calcination),	7.06	5.52	7.96	9.19	11.40

All above-stated samples of unleached wood ashes are represented as Canada wood ashes, except No. II., which is a home-made wood ash.

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., sent on from Concord, Mass.; II., sent on from Beverly, Mass.; III., sent on from Sunderland, Mass.; IV., sent on from North Amherst, Mass.; V., sent on from Sunderland, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	15.50	11.78	15.69	9.52	17.48
Calcium oxide,	30.16	29.12	31.59	25.12	32.23
Magnesium oxide,	3.28	4.53	3.30	4.67	3.07
Ferric oxide,	0.99	1.14	0.40	1.49	0.67
Potassium oxide,	6.76	4.77	6.99	3.83	5.04
Phosphoric acid,	2.13	1.83	1.39	1.40	1.17
Insoluble matter (before calcination),	12.04	15.16	11.10	28.38	11.72
Insoluble matter (after calcination),	11.68	11.48	10.26	22.05	10.74

Wood Ashes.

[I., sent on from Rock Bottom, Mass.; II., sent on from South Framingham, Mass.; III., sent on from Berlin, Mass.; IV., sent on from Amesbury, Mass.; V., sent on from Beverly, Mass.; VI., sent on from Bolton, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	18.00	20.08	2.10	9.43	10.22	11.50
Calcium oxide,	34.40	32.16	36.00	32.52	38.98	35.66
Magnesium oxide,	2.90	3.28	3.30	2.14	3.39	4.45
Ferric oxide,	–	0.69	–	–	–	–
Potassium oxide,	4.52	4.65	5.27	4.90	6.28	4.57
Phosphoric acid,	1.46	2.70	1.62	1.84	1.42	1.56
Insoluble matter (before calcination),	12.39	9.67	19.47	20.52	9.51	16.58
Insoluble matter (after calcination),	11.44	8.12	17.78	18.30	8.54	14.83

All above-stated samples of unleached wood ashes are represented as Canada wood ashes. Samples I., II., IV. and VI. contain less potash than the average of Canada wood ash usually sold in our markets.

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., sent on from Framingham, Mass.; II. and III., sent on from South Deerfield, Mass.; IV., sent on from Essex, Mass.; V. and VI., sent on from Sudbury, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	19.73	7.26	20.65	0.64	16.64	24.26
Calcium oxide,	31.49	37.07	29.65	40.49	–	–
Magnesium oxide,	2.85	2.90	2.70	3.07	–	–
Ferric oxide,	1.24	1.02	1.89	–	–	–
Potassium oxide,	4.94	4.34	4.62	6.42	4.24	4.71
Phosphoric acid,	1.57	1.48	1.46	1.57	1.34	2.66
Insoluble matter (before calcination),	12.57	14.45	10.10	12.03	18.08	23.92
Insoluble matter (after calcination),	10.29	12.48	8.13	9.10	14.84	19.92

Wood Ashes.

[I., sent on from Amherst, Mass.; II., sent on from Holden, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Rock Bottom, Mass.; VI., sent on from Stow, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	12.34	19.34	17.98	16.65	11.62	13.27
Calcium oxide,	33.08	30.27	28.86	30.36	35.63	34.74
Magnesium oxide,	2.85	3.98	3.12	3.10	2.97	3.04
Ferric oxide,	0.79	0.86	0.09	1.44	0.86	0.66
Potassium oxide,	5.60	5.11	6.81	6.10	6.40	6.32
Phosphoric acid,	1.93	3.53	1.66	1.54	1.60	1.57
Insoluble matter (before calcination),	15.45	10.86	17.22	13.00	10.93	10.02
Insoluble matter (after calcination),	11.19	9.37	14.66	11.32	9.02	8.44

5. *Analyses, etc.* — Continued.

Cotton-seed-hull Ashes.

[I., sent on from Sunderland, Mass.; II. and III., sent on from North Hadley, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.77	6.30	4.58
Calcium oxide,	8.02	–	–
Magnesium oxide,	12.57	–	–
Potassium oxide,	30.00	16.48	9.91
Phosphoric acid,	13.19	6.58	4.41
Insoluble matter (before calcination),	12.52	41.94	57.40
Insoluble matter (after calcination),	9.40	29.65	34.28

Sample II. and in particular Sample III. are of an exceptional inferior quality. Cotton-seed-hull ashes and cotton-seed meal sold for manurial purposes ought to be bought on a guaranteed composition. Both articles are liable to a serious fluctuation in composition. All articles sold for manurial purposes, at ten dollars or more per ton, are subject to our laws for the regulation of the trade in commercial fertilizers.

Cotton-hull Ashes.

[I., sent on from North Hadley, Mass.; II., sent on from Feeding Hills, Mass.; III., sent on from Sunderland, Mass.*]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	11.79	6.30	4.41
Calcium oxide,	8.37	13.94	4.91
Magnesium oxide,	10.27	2.85	5.57
Ferric and aluminic oxides,	1.50	2.49	4.35
Potassium oxide,	26.26	26.98	16.63
Phosphoric acid,	12.06	8.40	7.21
Insoluble matter (before calcination),	15.37	13.23	47.47
Insoluble matter (after calcination),	11.94	11.19	40.02

* Cotton-hull and wood ashes mixed.

5. *Analyses, etc.* — Continued.

Cotton-hull Ashes.

[Three samples, sent on from Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C ,	14.18	13.65	14.22
Calcium oxide,	10.26	15.12	15.25
Magnesium oxide,	10.28	6.37	6.02
Ferric oxide,	1.88	1.51	1.08
Potassium oxide,	20.56	27.06	26.91
Phosphoric acid,	9.13	8.07	13.48
Insoluble matter (before calcination),	12.64	10.14	9.87
Insoluble matter (after calcination),	11.48	8.10	7.24

Cotton-seed Meal for Fertilizer.

[I. and II., sent on from Hatfield, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.98	9.84	7.28
Ash,	–	–	7.14
Phosphoric acid,	3.26	3.30	2.20
Potassium oxide,	2.01	2.03	2.06
Nitrogen,	6.21	6.64	6.28
Insoluble matter,	0.07	0.08	0.09

5. *Analyses, etc.* — Continued.

Calcium Sulphate.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	18.02
Calcium oxide,	32.40
Sulphuric acid,	42.08
Insoluble matter,	2.35

Burnt Lime.

[Sent on from Amherst, Mass.]

	Per Cent.
Calcium oxide,	88.64
Insoluble matter,	4.71

Nitrate of Soda.

[I., sent on from South Sudbury, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	1.38	1.78	1.20
Sodium oxide,	–	–	38.90
Nitrogen,	15.56	15.77	15.81

Muriate of Potash.

[I., sent on from Hadley, Mass.; II., sent on from Richmond, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	1.40	1.30	1.09
Potassium oxide,	49.95	46.64	50.40
Insoluble matter,	–	0.44	–

5. *Analyses, etc.* — Continued.

Sulphate of Potash.

[Sent on from Richmond, Mass.]

	Per Cent.
Moisture at 100° C.,	6.17
Potassium oxide,	24.32
Insoluble matter,	0.56

Florida Phosphate Rock.

[I., sent on from Amherst; II., sent on from Fort Meade, Fla.; III. and IV., sent on from Vicksburg, Miss.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.24	13.62	1.59	1.38
Phosphoric acid,	21.67	22.42	23.96	23.71
Calcium oxide,	–	28.06	35.41	33.84
Ferric and aluminic oxides,	5.02	9.46	9.70	4.80
Insoluble matter,	34.67	23.30	4.68	9.52
Carbonic acid,	Trace.	–	–	–

Florida Phosphate Rock.

[I., II., III. and IV., from Oscala, Fla.; V., from Pitman, Fla.; VI., sent on from Boston, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	2.03	1.90	6.53	0.99	5.28	0.58
Phosphoric acid,	21.34	24.10	7.68	38.97	18.23	32.18
Calcium oxide,	–	–	–	–	–	29.78
Ferric and aluminic oxides,	2.53	2.42	2.84	1.20	3.11	15.85
Insoluble matter,	24.64	26.44	48.77	2.35	33.89	9.16

5. *Analyses, etc.* — Continued.

Dissolved Bone-black.

[I. and II., sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	18.50	15.15
Ash,	55.52	50.40
Total phosphoric acid,	15.35	17.55
Soluble phosphoric acid,	14.87	17.51
Reverted phosphoric acid,	0.29	–
Insoluble phosphoric acid,	0.19	–
Insoluble matter,	2.95	0.12

Superphosphate.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	14.23
Ash,	69.95
Total phosphoric acid,	14.64
Soluble phosphoric acid,	10.34
Reverted phosphoric acid,	2.42
Insoluble phosphoric acid,	1.88
Insoluble matter,	10.81

Fine-ground Bone.

[Sent on from Amherst, Mass.]

Mechanical Analysis.

	Per Cent.
Fine,	48.57
Fine medium,	24.20
Medium,	20.59
Coarse medium,	6.64

Chemical Analysis.

Moisture at 100° C.,	8.40
Ash,	54.81
Total phosphoric acid,	15.16
Soluble phosphoric acid,	2.33
Reverted phosphoric acid,	6.42
Insoluble phosphoric acid,	6.41
Nitrogen,	3.89
Insoluble matter,	0.42

5. *Analyses, etc.* — Continued.

Tankage.

[I., sent on from Worcester, Mass.; II., sent on from Hadley, Mass.; III., sent on from Lexington, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.78	6.05	40.92
Ash,	49.57	35.58	28.53
Total phosphoric acid,	18.86	8.65	7.39
Soluble phosphoric acid,	0.54	0.05	Trace.
Reverted phosphoric acid,	9.88	5.39	4.30
Insoluble phosphoric acid,	8.38	3.21	3.09
Nitrogen,	4.16	5.04	4.73
Insoluble matter,	1.48	2.62	0.40

Dry Ground Fish.

[I., sent on from Hadley, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.54	9.12	13.66
Ash,	17.45	20.13	19.23
Total phosphoric acid,	6.75	7.04	7.39
Soluble phosphoric acid,	0.75	0.27	–
Reverted phosphoric acid,	3.25	3.10	–
Insoluble phosphoric acid,	2.75	3.67	–
Nitrogen,	7.64	8.47	9.16
Insoluble matter,	1.06	2.85	2.39

5. *Analyses, etc.* — Continued.

Fish Chum.

[Sent on from Beverly, Mass.]

	Per Cent.
Moisture at 100° C.,	6.46
Ash,	25.33
Total phosphoric acid,	9.15
Soluble phosphoric acid,	0.56
Reverted phosphoric acid,	5.99
Insoluble phosphoric acid,	2.60
Nitrogen,	5.50
Insoluble matter,	1.12

Wool Waste from Factories.

[I., shoddy mill waste, sent on from Lawrence, Mass.; II., wool waste, sent on from Spencer, Mass.; III., wool refuse, sent on from Gilbertville, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	11.38	43.05	27.05
Ash,	12.23	3.93	38.84
Potassium oxide,	0.14	0.06	0.42
Phosphoric acid,	0.08	0.05	0.07
Nitrogen,	3.44	6.67	1.05
Insoluble matter,	7.52	1.08	34.00

The best use which can be made of this class of refuse materials is to incorporate them into the barn-yard manure; they are essentially a nitrogenous source of plant food. Their commercial manurial value depends on their percentage of nitrogen. From seven to eight cents per pound of the latter is a fair basis of valuation.

Cotton Waste.

[Sent on from Fall River, Mass.]

	Per Cent.
Moisture at 100° C.,	5.63
Ash,	60.68
Potassium oxide,	0.66
Phosphoric acid,	0.26
Nitrogen,	0.96
Insoluble matter,	55.20

5. *Analyses, etc.* — Continued.

Tobacco Leaves.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	11.97
Ash,	20.48
Calcium oxide,	4.83
Magnesium oxide,	1.36
Ferric oxide,	0.22
Potassium oxide,	6.06
Phosphoric acid,	1.15
Nitrogen,	2.95
Insoluble matter,	2.35

The tobacco leaves contain more than twice the amount of mineral constituents found in the tobacco stems. The ash of the latter contains more phosphoric acid and potash than that of the former, while that of the leaves is richer in lime and magnesia than that of the stems.

Saltpetre Waste.

[Sent on from Littleton Common, Mass.]

	Per Cent.
Moisture at 100° C.,	1.23
Potassium oxide,	2.70
Sodium oxide,	47.99
Nitrogen,	0.61

The material contains usually a large amount of common salt, and may be used with good effect upon grass lands.

Waste from Lactate Factory.

[Sent on from Littleton Centre, Mass.]

	Per Cent.
Moisture at 100° C.,	34.11
Ash,	60.24
Calcium oxide,	22.55
Potassium oxide,	Trace.
Phosphoric acid,	0.67
Nitrogen,	0.68
Insoluble matter,	6.92

5. *Analyses, etc.* — Continued.

Muck.

[I., sent on from Brookline, Mass.; II., sent on from Fort Meade, Fla.; III. and IV., sent on from Boston, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	81.03	31.17	70.00	74.87
Organic matter,	10.96	4.18	14.84	14.46
Ash,	8.01	64.65	15.16	10.67
Calcium oxide,	–	–	0.28	0.14
Nitrogen,	0.36	0.06	0.49	0.46
Phosphoric acid,	–	–	0.17	0.073
Insoluble matter,	7.04	59.13	13.47	9.24

Peat.

[Sent on from Marshfield, Mass.]

	Per Cent.
Moisture at 100° C,	35.17
Ash,	21.92
Nitrogen,	1.16

Mud.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	22.45
Organic matter,	10.83
Ash,	66.72
Calcium oxide,	3.64
Potassium oxide,	0.25
Phosphoric acid,	Trace.
Nitrogen,	0.43
Insoluble matter,	29.26

5. *Analyses, etc.* — Continued.

Marl.

[I., sent on from West Springfield, Mass.; II., sent on from Marshfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	1.65	3.15
Calcium oxide,	47.61	0.37
Magnesium oxide,	0.58	1.71
Ferric oxide,	Trace.	Trace.
Potassium oxide,	Trace.	0.24
Phosphoric acid,	0.10	1.41
Carbonic acid,	34.03	None.
Insoluble matter,	2.81	79.73

Home-mixed Fertilizers.

[I., sent on from North Hadley, Mass.; II., sent on from Agawam, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	15.86	9.69
Ash,	63.56	39.20
Total phosphoric acid,	12.88	5.36
Soluble phosphoric acid,	8.24	1.69
Reverted phosphoric acid,	2.87	3.06
Insoluble phosphoric acid,	1.77	0.61
Potassium oxide,	5.97	8.28
Nitrogen,	1.53	4.30
Insoluble matter,	1.69	0.87

5. *Analyses, etc.* — Concluded.

Complete Fertilizers.

[I., sent on from Boston, Mass.; II., home-mixed fertilizer, sent on from Conway, Mass.; III. and IV., sent on from North Hadley, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.54	6.67	17.78	14.54
Ash,	46.27	49.21	50.12	48.42
Total phosphoric acid,	11.64	13.82	4.57	7.42
Soluble phosphoric acid,	7.78	6.27	1.77	6.90
Reverted phosphoric acid,	2.81	5.99	0.78	0.33
Insoluble phosphoric acid,	1.05	1.56	2.02	0.19
Potassium oxide,	4.29	4.98	10.72	7.19
Nitrogen,	3.66	3.44	5.14	3.75
Insoluble matter,	1.72	0.64	3.12	0.81

Complete Fertilizers.

[I., II. and III., sent on from South Sudbury, Mass.; IV., sent on from Sixteen Acres, Mass.; V. and VI., sent on from Richmond, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	18.05	15.92	16.54	12.43	12.14	13.54
Ash,	56.55	55.82	69.10	37.44	48.40	46.96
Total phosphoric acid,	8.47	11.68	10.26	8.05	9.44	10.87
Soluble phosphoric acid,	1.64	6.91	7.16	2.58	3.48	6.12
Reverted phosphoric acid,	3.67	1.19	1.69	3.27	3.24	3.59
Insoluble phosphoric acid,	3.16	3.58	1.36	2.20	2.72	1.16
Potassium oxide,	4.04	2.32	1.98	6.08	7.94	5.20
Nitrogen,	2.13	2.28	1.10	2.58	2.89	2.73
Insoluble matter,	3.58	5.37	6.72	1.10	1.82	0.64

6. *Miscellaneous Analyses.*

Paris Green.

[I. and II., sent on by the Gypsy Moth Commission from Boston, Mass.; III. and IV., sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	1.30	1.15	1.41	1.40
Copper oxide,	32.84	30.40	33.20	33.10
Arsenious oxide,	62.55	59.92	61.40	61.15
Insoluble matter,	0.21	0.10	0.09	0.64
Acetic acid,	3.10	8.43	3.90	3.71

Tobacco Liquor.

[Two samples sent on from Hyannis, Mass.]

	Per Cent.	
	I.	II.
Nicotine,	4.55	4.82

Dalmation Insect Powder.

[Sent on from Boston, Mass.]

	Per Cent.
Total ash,	15.52
Ash insoluble in hydrochloric acid,	9.20

No trace of mineral poisons was found. Under the microscope the vegetable matter had the general appearance of genuine pyrethrum powder.

6. *Miscellaneous Analyses* — Continued.

Carnation Pinks (Whole Plant).

[Sent on from Framingham, Mass.]

	Per Cent.
Moisture at 100° C.,	8.08
Ash,	8.80
Calcium oxide,	1.64
Magnesium oxide,	0.35
Ferric and aluminic oxides,	0.03
Sodium oxide,	1.13
Potassium oxide,	3.35
Phosphoric acid,	0.46
Nitrogen,	1.06
Insoluble matter,	0.21

Grapes.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	86.23
Ash,	0.5481
100 parts of ash contain: —	
Calcium oxide,	3.50
Magnesium oxide,	2.531
Ferric oxide,	1.193
Potassium oxide,	49.765
Phosphoric acid,	13.567
Nitrogen (in dry matter),	0.961

*Woods.**

[I, sound wood of plum; II., black knot of plum.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.590	7.990
Ash,	2.220	4.220
Calcium oxide,	0.684	0.690
Magnesium oxide,	0.119	0.232
Ferric oxide,	0.012	0.052
Potassium oxide,	0.387	1.438
Phosphoric acid,	0.132	0.475
Nitrogen,	0.570	1.450
Insoluble matter,	0.013	0.009

* Collected off of the same tree, Amherst, Mass.

6. *Miscellaneous Analyses* — Continued.

Banana Skins.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	13.99
Ash,	13.06
Calcium oxide,	1.44
Magnesium oxide,	0.11
Ferric and aluminic oxides,	0.26
Potassium oxide,	5.46
Phosphoric acid,	1.48
Nitrogen,	0.24

Analysis of the Ash.

Calcium oxide,	11.12
Magnesium oxide,	0.84
Ferric and aluminic oxides,	1.99
Potassium oxide,	41.80
Phosphoric acid,	11.33
Insoluble matter,	10.15

Sugar Beets.

[Sent on from Boston, Mass.]

Analysis of Beets.

	Per Cent.
Moisture at 100° C.,	77.35
Sugar by Fehling's test,	13.57
Sugar by polariscope,	13.59

Analysis of Juice.

Degrees Brix, corresponding for temperature,	21.2°
Specific gravity,	1.08869
Total solids,	20.52
Ash,	1.65
Sugar by Fehling's test,	16.02
Coefficient of purity,	78.05

Vinegar.

[I., sent on from Williamsburg, Mass.; II., III., IV., V., sent on from Prescott, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Specific gravity,	1.02565	1.00998	1.00732	1.01172	1.00448
Acetic acid,	4.80	4.66	4.82	5.27	3.97
Solid residue,	4.51	1.70	1.76	1.55	1.00

6. *Miscellaneous Analyses* — Continued.

Vinegar.

[Sent on from Amherst, Mass.]

	Per Cent. I.	Per Cent. II.
Specific gravity,	1.01086	1.01206
Acetic acid,	5.02	5.15
Solid residue,	1.51	1.48

Vinegar Mash.

[Sent on from Boston, Mass. I., total solid residue on evaporation; II., residue from which liquid or soluble portion had been removed (insoluble residue).]

Average Composition.

	Per Cent.
Moisture at 100° C.,	94.49
Dry matter,	5.51
	100.00

Analysis of Dry Matter.

	Per Cent. I.	Per Cent. II.
Crude ash,	3.03	2.92
" cellulose,	8.55	9.42
" fat,	8.45	7.77
" protein,	16.50	13.91
Non-nitrogenous extract matter,	63.47	65.98
	100.00	100.00
Nitrogen in dry matter,	2.64	2.22
Potassium oxide in dry matter,	0.84	0.34
Phosphoric acid in dry matter,	1.27	0.93
Acidity (calculated as acetic acid),	–	0.33

6. *Miscellaneous Analyses* — Continued.

Baking Powder.

[Sent on from Amherst, Mass.]

	Per Cent.
Total carbonic acid,	8.28
Phosphoric acid,	0.10
Sulphuric acid,	11.17
Aluminic oxide,	2.00

Analyses of Milk sent on for Examination.

[Per Cent.]

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
1,	11.95	3.18	8.77	Lee.	
2,	11.96	3.51	8.45	Lee.	Skim-milk.
3,	9.42	0.63	8.79	Lee.	
4,	13.21	3.90	9.31	Millbury.	
5,	12.74	4.20	8.54	Lee.	
6,	9.24	0.28	8.96	Belchertown.	Buttermilk.
7,	11.18	2.92	8.26	Lawrence.	
8,	9.31	0.20	9.11	Tully.	Skim-milk.
9,	12.72	4.23	8.49	Amherst.	
10,	11.94	3.16	8.78	Amherst.	
11,	13.28	4.17	9.11	Amherst.	
12,	14.19	5.10	9.09	Warren.	
13,	12.84	3.85	8.99	Warren.	
14,	14.10	4.54	9.56	Warren.	
15,	13.28	3.79	9.49	Warren.	
16,	13.18	3.87	9.31	Warren.	
17,	13.98	4.73	9.25	Warren.	
18,	15.76	5.95	9.81	Worcester.	
19,	14.47	4.30	10.17	Worcester.	
20,	15.93	6.40	9.53	Worcester.	
21,	16.68	6.75	9.93	Worcester.	
22,	16.64	6.92	9.72	Worcester.	
23,	15.39	5.85	9.54	Worcester.	
24,	13.64	4.43	9.21	Warren.	
25,	12.38	3.27	9.11	Warren.	
26,	12.67	3.79	8.88	Warren.	
27,	13.85	4.38	9.47	Warren.	
28,	12.99	3.94	9.05	Warren.	
29,	12.46	3.89	8.57	Warren.	
30,	14.14	4.75	9.39	Warren.	
31,	13.17	3.65	9.52	Warren.	
32,	13.14	4.33	8.81	Warren.	
33,	12.84	4.61	8.23	Warren.	
34,	11.95	3.62	8.33	Warren.	
35,	13.10	4.22	8.88	Barre Plains.	
36,	10.58	2.79	7.79	Barre Plains.	
37,	13.52	4.73	8.79	Barre Plains.	
38,	12.21	3.85	8.36	Barre Plains.	

6. *Miscellaneous Analyses* — Concluded.

Analyses of Milk, etc. — Concluded.

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
39, . .	12.19	3.63	8.56	Belchertown.	
40, . .	13.65	4.65	9.00	Barre Plains.	
41, . .	13.35	4.42	8.93	Barre Plains.	
42, . .	14.24	4.69	9.55	Barre Plains.	
43, . .	13.08	4.17	8.91	Barre Plains.	
44, . .	12.38	3.19	9.19	Barre Plains.	
45, . .	16.87	6.37	10.50	Barre Plains.	
46, . .	15.16	5.81	9.35	Barre Plains.	
47, . .	16.46	6.76	9.70	New Braintree.	
48, . .	16.00	6.51	9.49	New Braintree.	
49, . .	15.41	6.13	8.28	New Braintree.	
50, . .	16.61	7.33	9.28	New Braintree.	
51, . .	15.31	5.58	9.73	New Braintree.	
52, . .	16.05	6.40	9.65	New Braintree.	
53, . .	13.04	4.63	8.41	Barre Plains.	
54, . .	12.72	3.83	8.89	Barre Plains.	
55, . .	11.10	3.27	7.83	Barre Plains.	
56, . .	11.28	3.59	7.69	Barre Plains.	
57, . .	11.68	4.78	6.90	Barre Plains.	
58, . .	11.15	3.91	7.24	Barre Plains.	
59, . .	13.32	4.62	8.70	Barre Plains.	
60, . .	12.29	4.56	7.73	North Adams.	
61, . .	15.23	6.92	8.31	North Adams.	
62, . .	13.25	4.25	9.00	Northborough.	

II. Analyses of Water sent on for Examination.

[Parts per Million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1	.084	.116	24.00	86.00	56.00	2.60	None.	Billerica.
2	.096	.144	16.00	80.00	50.00	–	–	Upton.
3	.120	.128	10.00	94.00	54.00	–	–	Upton.
4	.080	.136	5.00	12.00	6.00	–	–	Upton.
5	.112	.296	36.00	308.00	152.00	–	–	Upton.
6	.072	.104	4.00	86.00	60.00	2.86	None.	Amherst.
7	.052	.828	Trace.	36.00	20.00	1.27	None.	Sunderland.
8	.026	.070	8.00	98.00	44.00	1.27	–	Methuen.
9	.060	.108	Trace.	50.00	20.00	.95	None.	Cooleyville.
10	.088	.168	144.00	606.00	214.00	8.86	None.	North Amherst.
11	.020	.060	16.00	96.00	36.00	3.90	None.	Amherst.
12	.088	.092	34.00	150.00	96.00	2.60	None.	Plainville.
13	.640	.328	20.00	112.00	8.00	3.90	None.	Amherst.
14	–	–	56.00	–	–	–	–	Amherst.
15	–	–	24.00	–	–	–	–	Amherst.
16	.052	.136	Trace.	82.00	72.00	.16	None.	Westford.
17	.060	.140	Trace.	100.00	36.00	1.95	None.	Amherst.
18	.092	.204	Trace.	74.00	56.00	2.60	–	Amherst.
19	.140	1.480	48.00	322.00	48.00	5.29	None.	Weston.
20	.172	.176	12.00	146.00	26.00	2.60	None.	Amherst.
21	.050	.080	Trace.	56.00	26.00	1.27	Present.	Cooleyville.
22	.068	.072	Trace.	58.00	30.00	1.27	None.	Leverett.
23	.144	.120	Trace.	44.00	24.00	.32	None.	Westford.
24	.080	.148	28.00	314.00	154.00	6.00	None.	Natick.
25	.060	.052	20.00	154.00	86.00	4.57	None.	Amherst.
26	.108	.156	20.00	254.00	90.00	5.00	–	Agawam.
27	None.	.030	14.00	120.00	50.00	3.25	None.	North Amherst.
28	.040	.140	14.00	84.00	14.00	3.90	None.	Amherst.
29	.120	.080	8.00	80.00	50.00	1.27	None.	North Amherst.
30	–	–	–	–	–	–	Present.	North Amherst.
31	.200	.172	10.00	–	–	–	–	North Amherst.
32	.120	.072	Trace.	80.00	46.00	3.25	None.	Amherst.
33	1.680	.096	60.00	364.00	74.00	6.71	None.	Sunderland.

II. ANALYSES OF WATER, ETC. — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
34	.112	.140	12.00	90.00	80.00	5.25	None.	Amherst.
35	.112	.180	46.00	210.00	80.00	3.25	–	North Hadley.
36	.076	.118	Trace.	40.00	10.00	1.27	Present.	North Amherst.
37	.296	.240	20.00	314.00	74.00	–	–	Amherst.
38	.016	.264	Trace.	88.00	10.00	1.95	Present.	Graniteville.
39	.014	.140	12.00	58.00	16.00	2.60	None.	Athol.
40	.020	.088	8.00	20.00	6.00	1.95	–	North Amherst.
41	.100	.070	2.00	90.00	20.00	2.60	–	North Amherst.
42	.010	.066	4.00	32.00	6.00	.48	None.	Cooleyville.
43	.016	.132	8.00	130.00	70.00	2.60	None.	Sunderland.
44	.074	.098	6.00	50.00	6.00	1.95	–	Amherst.
45	.020	.066	170.00	608.00	378.00	12.56	None.	Amherst.
46	.012	.066	2.09	258.00	176.00	14.84	None.	Richmond.
47	.040	.084	9.00	174.00	84.00	6.00	None.	North Hadley.
48	None.	.106	4.00	62.00	16.00	.48	None.	Amherst.
49	.108	.180	4.00	130.00	70.00	1.95	None.	West Brookfield.
50	.140	.120	27.00	216.00	116.00	6.00	None.	Foxborough.
51	.040	.230	16.00	170.00	74.00	9.57	None.	Amherst.
52	.010	.066	Trace.	90.00	54.00	2.99	None.	Amherst.
53	None.	.084	20.00	252.00	72.00	4.57	None.	Amherst.
54	.112	.140	7.00	136.00	56.00	2.60	–	Blackstone.
55	.120	.120	11.00	170.00	70.00	5.29	–	Amherst.
56	.128	.160	4.00	126.00	46.00	3.25	–	Amherst.
57	.038	.150	4.00	84.00	24.00	2.60	–	Hadley.
58	.024	.092	8.00	94.00	54.00	2.60	None.	North Hadley.
59	None.	.200	2.00	46.00	20.00	.48	–	Hawley.
60	.096	.128	6.00	130.00	30.00	1.95	–	Amherst.
61	None.	.170	Trace.	160.00	90.00	1.27	–	Moore's Corner.
62	.018	.098	13.00	180.00	90.00	6.71	None.	Springfield.
63	.014	.070	3.00	34.00	20.00	1.95	None.	Rutland.
64	.060	.148	6.00	114.00	44.00	1.95	–	Westhampton.
65	.004	.100	4.00	116.00	40.00	.48	None.	Belchertown.
66	.990	.440	15.00	164.00	54.00	2.47	None.	Weston.
67	.080	.270	9.00	105.00	45.00	2.73	None.	Weston.
68	.260	.964	34.00	237.00	130.00	–	–	Grafton.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (= 71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 1, 2, 3, 4, 5, 10, 13, 18, 19, 20, 23, 24, 26, 29, 31, 32, 33, 34, 35, 37, 49, 50, 54, 55, 56, 60, 66, 67 and 68 ought to be condemned as unfit for family use; while Nos. 6, 9, 12, 16, 17, 22, 36, 41, 44 and 64 must be considered suspicious. From this record it will be seen that over two-fifths of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point removes not unfrequently immediate danger.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

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* One gallon equals 70,000 grains.

III. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by R. B. Moore.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1892.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1891, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash, ...	57	2.00	-	-	-	-	58.98	45.94	**51.48**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash, ...	20	2.54	-	-	-	-	51.28	21.36	**33.40**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia, . .	15	4.75	-	-	-	-	29.48	16.96	**23.50**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Kainite, ...	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite, ...	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite, ...	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite), . .	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash, ...	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda, ...	22	1.40	-	16.01	14.44	**15.70**	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia, ...	24	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Saltpetre waste, ...	11	2.60	-	3.30	.52	**2.28**	30.94	1.55	**14.34**	-	-	-	-	-	-	36.50	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake, ...	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3 92
Wood ashes, ...	189	12.50	-	-	-	-	10.80	2.32	**5.25**	5.58	.51	**1.70**	-	-	-	-	34.00	3.40	.90	-	-	-	12.50
Cotton-seed-hull ashes, ...	30	7.80	-	-	-	-	42.12	9.91	**22.50**	13.67	2.89	**8.50**	-	-	-	-	9.60	10.75	1.50	-	-	-	11.50
Ashes of spent tan-bark, ...	3	3.61	-	-	-	-	2.87	1.14	**2.04**	2.77	.13	**1.61**	-	-	-	-	33.46	3.55	-	-	-	-	24.33

Railroad-tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue works	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	.86	3.16	.36	1.18	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	-	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
II. Guanos, Phosphates, etc.—Concluded.																							
South Carolina rock phosphate,	5	1.50	-	-	-	-	-	-	-	30.51	25.81	**28.03**	.27	.07	27.69	-	41 87	3.03	4.80	-	-	-	9.04
Florida rock phosphate,	22	2.25	-	-	-	-	-	-	-	38.97	6.95	**24.50**	-	-	-	-	28.50	-	7.25	-	-	-	28.75
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	**34.27**	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	**35.21**	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	**23.49**	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Dissolved bone-black,	2	7.50	47.50	-	-	-	-	-	-	17.54	15.35	**16.45**	15.60	.60	.19	-	-	-	-	-	-	-	1.50
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	**28.28**	-	-	-	-	-	-	-	-	-	-	3.64
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	**35.89**	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	**14.64**	10.34	2.42	1.88	-	-	-	-	-	-	-	10.81
III. Refuse Substances.																							
Dried blood,	14	12.50	6.37	13.55	8.10	**10.52**	-	-	-	6.23	1.53	**1.91**	-	-	-	-	-	-	-	-	-	-	-
Ammonite,	1	5.88	-	-	-	**11.33**	-	-	-	-	-	**3.43**	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	**12.12**	-	-	-	-	-	**.88**	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	**5.26**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	**2.43**	-	-	-	-	-	**3.19**	-	-	-	-	3.94	1.27	-	-	-	-	39.05

Horn and hoof waste, ...	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool, ...	1	6.95	7.54	-	-	12.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste, ...	7	15.80	24.10	10.20	1.05	5.70	3.08	.06	1.20	.67	.05	.35	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water), ...	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid), ...	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline), ...	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Meat mass, ...	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Bone soup, ...	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone, . . .	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet, .	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering, . .	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse, ...	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	1.29
Bones, ...	134	7.50	55.90	4.70	1.62	4.05	-	-	-	32.52	15.16	23.25	.40	7.60	15.75	-	-	-	-	-	-	-	1.10
Tankage, ...	16	12.50	30.40	8.07	4.16	6.65	-	-	-	18.86	7.39	11.25	.30	5.10	5.85	-	-	-	-	-	-	-	1.35
Fish with less than twenty per cent. water,	59	12.75	21.50	11.40	6.81	7.25	-	-	-	11.26	5.50	8.25	.55	2.60	5.10	-	-	-	-	-	-	-	2.20
Fish with between twenty and forty per cent. water, ...	9	29.34	19.14	7.41	4.22	5.81	-	-	-	8.32	4.68	7.25	.82	2.87	3.56	-	-	-	-	-	-	-	1.85
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw, ...	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells, ...	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace, ...	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal, ...	13	7.75	5.90	7.26	4.02	6.55	2.09	.89	1.70	3.36	1.26	2.10	-	-	-	-	.39	.99	-	-	-	-	.40
Rotten brewer's grain, ...	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	.59

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
III. Refuse Substances — Concluded.																							
Tobacco stems,	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet,	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry,	3	6.44	60.60	2.09	.96	1.50	1.62	.66	1.10	.84	.26	.52	-	-	-	-	-	-	-	-	-	-	45.00
Cotton dust,	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory,	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse,	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins,	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Sumac waste,	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Wet kelp,	1	88.04	2.26	-	-	.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	14	57.50	13.75	2.54	.26	1.05	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat,	10	61.50	8.20	1.40	.41	.85	-	-	.18	-	-	.08	-	-	-	-	.52	.72	2.14	-	-	-	2.20
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	1	5.54	77.10	-	-	-	-	-	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	35.34
IV. Animal Excrement, etc.																							
Barn-yard manure,	24	68.87	8.36	.67	.26	.49	.80	.13	.43	.75	.13	.32	-	-	-	-	.30	.19	-	-	-	-	5.40
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fresh,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

IV. Compilation of Analyses of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.,

MADE AT

AMHERST, MASS.

1868-1892.

Prepared by R. B. Moore.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

F. Insecticides.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	24	30.53	10.33	19.50	17.19	7.62	10.22	6.10	1.42	2.41	63.13	42.02	55.59	31.53	19.26	25.90	5.88	1:8.10
Fodder corn ensilage,	30	37.43	13.12	22.25	12.58	5.98	8.12	6.49	1.82	3.83	65.69	42.99	55.26	38.92	17.67	27.44	5.35	1:10.22
Corn and soja bean ensilage,	1	–	–	28.97	–	–	15.27	–	–	5.35	–	–	40.50	–	–	37.84	11.04	1:5.32
Sorghum,	6	23.18	12.38	17.41	11.84	7.46	8.74	2.00	1.21	1.55	64.93	47.65	56.15	29.27	22.00	26.73	6.83	1:11.85
Common millet,	9	49.29	21.32	35.42	12.16	5.43	7.50	3.99	2.09	2.74	58.61	46.39	53.89	33.98	24.88	30.99	4.84	–
Japanese millet (white head),	3	26.24	20.95	24.76	10.98	7.26	8.72	2.64	1.94	2.33	50.87	46.71	49.60	38.90	30.12	34.47	4.88	–
Japanese millet (red head),	6	33.83	22.66	27.33	7.99	4.92	6.90	2.45	1.58	2.01	60.83	50.11	52.91	35.29	25.21	32.10	6.08	–
White kibi,	2	24.26	22.85	23.56	15.14	10.79	12.97	1.61	1.50	1.56	53.66	52.30	52.91	31.70	23.03	27.37	5.19	–
Mochi millet,	3	42.29	30.07	37.42	11.90	6.11	9.94	1.94	1.74	1.81	67.08	49.06	55.69	29.80	20.01	25.56	7.00	–
Mix,	3	31.36	18.17	24.45	16.70	9.81	13.53	2.48	1.35	1.86	52.30	47.75	51.27	27.44	26.82	27.06	6.28	–
Green oats,	5	28.82	15.51	20.03	20.47	7.05	13.85	3.32	2.02	2.68	50.69	40.81	45.90	33.12	25.20	29.70	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33	1:12.26
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	25.93	–	–	9.38	–	–	1.01	–	–	57.80	–	–	24.66	7.15	1:6.86
Vetch and oats (one part vetch and nine parts oats),	3	24.04	13.89	18.97	10.76	8.83	10.06	2.74	2.29	2.53	49.85	40.10	44.75	35.81	30.77	33.59	9.07	1:7.06
Horse bean, whole plant (*Vicia faba* L.),	1	–	–	15.17	–	–	16.68	–	–	2.31	–	–	47.09	–	–	28.17	5.75	1:2.71
Soja bean (whole plant, *Soja hispida* Mönch),	10	36.36	18.54	23.58	22.19	13.71	16.45	8.98	2.71	4.84	47.89	40.80	44.50	31.89	21.67	26.47	7.74	1:4.20

Cow-pea vines (*Dolichos sinensis* L.),	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	52.42	25.88	21.87	23.59	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	17.41	17.75	12.17	14.96	2.65	2.09	2.37	41.54	35.45	38.49	38.76	26.21	32.49	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	–	–	14.65	–	–	18.71	–	–	2.41	–	–	42.67	–	–	31.18	5.03	–
Spanish moss (*Tillandsia usneoides* L.),	1	–	–	39.20	–	–	4.45	–	–	2.54	–	–	57.73	–	–	32.61	2.67	–
II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	10	91.94	86.96	89.73	11.93	8.47	9.60	2.77	1.56	2.30	54.72	47.11	50.03	35.55	29.21	31.90	6.17	1:11.83
Rowen of mixed hays,	14	91.16	75.55	81.93	14.70	11.63	12.75	5.03	2.60	3.56	53.52	41.92	50.00	31.50	24.25	26.39	7.30	1:6.83
Timothy hay,	6	92.76	81.26	89.39	9.37	7.24	8.66	2.65	1.95	2.22	54.43	50.01	51.55	36.59	29.21	32.90	4.88	1:11.94
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	94.66	8.78	8.65	8.72	2.08	2.03	2.06	49.61	44.11	46.29	36.84	32.21	34.58	8.35	1:10.38
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	91.09	7.85	5.89	6.76	2.17	1.65	1.87	49.18	42.03	46.31	39.90	34.61	36.93	8.13	1:13.69
Perennial rye-grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1:7.40
Italian rye-grass (*Lolium Italicum* A. Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass,	1	–	–	92.55	–	–	9.45	–	–	2.22	–	–	50.64	–	–	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	93.35	–	–	15.27	–	–	1.95	–	–	30.24	–	–	33.72	10.02	1:2.94
Hay of black grass,	1	–	–	91.25	–	–	6.72	–	–	3.37	–	–	49.47	–	–	31.41	9.03	–
Low meadow hay,	1	–	–	91.99	–	–	9.51	–	–	1.88	–	–	46.27	–	–	35.59	6.75	–
Salt hay,	2	91.92	90.34	91.13	4.35	3.77	4.06	3.24	2.65	2.95	60.15	60.14	60.15	27.84	27.82	27.83	5.02	–
Millet,	6	93.85	90.25	92.54	8.88	7.09	7.81	3.63	.89	2.05	55.80	49.62	51.74	35.91	29.80	33.32	5.08	1:7.78
Oats in bloom,	1	–	–	93.57	–	–	6.58	–	–	2.92	–	–	50.03	–	–	34.06	6.41	1:14.23
Oats in milk,	1	–	–	90.45	–	–	10.89	–	–	2.69	–	–	46.02	–	–	34.32	6.08	1:7.90

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Concluded.																		
Oats, ripe,	1	–	–	91.30	–	–	6.05	–	–	2.61	–	–	48.92	–	–	36.31	6.11	1:15.03
Winter rye in bloom,	1	–	–	91.45	–	–	10.66	–	–	2.57	–	–	47.40	–	–	32.97	6.40	1:8.28
Barley in milk,	1	–	–	89.75	–	–	10.26	–	–	2.76	–	–	52.91	–	–	29.12	4.95	1:9.59
Japanese buckwheat,	1	–	–	94.29	–	–	10.80	–	–	2.22	–	–	38.60	–	–	36.02	12.36	–
Dry fodder corn,	4	93.35	90.58	92.11	9.31	6.17	7.74	2.76	1.11	1.84	58.89	53.86	55.97	33.75	23.03	29.31	5.14	1:10.98
Corn stover,	26	94.44	75.00	88.18	12.15	5.46	7.29	2.63	1.08	1.38	63.05	44.65	50.82	38.83	20.93	34.84	5.67	1:11.62
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	–	–	93.94	–	–	9.71	–	–	1.28	–	–	53.18	–	–	28.88	6.95	–
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	94.44	15.01	14.63	14.82	2.62	2.36	2.49	43.88	42.81	43.34	30.76	29.97	30.37	8.98	1:5.52
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	90.07	17.55	14.77	16.63	3.26	1.88	2.58	46.64	38.03	42.72	32.34	21.44	26.17	11.90	1:3.25
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.20	34.39	25.42	29.72	8.11	1:4.09
Sand lucerne (*Medicago media* Pers.),	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	2	93.64	91.50	92.57	14.93	11.81	13.37	4.79	1.85	3.32	51.36	38.83	45.08	33.05	28.08	30.57	7.66	–
Blue melilot (*Melilotus cœrulea* Desr.),	1	–	–	91.78	–	–	13.81	–	–	1.67	–	–	43.22	–	–	27.17	14.87	–
Sainfoin (*Onobrychis sativa*),	1	–	–	87.83	–	–	17.70	–	–	4.49	–	–	42.27	–	–	26.95	8.54	–
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	90.61	17.03	16.90	16.97	3.16	2.39	2.78	58.66	41.89	50.26	28.95	12.38	20.67	9.32	–

Hairy lotus (*Lotus villosus* Thuill),	2	89.32	87.64	**88.48**	16.12	13.49	**14.81**	3.00	2.69	**2.85**	57.82	50.80	**54.29**	24.48	15.07	**19.78**	8.27	-
Soja bean,	3	93.88	79.91	**89.10**	19.06	15.10	**16.68**	8.33	5.62	**6.77**	51.28	41.09	**46.96**	25.84	20.76	**22.79**	6.90	1:4.23
Cow pea,	3	90.70	90.25	**90.43**	17.17	16.95	**17.05**	4.49	3.81	**4.06**	51.41	46.06	**47.93**	23.58	19.06	**21.67**	9.29	1:4.82
Small pea (*Lathyrus sativus*),	1	-	-	**94.20**	-	-	**16.57**	-	-	**1.49**	-	-	**42.76**	-	-	**32.88**	6.30	-
Serradella,	3	92.80	87.23	**90.44**	17.97	15.26	**17.03**	2.91	2.37	**2.55**	50.23	44.49	**48.18**	25.92	24.37	**25.15**	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	-	-	**92.56**	-	-	**19.58**	-	-	**1.22**	-	-	**38.95**	-	-	**31.88**	8.37	-
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	**91.10**	15.76	14.42	**15.09**	2.69	2.30	**2.50**	44.34	43.29	**43.80**	30.68	30.05	**30.37**	8.24	1:3.87
Scotch tares,	1	-	-	**84.20**	-	-	**22.00**	-	-	**1.89**	-	-	**31.46**	-	-	**30.89**	13.76	-
Vetch and oats,	2	94.22	87.47	**90.85**	7.72	7.70	**7.71**	3.37	2.53	**2.95**	49.95	49.00	**49.47**	36.22	31.73	**33.98**	5.89	1:11.49
Horse-bean straw,	1	-	-	**90.85**	-	-	**9.69**	-	-	**1.51**	-	-	**37.77**	-	-	**41.44**	9.59	1:8.55
Soja-bean straw,	1	-	-	**87.00**	-	-	**5.39**	-	-	**1.80**	-	-	**43.72**	-	-	**43.85**	5.24	-
White daisy (*Chrysanthemum leucanthemum* L.),	1	-	-	**90.35**	-	-	**7.68**	-	-	**2.32**	-	-	**46.86**	-	-	**36.09**	7.05	-
Dry carrot tops,	1	-	-	**90.24**	-	-	**20.12**	-	-	**2.01**	-	-	**50.39**	-	-	**13.61**	13.87	-
Wheat straw,	1	-	-	**93.80**	-	-	**7.20**	-	-	**1.63**	-	-	**50.46**	-	-	**35.91**	4.80	1:8.00
Barley straw,	1	-	-	**88.56**	-	-	**9.24**	-	-	**3.38**	-	-	**48.23**	-	-	**33.85**	5.30	1:26.21
Japanese millet (white head),	1	-	-	**91.48**	-	-	**7.67**	-	-	**2.41**	-	-	**49.87**	-	-	**34.99**	5.06	-
Japanese millet (red head),	1	-	-	**91.13**	-	-	**5.76**	-	-	**1.70**	-	-	**49.66**	-	-	**39.52**	3.36	-
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	**12.17**	15.40	7.82	**12.29**	1.76	.59	**.94**	79.33	66.87	**72.19**	7.56	4.29	**6.00**	8.58	1:8.24
Beets, sugar,	11	19.53	9.87	**14.73**	17.44	7.32	**10.97**	.83	.58	**.66**	81.50	61.93	**75.93**	9.69	4.82	**6.49**	5.95	1:11.80
Mangolds,	3	13.08	11.73	**12.25**	12.84	7.83	**10.37**	1.01	.73	**.88**	73.38	70.32	**71.75**	9.54	7.08	**7.94**	9.06	1:8.83
Beets, yellow fodder,	1	-	-	**9.40**	-	-	**12.78**	-	-	**1.80**	-	-	**67.50**	-	-	**7.83**	10.09	1:9.94

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc. — Concluded.																		
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	3	12.80	8.22	9.79	10.81	9.67	10.12	2.05	1.42	1.74	70.62	65.91	68.44	12.61	10.12	11.23	8.47	1:13.26
Carrots,	4	12.52	9.95	10.72	9.63	7.98	8.93	3.94	1.67	2.34	73.96	67.24	71.27	10.76	7.55	9.19	8.27	1:9.67
Parsnips,	1	-	-	19.66	-	-	6.88	-	-	3.37	-	-	74.65	-	-	-	7.67	-
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn and cob meal,	37	94.00	80.89	89.47	15.06	7.82	10.01	5.27	3.36	4.19	81.41	70.13	76.62	10.41	5.63	7.54	1.64	-
Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.20	-	-	2.42	2.18	1.6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24
Red adzinki beans,	2	85.18	83.10	84.14	25.14	23.75	24.45	.88	.76	.82	66.48	65.41	65.95	4.68	4.50	4.59	4.19	-
Saddle beans,	1	-	-	87.62	-	-	15.12	-	-	16.58	-	-	57.34	-	-	4.75	6.21	-

Daidzu beans,	1	-	-	88.47	-	-	38.99	-	-	18.59	-	-	30.41	-	-	4.97	7.04	-
Millet seed,	3	87.32	86.11	86.65	14.60	11.76	13.24	4.94	3.53	4.32	73.19	66.94	70.56	10.23	6.48	8.88	3.00	-
Chestnuts,	1	-	-	55.14	-	-	13.32	-	-	14.46	-	-	67.05	-	-	2.45	2.72	-
V. Flour and Meal.																		
Corn meal,	27	89.95	82.96	85.99	16.08	9.73	11.08	5.08	3.10	4.50	83.24	73.20	80.53	3.60	1.20	2.19	1.70	-
Hominy meal,	4	91.89	88.68	90.23	11.88	6.77	10.41	12.22	4.89	9.81	78.07	68.00	73.00	5.12	3.69	4.34	2.44	-
Ground barley,	3	87.81	82.59	85.59	14.93	10.42	12.17	2.38	1.69	2.09	78.25	74.47	76.69	7.37	5.04	6.42	2.63	-
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
VI. By-products and Refuse.																		
Linseed cake, old process,	7	92.52	88.50	90.54	39.97	30.98	36.64	9.87	6.24	7.16	44.72	37.76	40.61	9.69	8.04	8.68	6.91	1:1.66
Linseed cake, new process,	5	94.94	88.17	92.05	41.02	35.03	39.18	4.08	2.17	3.12	46.49	40.83	41.87	10.31	8.93	9.38	6.45	1:1.32
Cotton-seed meal, decorticated,	14	93.16	88.81	91.32	51.79	36.54	44.43	14.72	9.57	12.23	33.87	20.22	27.18	10.83	6.28	8.11	8.05	1:1.39
Wheat bran,	32	92.58	86.30	89.44	20.54	15.67	17.71	6.08	2.80	4.99	62.18	51.77	59.39	14.26	7.49	10.90	7.01	-
Wheat middlings,	6	90.75	87.57	89.93	19.21	15.13	16.72	6.46	3.19	5.31	74.30	58.03	61.77	11.21	1.40	9.21	6.99	1:4.21
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Buckwheat middlings,	1	-	-	88.49	-	-	25.49	-	-	7.53	-	-	66.36	-	-	5.18	5.44	-
Gluten meal,	22	93.50	68.32	90.36	39.28	25.94	32.06	12.05	3.92	7.35	66.26	48.26	58.62	5.43	.41	1.26	.71	1:2.75
Maize feed,	1	-	-	90.25	-	-	21.33	-	-	6.15	-	-	62.12	-	-	9.65	.75	1:4.49
Corn germ meal,	1	-	-	90.65	-	-	28.26	-	-	11.82	-	-	42.49	-	-	9.18	8.25	-

A. Analyses of Fodder Articles — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain— Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
VI. By-products and Refuse — Concluded.																		
Bakery refuse,	1	-	-	86.66	-	-	9.23	-	-	6.36	-	-	72.34	-	-	.43	11.64	-
Vinegar mash,	1	-	-	5.51	-	-	16.50	-	-	8.45	-	-	63.47	-	-	8.55	3.03	-
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewer's grain,	4	93.02	88.00	90.13	33.16	16.08	23.29	6.29	1.95	4.89	67.62	42.32	54.04	15.90	8.07	11.25	4.53	1:2.90
Cocoa dust from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.10	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	1:28.16
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46	-
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
I. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$1 65
Fodder corn ensilage,	1	71.60	.360	–	.330	.050	.100	.090	.020	.140	.040	1 53
Corn and soja bean ensilage,	1	71.03	.790	–	.444	–	–	–	–	.420	–	3 23
Sorghum,	7	82.19	.233	–	.229	.025	.076	.075	.012	.088	.136	1 00
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	1 79
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 50
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 08
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	1 95
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 53
Horse bean,	1	74.71	.675	–	1.370	.090	1.370	.620	.200	.330	2.040	3 62
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 21
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 77
White lupine,	1	85.35	.440	–	1.730	.680	3.070	.730	.170	.350	.900	3 26
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 10

* The valuation is based on the following prices per pound of the essential fertilizing ingredients: Nitrogen, 15 cents; potassium oxide, 4½ cents; phosphoric acid, 5½ cents.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
II. Hay and Dry Coarse Fodders.												
English hay,	9	11.99	1.409	6.34	1.550	.110	.344	.240	.021	.269	.980	$5 92
Rowen,	12	18.52	1.609	9.57	1.486	.140	.640	.280	.034	.432	1.840	5 64
Timothy hay,	3	11.26	1.240	4.93	1.460	.180	.620	.120	.006	.342	1.000	5 41
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	4 76
Kentucky blue-grass,	2	5.34	1.320	-	1.694	.129	.398	-	.044	.431	2.863	5 95
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 08
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	5 30
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	5 69
Italian rye-grass,	4	8.71	1.189	-	1.273	.451	.857	.321	.071	.556	2.598	5 32
Salt hay,	1	5.36	1.180	-	.718	.017	.371	.335	.028	.248	-	4 46
Japanese millet (white head),	3	10.45	1.105	5.80	1.223	.012	.465	.377	.028	.403	1.633	4 86
Japanese buckwheat,	1	5.72	1.629	-	3.320	.349	3.418	.421	.148	.852	.378	8 81
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	6 69
Corn stover,	16	9.12	1.043	3.74	1.400	.112	.622	.384	.068	.293	1.885	4 71
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 31
Millet hay,	1	9.75	1.280	-	1.690	.020	.500	.460	.030	.490	1.360	5 90

Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	8 39
Medium red clover,	2	7.91	2.184	8.36	2.286	.210	1.689	.402	.099	.447	.919	9 10
Alsike clover,	6	9.94	2.342	11.11	2.227	.309	2.153	.537	.197	.668	1.776	9 77
Lucerne (alfalfa),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 12
Bokhara clover,	2	7.43	1.975	7.70	1.832	.114	1.784	.347	.023	.558	.057	8 19
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	8 87
Sainfoin,	1	12.17	2.630	7.55	2.020	.540	1.160	.430	.040	.760	.470	10 54
Sulla,	2	9.39	2.460	–	2.093	.223	2.497	.350	.114	.453	.614	9 76
Lotus villosus,	2	11.52	2.095	8.23	1.807	.499	2.220	.476	.112	.594	.976	8 56
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	8 66
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 31
Small pea,	1	5.80	2.497	–	1.990	.469	1.373	.276	.138	.592	1.081	9 93
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	9 83
Scotch tares,	1	15.80	2.964	–	3.004	.238	1.698	.354	.460	.815	4.062	12 49
Vetch and oats,	3	9.91	1.299	9.58	1.349	.420	.663	.265	.098	.560	.521	5 72
Soja-bean straw,	1	13.00	.750	–	1.322	–	.436	.469	.035	.397	.218	3 88
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	2 44
Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	14 46
Barley straw,	1	11.44	1.310	5.30	2.086	.183	.572	.180	–	.303	2.380	6 14
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	1 22
Beets, sugar,	4	86.95	.223	1.04	.477	.081	.057	.040	.013	.101	.048	1 21

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
III. Roots, Bulbs, Tubers, etc. — Concluded.												
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	$1 09
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 01
Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 15
Turnips,	2	89.49	.178	1.01	.385	.078	.089	.027	.009	.104	.055	0 99
Carrots,	2	89.79	.147	9.22	.506	.062	.067	.023	.009	.093	.019	1 00
Parsnips,	1	80.34	.217	–	.617	.006	.088	.045	.005	.187	.019	1 41
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	0 96
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	0 57
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	6 60
Corn and cob meal,	29	8.96	1.409	–	.472	.059	.018	.176	.011	.571	.430	5 28
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	19 75
Red adzinki beans,	1	14.82	3.240	–	1.540	.035	.090	.210	.180	.940	.050	12 14
White adzinki beans,	1	16.90	3.330	–	1.480	.190	.130	.220	.021	.970	.130	12 39
Saddle beans,	1	12.38	2.120	–	2.130	.020	.250	.430	.032	1.520	.250	9 95

Daidzu beans,	1	11.53	5.520	–	1.960	.210	.220	.400	.050	1.480	.280	19 95
Japanese millet,	2	13.68	1.730	–	.380	.030	.045	.225	.015	.685	–	6 22
Common millet,	1	12.68	2.040	–	.360	.060	.040	.260	.030	.850	.143	7 38
Chestnuts,	1	44.86	1.175	2.72	.632	–	.060	.135	.010	.392	.069	4 53
V. Flour and Meal.												
Corn meal,	2	13.52	2.050	1.42	.435	.064	.034	.187	.015	.707	.005	7 31
Hominy feed,	1	8.93	1.630	2.21	.490	–	.180	.280	–	.980	–	6 41
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	5 68
Wheat flour,	1	9.83	2.210	1.22	.540	–	.170	.050	–	.570	–	7 74
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	11 04
VI. By-products and Refuse.												
Linseed cake, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	19 22
Linseed cake, new process,	4	7.35	5.808	5.04	1.288	.823	.663	.655	.062	1.628	.345	20 37
Cotton-seed meal,	9	8.96	6.467	6.49	1.723	.291	.587	.589	.020	2.333	.457	23 52
Wheat bran,	5	11.39	2.879	6.44	1.625	.159	.168	.899	.019	2.845	.141	13 23
Wheat middlings,	1	9.18	2.630	2.30	.630	.110	.200	.210	–	.950	–	9 50
Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	7 63
Gluten meal,	5	8.53	5.090	.65	.047	.018	.050	.035	.009	.420	–	15 77
Spent brewer's grain,	2	8.58	2.680	6.15	.853	.347	.296	.286	.159	1.045	1.770	9 96
Cocoa dust,	1	7.10	2.299	6.35	.630	–	.630	–	–	1.340	–	8 94
Broom corn waste (stalks),	1	10.37	.870	4.70	1.858	–	.242	.170	–	.460	1.000	4 79

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
VI. By-products and Refuse — Concluded.												
Cotton hulls,	3	10.63	.750	2.61	1.080	-	.200	.260	-	.180	.060	$3 42
Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	0 82
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 12
Palmetto roots,	1	11.51	.540	3.93	1.380	.345	.045	.004	.017	.157	.410	3 03
Buckwheat hulls,	1	11.90	.490	-	.521	-	.247	.236	.020	.073	.066	2 02

C. *Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin),	Sept. 1,	20.14	1.055	12—15	3.09	-	-	-
Apple (Baldwin),	Oct. 9,	19.66	1.065	12—15	6.25	-	-	-
Apple (Baldwin),	Nov. 27,	-	1.075	12—15	10.42	-	-	-
Rhode Island Greening,	Sept. 1,	20.27	1.055	12—15	3.16	-	-	-
Rhode Island Greening,	Oct. 9,	19.68	1.066	12—15	7.14	-	-	-
Rhode Island Greening,†	Nov. 27,	20.25	1.080	12—15	11.36	-	-	-
Pear (Bartlett),	Aug. 31,	15.00	1.060	12—15	4.77	-	-	-
Pear (Bartlett),	Sept. 7,	16.55	1.060	12—15	5.68	-	-	-
Pear (Bartlett),	Sept. 20,	-	1.065	12—15	8.62	-	-	-
Pear (Bartlett),‡	Sept. 22,	-	1.060	12—15	8.93	-	-	-
Cranberries,	-	10.71	1.025	15	1.35	-	-	-§
Cranberries,	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe),	-	-	1.045	25	-	1.92	6.09	45
Early York Peach (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42.3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
Crawford Peach (mellow),	-	11.36¶	1.055	18	-	1.70	8.94	76
Crawford Peach (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part $Na_2\ CO_3$ in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord, ...	July 17,	1.0175	31	8.30	.645	7.77	–
Concord, ...	July 20,	1.0150	31	8.10	.625	7.72	216
Concord, ...	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord, ...	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord, ...	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord, ...	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord, ...	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Wild Purple Grape, . . .	July 19,	1.020	31	9.00	.714	7.93	204
Wild Purple Grape, . . .	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Wil l Purple Grape, . . .	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Wild Purple Grape, . . .	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape, . . .	Aug 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific, ...	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' seedling, ...	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona, ...	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed), ...	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam, ...	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder, ...	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware, ...	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak, ...	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella, ...	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling, ...	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack, ...	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba, ...	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder, ...	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak, ...	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord, ...	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord, ...	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan, ...	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape, . . .	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled), .	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled), .	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure $Na_2\ CO_3$ in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1 075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15 63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 PARTS OF GRAPES CONTAINED —			
		Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	.75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled,	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled,	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled,	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled,	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled,	Oct. 9,	.54	85.15	9.12	.74

* One part of pure $Na_2 CO_3$ in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	-	-	8.03	-	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	-	-	13.51	-	Fertilized.
Wild Purple Grape Juice, .	"	-	1.045	16	8.22	9 840	Unfertilized.
Wild Purple Grape Juice, .	"	-	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	-	-	-	-	Unfertilized.
Wild White Grape Berries, .	"	21.65	-	-	-	-	Fertilized.
Wild White Grape Juice, .	"	-	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, .	"	-	-	-	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	-	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6 38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. Analyses of Fruits — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 PARTS OF ASH CONTAINED —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,*	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Concord Grapes, 1891,‡	.55	49.76	–	3.50	2.53	1.19	13.56	2.01
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),§	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),‖	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,¶	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,¶	–	15.67	–	64.23	10.28	1.45	8.37	–
Carnation Pinks (whole plant),**	8.80	38.07	12.84	18.64	3.98	.34	5.23	.24
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms.
† One year old.
‡ Nitrogen in dry matter, .96 per cent.
§ Wilder.
‖ Downing.
¶ Yellows.
** Nitrogen in dry matter, 1.15 per cent.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	Saxony, .	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial, ...	Saxony, .	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	Saxony, .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, ...	Saxony, .	$1\frac{1}{2}$ to 2	13.10
II White Magdeburg, ...	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam,	Fresh yard-manure,	16.5	12.50	4.00	75.08
Clayish loam,	Fresh yard-manure,	15.5	11.05	4.45	71.30
Warm alluvial,	Yard-manure and chemicals,	12.75	9.17	3.58	71.92
Warm alluvial,	Fresh hog-manure,	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure,	18.5	13.73	4.77	74.21
Alluvial soil,	Brighton fish,	14.5	11.15	3.35	76.90
Heavy soil,	Yard-manure,	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure,	11.96	9.42	7.80
Blood guano without potash,	10.99	10.10	10.20
Blood guano with potash,	12.55	13.24	10.50
Kainite and superphosphate,	13.15	12.16	10.50
Sulphate of potash,	14.52	14.32	12.78
Second year after stable-manure,	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y., ...	1872–73	11	7.80	3.20
2. Washington, N. Y., . . .	"	14	10.97	3.03
3. South Hartford, N. Y., . .	"	15	11.70	3.30
4. Greenwich, N. Y., ...	"	12	9.50	2.50
5. Frankfort, N. Y., ...	"	13.5	11.00	2.50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal, . .	2 to 2½ lbs.	15.4°	64° F.	11.38
Riviere du Loup, ...	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly, ...	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge, ...	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight,*	4.2	27	2.48	None.	6.8	7.93
Aug. 16,	No flower stalks in sight,*	5.8	24	4.06	None.	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	–	–
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21,	Juice from the above,*	13.0	21	–	–	–	–
Sept. 23,	Juice from the above,*	15.0	18	–	–	–	–
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	–	–
Sept. 28,	Left on field 3 weeks,†	17.8	12	16.60	–	–	–
Oct. 4,	Left on field 3 weeks,†	16.1	17	8.62	6.16	12.0	–
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8,	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9,	Freshly cut. Stripped two weeks,†	18.4	17	7.57	–	10.6	–
Oct. 14,	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18,	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19,	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22,	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23,	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24,	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October,	Early Tennessee sorghum, mature,	77.43	1.79	3.21	5.00	Grown on station grounds.
October,	Price's new hybrid, ripe,	77.80	2.92	3.78	6.70	
October,	Kansas orange, green,	80.67	2.38	3.63	6.01	
October,	New orange, green,	78.30	2.96	3.85	6.81	
October,	Honduras, green,	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,† . .	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,† . . .	1.052	–	4.85	5.70	20.38
Common sweet corn,‡ . . .	1.035	–	6.60	None.	–
Common yellow musk-melon,§ .	1.040	26	1.67	2.65	–
White-flesh water-melon, . .	1.025	18	2.91	2.16	–
Red-flesh water-melon, . . .	1.025	22	3.57	2.18	–
Red-flesh water-melon, . . .	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖ . . .	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶ . . .	1.050	20	2.27	5.38	–
Nutmeg musk-melon,** . .	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	Solids. Maximum.	Solids. Minimum.	Solids. Average.	Fat. Maximum.	Fat. Minimum.	Fat. Average.	Curd. Maximum.	Curd. Minimum.	Curd. Average.	Salt. Maximum.	Salt. Minimum.	Salt. Average.	Ash.
Whole milk,	899	18.27	10.58	13.60	7.54	2.48	4.00	-	-	3.20	-	-	-	.70
Skim milk,	76	10.40	7.68	9.50	1.02	.20	.45	-	-	3.53	-	-	-	.80
Buttermilk,	18	9.86	7.40	8.16	.38	.15	.21	-	-	2.79	-	-	-	.80
Cream (from Cooley Creamer),	94	29.35	21.30	25.50	20.90	13.74	17.70	-	-	-	-	-	-	.62
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture, 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	.316	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga d iry salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97.650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	
Royal salt,	.880	97.877	1.108	.016	.010	–	–	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	–	–	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	–	–	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	–	–	–	
Bradley salt,	.200	98.575	1.185	.029	.007	–	–	–	
Higgins' Eureka salt,	.855	98.891	.906	.293	.055	–	–	–	
Worcester refined salt,	.565	97.935	1.376	.097	.027	–	–	–	

F. Analyses of Insecticides.

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and AluminicOxides.	Insoluble Matter.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	38.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

METEOROLOGY.

1891.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same times. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society. During the summer months partial monthly reports have been furnished also for the use of the secretary of the State Board of Agriculture.

At the beginning of the year there were nine inches of snow on the ground. The total snowfall of the season after January 1 amounted to fifty-eight inches. The heaviest snow-storm during the time occurred January 25, measuring thirteen inches. A storm giving twelve inches of snow occurred on the 3d and 4th of March. The last snow of this part of the season fell on the 2d and 3d of April. Sleighing was good most of the time until the 10th of March. A snow-storm on the 26th of November amounted to one and one-half inches. The snowfall during December was very light. The precipitation of moisture (rain and snow) during the year was below the average and unevenly distributed.

The largest amount of water falling in one month was 6.61 inches, January; the smallest amount 1.98 inches, November. The heaviest storm of the year occurred from the 2d to the 4th of June, with 2.92 inches of rainfall. The largest amount of rain falling in any one day was 1.73 inches, June 2.

The rainfall during April and May was light, otherwise the early part of the season was favorable for farm crops. The large number of rainy days during July and August interfered to some extent with haying and harvesting. The rainfall for the months September, October and November was much below the usual average. A scarcity of water was seriously felt in many localities of this vicinity.

The last heavy frost of the season occurred on the 19th of May; there was a slight one on the 5th of June. No frost was noticed in the autumn before October 10.

The mean annual temperature for the year was 47.62° F., which is slightly above the average. The monthly average temperatures did not vary much from those of former years except during September, which was considerably warmer than usual.

The highest temperature for the year, 93° F., occurred June 16; the lowest, — 5.5, February 15.

The prevailing wind during six months of the year came from the north-east. It was north-west during April and May, south during July, and south-east during September, November and December.

During the year there were one hundred and forty-five days recorded as "cloudy," seventy-nine as "cloudless." The greatest number of cloudy days, fifteen, occurred in January, and the greatest number of cloudless days, eight, in November and December.

Summary of Meteorological Observations, 1891.

	Temperature, Degrees Fahrenheit.											Relative Humidity, Per Cent.				Precipitation, Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	21.7	30.3	26.6	26.3	41.5	14.4	27.1	50.5	22d	—1.0	10th	-	-	-		6.61	22d
February,	23.4	32.1	27.2	27.5	47.9	10.4	37.5	53.5	25th	—5.5	15th	-	-	-	-	3.84	9th, 10th
March,	27.2	37.7	31.7	32.1	44.5	10.2	34.3	55.5	29th	—1.0	2d	-	-	-	-	2.89	8th, 9th
April,	41.6	55.2	45.4	46.9	64.0	10.8	33.2	77.0	30th	18.0	6th	-	-	-	-	2.74	11th
May,	49.3	64.4	53.4	55.2	68.1	37.4	37.0	86.0	10th	25.0	6th	79.0	56.2	71.5	68.9	1.82	29th
June,	59.6	74.6	62.8	64.9	77.1	49.3	27.8	93.0	16th	34.5	5th	87.7	60.8	80.2	76.2	4.61	2d
July,	61.7	74.2	64.4	66.2	76.2	58.6	17.6	89.0	13th	42.0	28th	87.4	62.4	81.9	77.2	5.09	30th
August,	63.9	76.3	66.6	68.3	77.4	58.8	18.6	90.0	11th	46.0	1st	90.9	66.1	86.6	81.2	3.67	28th
September,	57.8	73.0	61.7	63.6	75.0	50.5	24.5	89.0	18th	37.0	9th	95.7	64.4	87.4	82.5	2.22	29th
October,	41.4	56.8	46.0	47.5	67.2	33.0	34.2	87.0	4th	21.0	29th	88.4	62.6	82.5	77.8	2.56	20th
November,	32.3	45.1	35.2	37.0	56.0	14.6	41.4	63.0	11th	4.0	30th	-	-	-	-	1.98	16th, 17th
December,	31.0	42.3	35.2	35.9	52.9	12.8	40.1	58.5	4th	9.0	17th	-	-	-	-	4.55	29th, 30th
Sums,	510.9	662.0	556.2	571.4	747.8	380.8	367.0	892.0	-	229.0	-	529.1	372.5	490.1	463.8	42.58	-
Mean,	42.57	55.17	46.35	47.62	62.32	31.73	30.58	74.33	-	19.08	-	88.18	62.08	81.68	77.30	3.55	-

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.	Solar Halos.
1891.						
January, .	–	1, 5, 14, 17, 18, 25, 27, 29.	1, 11, 12, 17, 18, 22, 29, 31.	2,	15,	–
February, .	–	7, 8, 9, 20, 26,	1, 3, 9, 10, 16, 17, 18, 21, 25.	–	15, 19,	6, 28.
March, . .	–	3, 4,	8, 9, 12, 13, 21, 22.	–	18,	27, 31.
April, . .	–	2, 3,	11, 14,	15, 18,	–	–
May, . .	19,	–	3, 6, 15, 16, 21, 29.	11, 26,	20,	2.
June, . .	5,	–	4, 17, 18, 19, 21, 22.	2, 3,	11,	–
July, . .	–	–	4, 7, 8, 18, 24, 28, 29, 30.	15, 25,	–	–
August, . .	–	–	4, 5, 21, 22, 23, 24, 26, 27.	7, 12, 15, 18, 28.	–	–
September, .	–	–	5, 6,	13, 29,	11,	–
October, .	10, 12, 16, 17, 24, 25, 29, 30.	–	7, 8, 13, 26, 27,	20,	–	–
November, .	3, 4, 5, 7, 8, 13, 14, 15, 19, 20, 21, 26.	26,	10, 11, 16, 17, 23, 26, 27, 28.	–	19,	–
December, .	1, 12, 13, 28, 29.	–	4, 7, 15, 16, 22, 23, 24, 26, 29, 30.	–	9, 19,	–

Amherst, Mass.

C. A. GOESSMANN,
Director.

ANNUAL REPORT OF FRANK E. PAIGE,

TREASURER OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

For the Year ending Dec. 31, 1891.

RECEIVED.		
Cash on hand from last year,	$343 86	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from fertilizer account,	2,250 00	
Cash from expense,	325 00	
Cash from farm,	978 71	
		$13,897 57
EXPENDED.		
Cash paid salaries,	$5,243 31	
Cash paid laboratory supplies,	738 43	
Cash paid printing and office expenses,	680 75	
Cash paid farmer and farm labor,	2,330 24	
Cash paid farm supplies,	1,505 47	
Cash paid incidental expenses,	528 66	
Cash paid construction and repairs,	138 77	
Cash paid expense of board of control,	138 63	
Cash paid fertilizer account,	2,590 00	
Cash on hand,	3 31	
		$13,897 57

SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

(Dec. 31, 1891.)

Farm:		
Live stock,	$821 00	
Tools, implements and machinery,	935 95	
Produce on hand,	607 20	
Fertilizers,	72 67	
Chemical Laboratory:		
Laboratory inventory,	2,740 27	
Office furniture,	1,617 00	
Agricultural and Physiological Laboratory:		
Furniture, herbariums, library (first floor),	734 75	
Instruments, apparatus, etc. (first floor),	691 20	
Furniture (second floor),	394 52	
Instruments, apparatus, etc. (second floor),	369 90	
Buildings, land, etc.,	32,202 00	
Total of inventory,		$41,186 46

BOSTON, MASS., Jan. 14, 1892.

This is to certify that I have examined the books and accounts of Frank E. Paige, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1891, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of three dollars and thirty-one cents, which is shown to be in bank.

W. R. SESSIONS,
Auditor.

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TO NINTH ANNUAL REPORT, 1891.

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